

Chapter 1

Construction

Section A

Chapter 1

Construction



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1.0 Scope

1.1 This section explains about the General Directorate of Civil Defence – Kingdom of Bahrain requirements of building construction and the construction materials like cladding, roofing and glazing.

1.2 To ensure Life Safety of the occupants of buildings and structures through regulating design, construction and materials used in the construction.

1.3 To identify Structural Fire ratings, Compartmentation, height and area restrictions, distance between adjacent buildings to ensure the effect of Fire hazard to occupants and to the neighboring buildings and structures is minimized.

1.4 To restrict Fire spread outside and within building by regulating Exterior and Interior Finish Material quality

2.0 Definitions

2.1 Construction

2.1.1 Shall
It is a mandatory requirement from General Directorate of Civil Defence – Kingdom of Bahrain

2.1.2 Should
It is a suggested requirement recommended by the General Directorate of Civil Defence – Kingdom of Bahrain but not mandatory.

2.1.3 Listed
Permitted and registered by the General Directorate of Civil Defence – Kingdom of Bahrain.

2.1.4 Building Area
The total area within surrounding exterior walls (or exterior walls and fire walls) exclusive of vent shafts and courts. Areas of the building not provided with surrounding walls shall be included in the building areas if such areas are included within the horizontal projection of the roof or floor above.

2.1.5 Control Area
A building or portion of a building within which hazardous materials are allowed to be stored, dispensed, used, or handled in quantities not exceeding the maximum allowable quantities.

2.1.6 Maximum Allowable Quantity per Control Area (MAQ)
Maximum quantity of hazardous material allowed to be in a control area.

2.1.7 Fire Area
An area separated from rest of the building by fire walls, fire barriers or combination thereof.

2.1.8 Gross Floor Area

The area of a floor within the inside perimeter of the exterior walls of the building, with no deductions for hallways, stairs, closets, thickness of interior walls, columns, elevator and building services shafts, or other features, but excluding floor openings associated with atriums and communicating spaces.

2.1.9 Net Floor Area

The area of a floor within the inside perimeter of the exterior walls of the building, or the outside walls and fire walls of a building, or outside and/or inside walls that bound an occupancy or incidental use area requiring the occupant load to be calculated using net floor area under consideration with deductions for hallways, stairs, closets, thickness of interior walls, columns, or other features.

2.1.10 Gross Leasable Area

The area of tenant occupancy measured from the centerline of joint partitions to the outside of the tenant walls.

2.1.11 Hazardous Area

An area in a building or structure with a greater Fire Hazard than the normal hazard to general occupancy of that building or structure.

2.1.12 Area of Refuge

An area that is either

a. A storey in a building fully protected automatic sprinkler system and has not less than two accessible rooms or spaces separated from each other by smoke-resisting partitions. OR

b. A space located in a path of travel leading to a public way that is protected from the effects of fire, either by means of separation from other spaces in the same building or by virtue of location, thereby permitting a delay in egress travel from any level.

2.1.13 Fire Door Assembly

An assembly of door leaf(s), a frame, hardware, and other accessories that together provide a specific degree of fire protection to the opening. Fire Door assembly shall be tested and certified to declare its fire rating.

2.1.14 Fire Window Assembly

A window assembly or glass block assembly having a fire protection rating. The same shall be tested and certified to declare its fire rating.

2.1.15 Atrium

A large-volume space created by a floor opening or series of floor openings connecting two or more storeys or exceeds 15 m in height from finished floor, that is covered at the top of the series of openings and is used for purposes other than an enclosed stairway, an elevator, hoistway, an escalator opening or as a utility shaft used for plumbing, electrical, air conditioning, or communications facilities

2.1.16 Fire Barrier

A continuous membrane or a membrane with discontinuities created by protected openings with a minimum of 1-hour fire protection rating, where such membrane is designed and constructed to limit the spread of fire. Fire barriers are to be continuous from floor to underside of the floor above or fire rated ceiling and from the inside face of exterior to another exterior wall or other fire barrier with equal or greater fire rating.

2.1.17 Smoke Barrier and Smoke Partition

A continuous membrane or a membrane with discontinuities created by protected openings with a minimum of 1-hour fire rating designed and constructed to limit the spreading and movement of smoke.

2.1.18 Thermal Barrier (Thermal Insulation)

A material, product, or assembly that prevents or delays ignition of an unexposed surface by limiting the temperature rise and by acting as a flame exposure barrier.

2.1.19 Fire Protection Rating

The period of time that an opening protective will maintain the ability to confine a fire and heat. Ratings are stated in hours or minutes.

2.1.20 Fire Resistance Rating

The period of time a building element, component or assembly maintains the ability to confine a fire, continues to perform a given structural function, or both.

2.1.21 Fire Wall

A specified fire-resistance-rated wall having protected openings, which restricts the spread of fire, heat and extends continuously from the foundation to or through the roof, with sufficient structural stability under fire conditions without collapse of the wall.

2.1.22 High Challenge Fire Wall (HC Fire Wall)

A wall used to separate buildings or subdivide a building with high fire challenge occupancies, having enhanced fire resistance ratings and enhanced opening protection to prevent the spread of fire, and having structural stability

2.1.23 Smoke Compartment

A space within a building enclosed by smoke barriers on all sides, including the top and bottom.

2.1.24 Fire Compartment

A space within a building enclosed by specific fire rated Fire Walls, fire rated opening protective on all sides, including the top and bottom.

2.1.25 Basement

Any storey of a building wholly or partly below grade plane that is not considered the first storey above grade plane.

2.1.26 Existing Building

A building erected or officially permitted by the General Directorate of Civil Defence – Kingdom of Bahrain and authorized prior to the effective date of the adoption of this edition of the Bahrain Fire and Life Safety Code of Practice.

2.1.27 Structural Element

The columns and girders, beams, trusses, joists, braced frames, moment-resistant frames, and vertical and lateral resisting elements, and other framing members that are designed to carry any portion of the dead or live load and lateral forces, that are essential to the stability of the building or structure.

2.1.28 Building Height

The vertical distance from the grade plane to the average elevation of the highest roof surface.

2.1.29 Horizontal Separation

The width of the permanent open space as measured horizontally between a building exterior wall and the adjacent property line or the centerline of a facing street, alley, or public way, or to an imaginary line drawn between exterior walls of adjacent buildings on the same lot.

2.1.30 Combustible Material

A material that, in the form in which it is used and under the conditions anticipated, will ignite, burn, support combustion or release flammable vapors when subjected to heat and fire.

2.1.31 Non-Combustible Material

A material that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion or release flammable vapors when subjected to heat and fire. And a non-combustible material is certified as “passes” when tested as per ASTM 136, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 °C.

2.1.32 Limited Combustible Material

A material which does not comply to “Non-Combustible Material” definition and the Material in the form in which it is used when tested as per NFPA 259, Standard test Method for Potential Heat of Building Material, exhibits a potential heat value not exceeding 3500 Btu/lb. (8141 Kj/kg).

2.1.33 Partition

A nonstructural interior wall that spans horizontally or vertically from support to support. The supports may be the basic building frame, subsidiary structural members, or other portions of the partition system.

2.1.34 Swimming Pool

Any constructed pool intended for swimming or diving, permanent or non-portable, that is over 610 mm in depth, has a surface area exceeding 23 m2, or has a volume over 3250 gal.

2.1.35 Property Line

Line dividing one lot from another, or from a street or other public space.

2.1.36 ASTM E 84 or UL 723 – Flame Spread Classification - Class A

In accordance with ASTM E 84 or UL 723, Class A finishes shall be those finishes with a flame spread of 0–25 and smoke development of 0–450 and shall include any material classified at 25 or less on the flame spread test scale and 450 or less on the smoke test scale. Any element thereof, when so tested, shall not continue to propagate fire.

2.1.37 ASTM E 84 or UL 723 - Flame Spread Classification - Class B

In accordance with ASTM E 84 or UL 723, Class B finishes shall be those finishes with a flame spread of 26–75 and smoke development of 0–450 and shall include any material classified at more than 25 but not more than 75 on the flame spread test scale and 450 or less on the smoke test scale.

2.1.38 ASTM E 84 or UL 723 - Flame Spread Classification - Class C

In accordance with ASTM E 84 or UL 723, Class C Interior Wall and Ceiling Finish. Class C

interior wall and ceiling finishes shall be those finishes with a flame spread of 76–200 and smoke development of 0–450 and shall include any material classified at more than 75 but not more than 200 on the flame spread test scale and 450 or less on the smoke test scale.

2.1.39 BS Flame Spread Classification - Class 1 and Class 0

A Class 1 classification is assigned by testing in accordance with BS 476: Part 7. This specifies a method of test for measuring the lateral spread of flame along the surface of a specimen of a product orientated in the vertical position. A Class 1 classification is the best of four performance levels defined within the Standard. A Class 0 classification is assigned to Class 1 products which have a fire propagation index (I) of not more than 12 and a sub-index (i1) of not more than 6 when tested in accordance with BS 476: Part 6.

2.1.40 EN/DIN Combustibility and Flame Spread Classification – Class B or B1

i. Class B1 according to DIN 4102

ii. Class B-s1, d0 or B-s2, d0 according to EN 13501-1,

The materials tested to these standards are difficult to ignite and fire must extinguish itself when source of the fire is removed. They include materials such as wood treated with fire retardant and some rigid foam plastics.

2.1.41 EN/DIN Combustibility and Flame Spread Classification – Class A2

i. Class A2 as per DIN 4102

ii. Class A2-s2, d0 as per EN 13501-1

These materials are non-combustible with combustible organic components. This category includes materials like gypsum plasterboards (with sealed surface), polystyrene concrete and mineral wool. Under conditions of fully developed fire, these products will not contribute to fire load and fire growth.

2.1.42 Advertising Signboards

Any letter, figure, character, mark, plane, point, marquee sign, design, poster, pictorial, picture, stroke, stripe, line, trademark, reading matter or illuminated service, which shall be constructed, placed, attached, painted, erected, fastened or manufactured in any manner whatsoever, so that the same shall be used for the attraction of the public to any place, subject, person, firm, corporation, public performance, article, machine or merchandise, whatsoever, which is displayed in any manner outdoors or indoors.

2.2 Fire Stopping

2.2.1 Firestop

It is a general term for a passive fire protection system of various materials and components that are used to seal openings and joints in fire resistive wall and/or floor assemblies in a way that will preserve the full fire resistance rating of the assembly.

2.2.2 Firestop System

The use of a specific Firestop material or combination of materials around a specific penetrant(s) or into a specific joint in conjunction with a specific wall and/or floor construction type.

2.2.3 Barrier

Any bearing or non-bearing wall or floor that has an hourly fire and smoke rating.

2.2.4 Through-penetration

The term is used to denote an opening for penetrations that pass through both sides of a vertical or horizontal fire resistance-rated assembly, through a fire rated wall or floor through which passes a mechanical, electrical, piping, structural, communication or other device.

2.2.5 Membrane-penetration

Any penetration through a fire-rated wall that breaches the barrier.

2.2.6 Fire Resistive Joint

An arrangement with Fire resistive material for any gap or opening, whether static or dynamic, between two fire-rated barriers including where the top of a wall meets a floor; wall edge to wall edge configurations; floor edge to floor edge configurations; floor edge to wall configurations.

2.2.7 Perimeter Barrier

Any gap, joint, or opening, whether static or dynamic, between a fire-rated floor assembly and a rated and/or non-rated exterior wall assembly. A single or combination of materials are used to create a firestop assembly at the perimeter gap between a fire resistance rated floor assembly and a non-rated wall assembly, capable of preventing the spread of heat, fire, gases, smoke or other defined hazards through the internal opening in the wall and floor assembly.

2.2.8 Curtain-wall

A non-load-bearing external wall attached to a framed structure. It's usually a glass and/ or metal profile exterior wall assembly with all the associated accessories to provide an aesthetic exterior building envelope.

2.2.9 Dynamic Joint

The linear opening or gap between adjacent fire-resistant structures designed to allow independent movement of a building. A joint is designed into structures to accommodate movement in any plane caused by thermal, wind, seismic or other loading forces.

2.2.10 Static Joint

The linear opening or gap between adjacent fire-resistant structures that would not accommodate movement of a building.

2.2.11 F' Rating

The time, stated in hours, that a Firestop system will prevent the passage of flame through an opening and not permit the projection of a water stream through a fire rated assembly. Firestop systems and devices shall have an F rating of at least 1 hour, but not less than the required fire resistance rating of the fire barrier penetrated, as determined by NFPA 251, ASTM E-814, UL 1479, UL 2079, FM 4990, BS EN1366-3 or other equivalent standards.

2.2.12 T' Rating

The period of time (in hours or 15-minute increments) a Firestop system has been shown capable of keeping the unexposed surface of the Firestop system and/or any penetrating items from exceeding a 3250F (1810C) above ambient temperature rise. This T rating also includes passage of F rating requirements for the same time period as determined by ASTM E 814, ASTM E-119, UL 1479, FM 4990, BS EN1366-3 or other equivalent standards.

2.2.13 L' Rating

The amount of air leakage through the fire rated assembly, determined by applying specified air pressure (0.30" water column) across the surface of the test assembly. The rating is expressed in cubic feet per minute (CFM) leakage per square foot of opening, as detailed in UL 1479, UL 2079, BS EN1366-3 or equivalent standards. An L rating is a measure of the ability of a fire-resistive assembly to prevent cold and warm smoke passage through fire stops, joint seals and other resistance rated assemblies, obtained at ambient or elevated temperatures.

2.2.14 W' Rating

W rating determines the capability of the firestop system to maintain water tightness of the penetration through a floor or wall construction at ambient air conditions under 3 ft. of water pressure head (1.3 psi) for a period of 72 hours.

2.2.15 Tested and Listed Assembly

Tested and listed assemblies are the systems that are successfully tested as assemblies to the test criteria mentioned in **Sub Section 8** by General Directorate of Civil Defence listed laboratories and certified by General Directorate of Civil Defence listed certification bodies. The supplier, manufacturer of such tested and certified assemblies shall be listed and Permitted by General Directorate of Civil Defence – Kingdom of Bahrain.

2.2.16 Engineering Judgments (EJ's)

An evaluation of the field conditions which do not conform to or deviate from an existing tested and listed assemblies. Engineering Judgment (EJ) shall be issued essentially by the original testing laboratory/Certification body that listed the system or registered Fire Consultant, Fire Protection Engineer, or an independent certification agency that provides certification services for such systems. EJ's are not to be used as a substitute for a classified system if it exists. EJ's, when considered, shall be Permitted by General Directorate of Civil Defence – Kingdom of Bahrain.

2.3 EIFS (Exterior Insulation and Finish Systems) and ETICS (Exterior Thermal Insulation Composite Systems)

2.3.1 Adhesive

A material used to attach the insulation board to the substrate.

2.3.2 Aesthetic Reveal

A groove cut into the insulation board, which serves the function of decoration and/or provides a starting or stopping point for application of the finish coat.

2.3.3 Backer Rod

A closed cell foam rod installed in a joint that is to receive sealant. Its purpose is to control joint depth and configuration as well as prevents three-sided adhesion.

2.3.4 Back wrap

The practice of attaching a strip of reinforcing mesh to the wall substrate, adhesively or mechanically attaching insulation board to the substrate then wrapping the mesh around to the face of the insulation board and encapsulating it in the base coat on the return edges and face of the insulation board.

2.3.5 Base Coat
A material applied to the face of the insulation board that is used to encapsulate the reinforcing mesh.

2.3.6 Brown Coat
The second coat of Portland cement plaster installed in a conventional hard coat stucco system.

2.3.7 Cold Joint
The visible junction in a finish coat. It occurs when a wet edge is not maintained. This can typically, be avoided with proper scaffold, sufficient manpower and aesthetic reveal/ joints.

2.3.8 Control Joint
Designed to relieve stresses of both expansion and contraction in large stuccoed areas.

2.3.9 Cornerite (Strip lath)
A strip of painted or galvanized Diamond Mesh Lath used as reinforcement.

2.3.10 Curing
A chemical process through which the properties of a material are developed.

2.3.11 Drainage
The collection and discharge of water by gravity flow.

2.3.12 Durability
The capability of the system to maintain serviceability over a specific period of time.

2.3.13 Edge wrap
A method used to protect the exposed edges of the insulation board with reinforcing mesh and base coat.

2.3.14 EIFS
Exterior Insulation and Finish System. A non-load bearing exterior wall cladding system consisting of a thermal insulation board, adhesively and/or mechanically attached to the substrate, base coat with reinforced fiberglass mesh and a textured finish coat.

2.3.15 Embed
A method implemented to encapsulate the fiberglass reinforcing mesh in the base coat.

2.3.16 EPS (Insulation Board)
A preformed insulating material of a specific type and density that functions to reduce the heat flow through the wall and provides the surface to receive the base coat.

2.3.17 ETICS
External Thermal Insulation Composite Systems. A non-load bearing exterior wall cladding system consisting of a thermal insulation board, adhesively and/or mechanically attached to the substrate, base coat with reinforced fiberglass mesh and a textured finish coat.

2.3.18 Expansion Joint
A structural separation between similar and/or dissimilar building components that allows independent movement of the components while preventing damage to the assembly.

2.3.19 Factory Mixed
A ready-to-use adhesive base coat or finish coat material prepared by the manufacturer.

2.3.20 Fasteners
Plastic washers used in conjunction with non-corrosive screws to attach insulation to substrate and/or framing.

2.3.21 Field Mixing
A material prepared by the user in the field that is mixed with other components and/or water.

2.3.22 Finish Coat
A decorative and protective textured coating applied over the dry reinforced base coat.

2.3.23 Flashing
A non-corrosive material of metal or plastic at a systems termination or interface with an opposing cladding component used to drain moisture to the face of the wall assembly.

2.3.24 Framing Member
Studs, joists, runners (tracks), bridging, bracing, and related accessories manufactured or supplied in wood or hot or cold-formed steel.

2.3.25 Lamina
The layer comprised of the base coat, reinforcing mesh and the finish coat.

2.3.26 Penetration
Any location in an EIF System where an object passes through all components of the system such as a window, door, light box, etc.

2.3.27 Primer
A material used to prepare a surface for application of EIFS to the substrate or of the finish coat to the base coat.

2.3.28 Reinforced Base Coat
A base coat in which an open-weave glass-fiber fabric has been encapsulated to provide reinforcement.

2.3.29 Reinforcing Mesh
Open-weave glass-fiber fabric treated for compatibility with other materials of the system that functions to strengthen the system.

2.3.30 Sealant
Installed with or without a backer rod for the purpose to allow thermal expansion and contraction of dissimilar cladding components to prevent moisture penetration.

2.3.31 Sealant System
The use of primer, backer rod or bond breaker in conjunction with the installation of sealant.

2.3.32 Scratch Coat
The first coat of Portland cement stucco installed over metal wire or lath.

2.3.33 Substrate
The surface over which the EIFS/ETICS or weather resistive barrier is applied.

2.3.34 Weather/Moisture Barrier
The surface over which the EIFS or weather resistive barrier is applied.

2.3.35 Wet Edge
The leading edge of a continuously applied wet state material.

2.3.36 Wrapping
The process of totally encapsulating all EPS to seal and strengthen the system by bringing reinforcing mesh around the system terminations, embedded in base coat. Wrapping is also referred to as back wrap or edge wrap.

2.4 Glazing

2.4.1 Glazing
A wall, floor, ceiling or roofing 'system' that contains glass as one of its components.

2.4.2 Fire resistant glazing
Glazing that provides a physical barrier to elements of fire including flame and hot gases, or flame and hot gases and heat and in addition the prevention of increase in temperature beyond a certain degree on the non-fireside of the glazing.

2.4.3 Fire resistance, integrity only (E)
A glazing that is required to resist the passage of flames and hot gasses and limit the size of openings developing, for a specified period of time, defined in minutes.

2.4.4 Fire resistance, integrity with radiation limitation (EW)
A glazing that meets the integrity criteria and is required to limit heat radiation below 15kW/m2 from its non-fire side, for a specified period of time, defined in minutes.

2.4.5 Fire resistance, integrity with insulation (EI)
A glazing that meets the integrity criteria and is required to restrict the rise in average surface temperature of the non-fireside of the glazing beyond 140°C above the initial surface temperature or to a maximum surface temperature rise up to 180°C (whichever is lower), for a specified period of time, defined in minutes.



2.4.6 Fire rated Glazing systems defined as per American standards
As per American standards in areas where there are automated sprinkler system and in areas that will be exposed to Fire fighters hose must pass the hose stream test. This test the ability of the glazing system to retain its integrity when a jet of water is blasted on the glazing surface (fire-side or non-fire side). The specimen should not develop openings that permit projection of water from the stream from one side to the other. The glazing assembly

shall remain in the opening and shall not loosen or separate from fastenings, or develop any through openings. Since the test specimen is subjected to pressure of water from the exposed side the test result covers the unexposed side.

2.4.7.a Fire protection glazing as defined in NFPA 257

As per NFPA 252, NFPA 257, UL 10B, UL 10C and UL 9, only glazing system integrity performance is assessed. Glazing that is not designed to limit the temperature rise on the non-exposed surface but has to withstand the impact of the hose stream test; radiation on the non-fire side can be measured whenever required.

2.4.7.b Fire resistance rated glazing as defined in NFPA 251

As per NFPA 251, UL 263, or ASTM E119, The conditions of acceptance of these standards include system integrity and temperature insulation on non-fire side.

2.4.8 Fire-rated glazing systems

Fire rated Glazing Systems are usually composed of following three main components that must work together during an occurrence of fire:

a. **Fire-rated frames -** typically steel, timber or aluminum
b. **Fire-rated glass – examples are:**
   i. Glass ceramics
   ii. Borosilicate glass
   iii. Soda-lime silicate glass (mostly unidirectional protection only)
   iv. Resin or polyvinyl butyral laminated glass
   v. Gel-filled laminated glass
   vi. Intumescent-filled laminated glass

2.4.9 Fire-rated accessories and hardware (or ironmongery).

These include (but are not limited to):

a. Fire-rated glazing seals and sealants
b. Types and profiles of fire-rated glazing beads and modes of fixing
c. Fire-rated fixings and anchoring
d. Fire-rated ceramic tapes
e. Fire-rated intumescent strips
f. Fire-rated infills for frames / doors
g. Fire-rated gaskets
h. Fire-rated setting blocks

2.4.10 Critical location

A location where breakage must be considered and safety glass or safety plastics must be used.

2.4.11 Safety glass

A glass configuration that provides the required level of Strength, protection and ensures less danger when breaks. **(See sub section 6.4.2.).** A safety glass is not a fire rated glass. Examples of safety glass types are:

a. Safety wired.
b. Thermally toughened safety glass
c. Laminated safety glass
d. Adhesive backed polymeric filmed safety glass
e. Safety backed mirrors
f. Safety backed painted glass

2.4.12 Safety plastic

A plastic glazing sheet material that provides the required level of protection when considering the criteria stated in (**See sub section 6.4.2.).** The breakage characteristics of plastics glazing sheet materials vary because of differences in their chemical composition, or structure. Two or more different materials may be combined to provide composite products. The three types of plastics glazing sheet materials most commonly used for external and internal glazing are as follows:

a. Polycarbonate (PC).
b. Polymethyl methacrylate (PMMA).
c. Polyvinyl chloride (PVCu).

2.4.13 Modes of Breakage

Type A: Cracks appear forming separate fragments with sharp edges, some of which are large. This is the mode of breakage typical of annealed glass. This is not consistent with safety glass.

Type B: Cracks appear, but the fragments hold together and do not separate. This is the mode of breakage typical of laminated glass. This may be typical of safety glass but specific precautions should be taken when used overhead (**See sub section 6.4.4.).**

Type C: Disintegration occurs, leading to a large number of small particles that are relatively harmless. This is the mode of breakage typical of toughened (fully tempered) glass. This is consistent with safety glass.

2.4.14 Annealed glass

The basic glass (e.g. float, patterned) from which most other glasses referred to in this annex is processed. If annealed glass is broken and pieces are displaced, the resulting glass edges will be sharp. Annealed glass has a mode of breakage classification of Type A. Annealed glass is not recommended for external use in the Bahrain due to its propensity for thermal cracking.

2.4.15 Wired glass

Glass with steel wire cast into the body of the glass. If wired glass is broken and the pieces are held together by the wires, penetration is unlikely. However, if the wires are broken and the material is penetrated, the resulting glass edges will be sharp. Wired glass has a mode of breakage classification of Type B.

2.4.16 Laminated glass

A glass configuration using more than one layer of material bonded together. The **breakage** characteristics will be similar to those of the types of glass used in its construction, but the pieces will remain substantially adhered to the interlayer. Depending on the type and thickness of the interlayer, the broken glass is unlikely to be penetrated.
Laminated glass has a mode of breakage classification of Type B.

2.4.17 Laminated glazing

The configuration designed such that the glass remains held in place in the frame if broken.
Note: for glass consisting of only FT panels, this will require a specially designed retention system for the broken glass.

2.4.18 Toughened Glass (Fully Tempered) (FT)

Glass that has been heat treated to enhance its strength and resistance to impact, and its breakage characteristic. Thermally toughened soda-lime glass is difficult to break, but if

broken, it fragments into small, relatively harmless pieces. Toughened (tempered) glass has a mode of breakage classification of Type C.

2.4.19 Heat Strengthened Glass (HS)

Glass that has been heat treated to enhance its strength and resistance to impact characteristics. If heat strengthened glass is broken the resulting edges will be sharp. Heat strengthened glass has a mode of breakage classification of Type A.

2.4.20 Plastics Covered Annealed (or Other) Glass

Annealed (or other) glass covered with specially formulated organic materials (e.g. adhesive backed polymeric filmed glass) intended to hold the glass together after breakage. If broken it will be difficult to penetrate provided that the covering is applied in accordance with the manufacturer's recommendations. Plastics covered annealed (or other) glass has a mode of breakage classification of Type B.

2.4.21 Plastics covered glazing

A configuration such that the glass remains held in place in the frame if broken. Note: for glass consisting of only FT panels, this will require a specially designed retention system for the broken glass.

2.4.22 Insulating glass

Glass involving more than one pane where each layer is separated with a space of several mm. The space may contain air or other specialist inert gasses designed to limit the transfer of heat.

a. If an insulating glass unit is installed in a critical location where there is pedestrian access to both sides of the unit, then both panes of the unit must meet these requirements. However, in situations where pedestrian access is restricted to one side of the unit, then only the accessible side must to conform to the requirements. An example would be where there is low level glazing in the facade of a building in the storeys above the ground floor, but with no pedestrian access to the external faces of the insulating glass units.

b. Care should be taken to ensure that an insulating glass unit with two different panes specifications are installed the correct way round.

c. Heat-treated glass should bear a small but legible mark, visible on the lower left corner of the glass when installed, which indicates its nature / performance.

2.4.23 Labeling/Manifestation

Patterns, logos or similar markings on glass, intended to make it immediately apparent to users of the area that glass is present in an opening, provided to reduce the likelihood of an accidental impact.

2.4.24 Overhead glazing

Glazing above head height that is either horizontal or inclined at an angle to the horizontal up to 75° and where there is general access to the areas beneath the glazing.

2.4.25 Plastic glazing materials

These are glazing materials made from polymers that may not necessarily have a safety or fire resistance capability but, due to their organic nature, are required to have known reaction to fire performance characteristics.

2.5 Roofing

2.5.1 Roof Assembly

A system designed to provide weather protection and resistance to design loads. The system consists of a roof covering and roof deck or a single component serving as both the roof covering and the roof deck. A roof assembly includes the roof deck, vapor retarder, substrate or thermal barrier, insulation, vapor retarder and roof covering.

2.5.2 Roof Covering

The covering applied to the roof deck for weather resistance, fire classification or appearance.

2.5.3 Roof Deck

The flat or sloped surface not including its supporting members or vertical supports.

2.5.4 Roof recover

The process of installing an additional roof covering over a prepared existing roof covering without removing the existing roof covering.

2.5.5 Roof repair

Reconstruction or renewal of any part of an existing roof for the purposes of its maintenance.

2.5.6 Roof replacement

The process of removing the existing roof covering, repairing any damaged substrate and installing a new roof covering.

2.5.7 Rooftop structure

An enclosed structure on or above the roof of any part of a building. Roof structures shall be constructed of materials consistent with the required type of construction of the building. Such structures shall not be used for habitation or storage and should not be considered a story. Roof structures on buildings shall be not more than 8535 mm in height above the roof of the building. Towers, spires, and other architectural embellishments shall not be limited in height where constructed entirely of noncombustible materials. Towers and spires shall extend not more than 6100 mm above the height limit permitted where constructed of combustible materials. See **Table: - A.02-T1.9.63.** for further requirements.

2.6 MCM/ACP Cladding

2.6.1 Cladding

Cladding, other than thermal barrier and Sandwich Panels is a non-structural covering installed over structural surfaces. It is usually in Metal Composite Materials (MCM) but it is also available in a variety of building materials and made to tolerate extreme weather conditions.

2.6.2 MCM (Metal Composite Material, including ACP, Aluminum Composite Panels)

A factory manufactured panel consisting of metal skins bonded to both faces of a "core" (See 2.6.3. for Core definition). All MCM's shall be tested and permitted at the maximum thickness intended for use and intended assemblies. However, MCM's including ACP's shall have a minimum exterior skin thickness of 0.019 in. (0.5 mm), a minimum

interior skin thickness of 0.010 in (0.25 mm), and a maximum panel thickness of ¼ in. (6.3 mm) where installed on exterior walls.

2.6.3 MCM and ACP Core

Core used in factory manufactured MCM can be of plastic or mineral or any such material other than foam plastic insulation, having flame and smoke spread characteristics.

2.6.4 Bearing Wall System

A structural system with bearing walls providing support for all or major portions of the vertical loads. Shear walls or braced frames provide seismic force resistance

2.7 Occupancies and Types of Buildings

2.7.1 Assembly

An occupancy used for a gathering of people for deliberation, worship, entertainment, eating, drinking, amusement, awaiting transportation, or similar uses.

2.7.2 Business

An occupancy used for the transaction of business other than mercantile, usually used for office, professional or service-type transactions, including storage of records and accounts.

2.7.3 Educational

An occupancy used for educational purposes.

2.7.4 Healthcare

An occupancy used to provide medical, psychiatric, surgical, therapeutic treatment for people.

2.7.5 Residential

An occupancy, other than Villa **(See definitions 2.7.43, 2.7.44),** that provides sleeping accommodations with independent cooking and bathroom facilities where people live on a permanent basis.

2.7.6 Hotel

A building or groups of buildings under the same management in which there are sleeping accommodations for lodging with or without meals for people on a transient's basis.

2.7.7 Daycare

An occupancy in which four or more clients receive care, maintenance, and supervision, by other than their relatives or legal guardians, for less than 24 hours per day.

2.7.8 Detention and Correctional

An occupancy used to house one or more persons under varied degrees of restraint or security where such occupants are mostly incapable of self-preservation because of security measures not under the occupants' control.

2.7.8.1 Use condition I, Free Egress

A condition under which free movement is allowed from sleeping areas and other spaces where access or occupancy is permitted to the exterior via means of egress.

2.7.8.2 Use condition II, Zoned Egress

A condition under which free movement is allowed from sleeping areas and any

other occupied smoke compartment to one or more other smoke compartments

2.7.8.3 Use condition III, Zoned Impeded Egress

A condition under which free movement is allowed within individual smoke compartments, such as within a residential unit comprised of individual sleeping rooms and a group activity space, with egress impeded by remote controlled release of means of egress from such a smoke compartment to another smoke compartment.

2.7 Occupancies and Types of Buildings

2.7.8.4 Use condition IV, Impeded Egress

A condition under which free movement is restricted from an occupied space, and remote controlled release is provided to allow movement from all sleeping rooms, activity spaces, and other occupied areas within the smoke compartment to another smoke compartment.

2.7.8.5 Use condition V, Contained

A condition under which free movement is restricted from an occupied space, and staff controlled manual release at each door is provided to allow movement from all sleeping rooms, activity spaces, and other occupied areas within the smoke compartment to another smoke compartment.

2.7.9 Mercantile

An occupancy used for the display and sale of merchandise. It involves stocks of goods, wares or merchandise.

2.7.9.1. Class A

Mercantile occupancies having an aggregate gross area of more than 2800 M^2 or occupying more than three storeys (Midrise building) for sales purposes.

2.7.9.2. Class B

Mercantile occupancies having an aggregate gross area of 280 M^2 to not more than 2800 m^2 and occupying not more than three storeys (Low-rise building) for sales purposes.

2.7.9.3. Class C

Mercantile occupancies having an aggregate gross area of not more than 280 m^2 and occupying only ground floor for sales purposes.

2.7.10 Storage/ Warehouse

An occupancy used primarily for the storage or sheltering of goods, merchandise, products, or vehicles.

2.7.11 Industrial/ Factory/ Workshop

An occupancy in which products are manufactured or in which processing, assembling, mixing, packaging, finishing, decorating, or repair operations are conducted.

2.7.12 Robotic or Mechanical Storage

A warehouse or storage structure that uses computer-controlled machines to store and retrieve goods, in multi-level storage racks with no floors.

2.7.13 Covered Mall

A roofed or covered common pedestrian area within a covered mall building that serves as access for multiple tenants and not to exceed three levels that are open to each other.

2.7.14 Open Mall

An unroofed common pedestrian way serving a number of tenants not exceeding three levels. Circulation at levels above grade shall be permitted to include open exterior balconies leading to exits discharging at grade.

2.7 Occupancies and Types of Buildings

2.7.15 Anchor Shop (Building)

A retail shop/building having low or ordinary hazard contents and having direct access to a mall building, but having all required means of egress independent of the mall.

2.7.16 Parking

A building, structure, or portion thereof used for the parking, storage, or both, of motor vehicles.

2.7.17 Open Parking

A Parking occupancy where in each parking level, any part of the carpark is within 30 m of the permanent natural ventilation wall openings open to the atmosphere for an area of not less than 0.4m2 for each linear meter distributed over 40 percent of the building perimeter surface or uniformly over two opposing sides. And interior wall lines and column lines are at least 20 percent open, with openings distributed to provide ventilation.

2.7.18 Enclosed Parking

A parking occupancy which doesn't qualify as open parking and is enclosed on all sides.

2.7.19 Robotic or Mechanical Parking

A parking structure that uses computer-controlled machines to store and retrieve vehicles, without drivers, in multi-level storage racks with no floors.

2.7.20 Animal Housing

An occupancy where animals, birds and creatures are fed, rested, exercised, Trained, sold, treated, exhibited, reproduced such as Veterinary Clinics, Zoos, Animal care centers, pet shops.

2.7.21 Fuel Dispensing Facilities/ Gas Stations/ Petrol Stations

An occupancy where motor fuels are stored and dispensed from fixed equipment into the fuel tanks of motor vehicles or marine craft or into permitted containers, including all equipment used in connection therewith.

2.7.22 Multiple Occupancy

A building or structure in which two or more classes of occupancy exist.

2.7.23 Mixed Occupancy

A multiple occupancy where the occupancies are intermingled.

2.7.24 Pedestrian Walkway/Bridge

A cross walk or other identified path, usually elevated bridge like structure or below grade

tunnel intended for pedestrian use in crossing a vehicular way, or connecting two buildings and primarily designed for pedestrian traffic.

2.7.25 Airport Terminal Building

A structure used primarily for air passenger enplaning or deplaning, including ticket sales, flight information, baggage handling, and other necessary functions in connection with air transport operations. This term includes any extensions and satellite buildings used for passenger handling or aircraft flight service functions.

2.7 Occupancies and Types of Buildings

2.7.26 Satellite

A structure that can be adjacent to but separated from the airport terminal building, accessible aboveground or through subway passages, and used to provide flight service operations, such as passenger check-in, waiting rooms, food service, enplaning or deplaning, etc.

2.7.27 Aircraft Hanger

A building or other structure inside any part of which aircraft are housed or stored and in which aircraft might undergo service, repairs, or alterations.

2.7.28 Airport Traffic Control Tower

An enclosed structure or building at airports with elevated levels for support of equipment and occupied for observation, control, operation, and signaling of aircraft in flight and on the ground.

2.7.29 Tent

A temporary structure, the covering of which is made of pliable material that achieves its support by mechanical means such as beams, columns, poles, or arches, or by rope or cables, or both. Locally tents are occupied as Ramadan Tents, Exhibitions, Marriages, funerals, Party, entertainment, Dining or meetings. See **Sub Section 8.1.42.** for material requirements.

2.7.30 Membrane Structure

A building or portion of a building incorporating an air-inflated, air-supported, tensioned-membrane structure; a membrane roof; or a membrane-covered rigid frame to protect habitable or usable space. See **Sub Section 8.1.41.** for material requirements.

2.7.31 Air-Inflated Structure

A structure whose shape is maintained by air pressure in cells or tubes forming all or part of the enclosure of the usable area and in which the occupants are not within the pressurized area used to support the structure. See **Sub Section 8.1.43.** for material requirements.

2.7.32 Air-Supported Structure

A structure where shape is maintained by air pressure and in which occupants are within the elevated pressure area. See **Sub Section 8.1.43.** for material requirements.

2.7.33 Kiosks

A structure, temporary or permanent in nature constructed of wood, textile, plastic, composite panels etc. occupied as retail outlet, food outlet, service outlet, generally located at malls, shopping centers, assembly areas and exhibition centers. See **Sub Section 8.1.40.** for

material requirements.

2.7.34 Private Villa

Single family dwelling unit, generally ground with first floor, built and solely owned by individual on the individual plot.

2.7.35 Commercial Villa

One- or Two-family dwelling units built in a group by developer and sold, leased or rented to individual families. Mosques, community halls, recreation facilities may also be part of this development.

2.7 Occupancies and Types of Buildings

2.7.36 Multiple Occupancy

A building or structure in which two or more classes of occupancy exist.

2.7.37 Mixed Occupancy

A multiple occupancy where the occupancies are intermingled.

2.7.38 Separated Occupancy

A multiple occupancy where the occupancies are separated by fire resistance–rated assemblies.

2.7.39 Low Rise Building

The occupancies or Multiple and Mixed occupancies, facilities, buildings and structures having total height of the building (excluding roof parapets) at or up to 15 Meters from the lowest grade or lowest level of Fire Service access into that occupancy is categorized as Low-rise Building.

2.7.40 Mid Rise Building

The occupancies or Multiple and Mixed occupancies, facilities, buildings and structures having total height of the building (excluding roof parapets) is between 15 Meters to 23 meters from the lowest grade or lowest level of Fire Service access into that occupancy is categorized as Midrise Building.

2.7.41 High Rise Building

The occupancies or Multiple and Mixed occupancies, facilities, buildings and structures having total height of the building (excluding roof parapets) is between 23 Meters to 90 meters from the lowest grade or lowest level of Fire Service access into that occupancy is categorized as Highrise Building.

2.7.42 Super High-Rise Building

The occupancies or Multiple and Mixed occupancies, facilities, buildings and structures having total height of the building (excluding roof parapets) is more than 90 meters from the lowest grade or lowest level of Fire Service access into that occupancy is categorized as Superhigh rise Building.

2.7.43 Underground Building or Structure

A structure or portion of a structure in which the floor level is below the level of exit discharge.

2.7.44 Low Depth Underground Building

An underground structure or a building up to 7 m below or having up to two basements below the level of exit discharge.

2.7.45 High Depth Underground Building

An underground structure or a building more than 7 m below or having more than two basements below the level of exit discharge.

2.7 Occupancies and Types of Buildings

2.7.46 Multiple Occupancies Protected as Mixed Occupancies

A building, structure or facility where more than one classes of occupancies exist is noted as Multiple occupancy. Occupancies are often mixed and their exits are intermingled with one type of occupancy located and associated with other classes of occupancies, facilities, buildings and structures without a definite Fire Barrier or with intermingling exits such as Offices located in Showrooms, Shopping Centers, Souks, industrial facilities or hospitals. Mixed occupancies are combinations of various Hazard Content and Hazard categories. Accordingly, the code application in such occupancies is based on the most stringent requirements.

2.7.47 Separated Multiple Occupancies as Protected Occupancies

A building, structure or facility which houses multiple occupancies similar to 'Mixed Occupancies' but with definite Fire Barriers, distinctive separate Exit Access and Exits, 'separating' the different classes of occupancies from each other.

2.7.48 Occupancy Hazard

Hazard Content and Hazard evaluation for the occupancies differ based on the material involved and its burning characteristics. General Directorate of Civil Defence – Kingdom of Bahrain has approached the occupancy hazards based on the life safety, risk involved and fire protection system requirements and categorized the types of occupancies further into Group A, Group B and Group C occupancies.

2.7.49 Category A (Group A)

Category A is the original occupancy classification as per international building and Life Safety Codes, which is based on hazard evaluation, occupant loads, functionality etc. in addition, General Directorate of Civil Defence – Kingdom of Bahrain considers Group A occupancy as having High hazard in terms of risk involved and high priority in terms of fire protection system requirements.

2.7.50 Category B (Group B)

Category B represents the original classifications as per international building and Life Safety Codes with moderate or ordinary hazard content. Most occupancies generally have moderate hazard or ordinary hazard such as Paper, Records, Books, Computers, Carpet, Household Plastic, Home Appliances, Electronic & Electrical Office Equipment, Furniture, Wood, Bedding and upholstery.

2.7.51 Category C (Group C)

Category C represents some additional occupancies as we know it locally along with the original classifications as per international building and Life Safety Codes. Group C occupancies have the lowest hazard or light hazard content and thus lowest requirements in terms of fire protection system requirements.

3.0 Construction Requirements

3.1. Intention

3.1.1. The construction requirements for buildings and structures in this chapter do not address Environmental impact, Structural Load analysis and withstanding natural disasters. The Construction requirements in this chapter are to ensure Fire Safety in and around buildings and structures and are to achieve the following.

3.1.1.1. Buildings are designed and constructed to provide safety from structural failure during fire.

3.1.1.2. Buildings are designed and constructed to provide protection to occupants from fire.

3.1.1.3. Buildings are designed and constructed to contain fire in its origin compartment and stop from spreading to other areas.

3.1.1.4. Fire in one building and structure do not spread to neighboring buildings or properties.

3.2. General

3.2.1. Each occupancy shall not exceed the area limitations or be located at a height greater than that permitted for such occupancy and the type of construction being used.

3.2.2. Where minor accessory usages do not occupy more than 25 percent of the area of any floor of a building, the principal use of the building shall determine the occupancy classification.

3.2.3. In high-rise occupancies, the most restrictive, applicable, high-rise building provisions and fire protection system requirements shall apply to all portions of the building.

3.2.4. Where separated occupancies are provided, each part of the building comprising a distinct occupancy, as described in this chapter, shall be completely separated from other occupancies by fire-resistive assemblies, as specified in **Table: - A.02-T1** below.

3.2.5. Requirements in this chapter are minimum guidelines. It is consultant's responsibility to refer to international standards such as **NFPA 5000, NFPA 501, NFPA 502, NFPA 409, NFPA 130, NFPA 88A, NFPA 30 and IBC**, on which this chapter is based on, for further clarifications and code complaint building constructions.

3.3. Types of Occupancies (Occupancy Classifications)

3.3.1. Table: - A.02-T1. defines the occupancies, based on which the construction requirement height, area, Fire resistance of structural elements, separation between buildings are dictated. For sprinkler design purpose, occupancy classifications shall be in accordance with **Section D**, **Chapter 05, Sub Section 2.1.13.**

Table: - A.02-T1: Types of Occupancies based on their usage, Hazard and number of occupants (RISKS)

OCCUPANCY	GROUP A	GROUP B	GROUP C
1. **Assembly** An occupancy used for a gathering of people for deliberation, worship, entertainment, eating, drinking, amusement, awaiting transportation, or similar uses.	1. Banquet halls 2. Night clubs 3. Discos 4. Restaurants with more than 50 people 5. Pubs 6. Bars 7. Theaters 8. Concert Halls 9. Cinemas 10. Indoor Stadiums 11. Studios with audience 12. Exhibition halls 13. Casinos	1. Amusement Park 2. Grandstands 3. Outdoor Stadiums 4. Bleachers 5. Swimming Pools 6. Skating Rinks 7. Indoor Kid's Play Areas 8. Bowling alleys 9. Pool/billiard parlors 10. Waiting areas in transportation terminals. 11. Airport Terminal Buildings 12. Food courts, seating areas	1. Art galleries 2. Community halls 3. Mosques 4. Churches 5. Temples 6. Courtrooms 7. Funeral parlors 8. Gymnasiums 9. Fitness Centers 10. Seminar halls 11. Libraries 12. Museums 13. Open air Theaters 14. Amphitheaters 15. Parks 16. Beaches
2. Business An occupancy used for the transaction of business other than mercantile, usually used for office, professional or service type transactions, including storage of records and accounts.	1. Electronic data processing 2. Telephone exchanges 3. Radio and television stations 4. Laboratories 5. Testing and research 6. Airport traffic control towers	1. Offices 2. Modular Site Offices 3. Banks 4. Government offices 5. Post offices 6. Money Exchange Centers. 7. Sales and Marketing Offices 8. Professional/ Consultancy services such as architects, attorneys, dentists, physicians, engineers, etc.	1. Barber Shops 2. Beauty Shops 3. Massage Centers 4. Typing Centers 5. Translation centers 6. Print Shops 7. Photo Studios
3. Educational An occupancy used for educational purposes.	1. Nurseries 2. Kindergarten 3. Preschool center 4. Talent Grooming centers for kids	1. Schools for up to 12th grade students	1. Colleges 2. Universities 3. Training centers for adults
4. Healthcare An occupancy used to provide medical, psychiatric, surgical, therapeutic treatment for people.	1. Hospitals. 2. Limited Care Facilities 3. Nursing Homes 4. Mental Asylums	1. Clinics	1. Ambulatory Health care center

3.3. Types of Occupancies

Table: - A.02-T1: Types of Occupancies based on their usage, Hazard and number of occupants (RISKS)

OCCUPANCY	GROUP A	GROUP B	GROUP C
5. Residential An occupancy, other than Villa, that provides sleeping accommodations with independent cooking and bathroom facilities where people live on a permanent basis.	1. Residential buildings 2. Residential Apartments 3. Assisted Living Homes 4. Labor Accommodation	1. Staff Accommodation 2. Hostels 3. Monasteries 4. School Boarding House	
6. Private Villa Single family dwelling unit, generally ground with first floor, built and solely owned by individual on the individual plot.	1. Private Villa with basement and basement car park. 2. Private Villa with marine front. 3. Private Villa on island.	1. Private Villa without basement	
7. Commercial Villa One- or Two-family dwelling units, generally ground with first floor, built in a group by developer and sold, leased or rented to individual families. Mosques, community halls, recreation facilities may also be part of this development.	1. Commercial Villa with basement and basement car park. 2. Commercial Villa with marine front. 3. Commercial Villa on island.	1. Commercial Villa	
8. Detention and Correctional An occupancy used to house one or more persons under varied degrees of restraint or security where such occupants are mostly incapable of self-preservation because of security measures not under the occupants' control.	1. Adult Prisons 2. Adult Detention centers 3. Adult Jails 4. Adult Correctional centers 5. Adult pre-release centers	1. Juvenile Prisons 2. Juvenile Detention centers 3. Juvenile Correctional centers	1. Medical Quarantines 2. Airport Quarantines

3.3. Types of Occupancies

Table: - A.02-T1: Types of Occupancies based on their usage, Hazard and number of occupants (RISKS)			
OCCUPANCY	**GROUP A**	**GROUP B**	**GROUP C**
9. Hotel A building or groups of buildings under the same management in which there are sleeping accommodations for lodging with or without meals for people on a transient's basis.	1. Hotels 2. Hotel Apartments 3. Time share properties / Vacation Ownership	1. Dormitory 2. Motels 3. Lodging	1. Resorts
10. Day care An occupancy in which four or more clients receive care, maintenance, and supervision, by other than their relatives or legal guardians, for less than 24 hours per day.	1. Child Day care centers 2. Old age care centers	1. Adult Day care centers	
11. Mercantile An occupancy used for the display and sale of merchandise. It involves stocks of goods, wares or merchandise. Group of mercantile occupancies under a single roof or not separated and having a ground floor built up area of more than 3600 $m^{2,}$ irrespective of the number of storeys, shall be considered as Malls.	1. Hardware Stores 2. Paint Stores 3. Chemical Stores 4. Furniture Stores 5. Motor Vehicle Showrooms 6. Restaurants with less than 50 people	1. Department Stores 2. Supermarkets 3. Hypermarkets 4. Shopping Centers 5. Anchor stores 6. Showrooms 7. Retail stores 8. Whole sale stores 9. Boutiques 10. Drugstores 11. Gift Shops	1. Kiosks 2. Food Trucks 3. Mercantile Trucks

3.3. Types of Occupancies

Table A.02.T1: Types of Occupancies based on their usage, Hazard and number of occupants (RISKS)			
OCCUPANCY	**GROUP A**	**GROUP B**	**GROUP C**
12. Storage / Warehouse An occupancy used primarily for the storage or sheltering of goods, merchandise, products, or vehicles.	**GROUP A-1** 1. Explosives 2. Detonators 3. Pyrophoric material 4. Unstable (Reactive) material 5. Organic Peroxide 6. Oxidizer 7. Fire Works **GROUP A-2** 1. Aerosols Level 1,2,3 2. Combustible Liquid Class I, II, III 3. Combustible Fiber 4. Combustible Dust 5. Pyrotechnic Material 6. Cryogenics, Flammable, Oxidizing 7. Flammable Gas 8. Flammable Liquid, IA, IB, IC 9. Flammable Solid 10. Oxidizing Gas 11. Water Reactive Material 12. Perfumes 13. Baled Cotton 14. Corrosive Material 15. Toxic Material 16. Plastic products 17. Tires	1. Aircraft hangar 2. Bags: cloth/burlap/ paper 3. Bamboos and rattan 4. Baskets 5. Belting: canvas/leather 6. Books and paper in rolls or packs 7. Boots and shoes 8. Buttons 9. Cardboard, its boxes 10. Clothing, woolen wearing apparel 11. Cordage 12. Dry boat storage (indoor) 13. Furniture 14. Furs 15. Glues, mucilage, pastes 16. Grains 17. Horns and combs, other than celluloid 18. Leather 19. Linoleum 20. Lumber 21. Motor vehicle repair garages 22. Photo engravings 23. Resilient flooring 24. Silks 25. Soaps 26. Sugar 27. Tobacco, cigars, cigarettes and snuff 28. Upholstery and mattresses 29. Wax candles	1. Frozen Food 2. Asbestos 3. Glass or ceramic 4. Cement in bags 5. Chalk and crayons 6. Dairy products in non-waxed coated paper containers 7. Dry cell batteries 8. Electrical coils 9. Electrical motors 10. Empty cans 11. Foods in non-combustible containers 12. Fresh fruits and vegetables in non-plastic trays or containers 13. Glass bottles, empty or filled with non-combustible liquids 14. Gypsum board 15. Inert pigments 16. Ivory 17. Meats 18. Metal cabinets 19. Metal desks with plastic tops and *trim* Metal parts 20. Metals 21. Mirrors 22. Oil-filled and other types of distribution transformers 23. Parking garages, open or enclosed 24. Porcelain and pottery 25. Stoves 26. Talc and soapstone 27. Washers and dryers

3.3. Types of Occupancies

Table A.02.T1: Types of Occupancies based on their usage, Hazard and number of occupants (RISKS)

OCCUPANCY	GROUP A	GROUP B	GROUP C
13.1. Industrial / Factories / Workshops An occupancy in which products are manufactured or in which processing, assembling, mixing, packaging, finishing, decorating, or repair operations are conducted. **13.2. Special purpose Industries and Factories** An industrial occupancy in which ordinary and low hazard industrial operations are conducted in buildings designed for, and suitable only for, particular types of operations, characterized by a relatively low density of employee population, with much of the area occupied by machinery or equipment.	**GROUP A-1** Manufacturing, Processing, Refilling, Packaging, Distributing of- 1. Explosives 2. Detonators 3. Pyrophoric material 4. Unstable (Reactive) material 5. Organic Peroxide 6. Oxidizer 7. Fire Works **GROUP A-2** Manufacturing, Processing, Using, Refilling, Packaging, Distributing of- 1. Aerosols Level 1,2,3 2. Combustible Liquid Class I, II, III 3. Combustible Fiber 4. Combustible Dust 5. Pyrotechnic Material 6. Cryogenics, Flammable, Oxidizing 7. Flammable Gas 8. Flammable Liquid, IA, IB, IC 9. Flammable Solid 10. Oxidizing Gas 11. Water Reactive Material 12. Perfumes 13. Baled Cotton 14. Corrosive Material 15. Toxic Material 16. Plastic products 17. Tires 18. Aircraft 19. Metal Extruding 20. Chemical Plants 21. Incinerates 22. Plywood 23. Tobacco 24. Paint and Varnish 25. Asphalt 26. Rubber works	1. Appliances 2. Athletic equipment 3. Automobiles 4. Bakeries 5. Beverages (alcoholic) 6. Bicycles 7. Boat building 8. Brooms or brushes 9. Business machines 10. Cameras and photo equipment 11. Cold Storage 12. Canvas or similar fabric 13. Carpets and rugs 14. Clothing 15. Construction 16. Disinfectants 17. Dry-cleaning /dyeing 18. Electric light plants and power houses 19. Substations 20. Electronics 21. Engines 22. Food processing 23. Furniture 24. Hemp products 25. Jute products 26. Laundries 27. Leather products 28. Machinery 29. Millwork 30. Media filming 31. Motor repair garages 32. Musical instruments 33. Optical goods 34. Paper mills or products 35. Photographic film 36. Printing or publishing 37. Recreational vehicles 38. Refuse incineration 39. Shoes 40. Soaps and detergents 41. Tobacco 42. Trailers 43. Upholstering 44. Wood (distillation) 45. Woodworking	1. Beverages (non-alcoholic) 2. Brick and masonry 3. Ceramic Foundries 4. Glass products 5. Gypsum 6. Ice 7. Metal products (fabrication and assembly) 8. Tele-communications signal processing 9. Telephone exchanges 10. GSM Switching Stations

3.3. Types of Occupancies

Table: - A.02-T1: Types of Occupancies based on their usage, Hazard and number of occupants (RISKS)			
OCCUPANCY	**GROUP A**	**GROUP B**	**GROUP C**
14. Malls **14.1. Covered Mall:** A roofed or covered common pedestrian area within a covered mall building that serves as access for multiple tenants and not to exceed three levels that are open to each other. **14.2. Open Mall:** An unroofed common pedestrian way serving a number of tenants not exceeding three levels. Circulation at levels above grade shall be permitted to include open exterior balconies leading to exits discharging at grade.	1. Covered Mall	1. Open Mall	
15. Parking A building, structure, or portion thereof used for the parking, storage, or both, of motor vehicles. **15.1. Open Parking:** A Parking occupancy where in each parking level, any part of the carpark is within 30 m of the permanent natural ventilation wall openings open to the atmosphere for an area of not less than 0.4 m^2 for each linear meter distributed over 40 percent of the building perimeter surface or uniformly over two opposing sides. And interior wall lines and column lines are at least 20 percent open, with openings distributed to provide ventilation. **15.2. Enclosed Parking:** A parking occupancy which doesn't qualify as open parking and is enclosed on all sides. **15.3. Robotic or Mechanical Parking:** A parking structure that uses computer-controlled machines to store and retrieve vehicles, without drivers, in multi-level storage racks with no floors.	1. Enclosed Parking	1. Mechanical Parking 2. Robotic Parking	1. Open Parking 2. Covered Parking

3.3. Types of Occupancies

Table: - A.02-T1: Types of Buildings based on the Height

OCCUPANCY	GROUP A	GROUP B	GROUP C
16. Robotic Storage An occupancy or A warehouse or storage structure that uses computer-controlled machines to store and retrieve goods, in multi-level storage racks with no floors.	1. Group A storage materials.	1. Group B Storage materials	1. Group C Storage Materials.
17. Animal Housing An occupancy where animals, birds and creatures are fed, rested, exercised, Trained, sold, treated, exhibited, reproduced such as Veterinary Clinics, Zoos, Animal care centers, pet shops.	1. Animal Market 2. Pet Shops 3. Bird Market 4. Veterinary Clinic	1. Stable 2. Animal sheds 3. Livestock Shelter 4. Slaughter Houses	1. Zoo
18. Motor Fuel Dispensing Facilities (Gas/Petrol Stations) An occupancy where motor fuels are stored and dispensed from fixed equipment into the fuel tanks of motor vehicles or marine craft or into permitted containers, including all equipment used in connection therewith.	1. Petrol Stations 2. Gas Stations With Mini Marts, Restaurants, Dining, food courts, Retail, Business and Service/ Repair stations.	1. Petrol Stations 2. Gas Stations Restaurants/Bakeries, Housed by Mini Marts, Service /Repair Stations 3. Fleet Vehicle Fuel Dispensing 4. Marine Motor Fuel Dispensing	1. Petrol Stations 2. Gas Stations With Mini Mart alone 3. Electric Charging Units

3.4. Mixed Occupancies

3.4.1. Mixed Occupancy is a multiple occupancy where two or more various occupancies are intermingled without fire resistive assembly separation between them.

3.4.2. Each part of such mixed occupancy shall be classified according to the specific usage as defined by **Table: - A.02-T1. Types of Occupancies**.

3.4.3. In Multiple Occupancies, where exit access from an occupancy traverse another occupancy, the multiple occupancy shall be treated (or protected) as a mixed occupancy.

3.4.4. Mixed Occupancies shall be provided with most restrictive Fire Safety requirements of the occupancy involved, including the egress and protection provisions.

3.5. Separated Occupancies

3.5.1. Separated Occupancy is a multiple occupancy where two or more various occupancies shall be compartmented by fire resistive assembly separation between them as per **Table: - A.02-T2.**

3.5.2. Such Occupancy separations shall be vertical, horizontal, or both or, when necessary, of such other form as required to provide complete separation between occupancy divisions in the building.

3.5.3. Each part of such separated occupancy shall be classified according to the specific usage as defined by **Table: - A.02-T1. Types of Occupancies**.

Table: - A.02-T2: Fire rating of fire-resistant assemblies to achieve Separation in multiple occupancies

MULTIPLE OCCUPANCIES	WITH SPRINKLERS	WITHOUT SPRINKLERS
1. BETWEEN—Assembly, Residential Apartments, Business, Educational, Day Care, Health care Group B or Group C, Villas, Hotel, Industrial Group C, Storage Group C, Covered Mall	1 Hour	2 Hour
2. BETWEEN—Healthcare Group A and any other occupancies	2 Hour	2 Hour
3. BETWEEN—Detention and Correction and any other occupancies	2 Hour	2 Hour
4. BETWEEN—Mercantile and any other occupancies	1 Hour	2 Hour
5. BETWEEN— Commercial villa and commercial villa (Townhouses)	2 Hour	2 Hour
6. BETWEEN—Industrial Group B or Industrial Group C and any other occupancies	1 Hour	2 Hour
7. BETWEEN—Industrial Group A and any other occupancies	2 Hour	3 Hour
8. BETWEEN—Storage Group B or Storage Group C and any other occupancies	1 Hour	2 Hour
9. BETWEEN—Storage and Storage occupancies	1 Hour	1 Hour
10. BETWEEN—Industrial and Industrial occupancies	1 Hour	1 Hour

3.6. Construction Types

3.6.1 Designation of Fire Resistance Rating

The system of designating types of construction includes a specific breakdown of the types of construction through the use of Arabic numbers. These Arabic numbers follow the roman numeral notation where identifying a type of construction *e.g., Type I(442), Type II (111), Type III (200) + and indicate the fire resistance rating requirements for certain structural elements as follows:

a. First Arabic number — Exterior bearing walls
b. Second Arabic number — columns, beams, girders, trusses and arches, supporting bearing walls, columns, or loads from more than one floor
c. Third Arabic number — floor construction

3.6.2. Buildings and structures shall be classified according to their type of construction, which Shall be based upon one of five basic types of construction designated as Type I, Type II, Type III, Type IV, and Type V.

3.6.3. Type I Construction

Noncombustible (or limited-combustible) construction with a high level of fire resistance, typically concrete construction.

3.6.4. Type II Construction

Noncombustible (or limited-combustible) construction with a lower level of fire resistance than Type I, typically this is steel construction with or without fireproofing.

3.6.5. Type III Construction.

Exterior walls and structural elements are noncombustible or limited-combustible materials, and interior structural elements, walls, arches, floors, and roofs are wood that is smaller than what is required for Type IV construction. This is usually called ordinary construction and an example of this is a mixed masonry/wood building.

3.6.6. Type IV Construction.

Fire walls, exterior walls, and interior bearing walls are approved noncombustible or limited-combustible materials. Other interior structural elements, arches, floors, and roofs are solid or laminated wood or cross-laminated timber.

3.6.7. Type V Construction.

Structural elements, walls, arches, floors, and roofs are wood or other approved material. Most residential construction is Type V.

3.7. Exterior Walls

3.7.1. Exterior walls shall have fire resistance rating in accordance with **Table: - A.02-T3. and Table: - A.02-T4,** whichever is greater.

3.7.2. Exterior walls required to be fire rated by **Table: - A.02-T3.** because of horizontal separation shall be continuous from the foundation to not less than 760 mm above the roof.

3.7.3. Horizontal separation distance between adjacent buildings to dictate the required Fire resistance of exterior walls shall be measured at a 90-degree angle to the exterior wall.

3.7.4. The imaginary line shall be placed at a distance from the facing exterior wall of the adjacent building that is equal to the horizontal separation applicable for that wall based on its fire resistance rating and protection of openings.

3.7.5. Where the exterior wall has regular vertical shape, the following criteria shall be met:

a. The horizontal separation shall be determined by measuring from a vertical plane that is located so that no portion of the exterior wall is between such vertical plane and the line to which the horizontal separation is measured.

b. The area of openings shall be determined from the projection of the openings in the exterior wall onto the vertical plane. See Figure**: - A.02-F2.**

3.7.6. Where two or more buildings are located on the same plot, the horizontal separation shall be measured from the exterior wall to an imaginary line or notional boundary drawn between the exterior walls of the adjacent buildings. See **Figure: - A.02-F1** for illustrations.

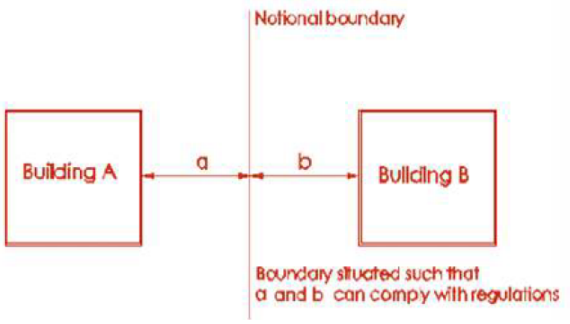


Figure: - A.02-F1: Measurement of Horizontal Separation

3.7.7. Where the exterior wall is an irregular vertical shape, the following criteria shall be met:

a. The horizontal separation shall be determined by measuring from a vertical plane that is located so that no portion of the exterior wall is between such vertical plane and the line to which the horizontal separation is measured.

b. The area of openings shall be determined from the projection (P) of the openings in the exterior wall onto the vertical plane. See **Figure: - A.02-F2.**

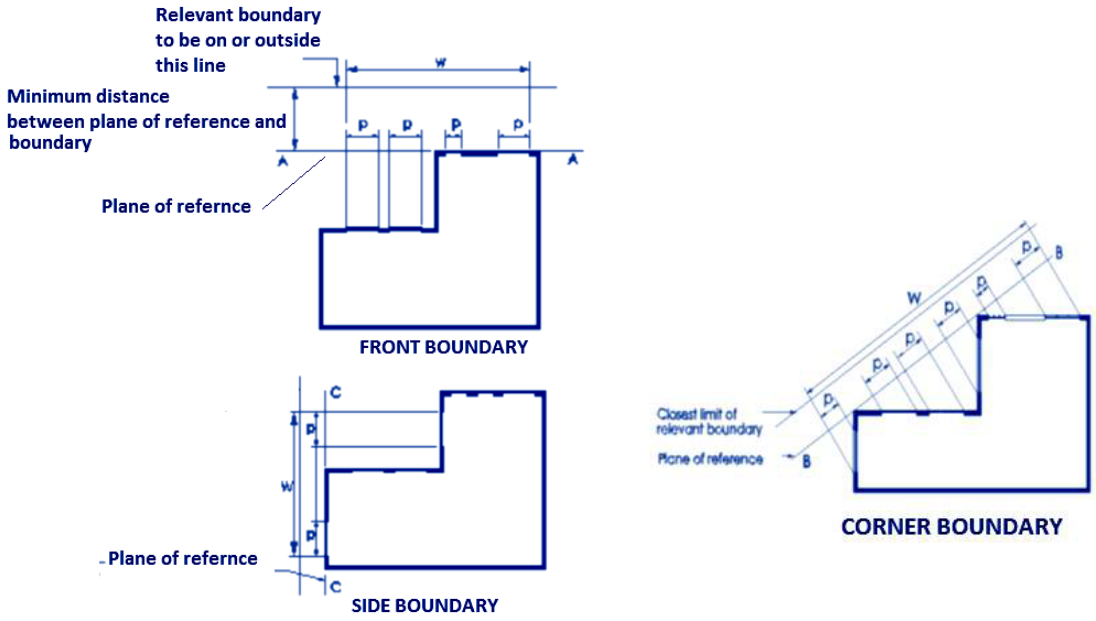


Figure: - A.02-F2: Measurements of Horizontal Separation and projection of openings of irregular buildings

Table: - A.02-T3: Fire Rating Requirements of Exterior Walls Based on Horizontal Separations (HS)

OCCUPANCY	0m – 1.5m HS	>1.5 m - 3m HS	> 3m — 9 m HS	> 9 m HS	OTHER OPENING PROTECTIVE MEASURES
1. Assembly, Business, Educational, Day Care, Health care, Hotel, Residential, Detention and Correctional.	1 Hour	1 Hour	Not Required	Not Required	AS PER TABLE: - A.02-T5.
2. Industrial Group C, Storage Group C.	1 Hour	1 Hour	Not Required	Not Required	AS PER TABLE: - A.02-T5.
3. Mercantile	2 Hour	1 Hour	Not Required	Not Required	AS PER TABLE: - A.02-T5.
4. Industrial Group B, Storage Group B.	2 Hour	1 Hour	Not Required	Not Required	AS PER TABLE: - A.02-T6.
5. Industrial Group A, Storage Group A.	3 Hour	2 Hour	1 Hour	Not Required	AS PER TABLE: - A.02-T6.

3.8. Openings in Exterior Wall

3.8.1. Where an exterior wall is required to have a fire resistance rating as determined by **Table: - A.02-T3**, the area of openings in exterior walls shall not exceed that permitted by Table**: - A.02-T4. or Table: - A.02-T5.**

3.8.2. The area of unprotected openings in an exterior wall shall be the aggregate of unprotected openings expressed as a percentage of the area of the exterior wall.

3.8.3. The area of an exterior wall shall be calculated as the length, edge to edge, of the exterior wall multiplied by the measurement from the finished ground level to the uppermost ceiling.

3.8.4. The area of unprotected openings permitted by **Table: - A.02-T4.** and **Table: - A.02-T5.** shall be permitted to be doubled under either of the following conditions.

a. Where the building is protected throughout with an permitted, electrically supervised automatic sprinkler system.

b. Where the openings are protected with a fire window, fire door, fire shutters assembly or other listed opening protective shall have the required fire protection rating in accordance with **Table: - A.02-T10**.

3.8.5. **Table: - A.02-T4.** shall be applicable to all occupancies except Mercantile, **Industrial Group** A, Industrial Group B, Storage Group A, Storage Group B, Private Villas.

Table: - A.02-T4: Maximum Percentage area (%) of exterior wall per storey openings allowed based on Separation Distance

SEPARATION DISATNCE	% ALLOWED FOR BUILDINGS NON-SPRINKLERED AND NOT PROTECTED AS PER 3.8.4. b.	% ALLOWED FOR SPRINKLERED BUILDINGS AS PER CHAPTER 9 AND NOT PROTECTED AS PER 3.8.4.b.	% ALLOWED FOR PROTECTED OPENINGS AS PER 3.8.4.b.
0 m – Less than 1 m	NO OPENINGS ALLOWED	NO OPENINGS ALLOWED	NO OPENINGS ALLOWED
1 m – Less than 1.5 m	NO OPENINGS ALLOWED	15 %	15 %
1.5 m – Less than 3 m	10 %	25 %	25 %
3 m – Less than 4.5 m	15 %	UNLIMITED ALLOWED	45 %
4.5 m – Less than 6 m	25 %	UNLIMITED ALLOWED	75 %
6 m – Less than 7.5 m	45 %	UNLIMITED ALLOWED	UNLIMITED ALLOWED
7.5 m – Less than 9 m	70 %	UNLIMITED ALLOWED	UNLIMITED ALLOWED
9 m or More	UNLIMITED ALLOWED	UNLIMITED ALLOWED	UNLIMITED ALLOWED

3.8.6. **Table: - A.02-T5.** shall be applicable to Mercantile, Industrial Group A, Industrial Group B, Storage Group A, Storage Group B.

Table: - A.02-T5: Maximum Percentage area (%) of exterior wall per storey openings allowed Group A, B Occupancies

SEPARATION DISATNCE	% ALLOWED FOR BUILDINGS NON-SPRINKLERED AND NOT PROTECTED AS PER 3.8.4. b.	% ALLOWED FOR SPRINKLERED BUILDINGS AS PER CHAPTER 9 AND NOT PROTECTED AS PER 3.8.4.b.	% ALLOWED FOR PROTECTED OPENINGS AS PER 3.8.4.b.
0 m – Less than 1 m	NO OPENINGS ALLOWED	NO OPENINGS ALLOWED	NO OPENINGS ALLOWED
1 m – Less than 1.5 m	NO OPENINGS ALLOWED	NO OPENINGS ALLOWED	NO OPENINGS ALLOWED
1.5 m – Less than 3 m	4%	8%	8%
3 m – Less than 4.5 m	4%	8%	8%
4.5 m – Less than 6 m	4%	8%	8%
6 m – Less than 7.5 m	5%	10%	10%
7.5 m – Less than 9 m	5%	10%	10%
9 m or More	UNLIMITED ALLOWED	UNLIMITED ALLOWED	UNLIMITED ALLOWED

3.8.7. The fire-resistance rating of exterior walls required by **Table: - A.02-T3 for** a fire separation distance of greater than 3 m shall be rated for exposure to fire from the inside. And for separation distance of less than or equal to 3 m shall be rated for exposure to fire from both inside and outside.

3.8.8. Opening protectives as required by **3.8.4.b.** are not mandated where the building is equipped throughout with an automatic sprinkler system in accordance with **Section D, Chapter 05** and the exterior openings are protected by a water curtain using automatic sprinklers permitted for that use.

$$(A_p/a_p)+(A_u/a_u)\le 1$$

where:

A_p = Actual area of protected openings, or the equivalent area of protected openings

a_p = Allowable area of protected openings.

A_u = Actual area of unprotected openings.

a_u = Allowable area of unprotected openings.

3.8.9. Where both unprotected and protected openings are located in the exterior wall in any storey of a building, the total area of openings shall be determined in accordance with this formula.

3.8.10. Except for Open parking OR buildings which are less than 15 m in height, openings in exterior walls in adjacent storeys shall be separated vertically to protect against fire spread on the exterior of the buildings where the openings are within 1524 mm radius of each other horizontally and the opening in the lower storey is not a protected opening with a fire protection rating of not less than 3/4 hour. Such openings shall be separated vertically at least 915 mm by spandrel girders, exterior walls or other similar assemblies that have

a fire-resistance rating of at least 1 hour or by flame barriers that extend horizontally at least 760 mm beyond the exterior wall. Flame barriers shall also have a fire-resistance rating of at least 1 hour.

3.9. Fire Resistance rating for Construction Types

3.9.1. Fire resistance rating of structural elements for Type I and Type II construction types shall comply with **TABLE: - A.02-T6.**

3.9.2. Where conflicts arise between fire resistance rating requirements of **Table: - A.02-T6.** and other fire resistance rating requirements in this chapter, **Table: - A.02-T6.** shall be superseded. (For example, exterior non-load bearing walls and interior non-load bearing corridor walls etc.)

Table: - A.02-T6: Fire Resistance Rating for Construction Types (Type I to Type II) in Hours

STRUCTURAL ELEMENTS	TYPE I (442)	TYPE I (332)	TYPE II (222)	TYPE II (111)	TYPE II (000)
1. EXTERIOR BEARING WALLS (NOT LESS THAN Table: - A.02-T3)					
Supporting more than 1 floor or columns or other bearing walls	4	3	2	1	0
Supporting 1 floor only	4	3	2	1	0
Supporting roof only	4	3	1	1	0
2. INTERIOR BEARING WALLS					
Supporting more than 1 floor or columns or other bearing walls	4	3	2	1	0
Supporting 1 floor only	3	2	2	1	0
Supporting roof only	3	2	1	1	0
3. COLUMNS					
Supporting more than 1 floor or columns or other bearing walls	4	3	2	1	0
Supporting 1 floor only	3	2	2	1	0
Supporting roof only	3	2	1	1	0
4. BEAMS, GIRDERS, TRUSSES AND ARCHES					
Supporting more than 1 floor or columns or other bearing walls	4	3	2	1	0
Supporting 1 floor only	2	2	2	1	0
Supporting roof only	2	2	1	1	0
5. FLOOR-CEILING ASSEMBLIES	2	2	2	1	0
6. ROOF-CEILING ASSEMBLIES	2	1.5	1	1	0
7. INTERIOR NON-BEARING WALLS	0	0	0	0	0
8. EXTERIOR NON-BEARING WALLS (NOT LESS THAN TABLE 1.3)	0	0	0	0	0

3.10. Building Height and Area limitations

3.10.1. Building Height.

The building height shall be measured from Lowest fire access road level to the highest finish roof surface in the case of flat roofs or to the average height of the highest sloped roof.

3.10.2. Number of Storeys.

The number of storeys shall be counted starting with the first storey above grade plane (ground floor) and ending with the highest occupiable storey.

3.10.3. The allowable building height and number of storeys of a building shall be determine based on the use, occupancy, and construction type of the building and shall no exceed the allowable heights specified in **Table: - A.02-T7. and A.02.T8.**

3.10.4. Allowable Area per Storey.

The allowable area per storey for any individual storey in a building shall not exceed the allowable area specified in **Table: - A.02-T7 and A.02.T8.**

3.10.5. Total Area in Multiple Types of Construction.

Where a building is constructed of two or more types of construction not separated by fire walls, the total area of the building shall not exceed the least maximum allowable building area, based on the occupancy and the types of construction of the building required by **Table: - A.02-T7. and A.02.T8.**

3.10.6. Total Height in Multiple Types of Construction.

Where two or more types of construction exist in the same building, the height of the entire building shall not exceed the least height permitted, based on the occupancy for the types of construction used in the building, as required by **Table: - A.02-T7. and A.02.T8.**

3.10.7. Mixed Occupancies.

Buildings with mixed occupancies shall have their required type of construction determined by applying the most restrictive type of construction as required by the occupancy to the entire building.

3.10.8. Roof structures.

Towers, spires, steeples and other roof structures shall be constructed of materials consistent with the required type of construction of the building. Such structures shall not be used for habitation or storage. The structures shall be unlimited in height if of noncombustible materials. If combustible materials are used, such structure shall not extend more than 6096 mm above the allowable building height.

3.10.9. Underground Buildings.

All structural members up to and including the floor of the lowest level of discharge of underground buildings more than 7 m below or more than one level below the lowest level of exit discharge shall be Type I or Type II (222) construction.

3.10.10. Mezzanines.

Mezzanine complying to its definition of having an area, one-third of the floor area of the floor it is contained in, shall not be considered as floor in accounting allowed number of floors.

3.10.11. Type of Constructions required based on General Directorate of Civil Defence – Kingdom of Bahrain Building Categories.

Table: - A.02-T7. and Table: - A.02-T8. shall be followed for construction types based on General Directorate of Civil Defence – Kingdom of Bahrain building categories.

Where,

S	If building is Sprinklered.
NS	If Building is Not Sprinklered.
AUL	Area allowed is Unlimited.
FUL	Floors allowed is Unlimited
F	Maximum Floors allowed.
G	Ground Floor only (No above grade floors are allowed)
xxxx m^2	Maximum Allowed Area per floor in Sq meters.
H	Maximum Allowed Building Height in meters.

3.10.12. Application of Table: - A.02-T7 and Table: - A.02-T8.

3.10.12.1. **Table: - A.02-T7** and **Table: - A.02-T8.** for the construction type requirements have been altered to suit the General Directorate of Civil Defence – Kingdom of Bahrain building categories. These tables shall be followed in conjunction with sprinkler requirements for buildings as per **Section D, Chapter 05 Automatic sprinkler Systems.**

3.10.12.2. The area increases of 300% has already been considered for all the buildings that are sprinklered.

3.10.12.3. The additional area increases of 30% to the figures in Table**: - A.02-T7.** can be considered for all the sprinklered buildings which are single storey. The same when considered in design, shall be clearly demonstrated in the drawing submissions.

3.10.12.4. Where a building is sprinklered and has more than 25 % of its perimeter fronting or facing a public way or an open space having a minimum width of 6 m, additional area increase of 30% can be added to existing figures of **Table: - A.02-T7**, using the formulas from **NFPA 5000, Section 7.6.** The same when considered in design, shall be clearly demonstrated in the drawing submissions.

3.10.12.5. Sprinklered One storey Business, Mercantile, Assembly without stage, Motion picture theater, Low Hazard Storage and Low Hazard Industrial buildings (Group C storage and industrial) of Type II construction shall be allowed to be unlimited in area when buildings are surrounded by public ways or yards of 18 m width.

3.10.12.6. Non-sprinklered One storey Sports arenas of Type II construction with automatic fire detection and alarm system shall be allowed to be unlimited in area when buildings are surrounded by public ways or yards of 18 m width.

3.10.12.7. Fully sprinklered One storey educational occupancies shall be allowed to be unlimited in area when each class room has not less than 2 means of egress directly to outside.

3.10.12.8. Height increase shall be permitted for towers, spires, roof structures, aircraft hangers, special purpose industrial occupancies and storage occupancies when justified as per **NFPA 5000, Section 7.4.3.6.**

3.10.12.9. Reduction of construction type for Highrise buildings (23 m – 90 m in height)

3.10.12.9.1. For high-rise buildings, other than mercantile occupancies or industrial and storage occupancies with ordinary and high hazard contents exceeding the maximum allowable quantities per control area as **Section F, Chapter 01**, Type I (442) construction shall be permitted to be reduced to Type I (332), and Type I (332) construction shall be permitted to be reduced to Type II (222).

3.10.12.9.2. For buildings 36.6 m or less in height containing occupancies other than mercantile occupancies or industrial and storage occupancies with moderate and high hazard contents, Type II (222) construction shall be permitted to be reduced to Type II (111), except that columns supporting more than one floor shall not be less than 2-hour fire resistance rated construction.

3.10.12.10. Reduction of construction type for Parking buildings

3.10.12.10.1. Heights and floor areas of 'open parking structures' of Type I (442 or 332), Type II (222), or Type II (111) construction shall be permitted to be unlimited.

3.10.12.10.2. Low-rise and Midrise **'**Open parking structures' of Type II (000) construction shall be permitted to be of unlimited area.

3.10.12.10.3. Low-rise and Midrise **'**Open parking structures' of Type II (000) construction shall be permitted to be of unlimited area.

3.10.12.10.4. A single basement or a single story above grade plane used as an 'enclosed or open parking building' shall be considered as a separate and distinct building for the purpose of determining the limitation on number of stories and type of construction than that of an occupancy above it, where all the following conditions are met.

i. The type of construction for structural members, including main bracing within the 'enclosed or open parking structure, shall be of that are necessary to support the upper occupancy and shall be provided with the more restrictive fire resistance ratings of the use groups involved.

ii. Such single basement or a single story above grade plane used as an 'enclosed or open parking building' shall be of Type I (442 or 332) construction and shall be separated from the building above with a horizontal assembly having a minimum 3-hour fire resistance rating.

iii. The building above the horizontal assembly shall contain only

business, mercantile, storage, or residential occupancies or assembly occupancies having an assembly room with an occupant load of less than 300.

iv. Shaft, stairway, ramp, or escalator enclosures through horizontal assembly shall have not less than a 2-hour fire resistance rating, complete with opening protectives.

v. The maximum building height shall not exceed the limits set forth in **Table: - A.02-T7** and **Table: - A.02-T8.**

vi. The entire structure is protected with automatic sprinkler system.

3.10.12.11. Unlimited area allowance

3.10.12.11.1. Sprinklered One-Story Assembly Building used as an auditorium, church, community hall, dance hall, exhibition hall, gymnasium, lecture hall, indoor swimming pool, or tennis court of Type II construction shall not be limited in area in accordance with **Table: - A.02-T7,** where all the following criteria are met:

i. The building shall not have a theatrical stage other than a raised platform.

ii. The building shall be equipped with an permitted, electrically supervised automatic sprinkler system in accordance with **Section D, Chapter 05.**

Iii. The assembly floor shall be located as follows:

a. At, or within, 535mm of the level of the exterior exit discharge accessible from the main entrance/exit.

b. Within 535 mm of the level of the exterior exit discharge accessible from any of the required exits for buildings that do not have a main entrance/exit.

iv. All exits and exit discharges shall be level or provided with ramps to a public way.

v. The building shall be surrounded and adjoined by public ways or yards not less than 18 m in width.

Legend:

S	If building is Sprinklered.
NS	If Building is Not Sprinklered.
AUL	Area allowed is Unlimited.
FUL	Floors allowed is Unlimited
F	Maximum Floors allowed.
G	Ground Floor only (No above grade floors are allowed)
xxxx m²	Maximum Allowed Area per floor in Sq meters.
H	Maximum Allowed Building Height in meters.

Table: - A.02-T7: Types of Constructions based on General Directorate of Civil Defence - Kingdom of Bahrain Building Categories and Occupancy Types.

OCCUPANCY	LOW DEPTH UNDER-GROUND BUILDINGS < 7 m IN HEIGHT	HIGH DEPTH UNDER-GROUND BUILDINGS > 7 m IN HEIGHT	LOW RISE BUILDINGS < 15 m IN HEIGHT	MID RISE BUILDINGS 15 m— < 23 m IN HEIGHT	HIGHRISE BUILDINGS 23 m— < 90 m IN HEIGHT	SUPER HIGH RISE BUILDING > 90 m IN HEIGHT
1. ASSEMBLY GROUP A, B. OL > 1000	TYPE I (442) S, AUL TYPE I (332) S, AUL TYPE II (222) S, AUL TYPE II (111) S, 4320 m²	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, FUL	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL F12 TYPE II (111) S, 4320 m², F3	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL F12 TYPE II (111) S, 4320 m², F3	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, F12, H55 TYPE II (111) S, 4320 m², H26m	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, H128m
2. ASSEMBLY GROUP A, B. OL > 300	TYPE I (442) S, AUL TYPE I (332) S, AUL TYPE II (222) S, AUL TYPE II (111) S, 4320 m² F1	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, FUL	TYPE I (442) S, AUL, FUL NS, AUL, F4 TYPE I (332) S, AUL, FUL NS, AUL, F4 TYPE II (222) S, AUL, F12 NS, AUL, F4 TYPE II (111) S, 4320 m², F4 NS, 1440 m², F3	TYPE I (442) S, AUL, FUL NS, AUL, F7 TYPE I (332) S, AUL, FUL NS, AUL, F4 TYPE II (222) S, AUL, F12 NS, AUL, F4 TYPE II (111) S, 4320 m², F4	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, F12, H55 TYPE II (111) S, 4320 m² H26m	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, H128m
3. ASSEMBLY GROUP A, B. OL < 300	TYPE I (442) S, AUL TYPE I (332) S, AUL TYPE II (222) S, AUL TYPE II (111) S, 2880 m²	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL FUL TYPE II (222) S, AUL FUL	TYPE I (442) S, AUL, FUL NS, AUL, F7 TYPE I (332) S, AUL, FUL NS, AUL, F7 TYPE II (222) S, AUL, F12 NS, AUL, F7 TYPE II (111) S, 4320 m², F4 NS, 1440 m², F3	TYPE I (442) S, AUL, FUL NS, AUL, F7 TYPE I (332) S, AUL, FUL NS, AUL, F7 TYPE II (222) S, AUL, F12 NS, AUL, F7 TYPE II (111) S, 4320 m², F4	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, F12, H55 TYPE II (111) S, 4320 m², H26m	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, H128m

Table: - A.02-T7: Types of Constructions based on General Directorate of Civil Defence - Kingdom of Bahrain Building Categories and Occupancy Types.

OCCUPANCY	LOW DEPTH UNDER-GROUND BUILDINGS < 7 m IN HEIGHT	HIGH DEPTH UNDER-GROUND BUILDINGS > 7 m IN HEIGHT	LOW RISE BUILDINGS < 15 m IN HEIGHT	MID RISE BUILDINGS 15 m— < 23 m IN HEIGHT	HIGHRISE BUILDINGS 23 m— < 90 m IN HEIGHT	SUPER HIGH RISE BUILDING > 90 m IN HEIGHT
4. ASSEMBLY GROUP C	TYPE I (442) S, AUL TYPE I (332) S, AUL TYPE II (222) S, AUL TYPE II (111) S, 4320 m², F1	TYPE I (442) S, AUL TYPE I (332) S, AUL TYPE II (222) S, AUL	TYPE I (442) TYPE I (332) TYPE II (222) TYPE II (111)	TYPE I (442) TYPE I (332) TYPE II (222) TYPE II (111) S, 4320 m², F4	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, H55 TYPE II (111) S,4320 m², H26m	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, H128m
5. BUSINESS	TYPE I (442) S, AUL NS, AUL TYPE I (332) S, AUL NS, AUL TYPE II (222) S, AUL NS, AUL	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, FUL	TYPE I (442) S, AUL, FUL NS, AUL, FUL TYPE I (332) S, AUL, FUL NS, AUL, UL TYPE II (222) S, AUL, F12 NS, AUL, F11 TYPE II (111) S, 10452 m², F6 NS, 3484 m², F5	TYPE I (442) S, AUL, FUL NS, AUL, FUL TYPE I (332) S, AUL, FUL NS, AUL, UL TYPE II (222) S, AUL, F12 NS, AUL, F11 TYPE II (111) S, 10452 m², F6 NS, 3484 m², F5	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, F12, H55 TYPE II (111) S, 10452 m², H26m	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, H128m
6. **EDUCATIO-NAL**	TYPE I (442) S, AUL TYPE I (332) S, AUL TYPE II (222) S, AUL TYPE II (111) S, 7386 m²	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, FUL	TYPE I (442) S, AUL, FUL NS, 1680 m², F3 TYPE I (332) S, AUL, FUL NS, 1680 m², F3 TYPE II (222) S, AUL, F12 NS, 1680 m², F3 TYPE II (111) S, 7386 m², F4 NS, 1680 m², F3	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, F12 TYPE II (111) S, 7386 m², F4	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, F12, H55	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, H128m
7.HEALTH CARE GROUP A, B	TYPE I (442) S, AUL TYPE I (332) S, AUL TYPE II (222) S, AUL	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, FUL	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, F12 TYPE II (111) S, 4182 m² , F3 NS, 1394 m², G	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, F12 TYPE II (111) S, 4182 m², F3	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, F12, H55	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, H128m
8. HEALTH CARE GROUP C	TYPE I (442) S, AUL NS, AUL TYPE I (332) S, AUL NS, AUL TYPE II (222) S, AUL NS, AUL	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, FUL	TYPE I (442) S, AUL, FUL NS, AUL, FUL TYPE I (332) S, AUL, FUL NS, AUL, FUL TYPE II (222) S, AUL, F12 NS, AUL, F11 TYPE II (111) S, 10452 m² , F6 NS, 3484 m², F5	TYPE I (442) S, AUL, FUL NS, AUL, FUL TYPE I (332) S, AUL, FUL NS, AUL, FUL TYPE II (222) S, AUL, F12 NS, AUL, F11 TYPE II (111) S, 10452 m² F6 NS, 3484 m², F5	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, F12, H55 TYPE II (111) S, 10452 m², H26m	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, H128m

Table: - A.02-T7: Types of Constructions based on General Directorate of Civil Defence - Kingdom of Bahrain Building Categories and Occupancy types.

OCCUPANCY	LOW DEPTH UNDER-GROUND BUILDINGS < 7 m IN HEIGHT	HIGH DEPTH UNDER-GROUND BUILDINGS > 7 m IN HEIGHT		MID RISE BUILDINGS 15 m— < 23 m IN HEIGHT	HIGHRISE BUILDINGS 23 m— < 90 m IN HEIGHT	SUPER HIGH RISE BUILDING > 90 m IN HEIGHT
9. RESIDENTIAL GROUP A, C	TYPE I (442) S, AUL NS, AUL TYPE I (332) S, AUL NS, AUL TYPE II (222) S, AUL NS, AUL	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL. FUL	TYPE I (442) S, AUL, FUL NS, AUL, FUL TYPE I (332) S, AUL, FUL NS, AUL, FUL TYPE II (222) S, AUL, F12 NS, AUL, F11 TYPE II (111) S, 6690 m², F5 NS, 2230 m², F4	TYPE I (442) S, AUL, FUL NS, AUL, FUL TYPE I (332) S, AUL, FUL NS, AUL, FUL TYPE II (222) S, AUL, F12 NS, AUL, F11 TYPE II (111) S, 6690 m², F5 NS, 2230 m², H20m	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, F12 TYPE II (111) S, 6690 m², H26m	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, H128m
10. RESIDENTIAL GROUP B	TYPE I (442) S, AUL NS, AUL TYPE I (332) S, AUL NS, 2418 m² TYPE II (222) S, AUL NS, 2418 m²	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, 3627 m², FUL	TYPE I (442) S, AUL, FUL NS, AUL, F3 TYPE I (332) S, AUL, FUL NS, AUL, F3 TYPE II (222) S, AUL, F12 NS, AUL, F3 TYPE II (111) S, 5441 m², F3 NS, 2230 m², F3	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, F12 TYPE II (111) S, 5441 m², H20m	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, 6690 m², F12, H55	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, H128m
11. PRIVATE VILLAS	TYPE II (111) S, AUL, F5 NS, AUL, F4 TYPE II (000) S, AUL, F5 NS, AUL, F4	TYPE II (111) S, AUL. F5 NS, AUL, F4 TYPE II (000) S, AUL, F5 NS, AUL, F4	TYPE II (111) S, AUL. F5 NS, AUL, F4 TYPE II (000) S, AUL, F5 NS, AUL, F4	TYPE II (111) S, AUL. F5 NS, AUL. F4 TYPE II (000) S, AUL. F5		
12. COM-MERCIAL VILLAS	TYPE I (442) S, AUL NS, AUL TYPE I (332) S, AUL NS, AUL TYPE II (222) S, AUL NS, AUL	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL. FUL	TYPE II (111) S, AUL, F5 NS, AUL, F4 TYPE II (000) S, AUL. F5 NS, AUL, F4	TYPE II (111) S, AUL, F5 NS, AUL, F4 TYPE II (000) S, AUL, F5		
13. DETEN-TION CORRECTION	TYPE I (442) S, AUL TYPE I (332) S, AUL TYPE II (222) S, AUL TYPE II (111) S, 4182 m²	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, FUL	TYPE I (442) S, AUL, FUL NS, AUL, F7 TYPE I (332) S, AUL, FUL NS, AUL, F7 TYPE II (222) S, AUL, F12 NS, AUL, F7 TYPE II (111) S, 4182 m², F2 NS, 1394 m², F2	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, F12	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, F12, H55	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, H128m

Table: - A.02-T7: Types of Constructions based on General Directorate of Civil Defence - Kingdom of Bahrain Building Categories and Occupancy Types.

OCCUPANCY	LOW DEPTH UNDER-GROUND BUILDINGS < 7 m IN HEIGHT	HIGH DEPTH UNDER-GROUND BUILDINGS > 7 m IN HEIGHT	LOW RISE BUILDINGS < 15 m IN HEIGHT	MID RISE BUILDINGS 15 m— < 23 m IN HEIGHT	HIGHRISE BUILDINGS 23 m— < 90 m IN HEIGHT	SUPER HIGH RISE BUILDING > 90 m IN HEIGHT
14. HOTEL	TYPE I (442) S, AUL NS, AUL TYPE I (332) S, AUL NS, AUL TYPE II (222) S, AUL NS, AUL	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, FUL	TYPE I (442) S, AUL, FUL NS, AUL, G TYPE I (332) S, AUL, FUL NS, AUL, G TYPE II (222) S, AUL, F12 NS, AUL, G TYPE II (111) S, 6690 m², F5 NS, 2230 m², G	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, F12 TYPE II (111) S, 6690 m², F5	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, F12, H55 TYPE II (111) S, 6690 m², H26m	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, H128m
15. DAY CARE	TYPE I (442) S, AUL TYPE I (332) S, AUL TYPE II (222) S, 16863 m² TYPE II (111) S, 7386 m²	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S,16863 m², FUL	TYPE I (442) S, AUL, FUL NS, AUL, F2 TYPE I (332) S, AUL, FUL NS, AUL, F2 TYPE II (222) S,16863 m², F12 NS, 5621 m², F2 TYPE II (111) S, 7386 m², F6 NS, 2462 m², F1	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S,16863 m², F12 TYPE II (111) S, 7386 m², F6	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S,16863 m², F12, H55 TYPE II (111) S, 7386 m², H26m	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, H128m
16. MERCAN-TILE	TYPE I (442) S, AUL NS, AUL TYPE I (332) S, AUL NS, AUL TYPE II (222) S, AUL NS, AUL	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, FUL	TYPE I (442) S, AUL, FUL NS, AUL, FUL TYPE I (332) S, AUL, FUL NS, AUL, FUL TYPE II (222) S, AUL, F12 NS, AUL, F11 TYPE II (111) S, 5991 m², F5 NS, 1997 m², F4	TYPE I (442) S, AUL, FUL NS, AUL, FUL TYPE I (332) S, AUL, FUL NS, AUL, FUL TYPE II (222) S, AUL, F12 NS, AUL, F11 TYPE II (111) S, 5991 m², F5 NS, 1997 m², H20m	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, 3994 m², F12, H55 TYPE II (111) S, 5991 m², H26m	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, H128m
17. STORAGE GROUP B	TYPE I (442) S, AUL NS, AUL TYPE I (332) S, AUL NS, AUL TYPE II (222) S, 13377 m² NS, 4459 m²	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, 13377 m², FUL	TYPE I (442) S, AUL, FUL NS, AUL, FUL TYPE I (332) S, AUL, FUL NS, AUL, FUL TYPE II (222) S, 13377 m², F1 NS, 4459 m², F1 TYPE II (111) S, 7245 m², F5 NS, 2415 m², F4	TYPE I (442) S, AUL, FUL NS, AUL, FUL TYPE I (332) S, AUL, FUL NS, AUL, FUL TYPE II (222) S,13377 m², F12 NS,4459 m², F11 TYPE II (111) S, 5991 m², F5 NS, 2415 m², H20m	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S,13377 m², F12, H55 TYPE II (111) S, 7245 m², H26m	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, H128m

Table: - A.02-T7: Types of Constructions based on General Directorate of Civil Defence - Kingdom of Bahrain Building Categories and Occupancy Types.

OCCUPANCY	LOW DEPTH UNDER-GROUND BUILDINGS < 7 m IN HEIGHT	HIGH DEPTH UNDER-GROUND BUILDINGS > 7 m IN HEIGHT	LOW RISE BUILDINGS < 15 m IN HEIGHT	MID RISE BUILDINGS 15 m— < 23 m IN HEIGHT	HIGHRISE BUILDINGS 23 m— < 90 m IN HEIGHT	SUPER HIGH RISE BUILDING > 90 m IN HEIGHT
18. STORAGE GROUP C	TYPE I (442) S, AUL NS, AUL TYPE I (332) S, AUL NS, AUL TYPE II (222) S, 22017 m² NS, 7339 m²	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S,22017 m², FUL	TYPE I (442) S, AUL, FUL NS, AUL, FUL TYPE I (332) S, AUL, FUL NS, AUL, FUL TYPE II (222) S, 22017 m², F11 NS, 7339 m², F11 TYPE II (111) S, 10869 m², F6 NS, 3623 m², F5	TYPE I (442) S, AUL, FUL NS, AUL, FUL TYPE I (332) S, AUL, FUL NS, AUL, FUL TYPE II (222) S,22017 m², F12 NS,7339 m², F11 TYPE II (111) S, 10869 m², F6 NS, 3623 m², F5	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S,22017 m², F12, H55 TYPE II (111) S, 10869 m², H26m	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, H128m
19.PARKING STRUCTURES	TYPE I (442) S, AUL NS, AUL TYPE I (332) S, AUL NS, 2418 m² TYPE II (222) S, AUL NS, 2418 m²	TYPE I (442) S, AUL TYPE I (332) S, 6696 m² TYPE II (222) S, 5441 m²	TYPE I (442) S, AUL NS, AUL TYPE I (332) S, AUL NS, 2418 m² TYPE II (222) S, 5441 m² NS, 2418 m²	TYPE I (442) S, AUL NS, AUL TYPE I (332) S, AUL NS, 2418 m² TYPE II (222) S, 5441 m² NS, 2418 m²	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S,13377 m² F12, H55	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, H128m
20. INDUSTRIAL GROUP B	TYPE I (442) S, AUL NS, AUL TYPE I (332) S, AUL NS, AUL TYPE II (222) S, AUL NS, AUL	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, FUL	TYPE I (442) S, AUL, FUL NS, AUL, FUL TYPE I (332) S, AUL, FUL NS, AUL, FUL TYPE II (222) S, AUL, F12 NS, AUL, F11 TYPE II (111) S, 6969 m², F5 NS, 2323 m², F4	TYPE I (442) S, AUL, FUL NS, AUL, FUL TYPE I (332) S, AUL, FUL NS, AUL, FUL TYPE II (222) S, AUL, F12 NS, AUL, F11 TYPE II (111) S, 6969 m², F5 NS, 2323 m², H20m	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, F12, H55 TYPE II (111) S, 6969 m², H26m	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, H128m
21. INDUSTRIAL GROUP C	TYPE I (442) S, AUL NS, AUL TYPE I (332) S, AUL NS, AUL TYPE II (222) S, AUL NS, AUL	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, FUL	TYPE I (442) S, AUL, FUL NS, AUL, FUL TYPE I (332) S, AUL, FUL NS, AUL, FUL TYPE II (222) S, AUL, F12 NS, AUL, F11 TYPE II (111) S, 10452 m², F6 NS, 3484 m², F5	TYPE I (442) S, AUL, FUL NS, AUL, FUL TYPE I (332) S, AUL, FUL NS, AUL, FUL TYPE II (222) S, AUL, F12 NS, AUL, F11 TYPE II (111) S, 10452 m², F6 NS, 3484 m², H20m	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, AUL, F12, H55 TYPE II (111) S, 10452 m², H26m	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, H128m

Table: - A.02-T8: Types of Constructions Based on General Directorate of Civil Defence - Kingdom of Bahrain Industrial Group A and Storage Group A Occupancies (Hazardous).

OCCUPANCY	LOW DEPTH UNDER-GROUND BUILDINGS < 7 m IN HEIGHT	HIGH DEPTH UNDER-GROUND BUILDINGS > 7 m IN HEIGHT	LOW RISE BUILDINGS < 15 m IN HEIGHT	MID RISE BUILDINGS 15 m— < 23 m IN HEIGHT	HIGHRISE BUILDINGS 23 m— < 90 m IN HEIGHT	SUPER HIGH RISE BUILDING > 90 m IN HEIGHT
22. STORAGE GROUP A-1	Not Allowed	Not Allowed	TYPE I (442) S, 5853 m², F1 TYPE I (332) S, 5853 m², F1 TYPE II (222) S, 4599 m², F1 TYPE II (111) S, 3066 m², F1	Not Allowed	Not Allowed	Not Allowed
23. STORAGE GROUP A-2	Not Allowed	Not Allowed	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, 4599 m², F3 TYPE II (111) S, 3066 m², F2	Not Allowed	Not Allowed	Not Allowed
24. INDUSTRIAL GROUP A-1	Not Allowed	Not Allowed	TYPE I (442) S, 5853 m², F1 TYPE I (332) S, 5853 m², F1 TYPE II (222) S, 4599 m², F1 TYPE II (111) S, 3066 m², F1	Not Allowed	Not Allowed	Not Allowed
25. INDUSTRIAL GROUP A-2	Not Allowed	Not Allowed	TYPE I (442) S, AUL, FUL TYPE I (332) S, AUL, FUL TYPE II (222) S, 4599 m², F3 TYPE II (111) S, 3066 m², F2	Not Allowed	Not Allowed	Not Allowed

3.9.11. Note.

Table: - A.02-T8. applies only to occupancies holding Hazardous Material quantities that exceed Maximum Allowed Quantities (MAQ) as required by Section **F, Chapter 01.**

3.11. Separation of incidental accessory Rooms and Occupancies

3.11.1. Incidental accessory occupancies are those occupancies that are ancillary to the main occupancy of the building or portion thereof and shall comply with **Table: - A.02-T9.**

3.11.2. **TABLE: - A.02-T9.** also provides separation between certain occupancies and shall be complied with **Table: - A.02-T2.** for separation requirements between occupancies.

3.11.3. Such Occupancy and incidental accessory room separations shall be vertical, horizontal or both or when necessary, of such other form as required to provide complete separation between occupancy divisions in the building.

Table: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory

INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM	REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM	OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS **(See Section D, Chapter 02 for Fire Protection requirements, Section E, Chapter 01 for smoke control requirements)**
1. EMERGENCY COMMAND CENTER	1 Hour	2 Hour	i. Fire Command Center shall be provided to the following occupancies. a. Highrise and Super high-rise buildings. b. Malls. c. Amusement and Theme Parks ii. Fire Command Center shall have a minimum size of 19 m^2 with minimum dimension of 3 m. iii. Emergency Command Center shall be located at the entrance side of the building and along fire access-way. iv. Emergency Command Center shall be permitted to be utilized as building security, BMS, Facility management office or building control room.

2. FIRE PUMP ROOM	2 Hour	2 Hour	i. Pump Room shall be located anywhere between ground floor near Fire access road to the lowest level of the building, within 6m and visible location from Exit stair leading to ground floor from that level. In case of Super high rise building, Pumps are provided in intermediate floors as per Section D, Chapter 11. ii. Pump Room shall have direct and standard access way/Stair, door with 2300 mm Headroom. Hatch entry, Cat ladders, Spiral Stairs, Winding Stairs are not allowed to access Fire Pump Room. iii. Minimum Pump Room height shall be 2.5 m and area for Horizontal pumpset shall be as follows. a. 3m X 3m for 50 gpm pump set b. 3m X 4m for 100 gpm pump set. c. 4m X 4m for up to 500 gpm pump set. d. 5m X 6m for up to 1500 gpm pump set. e. 6m X 6m for more than 1500 gpm pump set iv. Minimum Pump Room size and height for Vertical Turbine pumpset shall be as follows. a. 3m X 3m X 2.5m Ht for 50 gpm pumpset b. 3m X 4m X 3m Ht for 100 gpm pumpset. c. 4m X 4m X 3m Ht for up to 500 gpm pumpset. d. 5m X 6m X 3.5m Ht for up to 1500 gpm pumpset. e. 6m X 6m X 3.5m Ht for more than 1500 gpm pumpset

Table: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/ Occupancies.

INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM	REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM	OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS **(See Section D, Chapter 02 for Fire Protection requirements, Section E, Chapter 01 for smoke control requirements)**

3.A. FIRE WATER TANK FOR HORIZONTAL PUMP	0 Hour	0 Hour	i. Fire water tank shall be next to the Fire pump room horizontally. ii. Tank Materials are limited to Concrete, Steel or Fiberglass reinforced plastic and shall with- stand the unit weight of water of 1000 kg per cubic meter. iii. Where water tank is not constructed with concrete, the water tank shall be General Directorate of Civil Defence – Kingdom of Bahrain listed and permitted. iv. Fire water tank shall have 2 internal equal compartments, connected with isolation valves for tank cleaning and maintenance purpose with- out compromising whole water reserve. v. Pump suction shall be from both compartments through a common header. vi. Water tank sizes shall be based on fire pump capacity and duration as per **Section D, Chapter 05.** vii. Fire water tank shall be permitted to be combined with domestic water capacity, provided fire water capacity is maintained and ensured at all times.

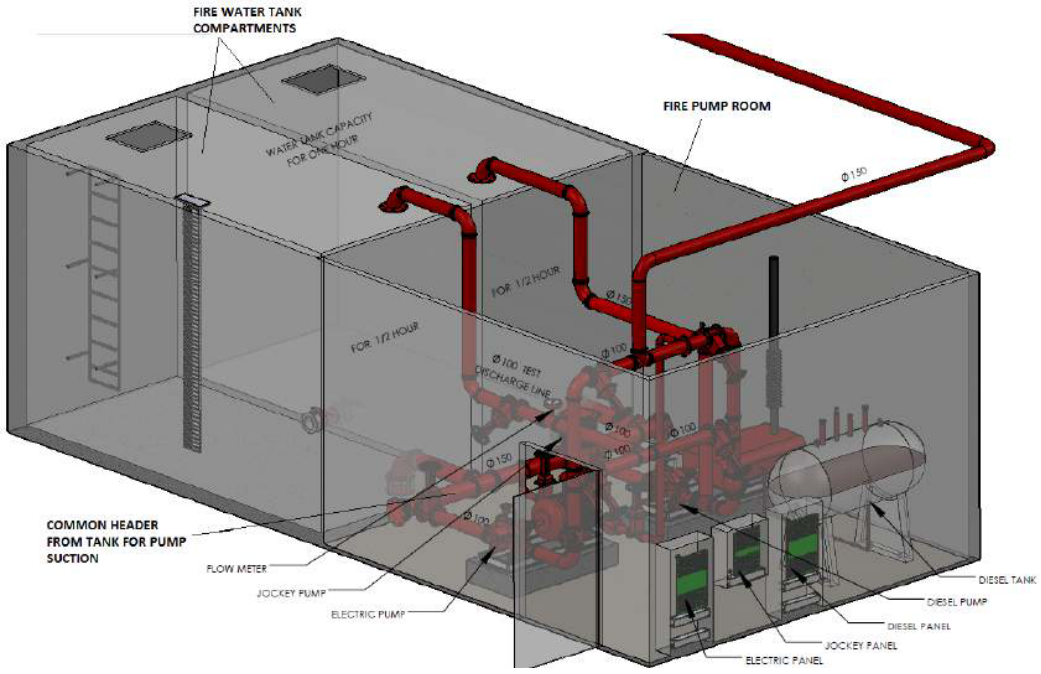


Figure: - A.02-F3A: Water Tank and Fire Pump Arrangement for Horizontal Pump

Table: - A.02-T9: Fire Resistance Separation and other requirement of incidental accessory /Occupancies.

INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM	REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM	OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS **(See Section D, Chapter 02 for Fire Protection requirements, Section E, Chapter 01 for smoke control requirements)**
3.B. FIRE WATER TANK FOR VERTICAL TURBINE PUMP	0 Hour	0 Hour	i. Fire water tank shall be directly below the pump suction for vertical turbine type pump-set. ii. Tank Materials are limited to Concrete, Steel or Fiberglass reinforced plastic and shall with- stand the unit weight of water of 1000 kg per cubic meter. iii. Where water tank is not constructed with concrete, the water tank shall be General Directorate of Civil Defence – Kingdom of Bahrain listed and permitted. iv. Fire water tank shall have 2 internal equal compartments, connected with isolation valves for tank cleaning and maintenance purpose with- out compromising whole water reserve. v. Pump suction shall be from sump pit. vi. Water tank sizes shall be based on fire pump capacity and duration as per **Section D, Chapter 05** vii. Fire water tank shall be permitted to be combined with domestic water capacity, provided fire water capacity is maintained and ensured at all times.

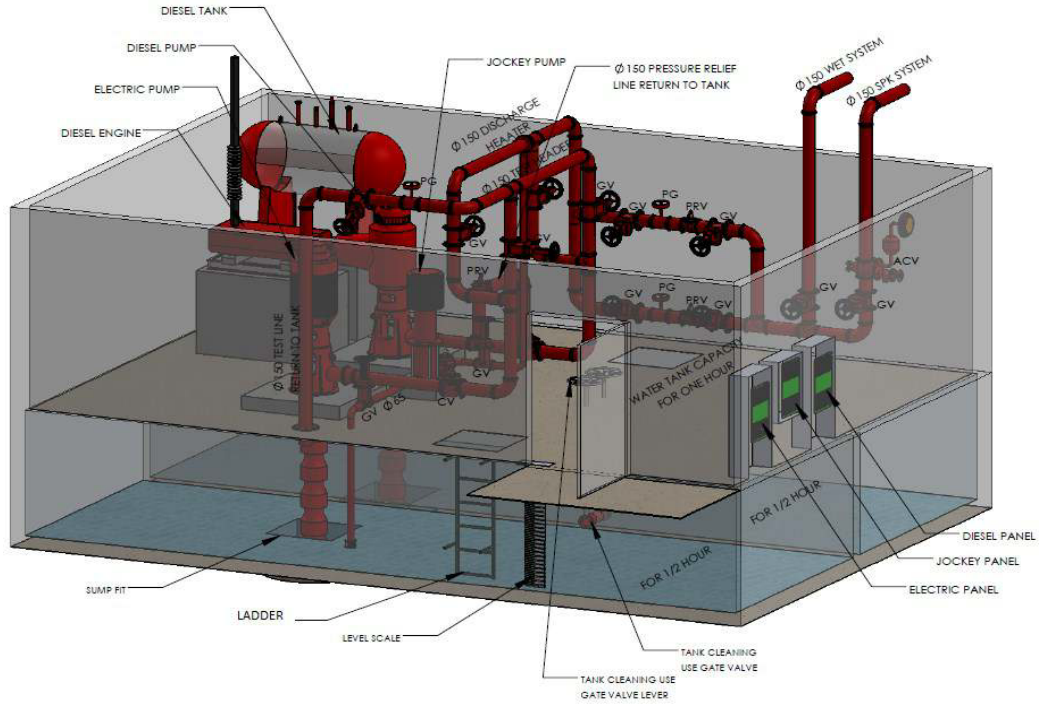


Figure: - A.02-F3B: Water Tank and Fire Pump Arrangement for Vertical Turbine Pump

Table: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/ Occupancies.			
INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	**REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS** **(See Section D, for Fire Protection requirements, Section E, Chapter 01 for smoke control requirements)**
4. KITCHEN RESTAURANTS KITCHEN— COMMERCIAL	0 Hour	1 Hour	i. Kitchens having area more than 150 m^2 shall be provided with automatic sprinkler system. ii. Doors shall be 30 min fire rated and self closing. iii. Kitchen-hood suppression shall be provided. iv. Show/Open Kitchens shall be provided with 1-hour Fire rated Smoke partition (Glazing) to be separated from seating, open, circulation areas. v. Kitchen shall be permitted to be in the basement, but not LPG Cylinders or storage tank.

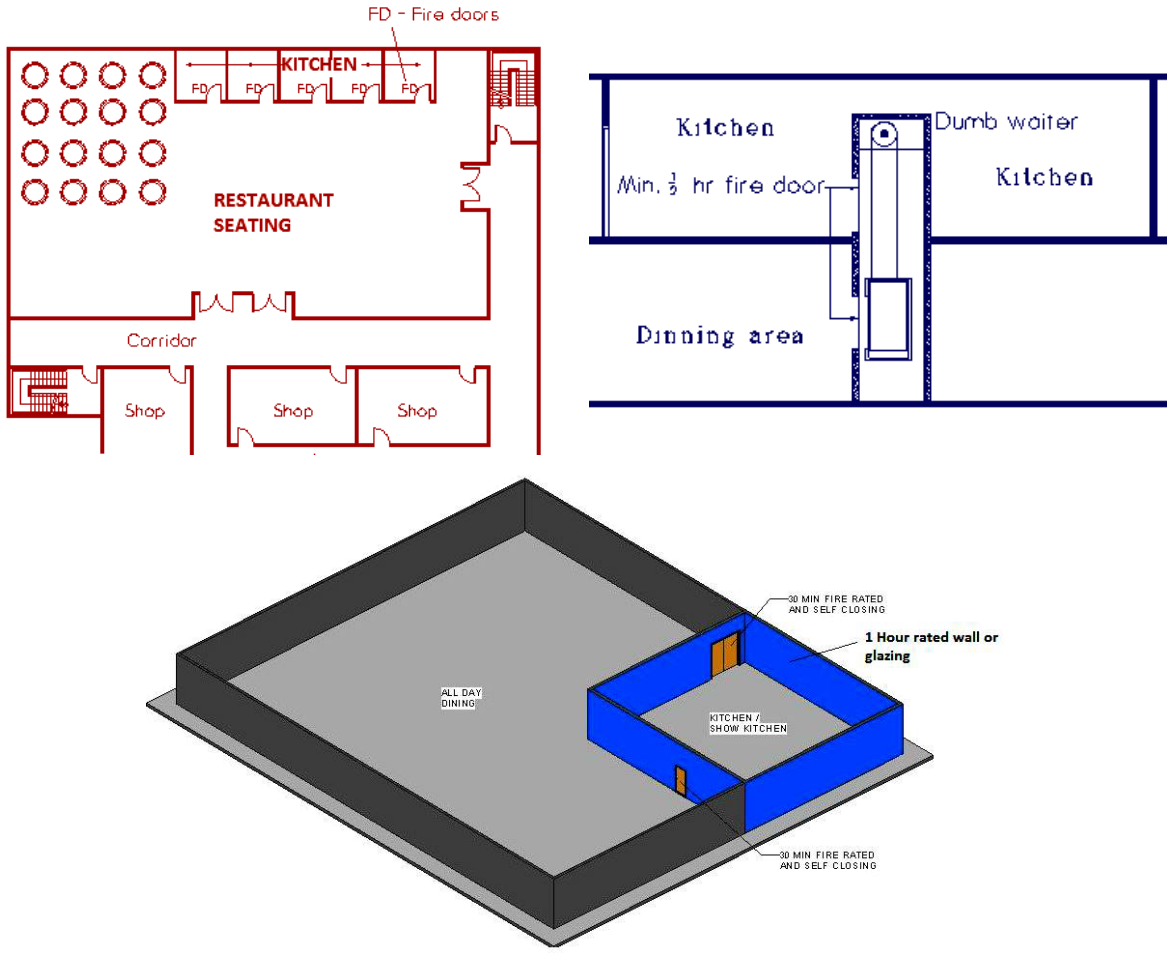


Figure: - A.02-F4: Separation of Kitchen

Table: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/ Occupancies.

INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM	REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM	OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS **(See Section D, for Fire Protection requirements, Section E, Chapter 01 for smoke control requirements)**
5. ASSEMBLY GROUP A (THEATER, CINEMA, CONCERT HALL, NIGHTCLUBS ETC.)	1 Hour	2 Hour	i. Separation and Compartmentation shall be complete with walls, floor, doors and opening protection. ii. Where entrance access to Assembly Group A is from other occupancies, it shall be protected with fire doors. iii. Where a lobby between Assembly Group A and other occupancies are required, such lobby shall be 1-hour fire resistance rated with self-closing door, 1-hour fire rated.

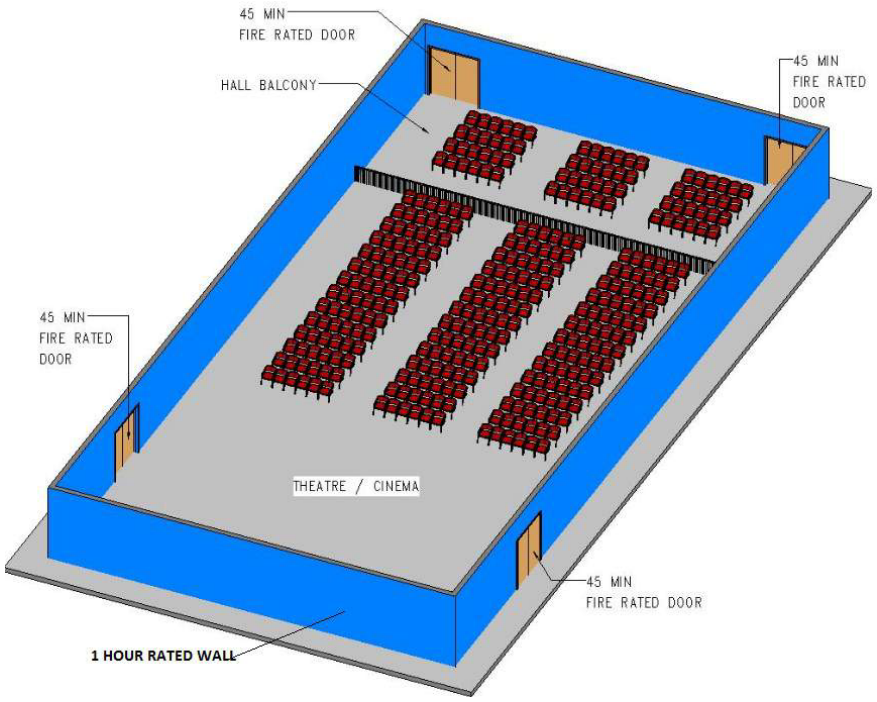


Figure: - A.02-F5: Separation of Cinema, Nightclub, Concert Hall

Table: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/ Occupancies.			
INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	**REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS** **(See Section D, for Fire Protection requirements, Section E, Chapter 01 for smoke control requirements)**
6. RETAIL UNIT	1 Hour	1 Hour	i. The separation is between retail units. Front of the retail unit if opens to enclosed mall, open mall, circulation areas, need not be fire resistance rated.
7. COLD ROOM > 20M²	1 Hour	2 Hour	i. Separation and Compartmentation shall be complete with walls, floor and opening protection with non-combustible and Permitted construction materials. ii. Fire door shall be 1-hour fire rated.
8. STAFF ACCOMMODATION	1 Hour	1 Hour	i. The separation is between labor dwelling units. Front side, including the door of the dwelling unit if opens to open corridor or open circulation areas, need not be fire resistance rated.
9. LABOR ACCOMMODATION	1 Hour	1 Hour	i. The separation is between labor dwelling units. Where front side, including the door of the dwelling unit if opens to open corridor or open circulation areas, need not be fire resistance rated. ii. Kitchens shall be separated from rest of the areas with 1-hour fire resistance rated construction.
10. APARTMENT UNIT	1 Hour	1 Hour	i. Separation and Compartmentation shall be complete with walls, floor, doors and opening protection. ii. Main door shall be 60 minutes fire rated.
11. HOTEL BEDROOM	1 Hour	1 Hour	i. Separation and Compartmentation shall be complete with walls, floor, doors and opening protection. ii. Main door shall be 60 minutes fire rated.
12. STORAGE ROOMS > 9.3 M²	1 Hour	2 Hour	i. See **Section D,** for Firefighting requirements. ii. See **Section E, Chapter 01.**for Smoke Control requirements.
13. AHU ROOM	1 Hour	1 Hour	i. See **Section D,** for Firefighting requirements. ii. See **Section E, Chapter 01.**for Smoke Control requirements.

TABLE: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/ Occupancies.			
INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	**REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS (See Section D, for Fire Protection requirements, Section E, Chapter 01 for smoke control requirements)**
14. EMERGENCY LIGHTING BATTERY ROOM/ UPS ROOM	1 Hour	2 Hour	i. Ventilation shall be provided for battery storage room and the UPS room. ii. Fire door shall be 60 minutes fire rated.
15. GENERATOR ROOM	2 Hour	2 Hour	i. Generator Room shall be located above grade level, on the exterior perimeter of the building. ii. Where located below grade, shall be on the perimeter of the space such that supply and exhaust can be achieved to exterior directly. iii. Where located below grade, shall be separated from rest of the area by the required fire rating and motorized louvers or fire curtains shall be provided to achieve the required fire rating. iv. Maximum Diesel Fuel allowed inside the Generator Room is 2498 L (660 gal). v. Generator room shall not be permitted on the roof of the building.
16. LOW VOLTAGE SWITCH ROOM (LV)	2 Hour	2 Hour	i. LV Room shall be located above grade level, on the exterior perimeter of the building. ii. When located on the perimeter of the building the separation shall be between LV room and other occupancies. Front side of the room exposed to exterior, need not be fire rated. iii. LV Rooms protected with Automatic Clean agent systems should have motorized louvers. iv. Door shall be 90 minutes Fire resistance rated with motorized louvers, where the room doesn't open to exterior of the building. v. Where located below grade, shall be on the perimeter of the space such that supply and exhaust can be achieved to exterior directly. vi. Where located below grade, shall be separated from rest of the area by the required fire rating and motorized louvers or fire curtains shall be provided to achieve the required fire rating.

17. TRANSFORMER ROOM AND HIGH VOLTAGE ROOM	2 Hour	2 Hour	i. Transformer /HV Room shall be located above grade level, on the exterior perimeter of the building. ii. When located on the perimeter of the building, the separation shall be between transformer/ HV room and other occupancies. Front side of the room exposed to exterior need not be fire rated.

TABLE: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/ Occupancies.			
INCIDENTAL ACCESSORY ROOMS	**REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE** PROTECTION SYS**TEM**	**REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE** PROTEC**TION SYSTEM**	**OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS** **(See Section D, for Fire Protection requirements, Section E, Chapter 01for smoke control requirements)**
			iii. Door shall be 90 minutes Fire resistance rated with motorized louvers, where the room doesn't open to exterior of the building. iv. Where located below grade, shall be on the perimeter of the space such that supply and exhaust can be achieved to exterior directly. v. Where located below grade, shall be separated from rest of the area by the required fire rating and motorized louvers or fire curtains shall be provided to achieve the required fire
18. RMU (RING MAIN UNIT) ROOM	2 Hour	2 Hour	i. RMU Room shall be located above grade level, on the exterior perimeter of the building. ii. When located on the perimeter of the building, the separation shall be between RMU room and other occupancies. Front side of the room exposed to exterior need not be fire rated. iii. RMU Rooms protected with Automatic Clean agent systems should have motorized louvers. iv. Door shall be 90 minutes Fire resistance rated where the room doesn't open to exterior of the building.
19. MDF (MAIN DISTRIBUTION FRAME) ROOM AND MMR ROOM (MEET ME ROOM)	1 Hour	2 Hour	i. MDF Room shall be protected in accordance with **Section D, Chapter 09, Table A.05.T3.** ii. Door shall be 90 minutes Fire resistance rated where the room doesn't open to exterior of the building.
20. BOILER ROOM	1 Hour	2 Hour	i. Separation and Compartmentation shall be complete with walls, floor and opening protection. ii. Fire door shall be 60 minutes fire rated.
21. A/C PLANT ROOM	1 Hour	1 Hour	i. Separation and Compartmentation shall be complete with walls, floor and opening protection. ii. Fire door shall be 60 minutes fire rated.
22. BULK LAUNDRY ROOM	1 Hour	2 Hour	i. Separation and Compartmentation shall be complete with walls, floor and opening protection. ii. Fire door shall be 60 minutes fire rated.

TABLE: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/ Occupancies.			
INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	**REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS (See Section D, for Fire Protection requirements, Section E, Chapter 01 for smoke control requirements)**
23. GARBAGE ROOM	1 Hour	2 Hour	i. Garbage Room shall be located above grade level, on the exterior perimeter of the building. ii. Separation and Compartmentation shall be complete with walls, floor and opening protection. iii. Fire door shall be 60 minutes fire rated.
24. LABORATORIES USING FLAMMABLE OR COMBUSTIBLE LIQUID (See Section F, Chapter 01. Preventive requirements of Hazardous materials)	1 Hour	2 Hour	i. Separation and Compartmentation shall be complete with walls, floor and opening - protection. ii. Fire door shall be 60 minutes fire rated.
25. PAINT SHOPS	1 Hour	2 Hour	i. Separation and Compartmentation shall be complete with walls, floor and opening protection. ii. Fire door shall be 60 minutes fire rated.
26. PAINT BOOTHS (SPRAY)	1 Hour	2 Hour	i. Separation and Compartmentation shall be complete with walls, floor and opening protection with non-combustible and permitted construction materials. ii. Vapor extract System shall be provided.
27. GIFT SHOPS	1 Hour	1 Hour	i. The separation is between gift shop and other occupancies. Front of the gift shop if opens to enclosed mall, open mall, circulation areas, need not be fire resistance rated.
28. MAINTENANCE WORKSHOPS	1 Hour Control	2 Hour requirements	i. See **Section D,** for Firefighting ii. See **Section E, Chapter 01.** for Smoke requirements

TABLE: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/ Occupancies.			
INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	**REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS (See Section D, for Fire Protection requirements, Section E, Chapter 01 for smoke control requirements)**
29. GROUP A STORAGE EXPLOSIVES, DETONABLE PYROPHORIC MATERIALS, BLASTING AGENTS < 100 KG **More than 100 kg shall have risk assessment and shall comply with Section F, Chapter 01 and NFPA 5000.**	2 Hour	2 Hour	i. Storage shall be in a separate building without basements and a maximum of one floor. ii. This dedicated building shall be minimum of 23 m away from other buildings and property line. iii. Separation and Compartmentation shall be complete with walls, floor, roof and opening protection. iv. Door shall be 90 minutes fire rated, self-closing and directly outside available on Fire accessway. v. Rolling shutters shall be 90 minutes rated and shall be closed automatically up- on receiving fire signal. vi. Vapor exhaust system shall be provided. vii. Steel structure fire rating shall not be required. Over pressure vents must be provided, ones that taken consideration the type of blasting agent and over pressure produced.
30. GROUP A STORAGE MATERIALS STORE ROOM (FLAMMABLE AND COMBUSTIBLE MATERIALS) > 93 M^2 IN AREA. **Rooms exceeding MAQ, as per Section F, Chapter 01, shall have risk assessment and shall comply with Section F, Chapter 01, NFPA 5000 and NFPA 30.**	1 Hour	2 Hour	i. Storage room shall be 9 m away from property line. ii. Storage room shall not be in the basement. iii. Separation and Compartmentation shall be complete with walls, floor, roof and opening protection. iv. Door shall be 90 minutes fire rated, self-closing and directly outside available on Fire accessway. v. Rolling shutters shall be 90 minutes rated and shall be closed automatically upon receiving fire signal. vi. Vapor exhaust system shall be provided. vii. Steel structure fire rating shall not be required.



HIGH HAZARD WAREHOUSES FOR ILLUSTRATION

TABLE: - A.02-T9: Fire Resistance Separation and other requirement of incidental accessory/ Occupancies.			
INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	**REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS (See Section D, for Fire Protection requirements, Section E, Chapter 01 for smoke control requirements)**
31. MULTI-TENANT WAREHOUSE AND MULTITENANT FACTORIES	1 Hour	2 Hour	i. Separation and Compartmentation shall be complete with walls, floor, roof and opening protection. ii. Separation between warehouse units shall extend above the roof to 760 mm. iii. Door shall be 60 minutes fire rated and self closing. iv. Rolling shutters shall be 60 minutes rated and shall be closed automatically upon receiving fire signal. v. Where sandwich panels are used for wall systems, it shall comply with **Sub Section 5.9.** of this chapter. vi. Steel structure fire rating shall not be required.

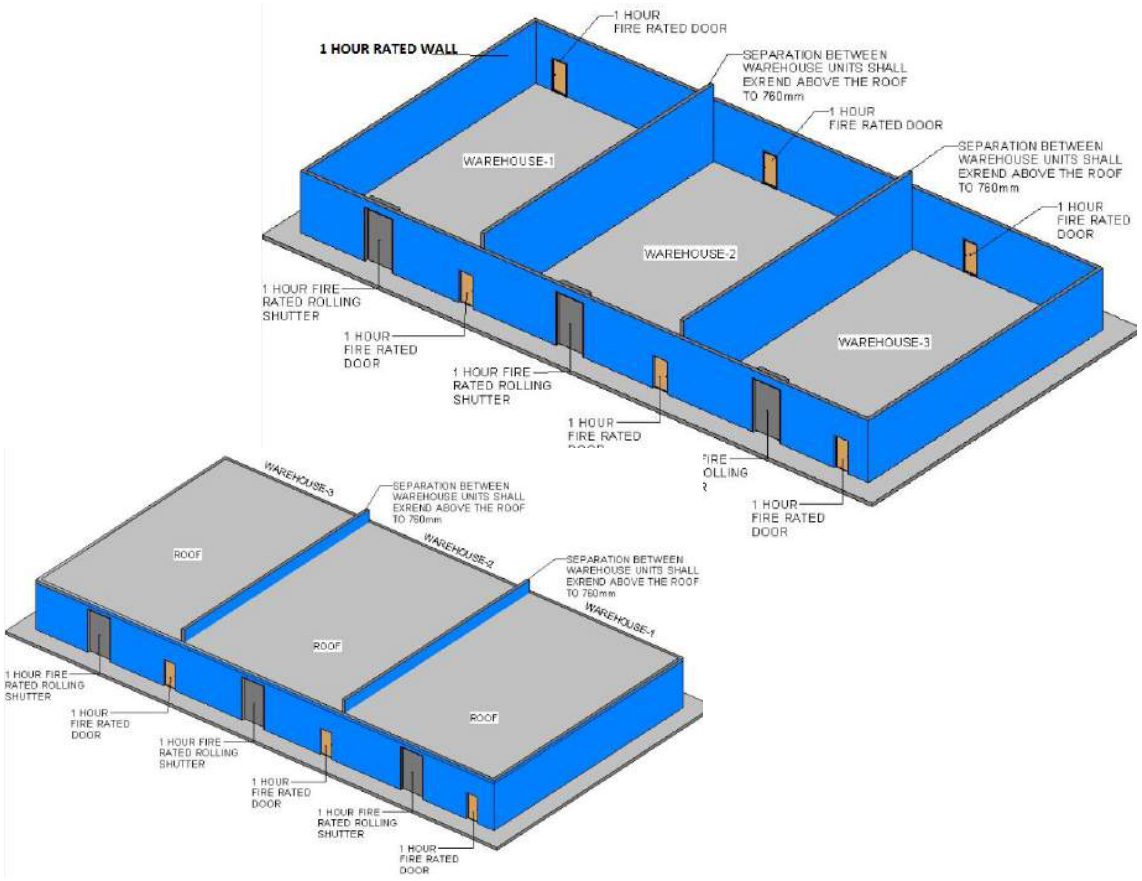


Figure:- A.02-F6: Separation of multitenant warehouses with sprinklers

Table: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/ Occupancies.			
INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	**REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS** **(See Section D, for Fire Protection requirements, Section E, Chapter 01 for smoke control requirements)**
32. OIL TANK ROOM	1 Hour	2 Hour	i. Separation and Compartmentation shall be complete with walls, floor and opening protection. ii. Fire door shall be 60 minutes fire rated for 1 hour rated wall and 90 minutes for 2 hour rated wall.
	1 Hour	1 Hour	i. The separation is between retail/restaurants/ department/workshops and storage occupancies. ii. Front side of these occupancies need not be fire resistance rated but shall be minimum of 3 m away from the fuel dispensing unit. iii. The Height of canopies shall not be less than 4115 mm. iv. Canopies, supports, shades, structure used for the petrol station fuel dispensing and other occupancies in the vicinity shall be 1-hour fire rated. See Sub **Section 8** for material test standards. v. Cladding and exterior façade shall comply with **Sub Section 5, Sub Section 6** and **Sub Section 7** of this chapter. vi. Provisions shall be made to prevent spilled liquids from flowing into adjacent buildings, such as grading driveways, raising door sills, drainage etc. vii. Motor vehicle traffic patterns at motor fuel dispensing facilities shall be designed to inhibit movement of vehicles that are not being fueled from passing through the dispensing area. Viii. See **Section F, Chapter 01, Sub Section 4. Motor Fuel Dispensing Facilities** for further requirements.



PETROL STATION FOR ILLUSTRATION

Figure: - A.02-F6. a: Separation of Fuel dispensing stations/Petrol stations

Table: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/ Occupancies.

INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM	REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM	OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS **(See Section D, for Fire Protection requirements, Section E, Chapter 01 for smoke control requirements)**
34. OPEN PARKING	1 Hour	2 Hour	i. Each parking level shall have permanent wall openings open to the atmosphere, for an area of not less than 0.4 m^2 for each linear meter of its two opposite exterior perimeters. ii. Such openings shall be distributed over 40 percent of the building perimeter surfaces, uniformly over each of at least two opposing side surfaces. iii. Interior wall lines and column lines shall be at least 20% open. iv. Any part of the carpark shall be within 30 m of the permanent natural ventilation opening on the perimeter surface. v. See **Section E, Chapter 01, Sub Section 4.5,** for further open parking categorization for smoke management system purposes.



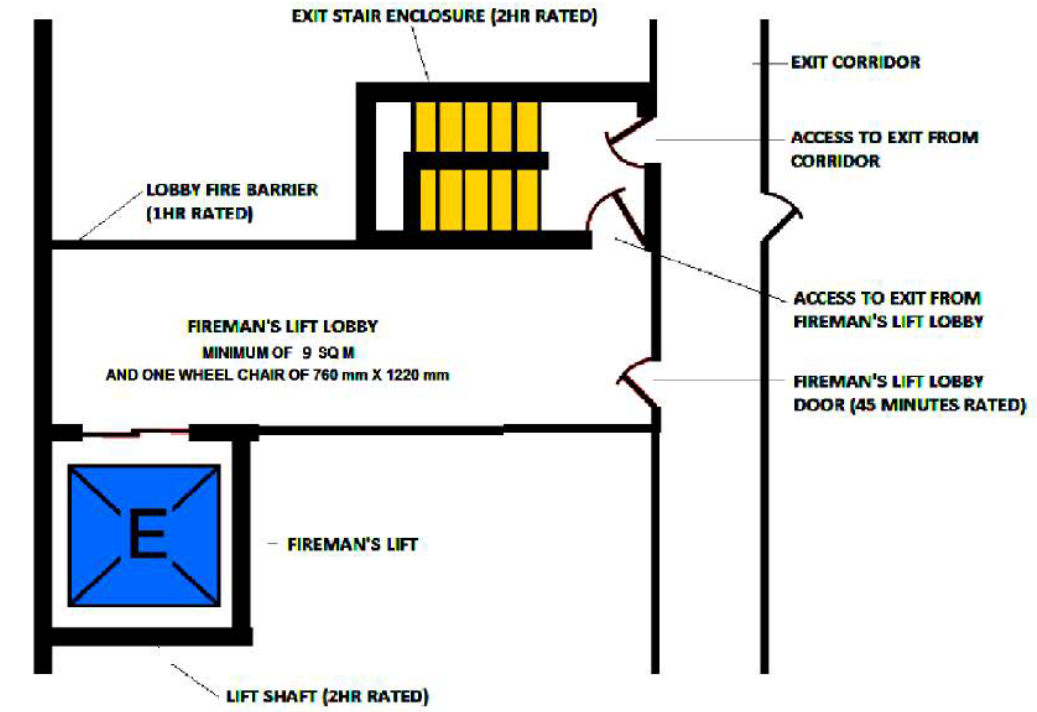


Figure:- A.02-F7: Open parking for illustration

Table: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/ Occupancies.			
INCIDENTAL ACCESSORY ROOMS AND OC CUPANCIES	**REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS** **(See Section D, for Fire Protection requirements, Section E, Chapter 01 for smoke control requirements)**
35. PASSENGER ELEVATOR LOBBY	1 Hour	1 Hour	i. Barriers forming the elevator lobby shall have a minimum 1-hour fire resistance rating and shall be arranged as a smoke barrier. ii. Elevator lobby door assemblies shall have a minimum 1-hour fire protection rating iii. Elevator lobby door leaves shall be self-closing or automatic-closing. iv. Each elevator landing and lobby shall have access to at least one exit. v. Every Super High-rise building, i.e., building with height more than 90 m from fire access level, shall have elevator lobby doors. Elevators shall not be open to exit corridors without lobby barriers in Super high-rise buildings.
36. ELEVATOR SHAFT/ HOISTWAY **(Elevator Shaft fire ratings mentioned here are minimum requirements and will increase based on the building construction type that the elevator shaft belongs to)**	1/2/3 Hour depending on the building construction type	1/2/3 Hour depending on the building construction type	i. Elevator shaft Separation requirement is exempted when elevator is on external face of façade or located in open spaces like atriums communicating space or convenience space. ii. Not more than 4 elevator cars shall be located in one single hoistway enclosure. iii. Hoistway can be glass and not fire rated but shall meet the requirements of ANSI Z97.1, Glazing materials used in buildings or CPSC 16 CFR 1201, Safety standard for architectural glazing materials. iv. Where an elevator is installed in a blind hoistway or on outside of a building, an emergency door in the blind portion or blank face of building, in accordance with ASME A17.1/CSA B44., Safety code of elevators and escalators.
37. LIFT MACHINE ROOM	Shall be same as Elevator Shaft	Shall be same as Elevator Shaft	i. Elevator machine rooms serving elevators used for occupant evacuation shall be separated by 2 hours fire resistance separation. ii. Provide ventilation as per **Section E, Chapter 01** for Smoke Control requirements.

Table: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/Occupancies.

ACCESSORY ROOMS AND OCCUPANCIES	REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM	REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM	OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS **(See Section D, for Fire Protection requirements, Section E, Chapter 01 for smoke control requirements)**
38. FIRE FIGHTERS LIFT AND LOBBY / OCCUPANT EVACUA-TION LIFT AND LOBBY (Also see Section A, Chapter 03, Sub section 4.9)	1 Hour	1 Hour	i. Fire fighters lift shall be protected within a dedicated RCC shaft throughout the entire height of the building. ii. Where Fire fighters lift is situated with multiple elevators in a single RCC shaft, all the elevators in such common shaft shall comply to Fire fighters lift specifications. iii. Fire fighters Lift Lobby shall be provided for all Super-high-rise buildings., i.e., buildings with height more than 90 m from fire access level. iv. Such Fire fighters Lift Lobby shall have direct access to an exit stair enclosure. This exit stair enclosure shall also have access to the floor corridor without passing through Fire fighters Lift Lobby. v. Fire fighters Lift Lobby shall be enclosed with smoke barrier having 1-hour fire resistance rating with a lobby door having 60 minutes fire resistance rating. such lobby door shall be self-closing or automatic closing upon alarm activation. vi. Fire fighters Lift Lobby shall be sized at not less than 9 m^2, and where used as an occupant evacuation lift lobby, at occupant load factor of 0.28 m^2 for 50 people and 1-wheel chair space of 760 mm X 1220 mm shall be considered. vii. Fire fighters Lift car shall have a minimum size and arrangement to accommodate ambulance stretcher of 610 mm X 2130 mm. viii. Class III Fire hose cabinet as per **Section D, Chapter 03**, shall be available immediately outside the stair enclosure. ix. Fire fighters Lift shall be monitored continuously at Emergency Command Center and by General Directorate of Civil Defence' 24X7. x. Where Fire fighters Lift has 2 entrance doors, second entrance shall not be required to open into Fire fighters Lift Lobby. xi. Fire fighters Lift shall be installed as per ASME A 17.1/ CSA B44. complete with communication and overriding features. See **Figure: - A.02-F8. a** and **A.02.F8. b.** for various acceptable arrangements of Fire fighters Lift Lobby. xii. Service rooms having floor or ceiling penetrations such as electrical rooms, meter rooms, gas rooms, storage rooms, garbage rooms, telephone rooms shall not be permitted to open inside the Fire fighters lift lobby space.



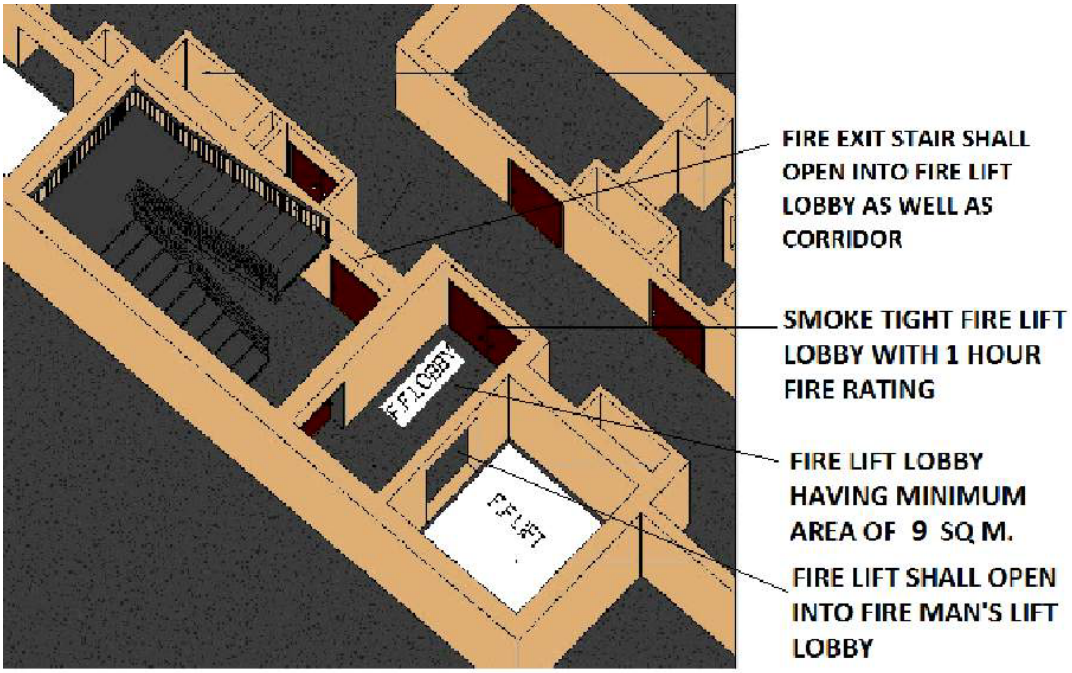
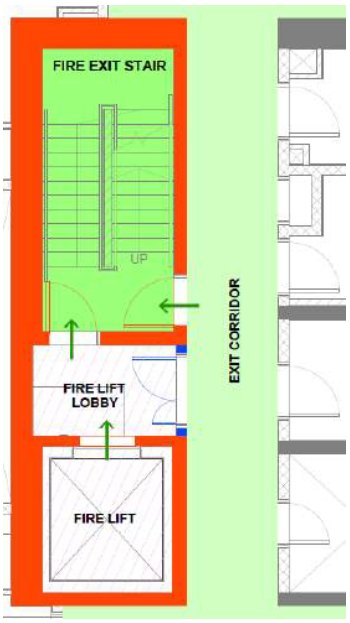
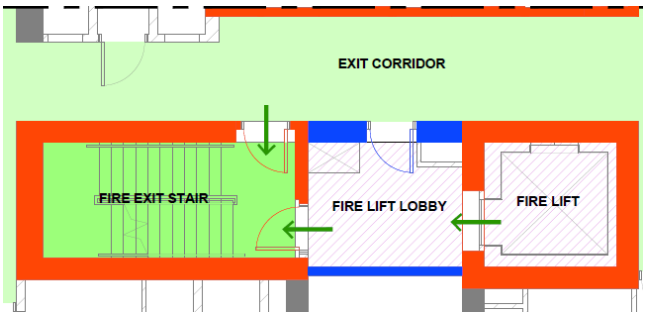
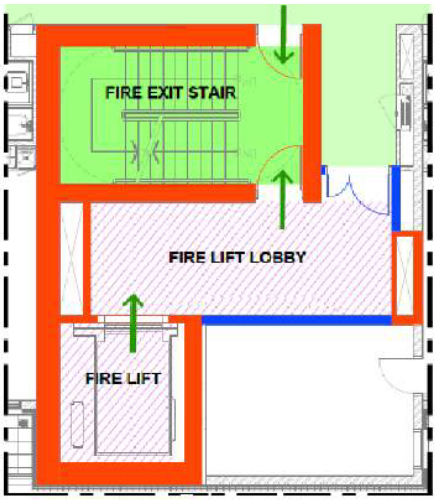


Figure: - A.02-F8.a: Fire fighters Lift Lobby/ Occupant evacuation Lift Lobby







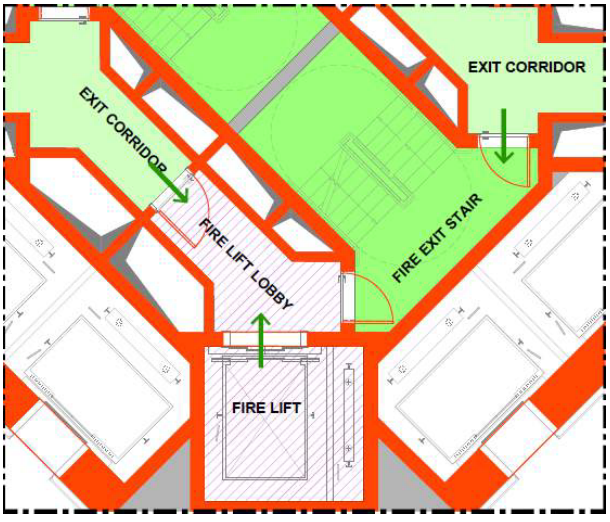


Figure: - A.02-F8.b: Acceptable arrangements of Fire fighters Lift Lobby

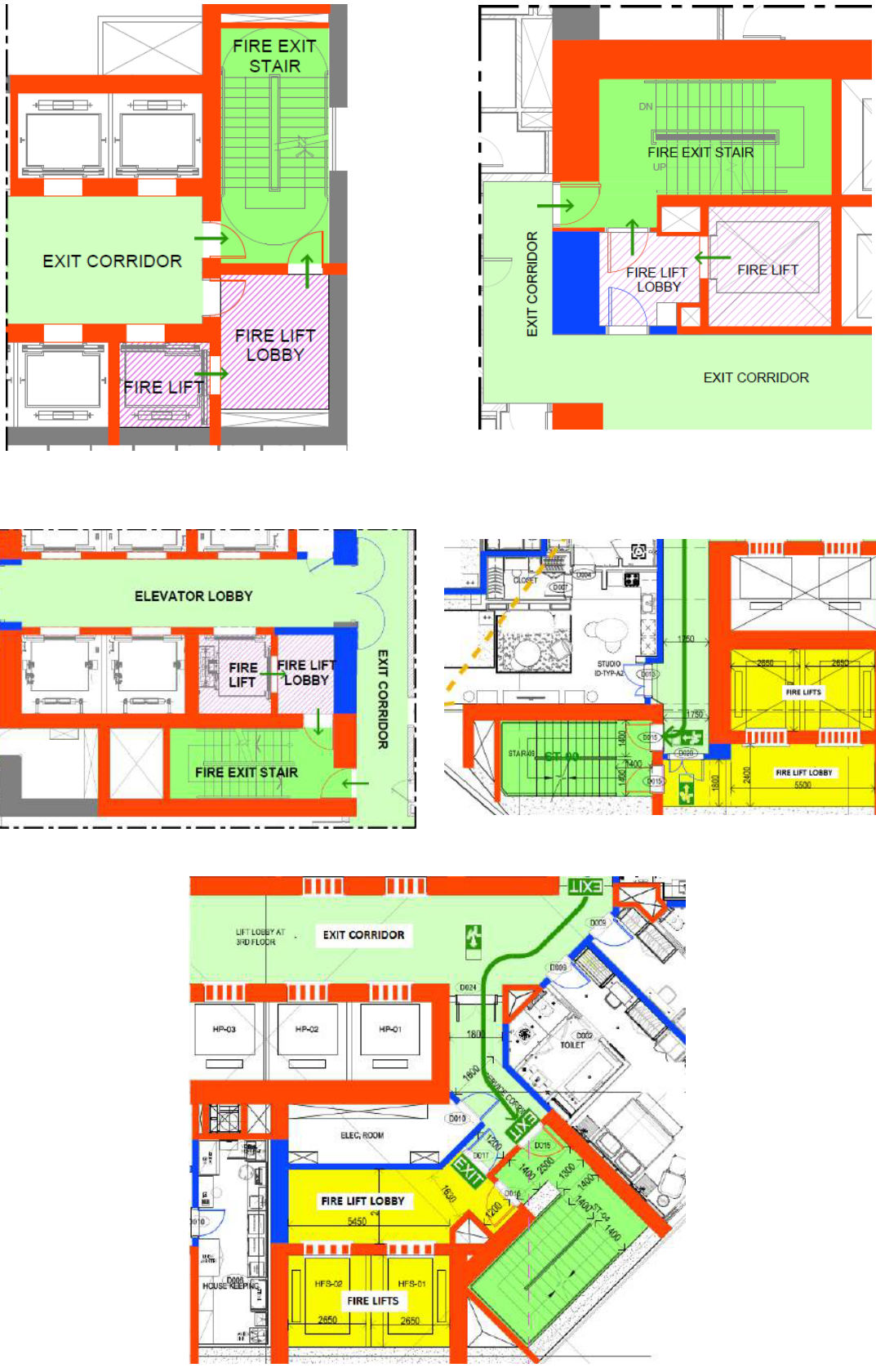
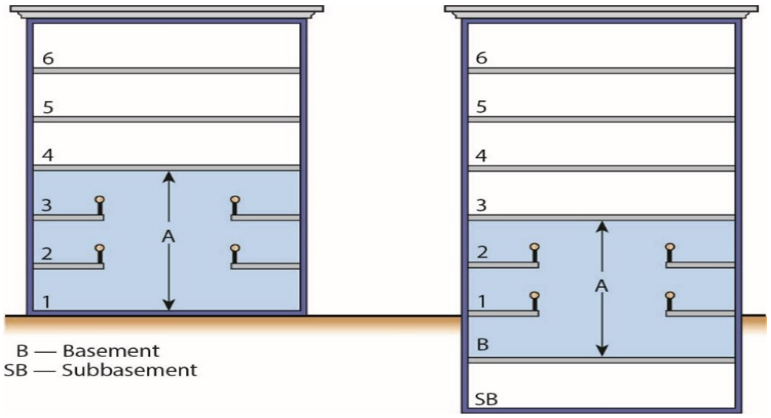


Figure:- A.02-F8.b: Acceptable arrangements of Fire fighters Lift Lobby

Table: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/ Occupancies.

INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM	REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM	OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS **(See Section D, for Fire Protection requirements, Section E, Chapter 01 for smoke control requirements)**
39. COMMUNICATING SPACE	0 Hour (Smoke Barrier is required)	1 Hour	i. Communicating space shall not connect more than 3 floors. ii. The lowest or next to lowest floor within communicating space shall be a discharge street floor. iii. Egress capacity of communicating space shall be sufficient for all occupants within communicating space/levels to egress simultaneously. iv. Each occupant within communicating space/level shall have access to at least one exit within communicating space from each level. v. Occupants outside communicating space shall have at least one exit independent of Communicating space. vi. Shall have ordinary hazard content (Group B, C) and sprinkler Protected.



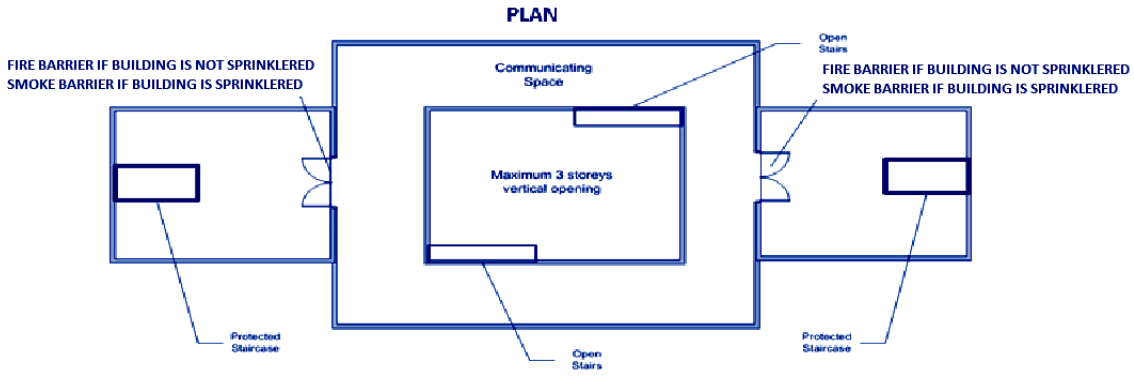
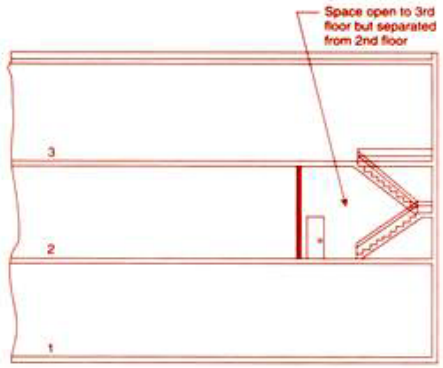
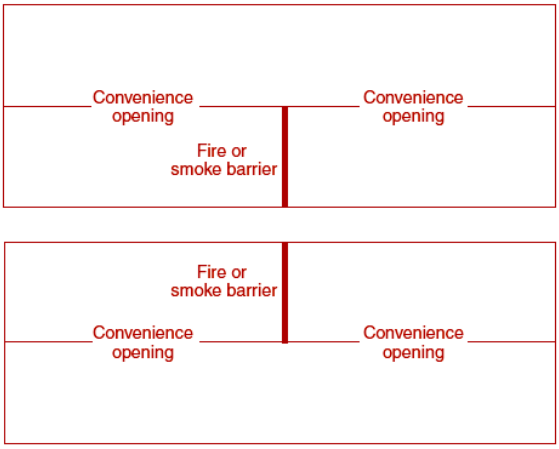


Figure: - A.02-F9.: Communicating Space

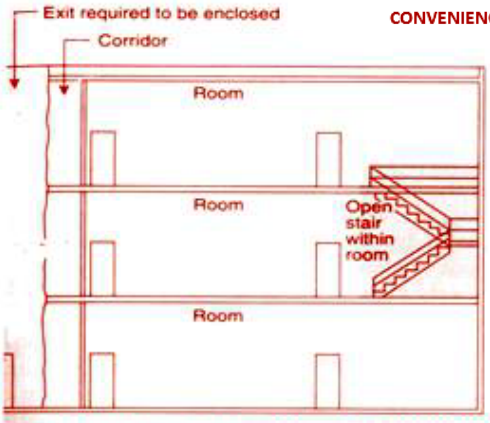
Table: - A.02-T9: Fire Resistance Separation and other requirement of incidental accessory/ Occupancies.			
INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	**REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS** **(See Section D, for Fire Protection requirements, Section E, Chapter 01 for smoke control requirements)**
40. CONVENIENCE OPENINGS	0 Hour	1 Hour	i. Separation is between convenience opening and protected corridors and fire compartments. ii. Convenience openings shall pierce only one floor and not connect more than 2 adjacent floors. iii. Such openings shall be separated from unprotected vertical openings serving other floors. iv. Such openings shall be separated from corridors, other fire compartments or smoke compartments on the same floor. v. Such openings shall not serve as required means of egress.



SEPARATED CONVENIENCE OPENING



CONVENIENCE OPENING ARRANGEMENT



NON SEPARATED CONVENIENCE OPENING

Figure: - A.02-F10: Convenience Opening

TABLE: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/ Occupancies.			
INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	**REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS** **(See Section D, for Fire Protection requirements, Section E, Chapter 01 for smoke control requirements)**
41. CONVENIENCE STAIR OPENING	0 Hour	0 Hour	i. Convenience stair shall not be considered as an exit stair. ii. Convenience stair shall not connect more than 2 floors. iii. Convenience stair shall not be permitted in non-sprinklered buildings. iv. The area of the opening shall not exceed twice the horizontal projected area of the stairway. v. Such openings shall be separated from unprotected vertical openings serving other floors. vi. Such openings shall be separated from corridors, other fire compartments or smoke compartments on the same floor.
42. VERTICAL OPENING ENCLOSURES	2 Hour	2 Hour	i. Enclosures for Exits and Exit passageways for non-high-rise buildings and low depth underground buildings shall be 2-hour fire resistance rated and shall be 2 hours rated reinforced concrete for High-rise buildings and high depth underground buildings. ii. Openings through floors shall be enclosed with fire barrier walls/Fire walls, shall be continuous from floor to floor or floor to roof. iii. Shafts shall be permitted to terminate in a room or space having a use related to the purpose of the shaft, provided that the room or space is separated from the remainder of the building by construction having a fire resistance rating and opening protection. iv. Shafts that do not extend to the bottom or top of the building or structure shall be permitted to be protected by permitted fire dampers installed in accordance with their listing at the lowest or highest floor level, as applicable, within the shaft enclosure. (Subject to General Directorate of Civil Defence – Kingdom of Bahrain evaluation and decision)

Table: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/ Occupancies.

INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM	REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM	OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS **(See Section D, for Fire Protection requirements, Section E, Chapter 01 for smoke control requirements)**
43. ESCALATOR/ CONVEYOR OPENINGS	0 Hour	0 Hour	i. Service openings for Escalators and conveyors, where required to be open on more than one floor at the same time for purposes of operation, shall be provided with closing devices. ii. In buildings protected throughout by an approved automatic sprinkler system, escalators or moving walk openings shall be permitted to be protected by rolling steel shutters appropriate for the fire resistance rating of the vertical opening protected. iii. The shutters shall close automatically and independently of each other upon smoke detection and sprinkler operation at a speed not exceeding 0.15 meters/second. iv. Shutters shall be equipped with sensitive leading edge which shall arrest the progress of a moving shutter and cause it to retract a distance of approximately 150 mm upon the application of a force not exceeding 90 N applied to the surface of the leading edge. Shutter shall have backup power supply. v. In buildings protected throughout by an approved automatic sprinkler system, escalators or moving walk openings shall be permitted to be protected in accordance with the sprinkler-draft curtain method.

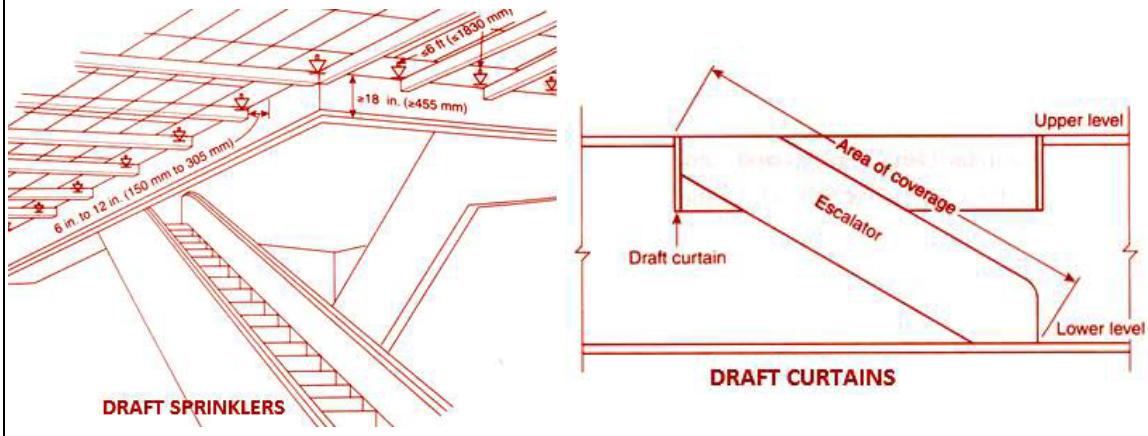


Figure: - A.02-F11.: Draft Curtain and Draft Sprinklers

Table: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/ Occupancies.

INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM	REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM	OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS (See Section D, for Fire Protection requirements, Section E, Chapter 01 for smoke control requirements)
44. ATRIUM	1 Hour	1 Hour	i. Separation required on each floor, unless supported by engineering analysis, Performance based design, demonstrating multiple types of fires and permitted by GDCD. ii. Glass walls and inoperable windows if any, shall be 1-hour fire resistance rated assemblies. iii. Where 1-hour fire resistance rating is not met, sprinklers shall be provided on both sides of such glazing and inoperable windows such that sprinklers are located not more than 305 mm from glazing and at an interval of 1.8 m to cover the entire surface of the glazing. iv. Such sprinklers shall not be required on atrium side of the glass or window if there is no walk- way or other floor area on the atrium side above the main floor level. v. Doors in such glass walls shall be self-closing or activated automatically upon alarm initiation. vi. Access to exits or exit discharge within atrium shall be allowed if sprinklered.

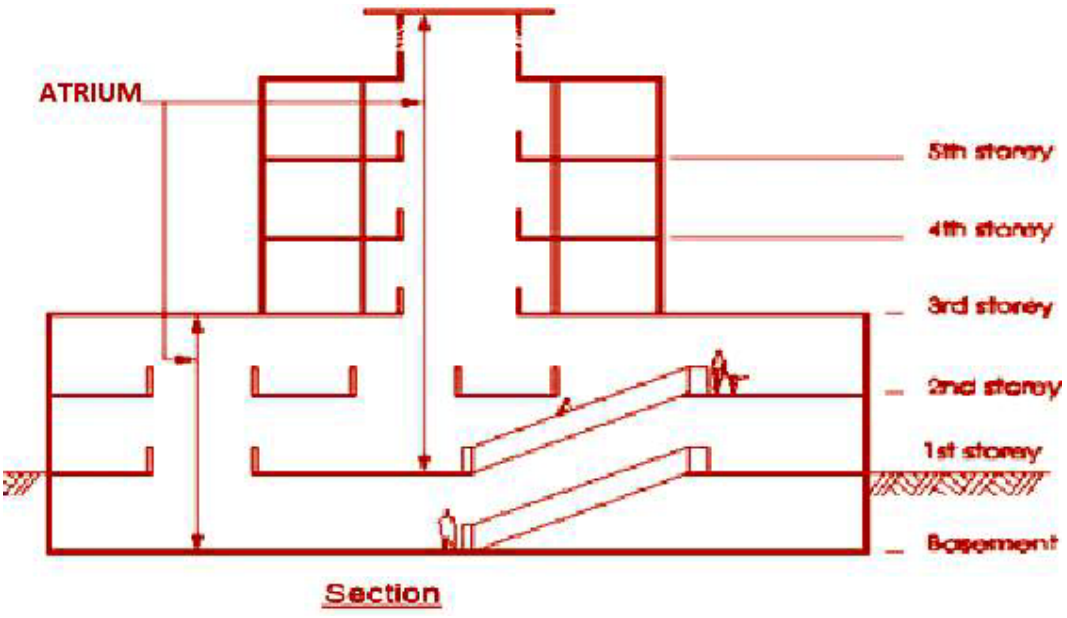
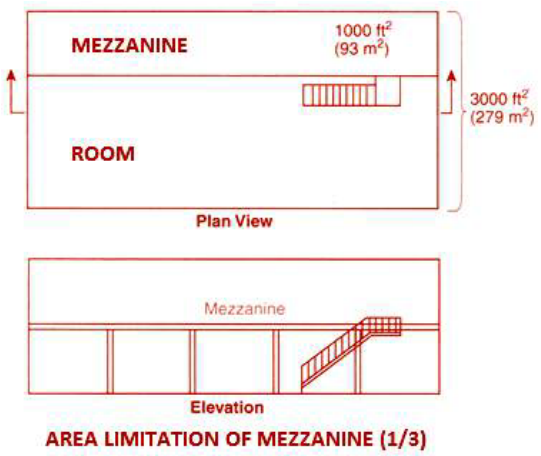


Figure: - A.02-F12.: Atrium

Table: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/ Occupancies.

INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM	REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM	OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS **(See Section D, for Fire Protection requirements, Section E, Chapter 01 for smoke control requirements)**
45. MEZZANINE	0 Hour	0 Hour	i. Mezzanines construction shall be with 1 hour fire resistance rating. The aggregate area of mezzanines within a room, other than those located in special-purpose industrial occupancies, shall not exceed one-third the open area of the room in which the mezzanines are located. ii. Enclosed space shall not be included in a determination of the size of the room in which the mezzanine is located. iii. There shall be no limit on the number of mezzanines in a room. iv. the area of the mezzanines shall not be - included in the area of the room. v. All portions of a mezzanine, other than walls not more than 1065 mm high, columns, and posts, shall be open to an unobstructed exit from the room in which the mezzanine is located, unless the occupant load of the aggregate area of the enclosed space does not exceed 10. vi. A mezzanine having two or more means of egress shall not be required to open into the room in which it is located if not less than one of the means of egress provides direct access from the enclosed area to an exit at the mezza-nine level.



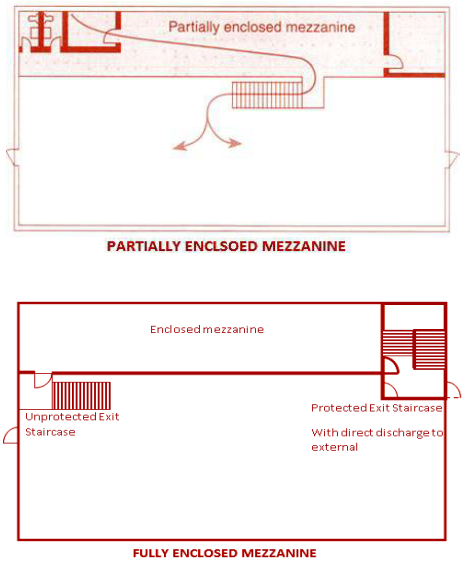


Figure: - A.02-F13: Definition of Mezzanine

TABLE: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/ Occupancies.			
INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	**REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS** **(See Section D, for Fire Protection requirements, Section E, Chapter 01 for smoke control requirements)**
46. GARBAGE CHUTES/ LINEN CHUTES	2 Hour	2 Hour	i. Enclosures garbage and linen chutes shall be 2 hour fire resistance rated. ii. Openings through floors shall be enclosed with fire barrier walls/Fire walls, shall be continuous from floor to floor or floor to roof. iii. Doors of garbage and linen shafts shall open to a room that does not exceed 37 m^2, provided that the room or space is separated from the remainder of the building by construction having a fire resistance rating and opening protection in accordance with NFPA 5000 , Chapter 8 or fully sprinklered.
47. CONCEALED SPACES **(Concealed spaces generally, are above false ceiling spaces or be- low false floor spaces, located at corridors and circulation areas, connecting service shafts and serve as corridors for service installations such as ducts, cables, piping etc.)**	0 Hour	0 Hour	i. Combustible materials shall not be permitted within the concealed spaces of buildings classified as Type I or Type II construction and within walls required to be constructed of noncombustible or limited-combustible materials. Timber/Wood/Plastic shall not be used in concealed spaces. ii. Any concealed space more than 800 mm accommodating services such as non-fire rated ventilation ducting, exposed cables, wiring and fuel gas pipes shall be provided with automatic sprinkler system. iii. Concealed space shall only be allowed as plenum and exempted from sprinkler provision when constructed with non-combustible material and classified as having Class A flame spread index. iv. Where i and ii are not met draft stops shall be provided such that any concealed space between ceiling and the floor or roof above shall be draft stopped for full depth of the space along the line of support for the floor and roof structure to form areas not to exceed 93 m^2 for any space between ceiling and floor and 280 m^2 between ceiling and roof. v. Draft stopping materials shall not be less than 13 mm gypsum board or other General Directorate of Civil Defence - Kingdom of Bahrain permitted material.

TABLE: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/ Occupancies.			
INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	**REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION**	**REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS** **(See Section D, for Fire Protection requirements, Section E, Chapter 01 for smoke control requirements)**
48. KIOSKS	0 Hour	0 Hour	i. Minimum horizontal separation between kiosks and other occupancies, including other structures within mall circulation area or retail spaces shall not be less than 1.5 m. ii. The minimum horizontal separation distance between 2 adjacent kiosks shall not be less than 6m. iii. Kiosks located at sprinkler protected areas and mall buildings shall be provided with automatic sprinkler system. iv. Kiosks shall be provided with automatic fire detection and alarm system. v. Kiosks or group of kiosks shall not have an area more than 18 m^2. See **Sub section 8.1.40.** for kiosk material requirements.

49. MEMBRANE STRUCTURES	0 Hour	0 Hour	i. Membrane structures shall be limited to single storey without any height limitation. ii. Area shall be limited as per Type II construction requirements, as per **Table: - A.02-T7.** based on the support system material. iii. Membrane structures or materials shall not be used where fire resistance rating is required for walls, roofs and ceilings. iv. Where located on roof, membrane structures, it shall not be less than 6 m above roof, terrace or balcony. v. Non-combustible membrane materials shall be used where constructed as roofs. vi. There shall be a minimum clearance of 1 m between the membrane and the contents or equipment within the building and between the membrane and any exterior object. See **sub section 8.1.41.** for material requirements. vii. The finished ground level inside and not less than 3 m outside of the structure, shall be cleared of all flammable or combustible material and vegetation. viii. Air inflated structures shall have not less than two weather proof automatic blower units complete with automatic control, incapable of over pressurization and powered by continuous-rated motors at the max-maximum power required. ix. Standby power capable of 4-hour backup shall be provided for Air inflated membrane structures. x. The design, materials, and construction of the membrane structures shall be based on plans and specifications prepared by a licensed architect or engineer knowledgeable in membrane construction. xi. Material loads and strength shall be based on physical properties of the materials verified and certified by an permitted testing laboratory.



KIOSK IN SHOPPING MALL FOR ILLUSTRATION



INFLATED STRUCTURE FOR ILLUSTRATION

TABLE: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/ Occupancies.			
INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	**REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS** **(See Section D, for Fire Protection requirements, Section E, Chapter 01 for smoke control requirements)**
50. TENTS AND MARQUEES	0 Hour	0 Hour	i. Minimum horizontal separation between Tents and other occupancies, including other tents shall not be less than 3m. ii. Such separation distance between tents shall not be required if tent area is less than 110m^2. iii. Maximum height shall not exceed 2.8 m. iv. The finished ground level enclosed by the structure, and the surrounding finished ground level not less than 3 m outside of the structure, shall be cleared of all flammable or combustible material and vegetation. v. Flammable and combustible storage shall not be allowed. vi. See **Sub Section 8.1.42.** for material requirements.
51. GRANDSTANDS AND BLEACHERS	0 Hour	0 Hour	i. Grandstands shall be erected to withstand structural loads and only where load carrying capacities exist to support loads. manufacturer, supplier and designer shall submit undertaking letter to General Directorate of Civil Defence – Kingdom of Bahrain stating that design and equipment comply to withstand load. ii. Grandstands can be of unlimited area when of Type I or Type II construction as per **Table: - A.02-T7**. iii. Outdoor Grandstand shall not be erected within 3 m of any building which has no 1 hour fire resistance rated exterior wall. iv. Outdoor grandstands constructed of Type III, Type IV or Type V shall not exceed 930 m^2 in area per unit or 61 m in length. v. Such outdoor grandstand units (iv) shall not be located within 6 m apart from each other. And not more than 3 units are allowed to be erected ed in one group. vi. Such groups (v) of less than 3 units shall be separated by either 2-hour fire rated construction extending 610 mm above the seating or shall be located 15 m apart. vii. Highest level of seat platforms shall not exceed 6 m from the finished ground level in front of the grandstand. viii. See **Section A**, **Chapter 03 for egress requirements**.

TABLE: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/ Occupancies.			
INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	**REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS** **(See Section D, for Fire Protection requirements, Section E, Chapter 01 for smoke control requirements)**
52.PEDESTRIAN WALKWAYS, PEDESTRIAN ROAD CROSSING BRIDGES, PEDESTRIAN BRIDGE (ENCLOSED OR UNENCLOSED) CONNECTING TWO BUILDINGS OR STRUCTURES.	0 Hour But shall be capable of resisting smoke	2 Hour	i. The separation requirement is between pedestrian walkway or bridge and the interior of buildings that such bridge or walkway connects, if any. Such separation fire resistance rating on the buildings or structures shall extend 3 m all around the walkway or bridge connecting the buildings. Any openings in such extended 3 m fire rating shall have 45 min fire resistance rating or equipment and devices to ensure the protection. (louvered Windows, Doors, curtains etc.). ii. Separation fire rating is not required if the buildings that the bridge connects are more than 3 m away AND sprinkler protected, or the building is open parking. Fire rating is not required where both sidewalls of the walkway or bridge are 50% open uniformly throughout. iii. Walkway or bridge shall be constructed of non-combustible or limited-combustible materials. Flammable panels and Plastic shall not be used in constructing walkways and bridges. iv. Fire retardant wood shall be permitted for roof construction. v. Minimum clear height of interior of the pedestrian walkway or bridge shall not be less than 2.13 m. vi. Minimum clear height of the pedestrian walk-way or bridge above the Fire Access road grade shall not be less than 4.5 m. vii. Interiors, Exterior claddings, façade material shall comply with **Sub Section 8** of this chapter.



PEDESTRIAN BRIDGE FOR ILLUSTRATION

TABLE: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/ Occupancies.			
INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	**REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS** **(See Section D, for Fire Protection requirements Section E, Chapter 01 for smoke control requirements)**
53. AIRPORT TERMINAL BUILDINGS.	0 Hour	0 Hour	i. Construction Types shall be limited to Type I, Type II or Type IV. (With tested and permitted noncombustible or limited combustible materials) ii. Interior finish shall be Class A. (See **Sub Section 8**). iii. The aircraft loading walkway exterior surfaces of floor, roof, walls, and load-bearing structural members shall be constructed entirely of materials or composite assemblies that maintain the structural integrity and heat transfer characteristics needed to meet the requirements of egress period of 5 minutes under free burning jet fuel spill fire. iv. Construction, Fuel Safety, Fire protection, Ventilation shall comply with **NFPA 415,** standard on Airport Terminal Buildings, Fuel Ramp Drain- age and Loading walkways.
54. AIR TRAFFIC CONTROL TOWER HAVING FLOOR AREA NOT MORE THAN 140 M^2	0 Hour	0 Hour	i. Airport Traffic Control Towers shall be constructed as follows with heights measured from grade plane to the cab floor. a. Type I with unlimited Height b. Type II (222) up to 73 m Height c. Type II (111) up to 30 m Height ii. The levels located below the observation level shall be permitted only for electrical, communications, electronic and mechanical equipment rooms, rest and small office area for employees.



AIRPORT TRAFFIC CONTROL TOWER FOR ILLUSTRATION

TABLE: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/ Occupancies.			
INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	**REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS** **(See Section D, for Fire Protection requirements Section E, Chapter 01 for smoke control requirements)**
55. AIRCRAFT HANGAR (All Construction requirements and specifications shall not be less than required by NFPA 409, Aircraft hangars)	1 Hour	1 Hour	i. Fire resistance separation are from aircraft hangars and adjoining occupancies, other than service and equipment rooms. ii. Equipment, Service rooms shall be separated from hangers by 2-hour fire rated construction. iii. All main steel columns shall be coated to achieve fire resistance rating of 2 hours. Such fire coating material shall resist the effects of Foam or other fire suppressing agents. iv. Roofing shall be Class A or Class B. **See sub section 7** for permitted roof coverings. v. Minimum of 15 m clear space shall be maintained around the aircraft hangar. Such clear space shall not be used for parking of aircraft or storage. vi. Exterior walls located less than 9 m from plot lines shall be of 2-hour fire resistance rated. vii. Group I Aircraft Hangar (Where aircraft access door height exceeds 8.5 m OR single fire area, compartment exceeds 3716 $m^{2)}$ shall be of Type I OR Type II (222) construction. viii. Group II Aircraft Hangar (Where aircraft access door height is 8.5 m or less AND single fire area, compartment is less than 3716 m^2 shall be of Type I for 2787 m^2-3716 m^2 area, of Type II (222) for 1858 m^2-3716 m^2area, of Type II (111) for 1394 m^2-3716 m^2 area. ix. Group III Aircraft Hanger (Where aircraft access door height is 8.5 m or less, are restricted to single storey only) AND single maximum fire area, compartment allowed shall be 2787 m^2 for Type I construction 1858 m^2 for Type II (222) construction, 1394 m^2 for Type II (111) construction, 1115 m^2 for Type II (000) construction. x. Group IV Aircraft hangars (Where construction is of membrane covered steel structure), shall be limited to single storey and membrane shall be tested and listed. See **Sub Section 8**. xi. Construction, cluster of hangars, Flooring, Roofing, Fuel Safety, Lightening/Fire protection, Ventilation shall comply with **NFPA 409,** Aircraft Hangars.

TABLE: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/ Occupancies.

INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM	REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM	OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS **(See Section D, for Fire Protection requirements Section E, Chapter 01 for smoke control requirements)**
56. SIGNBOARDS AND BILLBOARDS ON BUILDING ENVELOPE	0 Hour	0 Hour	i. Flammable, Combustible, Plastic, Foam materials shall not be used in erecting signboards. ii. Signboards erected on building envelope shall not reduce or compromise the fire resistance rating of the building façade system or building envelope. iii. All the electrical wiring, connections, luminaries and lamps shall be installed in accordance with relevant requirements of **NFPA 70** and Electricity Authority safety regulations. iv. All the combustible materials used for signboards shall comply with fire tests as per **Sub section 8.1.44.**
57. INTERIOR SIGNS AND BILLBOARDS	0 Hour	0 Hour	i. Interior Signboards and Billboards shall not exceed 10% of the wall they are installed on. ii. Flammable, Combustible, Plastic, Foam materials shall not be used in erecting signboards. iii. Interior signboards and billboards shall satisfy either Class A or Class B, in their reaction to fire tests.

58. MODULAR HOUSES/ MANUFACTURED HOUSES AND OFFICES	0 Hour	0 Hour	i. Construction, Structure, Planning, Materials etc. shall be as per **NFPA 501**. Standard on Manufactured housing. See Material Test Requirements in **Sub section 8.1.46.** ii. The interior finish of walls, columns, and partitions shall not have a flame-spread index exceeding 200. iii. Ceiling interior finish shall not have a flame-spread index exceeding 75. iv. Walls adjacent to or enclosing a furnace or water heater, and the ceilings above them, shall have an interior finish with a flame-spread index not exceeding 25. v. Thermal insulation shall have flame spread of not more than 25. See **Sub section 8.1.11**. vi. Materials used to surface the cooking and heating areas shall be limited-combustible materials *e.g., in. (8 mm) gypsum board+. vii. Cooking shall not be allowed inside the unit in group modular housing or office set up as in construction site. Cooking shall be arranged in a separate unit dedicated for cooking.

TABLE: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/ Occupancies.			
INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM	REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM	OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS (See Section D, for Fire Protection requirements Section E, Chapter 01 for smoke control requirements)

59. RAIL AND TRAM SYSTEMS	2 Hour	2 Hour	i. Planning, Construction, Structure, Strength, Materials etc. shall be as per **NFPA 130.** Standard for Fixed Guideway Transit and Passenger Rail Systems and latest edition of **Kingdom of Bahrain Fire and Life Safety Code of practice.** ii. Building construction for all new stations shall be not less than Type I– or Type II– or combinations of Type I– and Type II– permitted noncombustible construction as per the height and area calculations of latest edition of **Kingdom of Bahrain Fire and Life Safety Code of practice.** iii. Stairs and escalators regularly used by passengers shall not be required to be enclosed. iv. Ancillary buildings shall be separated from station. All power substations shall have a fire separation of at least 3 hours from all other occupancies. v. Electrical control rooms, auxiliary electrical rooms, and associated battery rooms shall have a fire separation of at least 2 hours from all other occupancies and spaces. vi. Trash rooms shall have a fire separation of at least 1 hour from all other occupancies and sprinkler protected. vii. Train control rooms and associated battery rooms shall have a fire separation of at least 2 hours from all other occupancies. Battery rooms shall be mechanically ventilated as per NFPA 1 requirements. viii. All public areas shall have a fire separation of at least 2 hours from nonpublic areas. ix. All station public areas shall have a fire separation of at least 2 hours from all no-transit occupancies, except where degree of hazard permits reduction in rating, such as suppression systems or open station configuration. x. Interior wall and ceiling finish materials, other than textile wall coverings or foam plastic insulation, shall exhibit a flame spread index not exceeding 25 and a smoke developed index not exceeding 450, when tested by NFPA 255 or by ASTM E 84 or UL 723. and shall comply with latest edition of **Kingdom of Bahrain Fire and Life Safety Code of practice.** xi. Perimeter Fire Barriers, Exterior Curtain Wall and Cladding systems shall be **General Directorate of Civil Defence – Kingdom of Bahrain Permitted System**.

TABLE: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/ Occupancies.			
INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	**REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS** **(See Section D, for Fire Protection requirements Section E, Chapter 01 for smoke control requirements)**
60. ROAD TUNNELS	0 Hour	0 Hour	i. Construction, Structure, Strength, Materials etc. shall be as per NFPA 502. Standard for Road Tunnels, Bridges and Other Limited Access Highways. ii. The emergency exits shall be enclosed in a minimum 2-hour fire-rated enclosure having a Class A interior finish
61. ROBOTIC/ MECHANICAL PARKING STRUCTURE	2 Hour	2 Hour	i. Construction, Structure, Strength, Materials etc. shall be as per **NFPA 88A**. Standard for Parking structure. ii. Those parts of parking structures located within, immediately below, attached to, or less than 3000 mm from a building used for any other purpose shall be separated by walls, partitions, floors, or floor–ceiling assemblies having fire re-resistance ratings of not less than 2 hours. iii. Offices or other similar spaces that are related to the operation of the parking structure and are less than 300 m^2 in area, other than cashier or attendant booths, shall be separated from parking areas by walls or partitions that resist the passage of smoke. iv. Perimeter Fire Barriers, Exterior Curtain Wall and Cladding systems shall be **General Directorate of Civil Defence – Kingdom of Bahrain permitted System**.
62. HELIPADS/ ROOFTOP HELIPADS			i. Where required and permitted by General Directorate of Civil Defence - Kingdom of Bahrain, Helipads and rooftop heliports and rooftop landing pads shall be constructed in accordance with NFPA 418, *Standard for Heliports*. ii. Fueling systems associated with rooftop heliports shall be constructed in accordance with NFPA 407, Standard for Aircraft Fuel Servicing. iii. For firefighting and protection requirements, refer to **Section D, Chapter 08**

TABLE: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory/ Occupancies.

INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM	REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM	OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS **(See Section D, for Fire Protection requirements, Section E, Chapter 01 for smoke control requirements)**
63. ROOFTOP STRUCTURES			i. Roof structures on buildings of Type I or Type II construction shall be not more than 8535 mm in height above the roof of the building. ii. In buildings of Type III, Type IV, or Type V construction, roof structures shall be not more than 6100 mm above the roof of the building. iii. The aggregate area of roof structures shall be not more than 33 percent of the area of the roof of the building. iv. Roof structures shall be consistent with the required type of construction of the building and shall comply with the fire resistance rating of exterior walls, based on the horizontal separation of the wall, in accordance with **Table: - A.02-T3. of this Chapter.** v. Except for the following materials all other roofing compositions shall meet the requirements of **Section 7 and Table: - A.02-T22.** a. Brick or masonry b. Clay or concrete roof tile c. Exposed concrete roof deck d. Copper or ferrous sheets or shingles e. Slate f. Minimum of 19.5 kg/m^2 of gravel or slag imbedded in a flood coat of asphalt or coal tar over built up roofing (BUR) installed at maximum slope of 13 mm/305 mm g. Ballasted sheet membrane roofing system h. Concrete paver blocks used as ballast.
64. ROOF-CEILING ABOVE ANY FLOOR			i. In occupancies other than mercantile, mall, industrial, or storage occupancies with ordinary or high hazard contents, or other occupancies with high hazard contents exceeding the maximum allowable quantities per control area as required by **Section Chapter 01**, the fire resistive protection of the roof-ceiling assembly required by **TABLE: - A.02-T6.** shall not be required where every part of the roof-ceiling assembly is 6100 mm or more above any floor immediately below.

TABLE: - A.02-T9: Fire Resistance Separation and Other Requirement of Incidental Accessory Occupancies.			
INCIDENTAL ACCESSORY ROOMS AND OCCUPANCIES	**REQUIRED SEPARATION WITH AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**REQUIRED SEPARATION WITHOUT AUTOMATIC FIXED FIRE PROTECTION SYSTEM**	**OTHER CONSTRUCTION AND PROTECTION REQUIREMENTS** **(See Section D, for Fire Protection requirements, Section E, Chapter 01 for smoke control requirements)**
65. ELECTRICAL ROOM	1 Hour	1 Hour	i. Separation and Compartmentation shall be complete with walls, floor and opening protection with permitted fire stopping system. ii. Fire door shall be 60 minutes fire rated.
66. TELEPHONE ROOM	1 Hour	1 Hour	i. Separation and Compartmentation shall be complete with walls, floor and opening protection with permitted fire stopping system. ii. Fire door shall be 60 minutes fire rated.
67. ETS ROOM	0 Hour	0 Hour	
68. GSM ROOM	0 Hour	0 Hour	

3.12. Minimum Fire Resistance Ratings for Opening Protections

3.12.1. Opening protective in Fire resistance rated assemblies in various building components shall be as per **Table: - A.02-T10.** See **Sub Section 8** for material tests requirements.

Table: - A.02-T10: Fire Resistance rating for opening protectives (Doors, Windows, Shutters etc.)

BUILDING COMPONENTS AND TYPE OF FIRE RATED ASSEMBLY	REQUIRED FIRE RATING OF THE WALL / PARTITION ASSEMBLY	MINIMUM FIRE RATING OF FIRE DOOR / FIRE SHUTTER ASSEMBLY	DOOR VISION PANEL / WIRED GLASS MAXIMUM SIZE	MINIMUM FIRE RATING OF FIRE WINDOW ASSEMBLY	MINIMUM SIDE LIGHT/ TRANSOM ASSEMBLY RATING
1. EXTERIOR WALLS					
	4 Hour	3 Hour	As per test	3 Hour	3 Hour
	3 Hour	3 Hour	As per test	3 Hour	3 Hour
	2 Hour	90 Minutes	As per test	90 Minutes	120 Minutes
	1 Hour	60 Minutes	0.065 m^2	45 Minutes	45 Minutes
2. INETERIOR WALLS					
2.1. Fire Walls and Fire Barriers	4 Hour	3 Hour	Not allowed	Not allowed	3 Hour
	3 Hour	3 Hour	Not allowed	Not allowed	3 Hour
	2 Hour	90 Minutes	Not allowed	Not allowed	120 Minutes
	1 Hour	60 Minutes	As per test	45 Minutes	45 Minutes
	30 Minutes	20 Minutes	As per test	20 Minutes	20 Minutes
2.2. Exit Corridor	2 Hour	90 Minutes	As per test	120 Minutes	120 Minutes
	1 Hour	60 Minutes	As per test	45 Minutes	45 Minutes
2.3. Elevator Hoistways	3 Hour	90 Minutes	0.1 m^2	Not allowed	120 Minutes
	2 Hour	90 Minutes	0.1 m^2	Not allowed	120 Minutes
	1 Hour	60 Minutes	0.1 m^2	60 Minutes	60 Minutes
2.4. Elevator Lobby	1 Hour	60 Minutes	0.065 m^2	60 Minutes	60 Minutes
2.5. Vertical Shafts (Stairs, Shafts, Chutes)	2 Hour When >4 floors	90 Minutes	As per test	Not allowed	120 Minutes
	1 Hour When <4 floors	60 Minutes	As per test	60 Minutes	60 Minutes
2.6. Horizontal Exit	2 Hour	90 Minutes	As per test	120 Minutes	120 Minutes
2.7. Smoke Barrier	1 Hour	20 Minutes	As per test	45 Minutes	45 Minutes
2.8. Smoke Partition	30 Minutes	20 Minutes	As per test	20 Minutes	20 Minutes

3.13. Minimum Fire resistance ratings for Exit corridors based on Occupancies

3.13.1. Fire rating of Exit Corridors, exit access corridors and internal partitions for various occupancies shall be as per **Table: - A.02-T11. a.**

Table: - A.02-T11.a: Fire Resistance rating of Exit Corridors and Exit Access Corridors

OCCUPANCY	EXIT ACCESS	EXIT ACCESS CORRIDOR WITHOUT SPRINKLER
1. ASSEMBLY	0 Hour	1 Hour
2. BUSINESS	0 Hour	1 Hour
3. EDUCATIONAL	0 Hour	1 Hour
4. HEALTHCARE GROUP A	0 Hour	1 Hour
5. HEALTHCARE GROUP B, C	0 Hour	1 Hour
6. RESIDENTIAL GROUP A, C	1 Hour	1 Hour
7. RESIDENTIAL GROUP B	1 Hour	1 Hour
8. PRIVATE VILLAS	Not Required	Not Required
9. HOTEL	1 Hour	1 Hour
10. DAY CARE	0 Hour	1 Hour
11. DETENTION CORRECTION	1 Hour	1 Hour
12. MERCANTILE	0 Hour	1 Hour
13. STORAGE GROUP A	1 Hour	1 Hour
14. STORAGE GROUP B, C	0 Hour	1 Hour
15. INDUSTRIAL GROUP A	1 Hour	1 Hour
16. INDUSTRIAL GROUP B, C	0 Hour	1 Hour

3.13.2. Compartmentation and Subdivisions within the same occupancies shall be as per **Table: - A.02-T11. b.**

Table: - A.02-T11.b: Compartmentation (Sub divisions) within the same occupancy

OCCUPANCY	COMPARTMENTATION (SUB DIVISIONS) WITH SPRINKLER	COMPARTMENTATION (SUB DIVISIONS) WITHOUT SPRINKLER
1. ASSEMBLY GROUP A, B, C.	No requirements	No requirements
2. BUSINESS GROUP A, B, C.	No requirements	No requirements
3. EDUCATIONAL GROUP A, B, C.	No requirements	i. 1 Hour fire resistance compartment shall be provided if area exceeds 2800 m^2 ii. 1 Hour fire resistance compartment shall be provided if length or width of building exceeds 91 m. iii. 1 Hour fire resistance rated compartment not required if there is direct discharge from the areas exceeding 2800 m^2 or the portion exceeding 91 m in length or width.
4. HEALTHCARE GROUP A	i.1 Hour fire resistance rated smoke barrier shall be provided for every hospital floor to achieve minimum of 2 smoke compartments, not exceeding 2100 m^2 in area. ii. 1 Hour fire resistance rated smoke barrier shall be provided for every hospital floor having occupant load of more than 50 persons to achieve minimum of 2 smoke compartments, not exceeding 2100 m^2 in area. iii. The travel distance in such smoke compartments, to reach an exit door, shall not exceed 61 m.	i. 1 Hour fire resistance rated smoke barrier shall be provided for every hospital floor to achieve minimum of 2 smoke compartments, not exceeding 2100 m^2 in area. ii. 1 Hour fire resistance rated smoke barrier shall be provided for every hospital floor having occupant load of more than 50 persons to achieve minimum of 2 smoke compartments, not exceeding 2100 m^2 in area. iii. The travel distance in such smoke compartments, to reach an exit door, shall not exceed 61 m.
5. HEALTHCARE GROUP C	i. 1 Hour fire resistance rated smoke barrier corridor shall be provided.	i. 1 Hour fire resistance rated smoke barrier corridor shall be provided. ii. 1 Hour fire resistance rated smoke barrier shall be provided for every floor exceeding 929 m^2 and/or exceeding 465 m^2 in area to achieve minimum of 2 smoke compartments.

Table: - A.02-T11.b: Compartmentation (Sub divisions) within the same occupancy		
OCCUPANCY	**COMPARTMENTATION (SUB DIVISIONS) WITH SPRINKLER**	**COMPARTMENTATION (SUB DIVISIONS) WITHOUT SPRINKLER**
6. RESIDENTIAL GROUP A, C	i. 1 Hour fire resistance rated walls and floors separation shall be provided for each Flat/Dwelling unit/ Sleeping room from other Flat/ Dwelling unit/Sleeping	i. 1 Hour fire resistance rated walls and floors separation shall be provided for each Flat/Dwelling unit/Sleeping room from other Flat/Dwelling unit/ Sleeping room.
7. RESIDENTIAL GROUP B	i. 1 Hour fire resistance rated walls and floors separation shall be provided for each Dormitory/Dwelling unit/Sleeping room from other Dormitory/Dwelling unit/Sleeping room.	i. 1 Hour fire resistance rated walls and floors separation shall be provided for each Dormitory/Dwelling unit/ Sleeping room from other Dormitory/ Dwelling unit/Sleeping room.
8. COMMERCIAL VILLAS	i. 1 Hour fire resistance rated walls from foundation to roof shall separate townhouses (Commercial villas with common wall between them).	i. 2 Hour fire resistance rated walls from foundation to roof shall separate townhouses (Commercial villas with common wall between them).
9. HOTEL GROUP A, B, C.	i. 1 Hour fire resistance rated walls and floors separation shall be - provided for each hotel guest room, including guest suites, and dormitory room from other guest rooms or dormitory rooms.	i. 1 Hour fire resistance rated walls and floors separation shall be provided for each hotel guest room, including guest suites, and dormitory room from other guest rooms or dormitory rooms.
10. DAY CARE GROUP A, B.	i. 1 Hour fire resistance rated smoke barrier shall be provided for every day care center floor located one or more floors above discharge level, to achieve minimum of 2 smoke compartments.	i. 1 Hour fire resistance rated smoke barrier shall be provided for every day care center floor located one or more floors above discharge level, to achieve minimum of 2 smoke compartments
11. DETENTION CORRECTION GROUP A, B, C.	i. 1 Hour fire resistance rated smoke barrier shall be provided for every floor to achieve minimum of 2 smoke compartments. ii. Such smoke compartment shall be limited to house occupant load of not more than 200 persons. iii. The travel distance in such smoke compartments, to reach an exit door, shall not exceed 61 m from any point.	i. 1 Hour fire resistance rated smoke barrier shall be provided for every floor to achieve minimum of 2 smoke compartments. ii. Such smoke compartment shall be limited to house occupant load of not more than 200 persons. iii. The travel distance in such smoke compartments, to reach an exit door, shall not exceed 61 m from any point.

3.13.2. Compartmentation and Subdivisions in occupancies shall be as per **Table: - A.02-T11.b,**

Table: - A.02-T11.b: Compartmentation (Sub divisions) within the same occupancy

OCCUPANCY	COMPARTMENTATION (SUB DIVISIONS) WITH SPRINKLER	COMPARTMENTATION (SUB DIVISIONS) WITHOUT SPRINKLER
12. MERCANTILE GROUP A, B, C.	No requirements	No requirements
13. MALL	i. Anchor Units/buildings or bulk merchandising Units more than 1000 m^2 shall be separated from the Mall by a fire resistance rated wall of the Mall construction type but not less than 2-hour fire resistance rated. ii. Each tenant unit including assembly, business, mercantile, in the mall shall be separated from other tenant Unit/space by fire resistance rated wall/partition of 1-hour fire resistance rating. (Such separation can be up to underside of the ceiling. if ceiling is not provided, separation shall be up to underside of roof). iii. Parking structure within 18.3 m of mall shall be of Type I or Type II	i. Anchor Units/buildings or bulk merchandising Units more than 1000 m^2 shall be separated from the Mall by a fire resistance rated wall of the Mall construction type but not less than 2-hour fire resistance rated. ii. Each tenant unit including assembly, business, mercantile, in the mall shall be separated from other tenant Unit/ space by fire resistance rated wall/ partition of 1-hour fire resistance rating. (Such separation can be up to underside of the ceiling. if ceiling is not provided, separation shall be up to underside of roof). iii. Parking structure within 18.3 m of mall shall be of Type I or Type II construction.
14. STORAGE GROUP A	i. 1 Hour fire resistance rated walls from foundation to roof shall separate multitenant warehouses as per **Table: -A02.T9-31.**	i. 2 Hour fire resistance rated walls from foundation to roof shall separate multi- tenant warehouses as per **Table: -A02.T9-31.**
15. STORAGE GROUP B, C	i. 1 Hour fire resistance rated walls from foundation to roof shall separate multitenant warehouses as per **Table: -A02.T9-31.**	i. 2 Hour fire resistance rated walls from foundation to roof shall separate multi-tenant warehouses as per **Table: -A02.T9-31.**
16. INDUSTRIAL GROUP A	i. 1 Hour fire resistance rated walls from foundation to roof shall separate multitenant warehouses as per **Table: -A02.T9-31.**	i. 2 Hour fire resistance rated walls from foundation to roof shall separate multi-tenant warehouses as per **Table: -A02.T9-31.**
17. INDUSTRIAL GROUP B, C	i. 1 Hour fire resistance rated walls from foundation to roof shall separate multitenant warehouses as per **Table: -A02.T9-31.**	i. 2 Hour fire resistance rated walls from foundation to roof shall separate multi-tenant warehouses as per **Table: -A02.T9-31.**

Table: - A.02-T11.b: Compartmentation (Sub divisions) within the same occupancy		
OCCUPANCY	**COMPARTMENTATION (SUB DIVISIONS) WITH SPRINKLER**	**COMPARTMENTATION (SUB DIVSIONS) WITHOUT SPRINKLER**
18. PARKING STRUCTURES	i. 2 Hour fire resistance rated walls from foundation to roof shall separate parking structures from other occupancies except repair shops, which shall be separated with 1 Hour fire resistance rated wall. ii. Such fire resistance rated wall shall not be required when parking structure is separated from other occupancies by 3 m. iii. Parking structures located above or below other occupancy, shall have construction type as of other occupancy but not less than Type I or Type II.	i. 2 Hour fire resistance rated walls from foundation to roof shall separate parking structures from other occupancies except repair shops, which shall be separated with 1 Hour fire resistance rated wall. ii. Such fire resistance rated wall shall not be required when parking structure is separated from other occupancies by 3 m. iii. Parking structures located above or below other occupancy, shall have construction type as of other occupancy but not less than Type I or Type II.

3.14. Interior wall or ceiling finish

3.14.1. The tests required for the classifications mentioned in the **Table: - A.02-T12.** shall be as per **Sub Section 8** of this chapter.

3.14.2. Interior finish of internal walls and partitions for various occupancies shall be as pe **Table: - A.02-T12**.

3.14.3. External Fire-retardant coatings to achieve the ratings of **Table: - A.02-T12.** Are not acceptable unless it is existing building. Materials have to achieve the **Table: - A.02-T12.** ratings through tests mentioned in **Sub Section 8.**

3.14.4. Where an permitted automatic sprinkler system is provided, Class C/Class III interior wall and ceiling finish materials shall be permitted in any location where Class B/ Class II is required, and Class B/ Class II interior wall and ceiling finish materials shall be permitted in any location where Class A/ Class I is required.

Table: - A.02-T12: Interior finish of internal walls and

OCCUPANCY	EXITS	CORRIDORS	OTHER SPACES	Roofs	Floors
1. **ASSEMBLY EDUCATION HEALTHCARE RESIDENTIAL HOTEL DAY CARE**	Class A Class 1 Class 2 Class I	Class A Class B Class 1 Class 2 Class I Class II	Class A Class B Class 1 Class 2 Class I Class II	Class A Class B Class 1 Class 2 Class I Class II	Class I Class II
2. **BUSINESS DETENTION MERCANTILE**	Class A Class B Class 1 Class 2 Class I Class II	Class A Class B Class 1 Class 2 Class I Class II	Class A Class B Class C Class 1 Class 2 Class I Class II Class III	Class A Class B Class 1 Class 2 Class I Class II	Class I Class II
3. **PRIVATE VILLA COMMERCIAL VILLA**	Class A Class B Class C Class 1 Class 2 Class I Class II Class III	Class A Class B Class C Class 1 Class 2 Class I Class II Class III	Class A Class B Class C Class 1 Class 2 Class I Class II Class III	Class A Class B Class C Class 1 Class 2 Class I Class II Class III	Class I Class II
4. **INDUSTRIAL STORAGE**	Class A Class B Class 1 Class 2 Class I Class II	Class A Class B Class C Class 1 Class 2 Class I Class II Class III	Class A Class B Class C Class 1 Class 2 Class I Class II Class III	Class A Class B Class C Class 1 Class 2 Class I Class II Class III	Class I Class II

3.15. Ducts and Air-Transfer Openings

3.15.1. Fire Damper Requirements

3.15.1.1. Fire dampers shall be installed to protect ducts and air-transfer openings that penetrate fire barriers and fire walls.

3.15.1.2. Fire dampers shall be designed and tested in accordance with **Sub Section 8**, and shall have the minimum fire protection rating specified in **Table: - A.02-T11** for the rating of the assembly penetrated.

Table: - A.02-T13: Fire Damper	
FIRE RESISTANCE RATING OF THE ASSEMBLY	**MINIMUM FIRE DAMPER RATING**
3 Hour or greater fire resistance rated assembly	3 Hour
Less than 3 Hour fire resistance rated assembly	90 Minutes
Ceiling or floor-ceiling or roof-ceiling assemblies	Same rating as of assemblies

3.15.1.3. Fire dampers shall be required in the following locations:

a. Ducts and air-transfer openings penetrating walls or partitions having a fire resistance rating of 2 or more hours.

b. Ducts and air-transfer openings penetrating shaft walls having a fire resistance rating of 1 or more hours.

c. Ducts and air-transfer openings penetrating floors that are required to have protected openings where the duct is not protected by a shaft enclosure.

d. Air-transfer openings that occur in walls or partitions that are required to have a fire-resistive rating of 30 minutes or more.

3.15.1.4. Please refer to **Section E, Chapter 01. Table E.01-T1.8.** for further details.

3.15.1.5. Fire dampers shall not be required in the following locations:

a. In floors that do not require protected floor openings.

b. In a duct system serving only one floor and used only for exhaust of air to the outside and not penetrating a wall or partition having a required fire resistance rating of 2 hours or more or passing entirely through the system and contained within its own dedicated shaft. See **Figure: - A.02-F14**.

c. Where branch ducts connect to enclosed exhaust risers in which the airflow is upward, and steel sub ducts at least 560 mm in length are carried up inside the riser at each inlet.

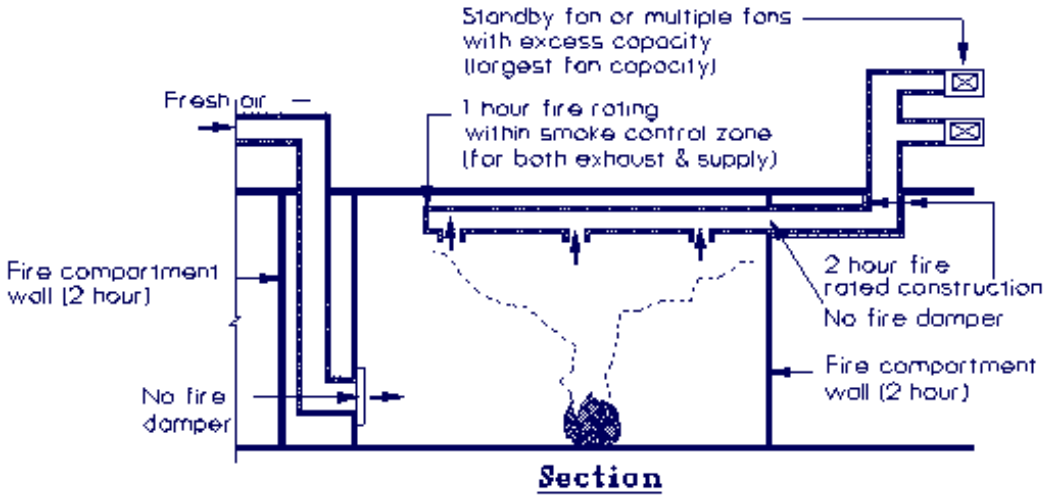


Figure: - A.02-F14.: Penetrations of ventilation ducts for exhaust and supply air

3.15.2. Installation

3.15.2.1. Air-conditioning, heating, and ventilating ductwork and related equipment, Including fire dampers, smoke dampers, combination fire and smoke dampers, and ceiling radiation dampers, shall be installed in accordance with **Section E, Chapter 01 of this Code, NFPA 90A or NFPA 90 B**, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

3.15.3. Access and Identification

3.15.3.1. Fire and smoke dampers shall be provided with an permitted means of access, as follows:

a. The means of access shall be large enough to allow inspection and maintenance of the damper and its operating parts.
b. The access shall not affect the integrity of fire resistance–rated assemblies.
c. The access openings shall not reduce the fire resistance rating of the assembly.
d. Access points shall be permanently identified.
e. Access doors in ducts shall be identified with a label having letters not less than13 mm in height.
f. The label shall read as follows in:
  i. FIRE/SMOKE DAMPER
  ii. SMOKE DAMPER
  iii. FIRE DAMPER
g. Access doors in ducts shall be tight-fitting and suitable for the required duct construction.

3.15.4. Fire Damper Actuation Device.

3.15.4.1. The operating temperature of the heat-actuating device shall be ap- proximately 27.8°C above the normal temperature within the duct system, but not less than

71°C; or it shall be not more than 141°C where located in a required smoke control system; or, where a combination fire and smoke damper is installed, it shall not exceed 177°C where located in a smoke control system.

3.16. Smoke barriers

3.16.1. Smoke barriers required by this Code shall be continuous from an outside wall to an outside wall, from a floor to a floor, or from a smoke barrier to a smoke barrier, or combination thereof.

3.16.2. Smoke barriers required by this Code shall be continuous through all concealed spaces, such as those found above a ceiling, including interstitial spaces.

3.16.3. A smoke barrier required for an occupied space below an interstitial space shall not be required to extend through the interstitial space, provided that the construction assembly forming the bottom of the interstitial space provides resistance to the passage of smoke equal to that provided by the smoke barrier.

3.16.4. Where a smoke barrier is penetrated by a duct or air-transfer opening, a smoke damper designed and tested in accordance with the requirements of **Sub Section 8** shall be installed.

3.16.5. Smoke barrier Penetrations

3.16.5.1. Penetrations for cables, cable trays, conduits, pipes, tubes, vents, wires, and similar items to accommodate electrical, mechanical, plumbing, and communications systems that pass through a wall, floor, or floor-ceiling assembly constructed as a smoke barrier, or through the ceiling membrane of a roof-ceiling of a smoke barrier, shall be protected by a listed system or a material . capable of restricting the transfer of smoke.

3.16.5.2. Where a smoke barrier is also constructed as a fire barrier, the penetrations shall be protected to limit the spread of fire for a time period equal to the fire resistance rating of the assembly, to restrict the transfer of smoke.

3.16.5.3. Where sprinklers penetrate a single membrane of a fire resistance- rated assembly in buildings equipped throughout with an permitted automatic fire sprinkler system, non-combustible escutcheon plates shall be permitted provided that the space around each sprinkler penetration does not exceed ½ in (13 mm), measured between the edge of the membrane and the sprinkler.

3.16.5.4. Where the penetration item uses a sleeve to penetrate the smoke barrier, the sleeve shall be securely set in the smoke barrier, and the space between the item and the sleeve shall be filled with a listed system or a material capable of restricting the transfer of smoke.

3.16.5.5. Where designs take transmission of vibrations into consideration, any vibration isolation shall meet one of the following conditions:

a. It shall be made on either side of the fire barrier.

b. It shall be designed for the specific purpose.

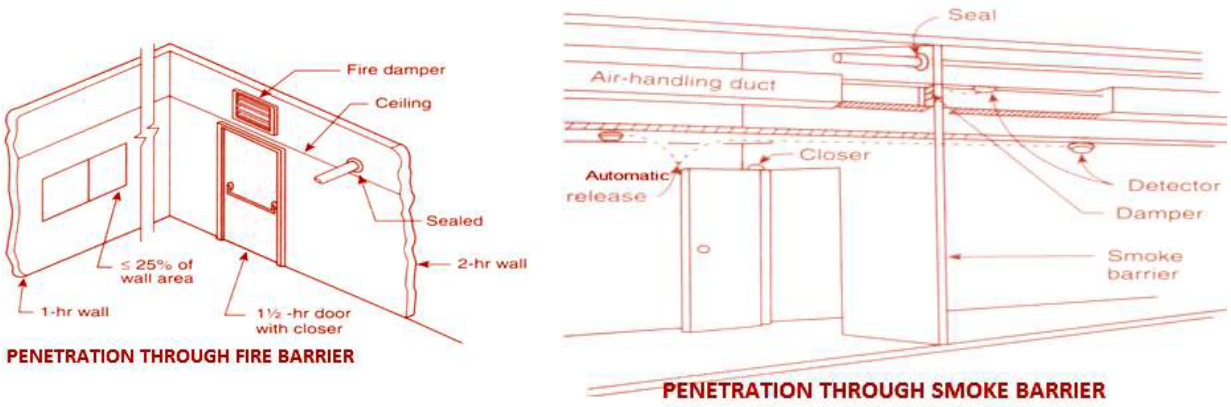


Figure: - A.02-F15.: Penetrations of Barriers

3.16.6. Smoke Dampers

3.16.6.1. Smoke damper leakage ratings shall be not less than Class II as per UL 555S or 200 $m^3/(h.m^2)$ as per EN 1366-10. **See Sub Section 8.** for test requirements.

3.16.6.2. Elevated temperature ratings shall be not less than 250°F (140°C).

3.16.6.3. Smoke dampers shall not be required in the following.

a. Where ducts or air-transfer openings are part of an engineered smoke control system and the smoke damper will interfere with the operation of a smoke control system.

b. Where the air in ducts continues to move and the air-handling system installed is arranged to prevent recirculation of exhaust or return air under fire emergency conditions.

c. Where the air inlet or outlet openings in ducts are limited to a single smoke compartment

d. Where ducts penetrate floors that serve as smoke barriers.

e. Where ducts penetrate smoke barriers forming a communicating space separation in fully sprinklered building.

3.16.7. Smoke Damper Actuation

3.16.7.1. Required smoke dampers in ducts penetrating smoke barriers shall close upon detection of smoke by means of permitted smoke detectors, unless ducts penetrate smoke barriers above the smoke barrier doors and the door release detector actuates the damper.

3.16.7.2. Required smoke dampers in air-transfer openings shall close upon detection of smoke by means of permitted smoke detectors.

3.17. Balcony, Windows, Terrace and Balustrades

3.17.1. Awareness

3.17.1.1. Codes and regulations cannot prevent falls and accidents involving balconies, windows, railings and terraces. Therefore, awareness of dangers caused by human negligence (Parents and Guardians) is of high importance, especially in these times of high-rise living and working spaces.

3.17.1.2. NEVER LEAVE children, special needs people, mentally challenged, mentally unstable and elderly people **UNATTENDED and UNSUPERVISED** at the balconies, near windows, railings and terraces.

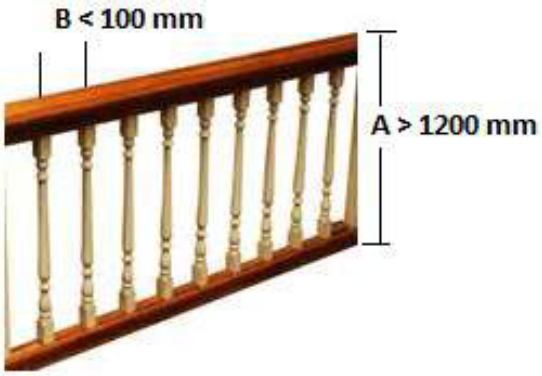
3.17.1.3. NEVER KEEP furniture, bedding, articles or climbable objects near windows balconies, railings and terraces, which can be translated into **'LADDER'** by innocent and unwary children.

3.17.1.4. ALWAYS LOCK access to terraces, balconies, railings and window panes when children, special needs people, mentally challenged, mentally unstable and elderly people are left unattended.

3.17.1.5. ALCOHOL, DRUGS AND INTOXICATION can cause accidents. As an Adult, behave safely and responsibly near balconies, windows, terraces and railings.

3.17.2. Minimum Construction Requirements for Balconies and Railings

3.17.2.1. Guards are required for any space, walking or standing which is elevated 760mm above the finished grade level.



3.17.2.2. From the finished floor level, Height of the balcony, terrace railings, elevated space railings **(A),** shall not be less than 1200 mm.

3.17.2.3. Balusters openings, the separation distance between vertical posts or members (**B),** of balcony, guardrail or handrail shall not allow the passage of a 100 mm diameter sphere.

Figure:- A.02-F16.a: Balcony Railing Specifications

3.17.2.4. Any opening **(B)** formed by either vertical posts, curved frames or design features in the balcony or railings shall not be more than 100 mm. See **Figure: - A.02-F16 a** and **Figure: - A.02-F16 b.**

3.17.2.5. Horizontal elements, bars, climbable features shall not be installed up to 760 mm. i.e., up to **(D)**. Where horizontal or climbable elements are present in this zone, the 1200 mm height requirement shall start at the highest of those climbable elements.

3.17.2.6. If the design demands any gap between finished floor surface and the bottom most horizontal component of the railing **(E),** such gap shall not be more than 100mm. See **Figure: - A.02-F16 b.**



Figure:- A.02-F16.b: Balcony Railing Specifications

3.17.2.7. The balcony, Handrail, Guard assembly shall be able to withstand a single concentrated load of 200 pounds (0.89 kN), applied in any direction at any point.

3.17.2.8. If the design demands usage of glass panels in the balcony construction, such glass shall be laminated glass which holds in place if shattered and withstand a load of 200 pounds (0.89kN), applied in any direction at any point. See **Sub Section 5, Glazing, Safety Glass.**

3.17.2.9. Balconies and terraces shall not have accesses with self-closing or self-latching doors, which can accidentally lock people outside in the balcony or terrace, compelling them to misadventures such as climbing, descending or crossing over to other balconies.

3.17.2.10. Also see **Chapter 3, Table A.03-T4.11,** Guards.

3.17.3. Minimum Construction Requirements for Windows

3.17.3.1. Openable Windows shall open outward from the top**. See Figure: - A.02-F17b.** Openable windows shall not open from below.

3.17.3.2. Sliding and openable Windows shall not be located at **(F)**, a height less than 1000 mm from the finished floor surface level. If window base is present on the finished floor, the height **(F)** shall be measured from the top of such Window base**. See Figure: - A.02-F17 a.**

3.17.3.3. The window pane, if openable, shall not create a gap of more than **(G),** 100 mm from the wall, when opened. **See Figure: - A.02-F17 b.**

3.17.3.4. The window assembly, shall have reinforced or safety glass and shall be able to withstand a single concentrated load of 200 pounds (0.89 kN), applied in any direction at any point.

3.17.3.5. There should not be any construction features at the bottom of the window which can be exploited into 'ladder or climbing feature'.



Figure: - A.02-F17a: Window Specifications



Figure:- A.02-F17b: Window Specifications







3.17.3.6. See **Sub Section 3.17.1.3.** Provide locks and safety measures for sliding windows**.** See **Figure: - A.02-F17c.**

Figure: - A.02-F17c: Window Safety

3.17.4. Balustrades

3.17.4.1. A railing or fencing supported by balusters, especially one forming an ornamental parapet or barrier to a balcony, bridge or terrace. However, in the context of safety intent of this section, the terms “Balustrade”, “Guard”, “Barrier” and “Railing” shall all have the same meaning and intent, that being to prevent persons accidentally interacting with the hazard on the other side of the barrier or slipping through to a falling hazard.

3.17.4.2. Where balcony finishes are flush with the edge of the balcony, an upstand feature of a minimum 20 mm height following the same line as the balustrade shall be provided to prevent items on the balcony rolling off the edge.

3.17.5. Railing, Balustrade and Fence Toppings

3.17.5.1. Fence or Railing or Balustrade toppings shall be designed and constructed such that they do not constitute a potential danger of injury to persons. This includes but not limited to spikes, sharp or barbed wire or other jagged or similarly protruding features.

3.17.6. Glass used in Railings and Guards

3.17.6.1. Glass used as structural balustrade panels in railings shall be constructed of one of the following.

a. Laminated fully tempered glass with a structural interlayer where structural capacity is calculated at 50 Deg Celsius.

b. Laminated heat-strengthened glass

3.17.6.2. Glazing in railing in-fill panels shall meet the requirements of **Sub Section 6.4.2.**

3.17.6.3. Structural balustrade panels shall meet the following requirements.

a. The panels and their support system shall be designed to withstand the loads specified in ASCE (American Society of Civil Engineers).

b. A human impact load safety factor of 4 shall be used.

3.17.6.4. Each handrail or guard section shall be supported by a minimum of three glass balusters, or shall be otherwise supported to remain in place if one baluster panel fails, and one of the following criteria shall be met.

a. An attached handrail or guard shall be provided.

b. The glass balusters shall be laminated glass with two or more glass plies of equal thickness and the same glass type, and each of the piles of the panels shall be designed to withstand the loads specified in ASCE (American Society of Civil Engineers) and any other structural requirements for a top rail.

3.17.6.5. Glazing materials shall not be installed in railings in parking garages, except for pedestrian areas not exposed to impact from vehicles.

3.17.7. Maintenance of Railings and Guards

3.17.7.1. Both Facility management and the occupants are responsible for SAFETY of railings and guards.

3.17.7.2. Balcony, Terrace and elevated spaces railings and guards shall be inspected regularly for damages and warning signs of wear and tear. See **Section G, Chapter 01. Responsibilities of Stakeholder, Sub Section 3.13. Facility Management Responsibilities**.

3.17.7.3. Some of the warning signs could be corrosion, cracks, bending, loose and shaking members of the railings and guards, including nuts, bolts and fasteners.

3.17.7.4. Any unsafe balcony, terrace or elevated spaces' railings and guards shall be replaced immediately.

4.0 Firestop Systems

4.1. Intention

4.1.1. The provision of this section shall specify the minimum requirements for the classification, design, installation, inspection, and maintenance of firestop systems to achieve required fire-resistance-rated construction and compartmentation.

4.1.2. To ensure Firestop systems consist of a material, or combination of material installed to retain the integrity of fire resistance rated construction by maintaining an effective barrier against the spread of flame, smoke and/or hot gases through openings (gaps) that accommodate penetrations, fire resistive joints and perimeter openings.

4.1.3. To ensure Firestop systems are used in locations including, but not limited to, the

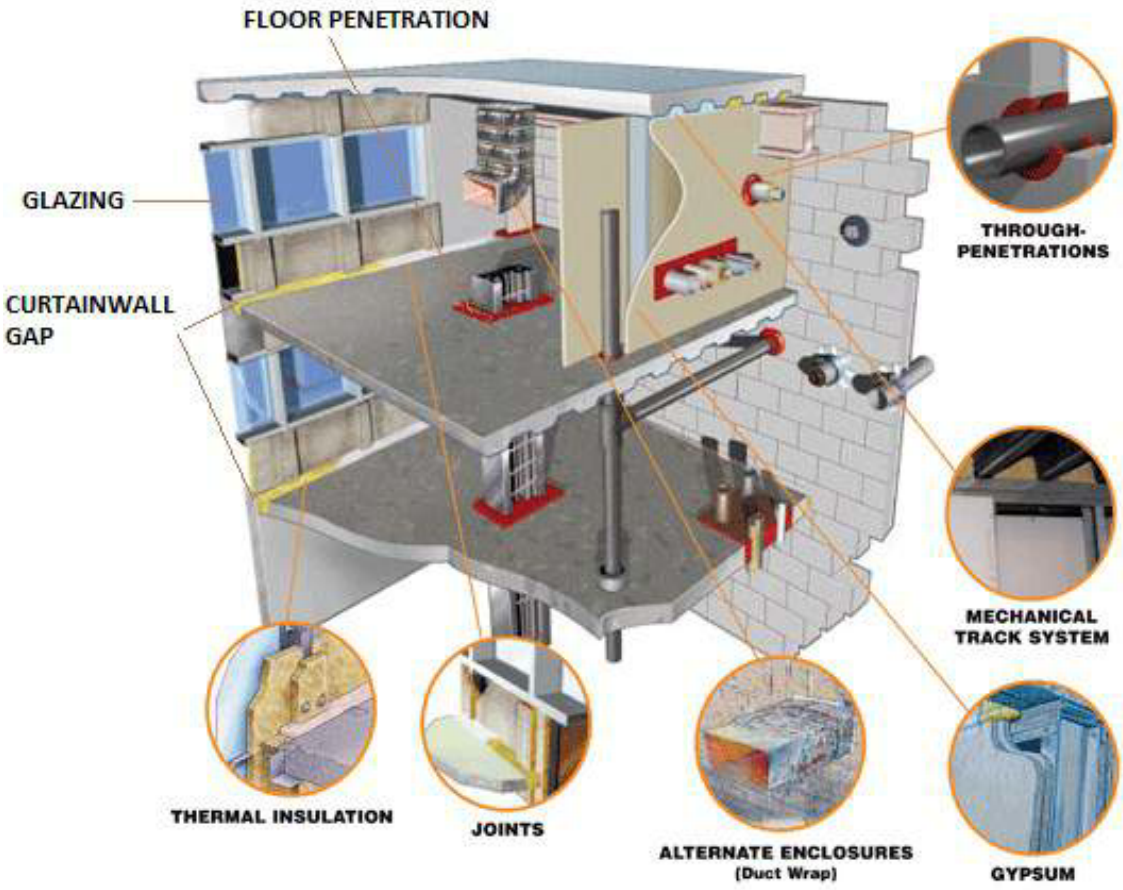


Figure: - A.02-F18.a: Firestopping Systems at various locations

a. Penetrations through fire resistance rated floor including both empty openings and openings containing penetrants.

b. Penetrations through fire resistance rated wall assemblies including both empty openings and openings containing penetrants.

c. Membrane penetrations in fire resistance rated wall assemblies where items penetrate one side of the barrier.

d. Joints between fire resistance rated assemblies.

e. Perimeter gaps between rated floors and an exterior wall assembly.

4.2. Classification of Firestop Systems

4.2.1. Through penetration Firestop system

a. This category addresses openings in fire rated assemblies where penetrants are passing through a fire-rated construction and where the integrity of the wall and/or floor needs to be maintained.

b. The penetrants include, but are not limited to, mechanical, electrical, piping, structural and communication devices.

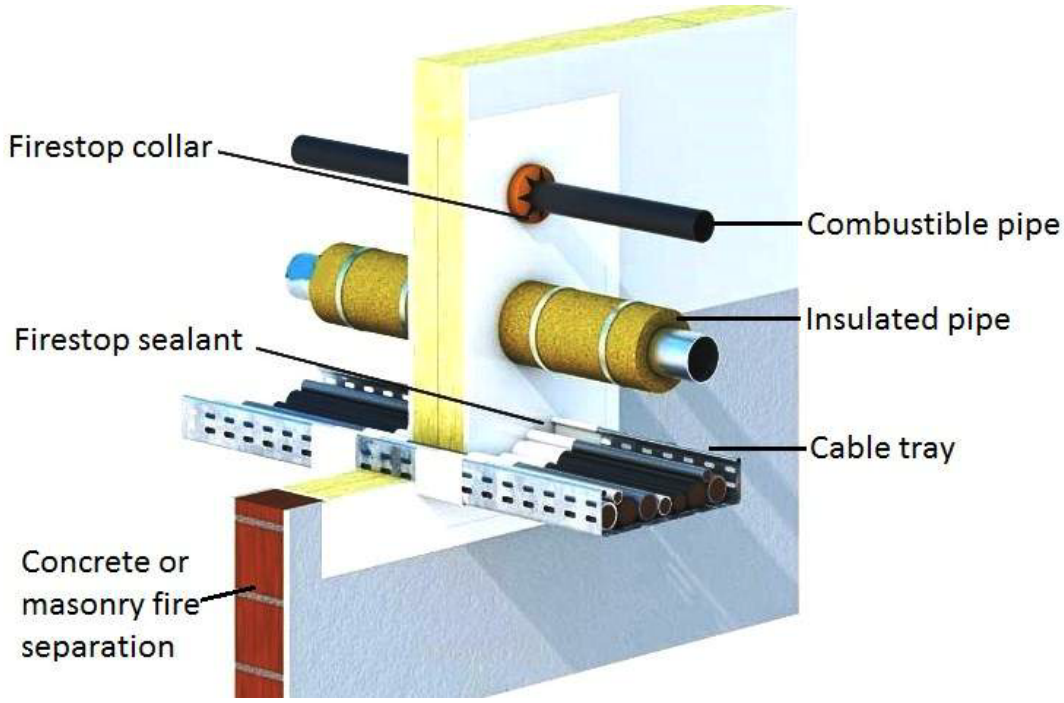


Figure:- A.02-F18.b: Through penetration Firestop System

4.2.2. Membrane-penetration

a. This category addresses openings in fire rated assemblies where only one side of the fire rated barrier is penetrated and where the integrity of the wall or floor needs to be maintained. This would include items such as, but not be limited to, electrical outlet boxes and other electrical devices.

b. Membrane penetrations shall be permitted to be created on both sides of the wall (or floor) as long as they are protected with a membrane penetration firestop system or wall opening protective.

4.2.3. Fire resistive joint systems

a. This category addresses any gap, joint, or opening (whether static or dynamic) between two fire-rated barriers including where the top of a wall meets a floor, wall edge to wall edge configurations, floor edge to floor edge configurations, floor edge to wall configurations.

b. The maximum movement that a fire resistive joint system is able to accommodate, as shown in the design listing, shall be equal to or greater than the movement that is expected or specified for a given joint in construction or design documents. All joints shall be assumed to be dynamic unless specified otherwise in construction documents.

4.2.4. Perimeter fire barrier system

a. This category addresses any gap, joint, or opening, whether static or dynamic, between a fire-rated floor assembly and a non-rated exterior wall assembly.

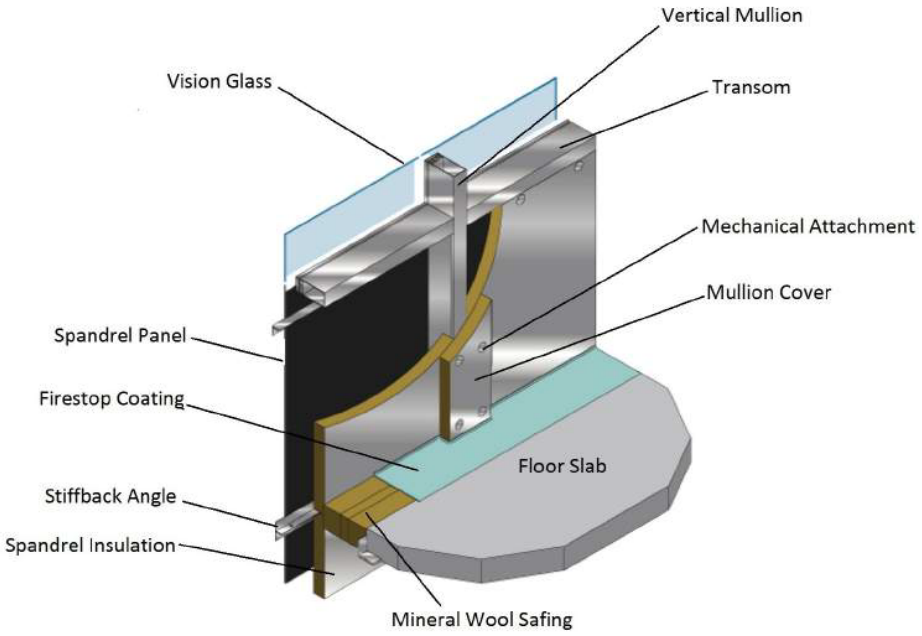


Figure:- A.02-F18.c: Perimeter Fire Barrier System

b. The perimeter barrier shall be intended to restrict the interior vertical passage of flame and hot gases from one floor to another at the location where the floor intersects the inside of an exterior curtain wall. The perimeter fire barrier shall remain securely in place and provide interior joint protection for the time period no less than the fire- resistance rating of the floor assembly.

c. Where air gaps and ventilation are intended behind the façade such as in rain screens or such designs, the vertical open gap between exterior façade and building envelope shall have an permitted cavity barrier using intumescent fire stopping arrangements at every floor joint.

d. Except for Open parking OR buildings which are less than 15 m in height, openings in exterior walls in adjacent storeys shall be separated vertically to protect against fire spread on the exterior of the buildings where the openings are within 1524 mm radius of each other horizontally and the opening in the lower storey is not a protected opening with a fire protection rating of not less than 3/4 hour. Such openings shall be separated vertically at least 915 mm by spandrel girders, exterior walls or other similar assemblies that have a fire-resistance rating of at least 1 hour or by flame barriers that extend horizontally at least 760 mm beyond the exterior wall. Flame barriers shall also have a fire-resistance rating of at least 1 hour. Where separation spandrel is less than 915 mm, the perimeter barrier system shall be tested, certified and listed with intended spandrel specifications, complete with installation guidelines.

e. Vertical separation between spaces leased to different tenants and between public and nonpublic spaces shall be protected to achieve a fire-resistance rating equal to that of the vertical wall assembly.

f. The components of the curtain wall and fire stopping shall be such that if sections of the curtain wall are damaged or collapse, the integrity of firestop and its ability to provide the required fire resistance is not compromised.

g. All perimeter barrier systems shall be listed and permitted system assemblies.

4.3. Firestop systems testing and acceptance

4.3.1. For all types of firestop systems, only tested and General Directorate of Civil Defence – Kingdom of Bahrain listed systems shall be used as per tests required by **Sub Section 8.**

4.3.2. Through penetration firestop system ratings shall be established in accordance with ASTM E814, UL 1479, EN 1366-3, FM 4990 or other equivalent tests as the test method, permitted by General Directorate of Civil Defence – Kingdom of Bahrain.
See **Sub section 8.1.12.**

4.3.3. Membrane firestop system ratings shall be established in accordance with ASTM E119, E 814, UL 263, UL 1479, BS EN 1366-3, BS EN 1366-4, FM 4990 or other equivalent tests as the test method, permitted by General Directorate of Civil Defence – Kingdom of Bahrain.
See **Sub section 8.1.14.**

4.3.4. Fire resistive joint system ratings shall be established in accordance with ASTM E 1966, UL 2079, FM 4990, BS EN 1366-4 or other equivalent tests as the test method.
See **Sub section 8.1.13.**

4.3.5. Perimeter fire barrier system ratings shall be established in accordance with ASTM E 2307, BS EN 1364-3 (Full configuration test) or BS EN 1364-4 (Part configuration test) or other equivalent tests using the Intermediate-Scale, Multi Story Test Apparatus (ISMA) as the test method. See **Sub section 8.1.17.**

4.3.6. System rating: The rating of installed firestop systems shall be equivalent to the rating of the barrier (floor/wall) in which the Firestopping is installed.

4.3.7. Single source limitation: Firestop systems for each kind of classified assembly shall be obtained from a single manufacturer. Materials from different manufacturers shall not be installed in the same firestop system or opening.

4.4. Design, Installation, Inspection and Maintenance

4.4.1. Design, planning and preparation

a. Design, material selection, scheduling, permitted contractor selection etc. shall be Consultant's responsibility. It is consultant's responsibility to recruit Fire- stopping specialists qualified as per **Sub Section 3.6.8.,** either in-house or hire General Directorate of Civil Defence – Kingdom of Bahrain permitted House of expertise having Firestopping Specialists to design, supervise contractors and perform progressive inspections.

4.4.2. Product systems and Submittal

a. All the products, as part of the system, shall bear design listing and permitted label to conform to the construction type, penetrant type, annular space, joint gap and fire rating requirements of each separate assembly.

b. Product manufacturer/supplier shall provide a formal submittal consisting of system design listing or test certifications, including illustrations, from an accredited testing laboratory as per referenced standards that is applicable to each system configuration.

c. Engineering Judgment (EJ) – Where there is no specific tested and listed fire- stop system available for a particular configuration, the manufacturer shall provide a site specific EJ, along with Consultant and Firestop system contractor's stamp and acceptance.

d. Method Statement shall clearly define the manufacturer's installation instructions.

e. Statement of manufacturer's or installer's standard warranty for minimum of 10 years.

f. Manufacturers shall submit an undertaking letter in understanding with General Directorate of Civil Defence – Kingdom of Bahrain that supplying any material that is non-complaint to this code is illegal and punishable.

g. It is main consultant's responsibility to verify all the above.

4.4.3. Delivery, Storage and Handling

a. The products shall be delivered to project site in original, unopened containers or packages with intact and legible manufacturer's labels identifying product name, product manufacturer, manufacturing and expiry dates, lot number, design listing and classification marking.

b. Products shall be stored and handled as per manufacturer's instructions to prevent deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

c. All materials shall be installed prior to expiration of shelf life.

d. It is main consultant's responsibility to verify all the above.

4.4.4. Site examination and preparation

a. General conditions of substrates, opening configurations, penetrating items, joint gaps, and other conditions affecting performance shall be thoroughly examined.

b. The installer shall verify that all pipes, conduits, cables, and/or other items which penetrate fire-rated construction have been permanently installed before starting firestop installation.

c. Installation of systems shall commence only after unsatisfactory conditions have been corrected.

d. It is main consultant's responsibility to verify all the above.

4.4.5. Project conditions (environmental limitations)

a. Systems shall be installed when ambient or substrate temperatures are within limits as per manufacturer's written instructions.

b. Do not install Firestopping when substrates are uncured, wet due to rain, frost condensation, or other causes. Installer shall ensure that firestop materials installed so as not to contaminate adjacent surfaces.

c. It is main consultant's responsibility to verify all the above.

4.5. Installation, Identification & Labeling

4.5.1. Installation

a. Installer shall strictly follow certified listed system including illustrations, installation drawing therein and manufacturer's installation instructions.

4.5.2. Identification & Labeling

a. Identify installed firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of firestop system where labels will be visible to anyone seeking to remove penetrating items or firestop systems.

b. The labels shall include the following information:

i. The words "**Warning – Through-Penetration Firestop System – Do Not Disturb. Notify Building Management of Any Damage**".

ii. Firestop product name with system listing number.

iii. Name and address of Manufacturer, Installer and Consultant/House of Expertise.

iv. Installation date.

c. Labels and markings may be omitted if they would be visible in a finished area. Such labels and tags shall be available with facility management with the written authorization of the General Directorate of Civil Defence – Kingdom of Bahrain.

4.5.3. Installer qualification

a. Installing contractors shall have the General Directorate of Civil Defence - Kingdom of Bahrain listing and permit based on any of the following certifications.

i. FM certification on Class 4991 permit for firestop contractors.

ii. UL certification for qualified firestop contractor.

iii. IFC (International Firestop Council) Firestop expert exam certificate.

b. The installer shall be tested with written examination and licensed by General Directorate of Civil Defence – Kingdom of Bahrain. The General Directorate of Civil Defence – Kingdom of Bahrain license is based on qualification as per **Sub Section 4.5.3.a.** and the training and certification by the firestop manufacturer to install manufacturer's products as per specified listed system requirements.

4.6. Inspection Acceptance and Field Quality Control

4.6.1. Inspection of through penetration firestop systems shall be in accordance with ASTM E 2174, Standard Practice for On-Site Inspection of Installed Fire Stops.

4.6.2. Inspection of fire resistive joints and perimeter barriers shall be in accordance with ASTM 2393, Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.

4.6.3. Inspection shall take place in successive stages as installation proceeds.

4.6.4. Installed firestop systems shall not be concealed from view until the Firestopping specialist has inspected and permitted each installation.

4.6.5. Do not proceed with installation for the next area until Firestopping specialists have determined that completed work shows compliance with requirements.

4.6.6. Work shall not be certified as completed unless permitted by the consultant's Firestopping Specialist or General Directorate of Civil Defence – Kingdom of Bahrain permitted house of Expertise or similar.

4.6.7 The main consultant, the firestop system manufacturer, firestop system installer, firestop Specialist and the house of expertise shall jointly sign off the installation and provide final inspection report for General Directorate of Civil Defence – Kingdom of Bahrain' acceptance as evidence of compliance.

Civil Defence permitted house of expertise, undertaking Fire stopping design, consultancy or inspection shall be certified and licensed by General Directorate of Civil Defence, based on their qualifications as required by **Sub Section 4.6.8.a.** and written examination.

4.7. Maintenance & Management

4.7.1. Provide protection and maintain conditions during & after installation that ensure installed firestop systems are without damage or deterioration at the time of Substantial Completion. If, despite such protection, damage or deterioration occurs, damaged/deteriorated systems shall be removed and replaced with new ones.

4.7.2. The condition of installed firestop systems shall be visually inspected by the owner or owner's representative annually. Damaged, altered or breached firestop systems shall be properly repaired, restored or replaced to comply with applicable codes as per the guidelines of General Directorate of Civil Defence – Kingdom of Bahrain.

4.7.3. Any new openings made therein for passage of through penetrants shall be protected with permitted firestop system to comply with applicable codes as per the guidelines of General Directorate of Civil Defence – Kingdom of Bahrain.

5.0 Façade and Exterior Wall Covering Systems

5.1. Applicability

5.1.1. The provision of this section specifies the minimum requirements for the classification combustibility, surface burning and flame spread ratings, design, installation, inspection, and maintenance of exterior façade wall cladding, balcony coverings and components such as, Metal Composite Panels, Aluminum Composite Panels, Polycarbonate Panels, EIFS, ETICS, GRC, GRFC, GRP, Glazing, insulation, sealants etc.

5.1.2. The weather protection of buildings is not the scope or intention of this section. Thermal and Weather protection aspect of the building façade, such as protection from temperature, wind, water, pressure etc., shall comply with General Directorate of Civil Defence – Kingdom of Bahrain regulations, assembly tests and requirements.

5.1.3. The intention of this section is to ensure that flame spread on exterior façade is restricted.

5.1.4. This section applies only to non-load bearing exterior walls.

5.1.5. Where exterior walls are required to be loadbearing, such walls shall comply with relevant sections of this **Chapter.**

5.2. Material Tests

5.2.1. Except for natural stones and concrete, only materials, tested, listed with

General Directorate of Civil Defence – Kingdom of Bahrain and complying to the following sections shall be allowed on exterior facades, based on the building height and occupancy types.

a. Metal Composite Materials (MCM, ACP) complying to **Sub Section 5.6.**

b. Exterior Insulation and Finish Systems (EIFS) and External Insulation Composite System (ETICS) complying to **Sub Section 5.7.**

c. Polycarbonate External Wall and Façade System (PEWFS) complying to **Sub Section 5.8.**

d. Sandwich Panels complying to **Sub Section 5.9.**

e. GRC /GRFC and GRP Systems to **Sub Section 5.10.**

f. Glazing Systems complying to **Sub Section 6.**

5.2.2. Where "Assembly Tests" are mandated by **Sub Section 5.2.1.,** the tests shall be conducted for the entire system assembly, that is intended for use on building façade, including **wall** panels, cavities, insulation, panel rails, joints, sealants, seams, fasteners, barriers and other construction details. Laboratories testing assembly tests shall ensure that the test specimen is duplicated as per intended final installation specifications, including dimensions, cavities, joints and sealants. Laboratories shall ensure that façade assembly tests are not 'over engineered' purely to pass test criteria.

5.2.3. The tests shall clearly indicate "Pass" or "Fail" criteria and such results shall be clearly noted on the Test Certificates (and CoC, Certificate of Compliance), in evaluation of the following minimum requirements.

a. The wall assembly shall resist flame propagation over the face of the exterior wall.

b. The wall assembly shall resist flame propagation over the face of the interior of the wall assembly and cavity.

c. The wall assembly shall resist flame propagation from one story to the next.

d. The wall assembly shall resist flame propagation from compartment of fire origin to the adjacent compartment.

5.3. Flame Spread on Exterior Façade

5.3.1. Building fires that envelope the façade may be initiated externally from outside the building sources such as BBQ activity in the balconies, trash can fire, fireworks displays, careless disposals of cigarette butts, electrical fires from cables running in façade cavities or arson. Fires can originate internally from internal room fire loads of the building and spread to exterior façade through openings on the exterior walls such as doors, windows, shattered glazing because of flashover.

5.3.2. Interior fires are intervened and controlled by automatic sprinkler system or by fire fighters. However, when the fire outgrows fire fighter's efforts or the sprinkler system and reaches flash over stage, it leaps out from the openings onto the exterior façade or cavities behind the façade of the building causing "leap frog" effect.

5.3.3. At this stage, if the façade material delaminates, exposing the core, if the core of the facade material is combustible, if the cladding system components such as sealants, linings, insulation are combustible, the flames start consuming the combustible material on the façade, spreading along the surface of the façade and along the cavities behind the façade.

5.3.4. If the floor slab fire stopping is absent or fire stop material is not permitted and not installed as per standards, if the curtainwall is not listed, the flames penetrate through the gaps and reach for the upper floors. Flames can even propagate down- wards if the material on façade is flammable.

5.3.5. Such propagated flames find the other openings of the building from exterior and enter back into the buildings, feeding on the interior fire loads. This "Reverse leap frog" effect continues along the building from floor to floor, to height and width, consuming the building façade swiftly.

5.3.6. Cavity can be part of the façade system by design or cavity can be created by combustible materials on façade system or poor integrity of the façade panels or poor performance of perimeter joint systems and fire stopping systems or combinations of these factors. As flame propagates and enters this cavity behind façade system, it can elongate ten times its length in its search for oxygen in the confined space of such cavity, thus burning behind the façade system unnoticed from outside for many floors above the fire origin.

5.3.7. As the intense heat develops behind the façade and flames continue to grow, façade panels delaminate, exposing more core material to the flame, resulting in a sudden engulfing of vast area and multiple stories of the building façade under fire.

5.3.8. Apart from combustible façade materials, poor installation, poor joint detailing, poor mechanical detailing in fixing insulation and façade panels and poor railing system installations contribute to the rapid façade flame spread and collapse of façade panels and frames, making external firefighting extremely difficult.

5.3.9. Thus, the whole mechanism involved in façade flame spread, after the initial ignition, can be pin pointed to the following factors.

a. Readily Combustible Core of the façade material (Insulation/Sealants/Panels)

b. Inferior Façade Panel integrity (Poor Panel make and skin bonding)

c. Non-tested and Non-listed Façade, Sealants and Fire stopping systems

d. Poor installation of Façade and Fire stopping Systems

e. Lack of Thermal barriers and Cavity fire barriers

5.3.10. The initial ignition of the fire can be attributed to human behavior as well. **See Section G, Chapter 01., Sub Section 3.22. Responsibilities of Residents.**

5.4. Façade Permits

5.4.1. Ten Point Approach to mitigate Façade Fires

Following 10 approaches have been adopted by General Directorate of Civil Defence – Kingdom of Bahrain to tackle the causes of Façade flame spread, pointed out in **Sub Section 5.3.9.**

5.4.1.1. Core of the Façade material shall be tested in exposed form as per test requirements of this code.

5.4.1.2. Façade panel as a product shall be tested as per test requirements of this code.

5.4.1.3. Façade system as wall assembly shall be tested or listed as per test requirements of this code.

5.4.1.4. Curtain wall, Perimeter joints and fire stopping shall be a listed system.

5.4.1.5. Cavity Fire Barrier bands shall be provided in concealed cavities between façade and primary substrate, at every slab.

5.4.1.6. Fire Breaks shall be provided vertically on exterior façade.

5.4.1.7. Exterior Sprinklers should be considered for the balconies having combustible facade. Interior window sprinklers should be considered for the glazing.
See Section D, Chapter 05.

5.4.1.8. Consultants shall have competent and qualified façade specialists in- house or shall hire General Directorate of Civil Defence – Kingdom of Bahrain permitted house of expertise who have experience and expertise in façade consultancy for Façade design, system selection and supervision of the façade contractor.

5.4.1.9. Façade contractor and fabricator shall be permitted by General Directorate of Civil Defence – Kingdom of Bahrain, with valid General Directorate of Civil Defence – Kingdom of Bahrain License.

5.4.1.10. Façade installation shall be inspected throughout installation process and certified by Consultant or General Directorate of Civil Defence – Kingdom of Bahrain permitted House of Expertise.

5.4.2. Component (Product/Panel) Permits

5.4.2.1. Permit of “product” or “panel” or component is manufacturer’s responsibility. Manufacturer or supplier shall test the individual product or component as part of the assembly (**TEST 1**, as per **Tables: - A02-T1.14., A02-T1.15., A02-T1.16., A02-T1.17.**, as applicable) to evaluate flame spread characteristics, droplets and smoke emission of the core, the skin, adhesive, panel and the product, and obtain permit and product registration from General Directorate of Civil Defence. The General Directorate of Civil Defence certificate shall only be for the product and permission to be installed “only on low rise buildings”.

5.4.3. Wall System or Wall Assembly Permits

5.4.3.1. Permit of façade wall "system" intended to be used as "assembly" on façade of a building shall be the responsibility of the consultant and façade contractor. The consultant shall ensure that the façade contractors or fabricators test the façade system as per General Directorate of Civil Defence – Kingdom of Bahrain regulation and configurations. (**TEST 2**, as per **Tables: - A02-T1.14., A02-T1.15., A02-T1.16., A02-T1.17.** as applicable).

5.4.3.2. Where manufacturer or supplier undertakes both tests, **TEST 1**, as per **Sub Section 5.4.2.1.** as well as **TEST 2**, as per **Sub Section 5.4.3.1.,** and produces the "system" test certificates, the General Directorate of Civil Defence – Kingdom of Bahrain registration and certificate shall be for the product including full system and permission to be installed on exterior façade of any building, provided that the façade fabricator undertakes that project façade arrangement matches the tested and certified wall assembly arrangement.

5.4.3.3. The system manufacturer or supplier and the fabricators shall provide a formal submittal to the General Directorate of Civil Defence and General Directorate of Civil Defence material permit department for the product registration, that shall consist of the following.

a. Product Data – Manufacturer's Specifications, Technical Data and Material Safety Data Sheet for each material including the composition and limitations, if any.

b. Design Listings and certifications – Core test certifications, Product test certifications, Assembly test certifications, System design listing or test certifications, including illustrations, from an accredited testing laboratory as per referenced standards that is applicable to each system configuration. Test reports without certification from accredited laboratories is invalid.

c. Method Statement shall clearly define component list and the manufacturer's installation instructions.

d. Statement of Manufacturer's standard warranty for minimum of 10 years.

e. An undertaking letter in understanding with General Directorate of Civil Defence – Kingdom of Bahrain, that supplying any material or system that is non-compliant to this code is illegal and punishable.

5.4.3.4. Where the building envelope is uniquely shaped and designed, or there is no clear distinction between vertical façade and horizontal roofing, or where a single envelope is installed as roofing as well as façade envelope, such materials and system assembly shall be tested for both façade as well as roofing requirements in accordance with **Sub Section 5, Sub Section 6 and Sub Section 7 of this chapter.**

5.4.4. Design, Specifications and Proposal Permits

5.4.4.1. It is consultant's responsibility to recruit Façade specialists in house or hire General Directorate of Civil Defence permitted House of Expertise to design the façade system in complete compliance with this code.

5.4.4.2. Consultant's façade design submittal to General Directorate of Civil Defence – Kingdom of Bahrain shall be during project design NOC application, along with architecture, fire alarm, firefighting and smoke control proposals.
See **Section H, Chapter 03. Drawing Submission Requirements.**

5.4.4.3. Consultant's façade design shall be complete with system listings, material permit certifications, drawings, sections, illustrations specifying installation methods as per manufacturer's guidelines, insulations, thermal barriers, panel railing, cavity fire barrier locations/specifications, primary substrate details and fixing details.

5.4.4.4. Engineering Judgments (EJ), if any, shall be permitted General Directorate of Civil Defence – Kingdom of Bahrain has no objections. Such Engineering Judgment submissions to General Directorate of Civil Defence – Kingdom of Bahrain shall be site specific, prepared and stamped jointly by main consultant, House of expertise, Cladding contractor, façade system manufacturers and façade installers.

5.4.4.5. Where the building envelope is uniquely shaped and designed, or there is no clear distinction between façade and roofing, or where a single envelope is installed as roofing as well as façade envelope, such materials and system assembly shall satisfy both façade and roofing test requirements and shall be subjected to "mock-up" tests, if General Directorate of Civil Defence - Kingdom of Bahrain initiates such a requirement based on the proposal reviews.

5.4.5. Installation

5.4.5.1. It is consultant's responsibility to ensure that the installers and fabricators hired are qualified and permitted by General Directorate of Civil Defence – Kingdom of Bahrain. See **Section G**, **Chapter 01. Sub Section 3.5. Consultant's Responsibilities.**

5.4.5.2. It is consultant's responsibility to ensure that the installation is carried out by General Directorate of Civil Defence – Kingdom of Bahrain permitted installers and fabricators as per the design specifications, system manufacturer's installation instructions and complies with code and the local construction regulations.

5.4.6. Installer Qualification

5.4.6.1. Installer specializing in façade and cladding system shall be trained as per manufacturer's standards and guidelines and certified by the system manufacturer.

5.4.6.2. The trained and experienced installer shall be qualified and licensed by General Directorate of Civil Defence – Kingdom of Bahrain. The General Directorate of Civil Defence – Kingdom of Bahrain written examinations and license shall be based on the training and certification provided by the system manufacturer to install manufacturer's products as per specified listed system requirements.

5.4.7. Inspection

5.4.7.1. Special inspections shall be required for all façade and cladding systems.
Inspection should be carried to samples at permit / delivery stage prior to site inspection
Site Inspection shall take place in successive stages as installation proceeds.
Such successive stages shall be at every 20% intervals of the total building height.

5.4.7.2. It is consultant's responsibility to ensure that installer's work is inspected during construction and installation at each stage.

5.4.7.3. It is consultant's responsibility to recruit in-house qualified façade engineers for inspections or to hire façade inspection services General Directorate of Civil Defence – Kingdom of Bahrain permitted House of Expertise.

5.4.7.4. Main consultant or house of expertise, who inspect the installation, shall certify and signoff the façade and cladding installations undertaken during progressive inspections at each successive stage of installations in report which shall be part of the documentation required by General Directorate of Civil Defence – Kingdom of Bahrain during final inspection and handing over.

5.4.7.5. Main consultant or Bahrain Civil Defence permitted House of Expertise individual inspector undertaking Façade inspections shall have the following qualifications.

a. Accreditation to ISO/IEC 17020 or relevant IAS criteria or ICC Specialist building inspection training and certification or an equivalent GDCD international criteria acceptable to General Directorate of Civil Defence – Kingdom of Bahrain and Ministry of Municipalities permitted

b. Training and certification by system manufacturers.

c. 3 years experience in fire and life safety aspects of Façade inspections.

5.4.8. Façade Specialist Qualifications

5.4.8.1. The Façade Specialists of Consultant's in-house team or of General Directorate Civil of Defence – Kingdom of Bahrain permitted House of Expertise, undertaking façade consultancy, design or inspection shall have the following qualifications.

a. Bachelor's degree in engineering.
b. 5 years experience in fire and life safety aspects of Façade engineering.
c. Training and certification by system manufacturers.

5.4.8.2. The Façade Specialists of Consultant's in-house team or of General Directorate of Civil Defence – Kingdom of Bahrain permitted House of Expertise, undertaking façade consultancy, design or inspection shall be certified by Bahrain Civil Defence based on their qualifications as required by **Sub Section 5.4.8.1.,** manufacturer's training certifications and written examination.

5.5. General Requirements for Exterior Façade Systems

5.5.1. Coatings on primary substrate

5.5.1.1. Bitumen, bituminous products and flammable agents as anti-corrosion or water proofing coatings shall not be applied on primary substrates, either on metals or concrete. Bitumen has fire point of 175°C and propagates building envelope fires.

5.5.2. Building Fire Rating

5.5.2.1. Façade materials, exterior wall systems, claddings and insulation installed on any building shall not reduce the fire resistance rating of the e**x**terior wall where required by other sections of this Chapter.

5.5.3. Thermal Barrier

5.5.3.1. Façade Cladding Materials such as MCM and ACP shall be completely separated from the building interior and plenum by a thermal barrier, complying to test standards of **Sub section 8.1.11.** of this chapter.

5.5.3.2. Required thermal barriers shall not be installed on the walls or frames with adhesives alone. Thermal barriers shall be fixed mechanically on primary substrate, structural frame or the wall or on rails as appropriate.

5.5.3.3. Thermal barrier is not mandatory only when MCM or ACP or cladding materials are used on balconies and minor architectural appendages on exterior wall.

5.5.3.4. In all cases the Building Exterior Base wall must be imperforate and provide a nominal 15 minutes fire resistance (Insulation and integrity).

5.5.4. Cavity Fire Barrier

5.5.4.1. Cavity Fire Barriers shall be incorporated into façade designs, including architectural features with uninterrupted vertical columns (e.g. High-Rise 'Fins'), at every floor horizontally around window openings on all sides to limit fire breakout from a room into the adjacent cavity. This cavity barrier shall not be a thermal bridge.

5.5.4.2. Cavity Fire Barriers shall be incorporated into façade design at every floor Vertically to restrict flame within continuous cavities or where cavities bridge the perimeter firestopping. Perimeter Firestopping systems shall be installed as per **Sub Section 4** of this chapter.

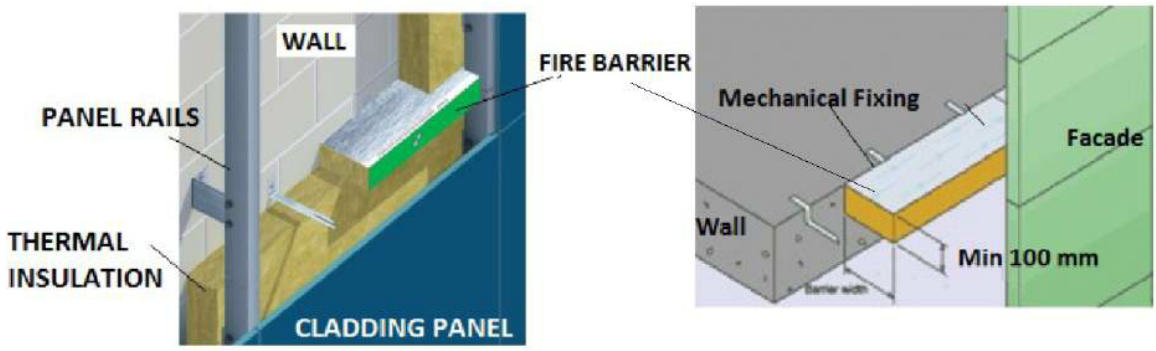
5.5.4.3. Cavity fire barrier shall be of Noncombustible material, in accordance with **Sub section 8.1.45.** of this chapter.

5.5.4.4. The cavity fire barrier shall be 100 mm high and, where the thermal insulation is not of equivalent fire resistance to the cavity barrier, shall run through insulation horizontally at each floor level and vertically on each face of façade as required by **Sub Section 5.5.4.2.**

5.5.4.5. The installation shall ensure that compartmentation is established between the façade skin and the primary substrate and no cavity exists for fire to pass through. See **Figure: - A.02-F19.a and Figure: - A.02-F19. b.**

5.5.4.6. The cavity fire barrier shall be mechanically bonded to the primary substrate or structural frame and extended or compressed behind the finish façade panel to ensure that no fire path are created between the barrier and substrate or external façade panel.

5.5.4.7. Where cavity is necessary part of ventilated façade design and cavity needs to be maintained, an intumescent system, permitted and listed for the purpose shall be fixed as cavity fire barrier band. These intumescent bands serve as fire barriers when exposed to flames and shall expand to seal the gaps.



CAVITY FIRE BARRIERS FOR ILLUSTRATION

5.5.5. Fire Breaks

5.5.5.1. It is highly recommended to provide "fire breaks" where cladding materials are installed on exterior façade by restricting the vertical length of building envelope of cladding materials to not more than 15 m, followed by 6 m of non-combustible material as envelope finish such as concrete or tiles or materials permitted as per **Sub section 8.1.45.,** in an alternative manner along the building envelope's face.

5.5.6. Groove Sealants, Gaskets, Backer Rod and vapour barrier systems

5.5.6.1. Use of flammable silicon or fillers or non-rated groove sealants, materials in between panel joints is not permitted unless these joint fillers are test- ed as per **Sub section 8.1.45** and part of their full wall assembly and were used in achieving "pass criteria" as the Wall Assembly "Large Scale Tests". See Figure **A02-F19.a and Figure: - A.02-F19. b.**

5.5.6.2. Vapour Barrier systems (VBS) and membranes are generally provided to resist water vapour and are often an essential part of the façade system. Vapour barriers, particularly rubber, bituminous based materials, maybe combustible by their nature and may affect the overall performance of the façade system in respect of fire development and spread. Therefore, the VBS product should be checked against the MSDS for base content (**See Sub Section 5.5.1.1).** VBS products must be registered and Licensed by the General Directorate of Civil Defence – Kingdom of Bahrain and must achieve EN13501-1 Class A as per **Sub Section 8.1.45.**

5.5.6.3. EPDM products, Rubber sheeting and architectural carpets are creating new design possibilities as building skins. EPDM rubber (ethylene propylene diene monomer rubber) and similar rubber products must not be used as a full VBS/Façade Liner. However, it is acceptable in other discrete locations, such as Curtain Wall Gaskets or window waterproofing provided the fire performance achieves a minimum of EN 13501-1 C, S2, d0., as per **Sub section 8.1.45.**

5.5.6.4. Artificial turf has been typically used for sports grounds or indoor solutions, but now this surface covering is being used in the design of indoor and outdoor spaces in horizontal and vertical applications. Where such applications are used as floor coverings they shall be tested to EN 13501-1 and achieve a minimum of Cfl,S1 where the premises are provided with a sprinkler system or, with the exception of areas being used for Assembly, where the installation is completely out doors. Where the material is being used as an internal wall covering it must comply with Sub **section 8.1.4.** or when proposed as an External wall covering, it shall comply with the requirements of **Section A, Chapter 02**, **Sub Section 5,** achieve ASTM E84 class A and EN13501-1 Class A2 minimum. The Façade system which the material forms a part must also be tested to NFPA 285 and NFPA 268 ('no ignition at 12.5 kw/m^2 at 20 minutes)

5.5.7. Openings (Window, Doors, Ventilation) Flashing

5.5.7.1. Window (opening) flashing where cladding materials intersect shall be of steel formed and fixed mechanically or an appropriate and General Directorate of Civil Defence – Kingdom of Bahrain permitted Fire Stopping/ safing system fire to completely line windows or openings and overlap onto both exterior and interior surfaces of wall assembly. It must be ensured that any void or cavity between the exterior and interior surfaces of the façade system is protected to prevent fire accessing the space. See **Figure: - A.02-F19.a and Figure: - A.02-F19. b.**

5.5.8. Architectural features

5.5.8.1. Architectural features shall comply to all the relevant requirements of **Sub Section 5.**

5.5.9. Openings on the exterior walls

5.5.9.1. Openings on exterior walls in adjacent stories shall be separated vertically to protect against fire spread on the exterior of the buildings where the openings are within 1524 mm of each other horizontally. Such openings shall be separated vertically not less than 914 mm by spandrel girders exterior or other similar assemblies that have a fire resistance rating of not less than 1 hour, rated for exposure to fire from both sides, or

by flame barriers that extend horizontally not less than 762 mm beyond the exterior wall. Flame barriers shall have a fire resistance rating of not less than 1 hour.

5.5.9.2. Where a Spandrel Panel is used to satisfy the requirement in **Sub Section**

5.5.9.1., it shall be ensured that the materials used and spandrel panel as system provides a minimum of 60 minutes fire resistance from BOTH sides of the panel. All transoms and Mullions must be protected in this respect.

5.5.9.3. Fire-safing forming the perimeter edge protection must ensure the same performance as the structural floor slab in respect of F and T ratings.

5.5.9.3. Aluminum Back Pans shall not be accepted.

5.5.10. Installation of Exterior Façade Lighting

5.5.10.1. Façade lighting fixtures have high intensity light and heat. When overheated or poorly installed, these fixtures emit intense heat and can be cause of fire ignition source when in contact with readily combustible materials.

5.5.10.2. Flood Lighting fixtures shall not be installed directly on façade surface, wood, plastic, insulation, façade cavity with combustible material etc. Flood lighting fixtures shall be installed such that lighting fixture heat is not dissipated directly onto the façade surface. Appropriate steel framing and noncombustible thermal insulation shall separate the lighting fixtures from façade surface.

5.5.11. Installation of Electrical Equipment on Facade

5.5.11.1. Installation of electrical equipment such as Air Conditioning units, Kitchen Exhaust ducts, Heaters, Boilers, Diesel generators directly in contact with Façade surface can be source of fire ignition.

5.5.11.2. Poor installation, poor wiring and overheating of such electrical equipment and its contact with combustible insulation or façade material shall be avoided. Electrical equipment shall be separated from façade surface with proper steel frames, steel lining, metal conduit for wiring and noncombustible insulation coverings.

5.5.11.3. Façade cavity shall not be used for routing electrical cabling, LPG or natural gas piping and hot water piping.

5.5.11.3. Regular maintenance of the electrical equipment shall be ensured to keep the equipment in good working condition.

5.5.12. Installation of Advertising Banners and Hoardings on Facade

5.5.12.1. Installation of non- permitted advertising billboard material on permitted façade material can compromise the exterior wall's safety.

5.5.12.2. Sign boards, billboards, advertising banners shall comply with **TABLE: - A.02- T9.56.**

5.5.12.2. Flammable, Combustible, Plastic and Foam materials shall not be used for advertising or billboard on façade envelope.

5.5.13. Housekeeping

5.5.13.1. Competent housekeeping shall be ensured in every building to keep exterior façade surface clean and free from flammable and combustible materials within the vicinity. Trash accumulation near façade surface shall be avoided. Trash cans shall not be placed adjacent to exterior façade surface.



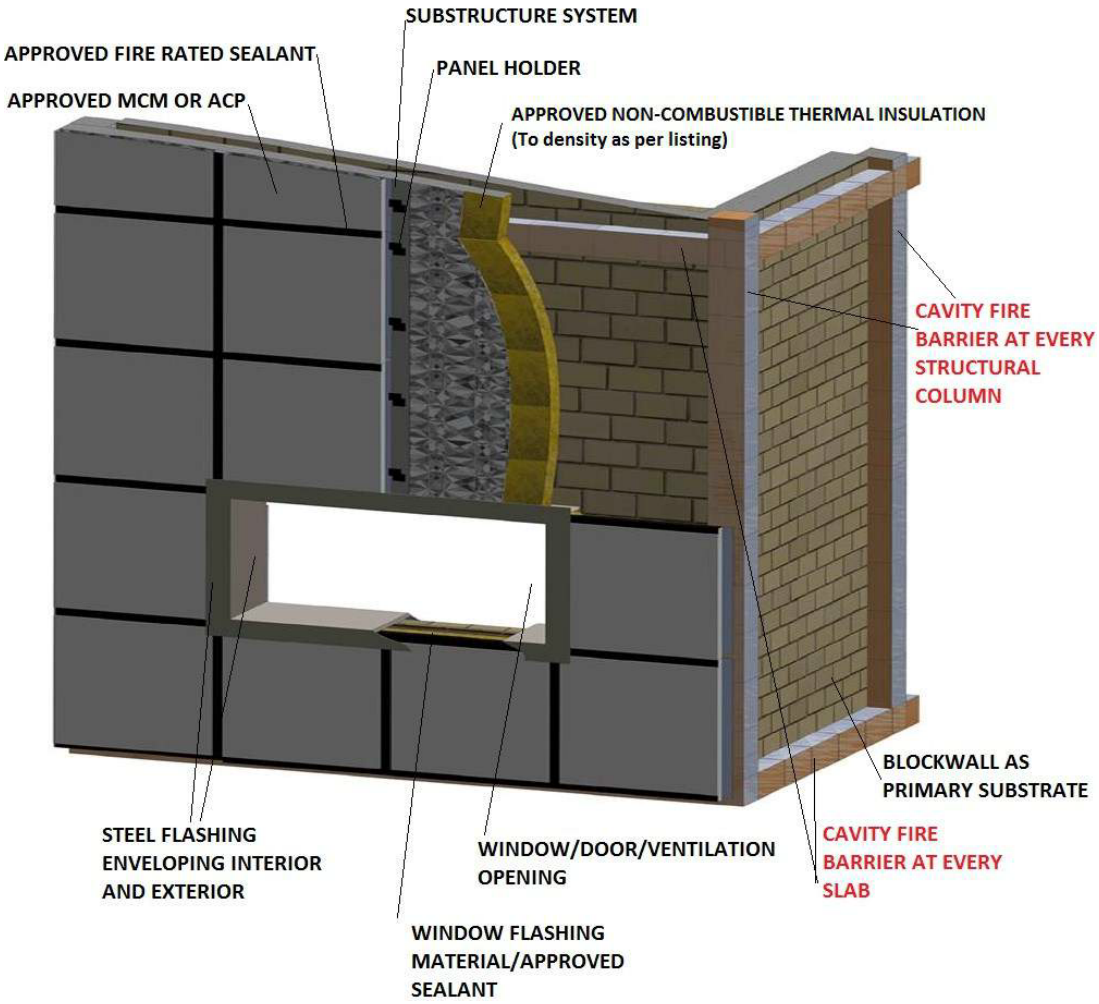


Figure: - A.02-F19. a.: Typical MCM / ACP Installation on Block wall

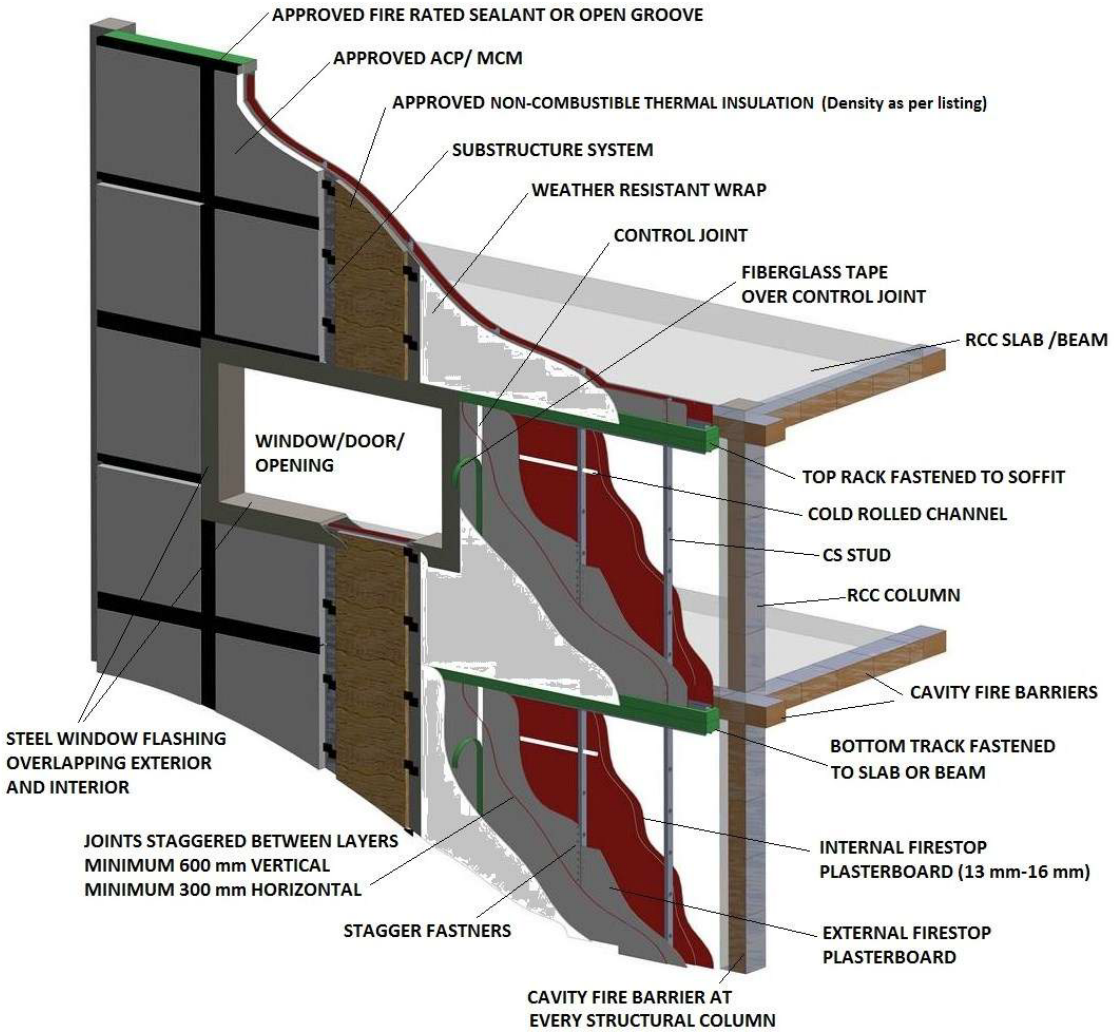


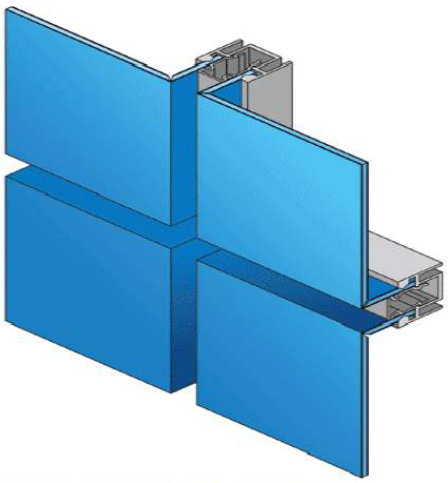
Figure:- A.02-F19.b.: Typical MCM / ACP Installation on Frame

5.6. Metal Composite Materials and Panels (MCM, ACP)

5.6.1. Metal Composite Panels (such as Aluminum Composite Panels, ACP), other than sandwich panels used on façade and exterior wall assembly shall comply with general requirements of **Sub Section 5.5** and the specific requirements of **Sub Section 5.6.**

5.6.2. Definition

5.6.2.1. A factory manufactured panel consisting of metal skins bonded to both faces of a "core". All MCM's shall be tested and permitted at the maximum thickness intended for use and intended assemblies. However, MCM's (Such as ACP's) shall have a minimum exterior skin thickness of 0.019 in. (0.5 mm), a minimum interior skin thickness of 0.010 in. (0.25 mm) and a maximum panel thickness of ¼ in. (6.3 mm) where installed on facades and exterior walls.



MCM/ACP FOR ILLUSTRATION



ACP CLADDING FOR ILLUSTRATION

5.6.3. Specific Requirements

5.6.3.1. MCM/ACP shall be permitted to be installed on the façade and exterior of buildings classified as Type I, Type II, Type III, or Type IV construction, as defined in **Chapter 02, Table: - A.02-T7.,** and such installation shall not change the construction classification or fire performance of the building.

5.6.3.2. MCM/ACPs shall be Marked/labeled to verify its certification mark from accredited certification body.

5.6.3.3. MCM/ACP Core shall not be of foam plastic insulation or LDPE (Low Density Polyethylene) or any such expanded plastic having density less than 320 kg/ m^3).

5.6.3.4. MCM/ACP Core shall be tested and evaluated separately. Core (exposed without skin) used in Cladding and façade Panels can be of plastic or mineral or combination of such material having flame and smoke spread characteristics as per **TEST 1** in accordance with **Table: - A.02-T14. a. and Table: - A.02-T14. b.** test requirements.

5.6.3.5. The fire resistance performance of Fire Rated façade system is a function of the base exterior wall when tested to ASTM E119 (or equivalent) and NOT only the MCM/ACP panel element. It must be made clear by the MCM/ACP manufacturer that their products have no Resistance to Fire qualities when tested as a system in accordance with **Table: - A.02-T14. b.** unless the MCM/ACP panel has been tested as an individual component product to ASTM E119.

5.6.4. Test Certifications

5.6.4.1. MCM/ACP panels and facade systems on non-fire resistance rated and non load bearing exterior wall coverings shall comply with **Table: - A.02-T14. a.**

5.6.4.2. MCM/ACP panels and facade systems on fire resistance rated exterior and non-load bearing wall assembly coverings shall comply with **Table: - A.02-T14. b.**

5.6.5. Application

5.6.6.1. The occupancies and type of buildings that are allowed to have MCM or ACP shall be in accordance with **Table: - A.02-T14. a.** and **Table: - A.02-T14. b.**

Table: - A.02-T14. a.: MCM and ACP On Non-Fire Resistance rated and Non-Load bearing Exterior wall coverings-Test Requirements

OCCUPANCY AND TYPE OF BUILDING	TEST 1 MCM/ ACP CORE AND PANEL AS PRODUCT	TEST 2 MCM/ ACP PANELS WITH WALL ASSEMBLY
1. SUPER HIGHRISE BUILDING **2. HIGHRISE BUILDING** **3. MALLS** **4. THEME PARKS** **5. SCHOOLS** **6. HOSPITALS** **7. ASSEMBLY**	i. Core shall be tested to the criteria iii and iv. ii. Panel shall be tested with the thickness intended to the criteria iii and iv. iii. EN 13501-1 With pass criteria A1 OR A2-s1-d0 AND iv. ASTM D1929 MCM/ACP shall have self-ignition temperature of not less than 343◦C.	i. BS 8414 –1 Or 2 With pass criteria as per BRE 135 OR ii. NFPA 285 With pass criteria “Pass” OR iii. FM 4881 With pass criteria “Pass” OR iv. ISO 13785-2 With pass criteria “Pass”
8. LOWRISE BUILDING **9. MIDRISE BUILDING** **10. WAREHOUSE** **11. INDUSTRIAL**	i. Core shall be tested to the criteria iii and iv. ii. Panel shall be tested with the thickness intended to the criteria iii and iv. iii. EN 13501-1 With pass criteria B-s1-d0 AND iv. ASTM D1929 MCM/ACP shall have self-ignition temperature of not less than 343◦C.	i. BS 8414 –1 Or 2 With pass criteria as per BRE 135 OR ii. NFPA 285 With pass criteria “Pass” OR iii. FM 4881 With pass criteria “Pass” OR iv. ISO 13785-2 With pass criteria “Pass”

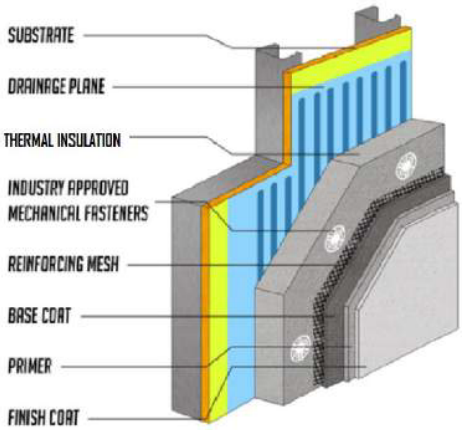
Table: - A.02-T14. b.: MCM and ACP on Fire Resistance rated Exterior wall coverings-Test Requirements		
OCCUPANCY AND TYPE OF BUILDING	**TEST 1** **MCM/ ACP CORE AND PANEL AS PRODUCT**	**TEST 2** **MCM/ ACP PANELS IN WALL ASSEMBLY**
1. ANY BUILDING WITH ANY HEIGHT AND ANY OCCUPANCY HAVING REQUIREMENT OF FIRE RESISTANCE RATED EXTERIOR WALL CONSTRUCTION, WHERE REQUIRED BY OTHER SECTIONS OF THIS CHAPTER.	i. Core shall be tested to the criteria iii and iv. ii. Panel shall be tested with the thickness intended to the criteria iii and iv. iii. EN 13501-1 With pass criteria A1 OR A2-s1-d0 AND iv. ASTM D1929 MCM/ACP shall have self-ignition temperature of not less than 343°C.	i. ASTM E 119 With pass criteria "1 Hr or 2 Hr OR 3 Hr as per required fire rating of the wall. OR ii. UL 263 With pass criteria "1 Hr or 2 Hr OR 3 Hr as per required fire rating of the wall. OR iii. EN 1362-3 With pass criteria "1 Hr or 2 Hr OR 3 Hr as per required fire rating of the wall. OR iv. EN 1362-4 With pass criteria "1 Hr or 2 Hr OR 3 Hr as per required fire rating of the wall.

5.7. Exterior Insulation and Finish Systems (EIFS) and External Thermal Insulation Composite System (ETICS)

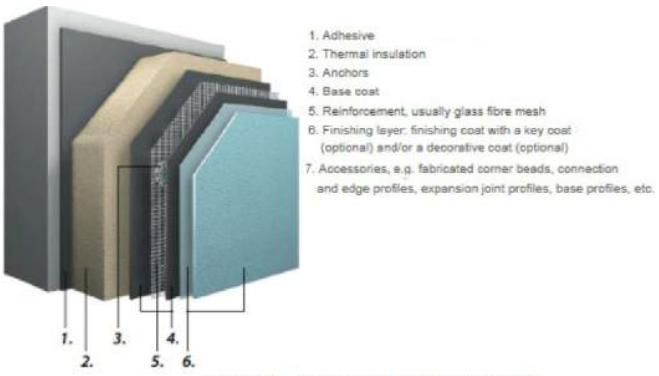
5.7.1. Exterior Insulation and Finish Systems (EIFS) and External Thermal Insulation Composite System (ETICS) used on façade and exterior wall assembly shall comply with general requirements of **Sub Section 5.5** and the specific requirements of **Sub Section 5.7.**

5.7.2. Definition

5.7.2.1. Exterior insulation and finish systems (EIFS) are materials, assemblies made up of layers of foam plastic insulation or expanded polystyrene or mineral insulation with adhesives and fiber reinforcement, used in exterior non-load bearing walls as wall coverings and exterior cladding systems



TYPICAL EIFS FOR ILLUSTRATION



TYPICAL ETICS FOR ILLUSTRATION


EIFS WALL COVERING FOR ILLUSTRATION

5.7.3. Specific Requirements

5.7.3.1. EIFS and ETICS shall be constructed such that it meets the performance characteristics required as per ASTM E 2568.

5.7.3.2. EIFS and ETICS shall be certified and listed by a third-party independent testing and Certification body, permitted by General Directorate of Civil Defence – Kingdom of Bahrain.

5.7.3.3. EIFS and ETICS shall be Marked/labeled to verify its certification mark from accredited certification body.

5.7.3.4. The layers and core materials shall be tested separately and entire assembly including ornaments, trims and moldings with intended thickness, joints, seams, fasteners and wall arrangement shall be tested in accordance with **Table: - A.02-T15. a.**

5.7.3.5. Where EIFS or ETICS is installed on Fire rated or load bearing walls, the wall arrangement shall be tested in accordance with **Table: - A.02-T15. b.**

5.7.3.6. EIFS shall be specified in accordance with ANSI/EIMA 99-A (Latest Edition) 'American National Standard for EIFS'. ETICS shall meet the performance requirements as per ETAG 004 (Latest Edition) 'Guidelines for European Technical permit of ETICS with Rendering'

5.7.3.7. Requirements of the ANSI/EIMA 99-A or ETAG 004 guidelines shall be followed independently. Using parts from each of the guidelines is not permitted.

5.7.4. Test Certifications

5.7.4.1. EIFS and ETICS panels and facade systems on non-fire resistance rated and non-load bearing exterior wall coverings shall comply with **Table: - A.02-T15. a.**

5.7.4.2. EIFS and ETICS panels and facade systems on fire resistance rated exterior wall assembly coverings shall comply with **Table: - A.02-T15. b.**

5.7.5. Application

5.6.6.1. The occupancies and type of buildings that are allowed to have EIFS and ETICS shall be in accordance with **Table: - A.02-T15. a.** and **Table: - A.02-T15. b.**

Table: - A.02-T15. a.: EIFS and ETICS on Non-Fire Resistance rated and Non-Load bearing Exterior wall coverings-Test Requirements		
OCCUPANCY AND TYPE OF BUILDING	**TEST 1** **EIFS/ETICS COMPONENTS AND PANEL AS PRODUCT**	**TEST 2** **EIFS/ETICS AS WALL ASSEMBLY**
1. ANY BUILDING **2. ANY INSTALLATION** **3. ANY AESTHETICS**	i. All components of the EIFS (All layers including EPS/ XPS, coating, insulation, mesh, adhesive and finish.) shall be class A (Flame spread 0-25, Smoke development 0-450) when individually tested to ASTM E 84 or UL 723 AND ii. NFPA 268 With pass criteria "No Ignition at 12.5 kw/m^{2} at 20 minutes"	i. BS 8414 –1 Or 2 With pass criteria as per BRE 135 OR ii. NFPA 285 With pass criteria "Pass" OR iii FM 4881 With pass criteria "Pass" OR iv. ISO 13785-2 With pass criteria "Pass"

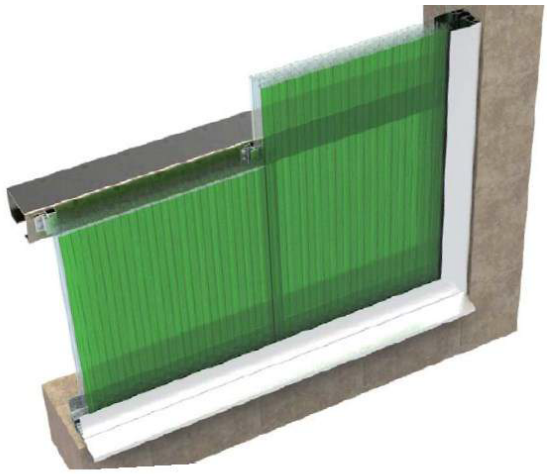
Table: - A.02-T15. b.: EIFS and ETICS on Fire Resistance rated Exterior wall coverings-Test Requirements		
OCCUPANCY AND TYPE OF BUILDING	**TEST 1** **EIFS/ETICS COMPONENTS AND PANEL AS PRODUCT**	**TEST 2** **EIFS/ETICS AS WALL ASSEMBLY**
1. ANY BUILDING **2. ANY INSTALLATION** **3. ANY AESTHETICS**	i. All components of the EIFS (All layers including coating, insulation, mesh, adhesive and finish.) shall be class A when individual- ly tested to ASTM E 84 or UL 723 AND ii. NFPA 268 With pass criteria "No Ignition at 12.5 kw/m^{2} at 20 minutes"	i. ASTM E 119 With pass criteria "1 Hr or 2 Hr OR 3 Hr as per required fire rating of the wall. OR ii. UL 263 With pass criteria "1 Hr or 2 Hr OR 3 Hr as per required fire rating of the wall. OR iii. EN 1362-3 With pass criteria "1 Hr or 2 Hr OR 3 Hr as per required fire rating of the wall. OR iv. EN 1362-4 With pass criteria "1 Hr or 2 Hr OR 3 Hr as per required fire rating of the wall.

5.8. Polycarbonate External Wall and Façade System (PEWFS)

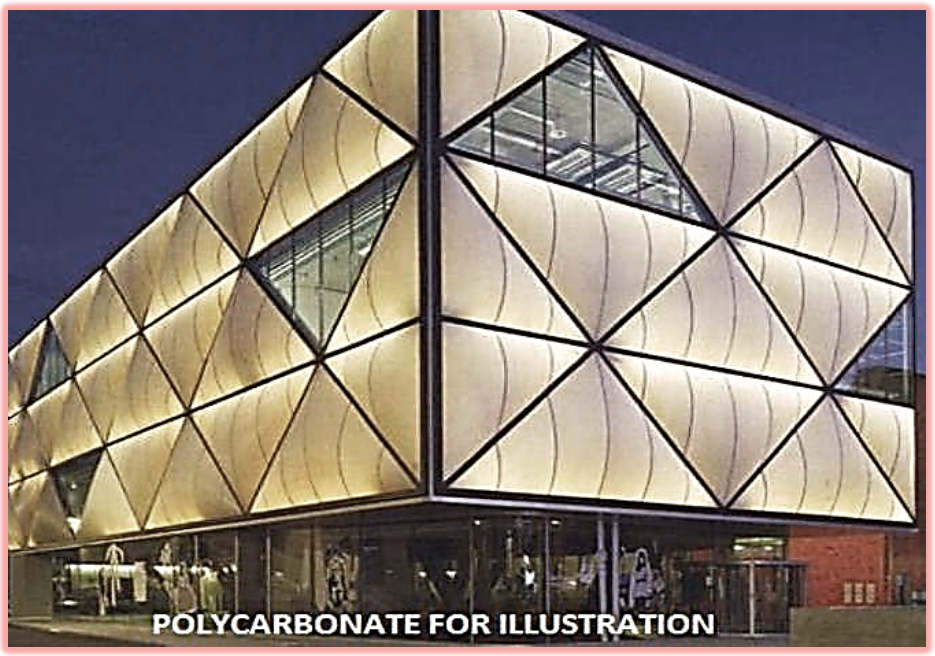
5.8.1. Polycarbonate External Wall and Façade System (PEWFS) used on façade and exterior wall assembly shall comply with general requirements of **Sub Section 5.5** and the specific requirements of **Sub Section 5.8.**

5.8.2. Definition

5.8.2.1. Polycarbonate is a type of thermoplastic, a polymer that becomes pliable or moldable above a specific temperature and returns to a solid state on cooling. Polycarbonate is an engineering thermoplastic.



PEWFS FOR ILLUSTRATION



5.8.3. Specific Requirements

5.8.3.1. PEWFS shall be certified and listed by a third-party independent Testing and Certification body, permitted by General Directorate of Civil Defence – Kingdom of Bahrain.

5.8.3.2. PEWFS shall be Marked/labeled to verify its certification mark from accredited certification body.

5.8.3.3. The entire assembly including ornaments, trims and moldings with intended thickness, joints, seams, fasteners and wall arrangement shall be tested in accordance with **Table: - A.02-T16. a.**

5.8.4. Test Certifications

5.8.4.1. PEWFS panels and facade systems on non-fire resistance rated and non load bearing exterior wall coverings shall comply with **Table: - A.02-T16. a.**

5.8.4.2. EIFS and ETICS panels and facade systems on fire resistance rated exterior wall assembly coverings shall comply with **Table: - A.02-T16. b.**

5.8.5. Application

5.8.5.1. The occupancies and type of buildings that are allowed to have PEWFS shall be in accordance with **Table: - A.02-T16. a.** and **Table: - A.02-T16. b.**

Table: - A.02-T16. a.: PEWFS on Non-Fire Resistance rated and Non-Load bearing Exterior wall coverings- Test Requirements

OCCUPANCY AND TYPE OF BUILDING	TEST 1 PEWFS PANEL AS PRODUCT	TEST 2 PEWFS AS WALL ASSEMBLY
1. SUPER HIGHRISE BUILDING **2. HIGHRISE BUILDING** **3. MALLS** **4. THEME PARKS** **5. SCHOOLS** **6. HOSPITALS** **7. ASSEMBLY**	i. EN 13501-1 With pass criteria A1 OR A2-s1-d0 AND ii. ASTM D1929 With pass criteria PEWFS shall have self-ignition temperature of not less than 343°C	i. BS 8414 –1 Or 2 With pass criteria as per BRE 135 OR ii. NFPA 285 With pass criteria “Pass” OR iii. FM 4881 With pass criteria “Pass” OR iv. ISO 13785-2 With pass criteria “Pass”
8. LOWRISE BUILDING **9. MIDRISE BUILDING** **10. WAREHOUSE** **11. INDUSTRIAL**	i. EN 13501-1 With pass criteria B-s1-d0 AND ii. ASTM D1929 With pass criteria PEWFS shall have self-ignition temperature of not less than 343°C	i. BS 8414 –1 Or 2 With pass criteria as per BRE 135 OR ii. NFPA 285 With pass criteria “Pass” OR iii. FM 4881 With pass criteria “Pass” OR iv. ISO 13785-2 With pass criteria “Pass”

Table: - A.02-T16. b.: PEWFS on Fire Resistance rated Exterior wall -Test Requirements		
OCCUPANCY AND TYPE OF BUILDING	**TEST 1** **PEWFS PANEL AS PRODUCT**	**TEST 2** **PEWFS IN WALL ASSEMBLY**
1. ANY BUILDING **2. ANY INSTALLATION** **3. ANY AESTHETICS**	i. EN 13501-1 With pass criteria A1 OR A2-s1-d0 AND ii. ASTM D1929 With pass criteria PEWFS shall have self-ignition temperature of not less than 343◦C	i. ASTM E 119 With pass criteria "1 Hr or 2 Hr OR 3 Hr as per required fire rating of the wall. OR ii. UL 263 With pass criteria "1 Hr or 2 Hr OR 3 Hr as per required fire rating of the wall. OR iii. EN 1362-3 With pass criteria "1 Hr or 2 Hr OR 3 Hr as per required fire rating of the wall. OR iv. EN 1362-4 With pass criteria "1 Hr or 2 Hr OR 3 Hr as per required fire rating of the wall.

5.9. Sandwich Panels

5.9.1. Sandwich Panels shall comply with general requirements of **Sub Section 5.5,** where used on façade and exterior wall and the specific requirements of **Sub Section 5.9.**

5.9.2. Sandwich Panels used in other applications such as internal partitions, cold storage or roofing shall comply with the specific requirements of **Sub Section 5.9.**

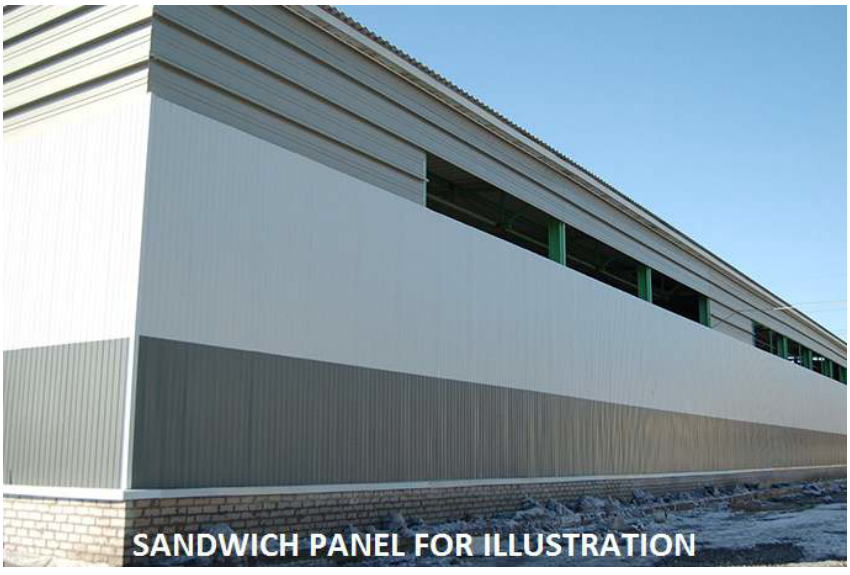
5.9.3. Sandwich panels shall be tested for the intended applications such as external, internal, roofing or cold storages and shall not be interchanged in their end applications.

5.9.4. Definition

5.9.4.1. Sandwich panels are foam plastic insulated sandwich panels (FISP) or mineral core insulated panels or self-supporting double skin metal faced insulating panels.



INSULATED SANDWICH PANEL FOR ILLUSTRATION



SANDWICH PANEL FOR ILLUSTRATION

5.9.4.2. Generally, cores used in the sandwich panels based on their intended application are Polyisocyanurate Foam (PIR), Polyurethane Foam (PUR), Expanded or Extruded Polystyrene (EPS and EXPS) or Non-combustible mineral wool or fiberglass.

5.9.4.3. Sandwich panels are generally used as external wall systems in low rise building such as warehouses and roofing. As internal partitions and ceiling applications, sandwich panels are used in, cold storages, food industries, warehouses and industries.

5.9.5. Specific Requirements

5.9.5.1. Where Sandwich panels are installed on the exterior walls, they shall not reduce the fire resistance rating of the wall.

5.9.5.2. Sandwich panels shall be Marked/labeled to verify its certification mark from accredited certification laboratory with its intended end use and application (Such as Internal wall, External wall, cold storage, roofing etc.), in compliance with this code.

5.9.5.3. Sandwich panels installed as exterior walls shall be completely separated from the building interior and plenum by a thermal barrier, complying to test . standards of **Sub section 8.1.11.** of this chapter.

5.9.5.4. Thermal barrier shall not be required in masonry or concrete wall, floor or roof constructions where the sandwich panel is covered on each face by concrete or masonry with a minimum thickness of 25 mm.

5.9.5.5. Thermal barrier shall not be required in fully Sprinkler protected cooler or freezer or cold rooms and the rooms they are located in, when sandwich panel is minimum 4-inch-thick and has Class A rating as per UL 723 or ASTM E 84 (FSI-25, SDI-450 or less), when tested both core and panel. Moreover, sandwich panel shall have self-ignition temperature, not less than 427°C in accordance with ASTM D 1929.

5.9.5.6. Thermal barrier shall not be required in roof assemblies where sandwich panels are separated from the interior of the building by wood structural sheathing not less than 12 mm in thickness. And the sandwich panel is part of roof covering assembly tested and passes with FM 4450 or UL 1256 or FM 4471.

5.9.5.7. Foam plastic insulation, exterior facings a coating shall be tested separately in the thickness of intended use as per **Table: - A.02-T17. c.**

5.9.6. Test Certifications

5.9.6.1. Sandwich panels shall be permitted to be installed as exterior walls when tested in accordance with **Table: - A.02-T17. a.**

5.9.6.2. Sandwich panels as fire resistance rated exterior wall assembly coverings shall comply with both **Table: - A.02-T17. a.** and **Table: - A.02-T17. b.**

5.9.6.3. Sandwich panels used in applications other than as exterior walls shall comply with test requirements in accordance with **Table: - A.02-T17. c.**

5.9.7. Application

5.9.7.1. The occupancies and type of buildings that are allowed to have sandwich panels in their exterior wall facades shall be in accordance with **Table 1.17.a.** and **Table: - A.02-T17. b.**

Table: - A.02-T17. a.: Sandwich Panels on Non-Fire Resistance rated and Non-Load bearing Exterior wall coverings-Test Requirements

OCCUPANCY AND TYPE OF BUILDING	TEST 1 SANDWICH PANEL AS PRODUCT	TEST 2 SANDWICH PANEL IN WALL ASSEMBLY
1. SUPER HIGHRISE BUILDING **2. HIGHRISE BUILDING** **3. MALLS** **4. THEME PARKS** **5. SCHOOLS** **6. HOSPITALS** **7. ASSEMBLY**	i. Core shall be tested to the criteria iii and iv. ii. Panel shall be tested with the thickness intended to the criteria iii and iv. iii. EN 13501-1 With pass criteria A OR A2-s1-d0 AND iv. ASTM D1929 With pass criteria PEWFS shall have self-ignition temperature of not less than 343◦C.	i. BS 8414 –1 Or 2 With pass criteria as per BRE 135 OR ii. NFPA 285 With pass criteria “Pass” OR iii. FM 4881 With pass criteria “Class 1” OR iv. ISO 13785-2 With pass criteria “Pass”
8. LOWRISE BUILDING **9. MIDRISE BUILDING** **10. WAREHOUSE** **11. INDUSTRIAL**	i. Core shall be tested to the criteria iii or iv and v. ii. Panel shall be tested with the thickness intended to the criteria iii or iv and v. iii. EN 13501-1 With pass criteria B-s1-d0 OR iv. FM 4880 With pass criteria “Non-combustible core” AND v. ASTM D1929 Shall have self-ignition temperature of not less than 343◦C.	i. BS 8414 –1 Or 2 With pass criteria as per BRE 135 OR ii. NFPA 285 With pass criteria “Pass” OR iii. FM 4881 With pass criteria “Class 1” OR iv. ISO 13785-2 With pass criteria “Pass”

Table: - A.02-T17. b.: Sandwich Panel on Fire Resistance rated Exterior wall -Test Requirements		
OCCUPANCY AND TYPE OF BUILDING	**TEST 1** **SANDWICH PANEL AS PRODUCT**	**TEST 2** **SANDWICH PANEL IN WALL ASSEMBLY**
1. ANY BUILDING WITH ANY HEIGHT AND ANY OCCUPANCY **(SHALL BE TESTED FOR THE THICKNESS INTENDED TO BE USED)**	i. Core shall be tested to the criteria iii or iv and v. ii. Panel shall be tested with the thickness intended to the criteria iii or iv and v. iii. EN 13501-1 With pass criteria A OR A2-s1-d0 OR iv. FM 4880 With pass criteria "Non-combustible core" AND v. ASTM D1929 Shall have self-ignition temperature of not less than 343°C.	i. ASTM E 119 With pass criteria "1 Hr or 2 Hr OR 3 Hr as per required fire rating of the wall. OR ii. UL 263 With pass criteria "1 Hr or 2 Hr OR 3 Hr as per required fire rating of the wall. OR iii. EN 1362-3 With pass criteria "1 Hr or 2 Hr OR 3 Hr as per required fire rating of the wall. OR iv. EN 1362-4 With pass criteria "1 Hr or 2 Hr OR 3 Hr as per required fire rating of the wall.

Table: - A.02-T17. c.: Sandwich Panel in various applications -Test Requirements		
APPLICATIONS	**TEST 1** **SANDWICH PANEL AS PRODUCT**	**TEST 2** **SANDWICH PANEL IN WALL ASSEMBLY**
1. INTERNAL NON-FIRE RESISTANCE RATED WALLS AND PARTITIONS **(SHALL BE TESTED FOR THE THICKNESS INTENDED TO BE USED)**	i. EN 13501-1 With pass criteria B-d0-S1 OR ii. ASTM E 84/ UL 723 With pass criteria "Class A" OR iii. BS 476 Part 7 With pass criteria "Class 1" OR iv. FM 4880 With pass criteria "Non-combustible core" AND v. ASTM D1929 Shall have self-ignition temperature of not less than 343°C.	NOT REQUIRED
2. INTERNAL FIRE RESISTANCE RATED WALLS AND PARTITIONS **(SHALL BE TESTED FOR THE THICKNESS INTENDED TO BE USED)**	i. EN 13501-1 With pass criteria B-d0-S1 OR ii. FM 4880 With pass criteria "Non-combustible core" AND iii. ASTM D1929 Shall have self-ignition temperature of not less than 343°C.	i. FM 4881 With pass criteria "Class 1" OR ii. UL 1715 With pass criteria "1 Hr or 2 Hr OR 3 Hr as per required fire rating of the wall. OR iii. UL 1040 With pass criteria "1 Hr or 2 Hr OR 3 Hr as per required fire rating of the wall.

Table: - A.02-T17. c.: Sandwich Panel in various applications -Test Requirements		
APPLICATIONS	**TEST 1** **SANDWICH PANEL AS PRODUCT**	**TEST 2** **SANDWICH PANEL IN WALL ASSEMBLY**
3. COLD STORAGE WALLS **(SHALL BE TESTED FOR THE THICKNESS INTENDED TO BE USED)**	i. EN 13501-1 With pass criteria B-d0-S1 OR ii. FM 4880 With pass criteria "Non-combustible core" AND iii. ASTM D1929 Shall have self-ignition temperature of not less than 343°C.	NOT REQUIRED
4. ROOFING-SPRINKLERED BUILDINGS **(SHALL BE TESTED FOR THE THICKNESS INTENDED TO BE USED)**	i. ASTM D1929 Shall have self-ignition temperature of not less than 343°C.	i. NFPA 256 With pass criteria "Class B" OR ii. ASTM E 108 With pass criteria "Class B" OR iii. EN 13501-5 +A1 With pass criteria "Class B roof t4". OR iv. UL 790 With pass criteria "Class B"

Table: - A.02-T17. c.: Sandwich Panel in various applications -Test Requirements		
APPLICATIONS	**TEST 1** **SANDWICH PANEL AS PRODUCT**	**TEST 2** **SANDWICH PANEL IN WALL ASSEMBLY**
5. ROOFING-NON SPRINKLERED BUILDINGS **(SHALL BE TESTED FOR THE THICKNESS INTENDED TO BE USED)**	i. ASTM D1929 Shall have self-ignition temperature of not less than 343°C.	i. NFPA 276 With pass criteria "Class 1" OR ii. ASTM E 108 With pass criteria "Class A" OR iii. EN 13501-5 +A1 With pass criteria "Class B roof t4". OR iv. UL 790 With pass criteria "Class A" OR v. FM 4470 Or FM 4471 With pass criteria "Pass"

5.10. GRC/GRFC and GRP Systems

5.10.1. GRP/GRFC and GRP systems shall comply with general requirements of **Sub Section 5.5,** where used on façade and exterior wall and the specific requirements of Sub **Section 5.10.**

5.10.2. GRP/GRFC and GRP systems may be used in a variety of building exterior envelope and Façade systems, many of which may be project based and of a specific design. However, Manufacturers, Consultants, Design Teams, Contractors and Testing laboratories must ensure that these systems comply in the first instance with the Reaction to Fire, Surface Spread of Flame and Resistance to Fire performance requirements and intent of the Kingdom of Bahrain Fire and Life Safety Code of Practice. This also includes selection of non-combustible formers, appropriate Fire Stopping and buildability of the tested system against the field application.

5.10.3. Definition

5.10.3.1. Glass fiber reinforced concrete or GFRC is a type of fiber-reinforced concrete. The product is also known as glass fiber reinforced concrete or GRC. Glass fiber concretes are mainly used in exterior building façade panels and as architectural precast concrete.



GRC PANEL FOR ILLUSTRATION



5.10.3.2. Glass-reinforced plastic (GRP), also known as glass fibre reinforced plastic (GRFP) is a fibre reinforced polymer made of a plastic matrix reinforced with Glass Fibres.

5.10.4. Specific Requirements

5.10.4.1. GRP(GRFP) shall be constructed such that it meets the performance characteristics required as per ASTM D3841.

5.10.4.2. GRC/GRFC and GRP systems shall be certified and listed by a third-party independent testing and Certification body, permitted by General Directorate of Civil Defence – Kingdom of Bahrain.

5.10.4.3. GRC/GRFC and GRP systems shall be Marked/labeled to verify its certification mark from accredited certification laboratory.

5.10.4.4. The Base layers and core materials shall be tested separately and entire assembly including ornaments, trims and moldings with intended thickness, joints, seams, fasteners and wall arrangement shall be tested in accordance with **Table: - A.02-T18. a.**

5.10.4.5. Where GRC/GRFC and GRP systems are installed on Fire rated or load bearing walls, the wall arrangement shall be tested in accordance with **Table: - A.02-T18. b.**

5.10.4.6. Reaction to Fire Testing of GRC/GRFS/GRP Products to EN13501-1 MUST include EN 13823 and EN ISO 11925 testing as a panel with the thickness and form of intended use, including consideration of air space behind the formed panel. Mounting on non-combustible substrates for the EN ISO 11925 test is not appropriate should the intended use not be reflected during reaction to fire testing.

5.10.5. Test Certification

5.10.5.1. GRC/GRFC and GRP panels and facade systems on non-fire resistance rated and non-load bearing exterior wall coverings shall comply with **Table: - A.02-T18. a.**

5.10.5.2. GRC/GRFC and GRP panels and facade systems on fire resistance rated exterior wall assembly coverings shall comply with **Table: - A.02-T18b.**

5.10.6. Application

5.10.6.1. The occupancies and type of buildings that are allowed to have GRC/GRFC and GRP shall be in accordance with **Table: - A.02-T18. a.** and **Table: - A.02-T18. b.**

Table: - A.02-T18. a.: GRC/ GRFC and GRP Panels on Non-Fire Resistance rated and Non-Load bearing Exterior wall coverings-Test Requirements		
OCCUPANCY AND TYPE OF BUILDING	**TEST 1** **GRC/ GRFC/ GRP AS PRODUCT**	**TEST 2** **GRC/ GRFC/ GRP AS WALL ASSEMBLY**
1. SUPER HIGHRISE BUILDING **2. HIGHRISE BUILDING** **3. MALLS** **4. THEME PARKS** **5. SCHOOLS** **6. HOSPITALS** **7. ASSEMBLY**	i. EN 13501-1 With pass criteria A OR A2-s1-d0 WITH ii. EN 13823 AND iii. EN ISO 11925 AND iv. ASTM D1929 Shall have self-ignition temperature of not less than 343°C. OR v. ASTM D3841 for GRP only with category CC1	i. BS 8414 –1 Or 2 With pass criteria as per BRE 135 OR ii. FM 4881 With pass criteria “Pass” OR iii. ISO 13785-2 With pass criteria “Pass”
8. LOWRISE BUILDING **9. MIDRISE BUILDING** **10. WAREHOUSE** **11. INDUSTRIAL**	i. EN 13501-1 With pass criteria B-s1-d0 OR ii. ASTM D1929 Shall have self-ignition temperature of not less than 343°C. OR iii. ASTM D3841 for GRP only with category CC2	i. BS 8414 –1 Or 2 With pass criteria as per BRE 135 OR ii. FM 4881 With pass criteria “Pass” OR iii. ISO 13785-2 With pass criteria “Pass”

Table: - A.02-T18. b.: GRC/ GRFC and GRP Panels on Fire Resistance rated and Non-Load bearing Exterior wall coverings-Test Requirements		
OCCUPANCY AND TYPE OF BUILDING	**TEST 1** **GRC/ GRFC/ GRP AS PRODUCT**	**TEST 2** **GRC/ GRFC/ GRP AS WALL ASSEMBLY**
1. ANY BUILDING **2. ANY INSTALLATION** **3. ANY AESTHETICS**	i. EN 13501-1 With pass criteria A OR A2-s1-d0 WITH ii. EN 13823 AND iii. EN ISO 11925 AND iv. ASTM D1929 Shall have self-ignition temperature of not less than 343◦C. OR v. ASTM D3841 for GRP only with category CC1	i. ASTM E 119 With pass criteria “1 Hr or 2 Hr or 3 Hr as per re- quired fire ratings of the wall. OR ii. UL 263 With pass criteria “1 Hr or 2 Hr or 3 Hr as per re-quired fire ratings of the wall. OR iii. EN 1362-3 With pass criteria “1 Hr or 2 Hr or 3 Hr as per re-quired fire ratings of the wall. OR iv. EN 1362-4 With pass criteria “1 Hr or 2 Hr or 3 Hr as per re-quired fire ratings of the wall.

6.0 Glazing Systems

6.1. Intention

6.1.1. The provisions of this document shall specify the minimum requirements for the certification and listing, design, installation, inspection and maintenance of glazing systems to achieve acceptable levels of Fire resistance, Reaction to fire, Perimeter fire protection, Safety of people from impact with glass.

6.1.2. The weather protection of buildings is not within the scope or intention of this section. Weather protection aspect to buildings, such as protection from wind and water, seismic pressure etc., shall comply with Ministry of Municipalities regulations and requirements.

6.1.3. The intention of this section is to ensure that flame spread on exterior glazed façade, or glazed room radiation or radiation from glazed fire doors is restricted to ensure safety of people.

6.2. Applications of Glazing Systems where glazing is specified as part of fire compartmentation

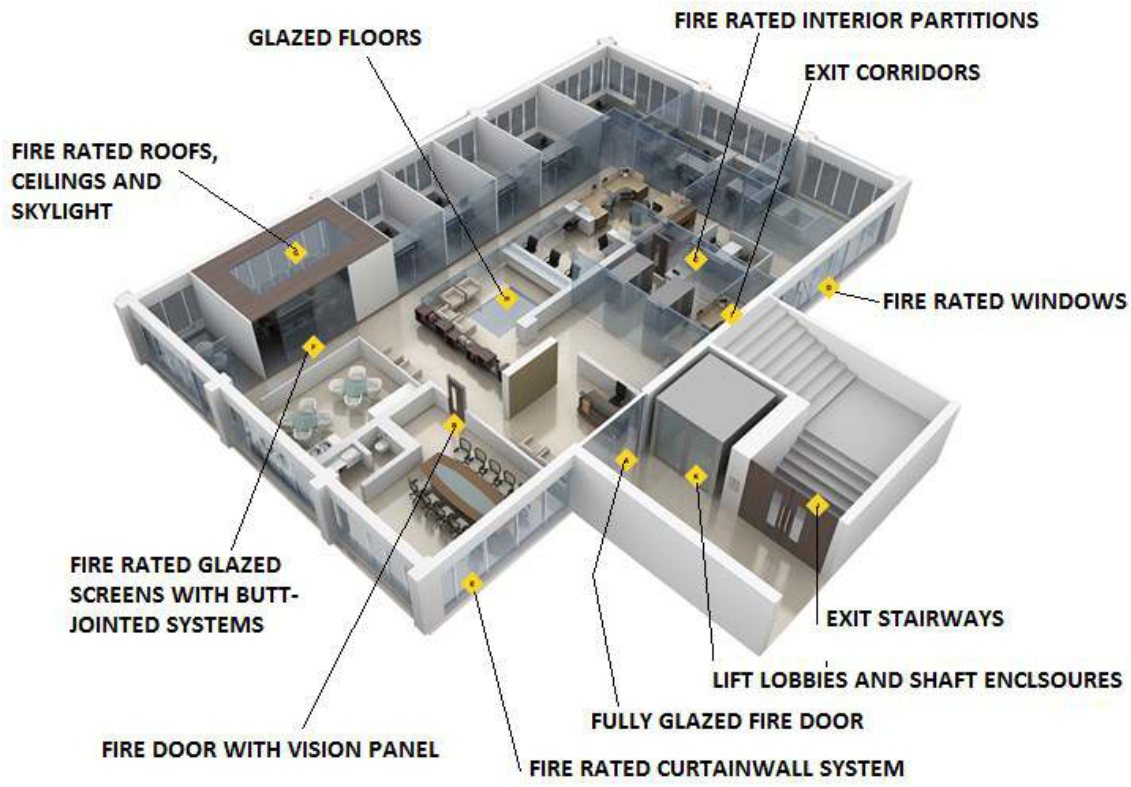


Figure:- A.02-F20.: Glazing Applications in a building

6.3. Glazing Testing and Acceptance

6.3.1. The requirement for fire rated glazing in any building shall be based on the General Directorate of Civil Defence – Kingdom of Bahrain permitted Fire and Life Safety Drawings and strategy for the building, which identifies the following.

a. The type of Fire resistance required according to EN standards or Fire resistance rating & Fire protection rating according to American standards.

b. The duration of fire resistance required (30 min, 45 min, 60 min, 90 min, 120 min etc.)

c. Whether the glazing should be 'integrity' only or 'integrity and insulation'.

6.3.2. The Glazing shall comply with the relevant general requirements of **Sub Section 5.5.,**

Table: - A.02-T18: Glazing Test requirements.

GLAZING APPLICATION IN THE BUILDING	TEST A WHERE FIRE RESISTANCE RATING IS REQUIRED	TEST B SAFETY GLAZING TESTS (Resistance to impact either without breaking, or breaking in way such that persons may not sustain piercing or cutting injuries.)
1. NON-LOAD BEARING CURTAINWALL WITH GLAZING,	TESTED WITH ANY OF THE FOLLOWING, WHERE FIRE RESISTANCE RATING IS REQUIRED Pass as assembly with NFPA 251 Pass as assembly with EN 1364-3 Pass as assembly with UL 263 Pass as assembly with ASTM E119	EN 12600 OR ANY OF THE FOLLOWING ANSI Z97.1, A FOR < 0.9 m^2, B FOR > 0.9 m^2 CPSC 16 CR 1202, I FOR < 0.9 m^2, II FOR > 0.9 m^2
2. NON-LOAD BEARING WALLS	TESTED WITH ANY OF THE FOLLOWING, WHERE FIRE RESISTANCE RATING IS REQUIRED Pass as assembly with EN 1364-1 Pass as assembly with NFPA 251 Pass as assembly with UL 263 Pass as assembly with ASTM E119	EN 12600 OR ANY OF THE FOLLOWING ANSI Z97.1, A FOR < 0.9 m^2, B FOR > 0.9 m^2 CPSC 16 CR 1202, I FOR < 0.9 m^2, II FOR > 0.9 m^2
3. CEILING	TESTED WITH ANY OF THE FOLLOWING, WHERE FIRE RESISTANCE RATING IS REQUIRED Pass as assembly with EN 1364-2 Pass as assembly with NFPA 251 Pass as assembly with UL 263 Pass as assembly with ASTM E119	EN 12600 OR ANY OF THE FOLLOWING ANSI Z97.1, A FOR < 0.9 m^2, B FOR > 0.9 m^2 CPSC 16 CR 1202, I FOR < 0.9 M^2, II FOR > 0.9 m^2
4. LOAD BEARING ELEMENTS (FLOOR AND ROOF)	TESTED WITH ANY OF THE FOLLOWING, WHERE FIRE RESISTANCE RATING IS REQUIRED Pass as assembly with EN 1365-2 Pass as assembly with NFPA 251 Pass as assembly with UL 263 Pass as assembly with ASTM E119	EN 12600 OR ANY OF THE FOLLOWING ANSI Z97.1, A FOR < 0.9 m^2, B FOR > 0.9 m^2 CPSC 16 CR 1202, I FOR < 0.9 m^2, II FOR > 0.9 m^2

Table: - A.02-T18: Glazing Test requirements.		
GLAZING APPLICATION IN THE BUILDING	**TEST A**	**TEST B** **SAFETY GLAZING TESTS** **(Resistance to impact either without breaking, or breaking in way such that persons may not sustain piercing or cutting injuries.)**
5. DOORS AND VISION PANELS	**TESTED WITH ANY OF THE FOLLOWING, WHERE FIRE RESISTANCE RATING IS REQUIRED** **Pass as assembly with UL 10 C** **Pass as assembly with NFPA 252** **Pass as assembly with EN 1634-1** **Pass as assembly with BS 476 Part 22.**	**EN 12600** **OR** **ANY OF THE FOLLOWING** **ANSI Z97.1, A FOR < 0.9 m^2,** **B FOR > 0.9 m^2** **CPSC 16 CR 1202, I FOR < 0.9 m^2, II FOR > 0.9 m^2**
6. WINDOWS	**TESTED WITH ANY OF THE FOLLOWING, WHERE FIRE RESISTANCE RATING IS REQUIRED** **Pass as assembly with UL 9** **Pass as assembly with NFPA 257** **Pass as assembly with EN 1634-1:2014**	**EN 12600** **OR** **ANY OF THE FOLLOWING** **ANSI Z97.1, A FOR < 0.9 m^2 ,** **B FOR > 0.9 m^2** **CPSC 16 CR 1202, I FOR < 0.9 m^2 ,** **II FOR > 0.9 m^2**
7. BATHING/SHOWER ENCLOSURE/SCREEN/ SWIMMING/ WET AREAS (SLIP RISK)	**No Requirements**	**EN 14428** **AND** **Also, shall comply with safety glass requirements of Section 5.4.2.**

6.4. Design, Installation, Inspection & Maintenance

6.4.1. Fire Resistant Glazing - Design / Specification

6.4.1.1. Fire resistant glazing systems shall be designed by a specialist manufacturer.

6.4.1.2. It is the consultant's responsibility to ensure that qualified glazing specialist is involved in the design, in full compliance with this code.

6.4.1.3. In addition to the fire strategy permitted by General Directorate of Civil Defence – Kingdom of Bahrain, the following points shall be addressed by the glazing installer to ensure they are consistent with the fire strategy and overall intent of the proposed glazing system:

a. The minimum fire rating specified relates to a full system of components. All elements of the fire barrier being created must collectively provide the performance required as part of a fire-resistant assembly.

b. The final glazing system installed must be the same as the system that has been tested in accordance with the General Directorate of Civil Defence- Kingdom of Bahrain requirements. Project-specific differences should be discussed with the manufacturer and system certifier.

c. The system selected must be capable of performing in the environment in which it is intended to be installed, in particular internal or external environments.

d. The impact-resistance of the glazing has to be met as specified by the impact rating as per **Table: - A.02-T18.**

e. For unidirectional systems, the direction of the fire-side should be labeled and easily identifiable on the glass, profiles or accessories. Where the direction of fire is not known, only bi-directional fire-rated glazing components should be used.

f. Fire-rated glazing in inclined and horizontal applications shall be tested and permitted separately to fire rated glazing in vertical applications. Vertically tested systems cannot be assumed to work in horizontal or inclined glazing applications.

g. The specified system should have a label with scope based on the type of fire represented during the fire test of the system (For example, a fire-resistant system tested for domestic fires may not sustain conditions of industrial fires).

h. Considerations for the glazing system design shall include but not be limited to the overall screen size, fenestration layout within the screen, materials used in construction of the profile (such as the gauge, quality, thickness, finish, etc.) and the amount of edge cover and edge clearance.

i. Standard impact safety toughened or safety / security laminated glass is not necessarily fire-rated and the same cannot be used without it being tested and permitted.

6.4.2. Safety Glazing - Design / Specification

6.4.2.1. The Safety Glazing is required in critical locations (2,3,4,5,6,7,8 and 11) described in doors, side panels and low-level glazing as shown in the Figure**: - A.02-F21 and A.02-F22.**

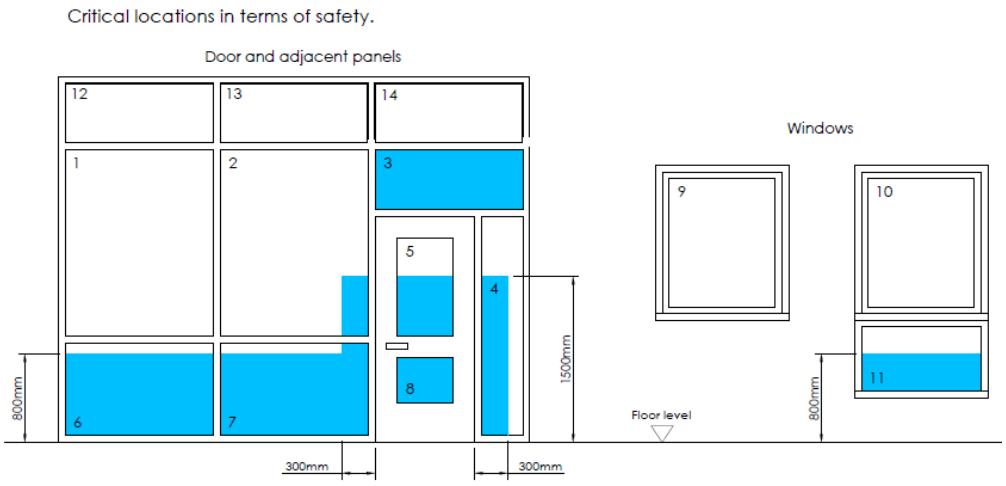


Figure:- A.02-F21.: Safety Glazing at Door and adjacent areas

Figure:- A.02-F22.: Safety Glazing at Windows

6.4.2.2. Minimum classification Requirements of safety glass or safety plastics to be used in critical locations (Such as Gymnasiums, places of energetic activities, play areas etc.,) shall be as per **Table: - A.02-T19.**

6.4.2.3. Where glazing is only accessible from one side (3.a, 4.a), the testing and classification can be from only that side.

Table:- A.02-T19: Minimum Classification for Safety Glazing

CRITICAL LOCATION	GLAZING PANE DIMENSION	SAFETY GLASS	SAFETY PLASTICS
1. DOORS	> 900 mm	2(β)Φ	Class B
	≤ 900 mm	3(β)Φ	Class C
2. DOOR SIDE PANEL	> 900 mm	2(β)Φ	Class B
	≤ 900 mm	3(β)Φ	Class C
3. FULLY BACKED MIRROR GLAZING (A)	> 900 mm	2(β)Φ	Class B
	≤ 900 mm	3(β)Φ	Class C
4. UNBACKED MIRROR GLAZING (A)	> 900 mm	2(β)Φ	Class Bo
	≤ 900 mm	3(β)Φ	Class Co
5. LOW LEVEL AREAS	Irrespective of pane dimensions	3(β)Φ	Class C
6. BATHING AREAS	Irrespective of pane dimensions	3(β)Φ	Class C
7. AREAS OF SPECIAL RISK	Irrespective of pane dimensions	3(β)Φ	Class C

6.4.2.4. Glass Safety classification as per EN 12600 shall be as per **Table: - A.02-T20. and Table: - A.02-T21.**

Table: - A.02-T20: Glass Classification as per EN 12600.

PVB LAMINATED GLASS CODE	PVB FILM THICKNESS	GLASS THICKNESS	CLASS AS PER EN 12600
33.1	0.38 mm	6.4 mm	2(B)2
44.1	0.38 mm	8.4 mm	2(B)2
55.1	0.38 mm	10.4 mm	1(B)1
33.2	0.76 mm	6.8 mm	1(B)1
44.2	0.76 mm	8.8 mm	1(B)1
44.4	1.52 mm	9.5 mm	1(B)1
44.6	2.28 mm	10.3 mm	1(B)1
55.2	0.76 mm	10.8 mm	1(B)1
66.2	0.76 mm	12.8 mm	1(B)1
88.2	0.76 mm	16.8 mm	1(B)1

Table: - A.02-T21: Tempered Glass Classification as per EN	
THICKNESS OF TEMPERED GLASS	MINIMUM REQUIRED CLASSIFICATION AS PER EN 12600
4 mm	1(C)2
6 mm	1(C)2
8 mm	1(C)2
10 mm	1(C)1
12 mm	1(C)1

6.4.3. Labeling / Manifestation

6.4.3.1. Under some conditions of lighting, large areas of transparent glazing used to subdivide a building might not be readily apparent. The risk of human impact with this glazing is greatest if adjacent areas within or immediately outside the building are at the same level so that a person might reasonably assume unimpeded passage from one part to another.

6.4.3.2. If the presence of such glazing is not sufficiently well indicated by mullions, transoms, door frames, large door handles, stall risers or other components of the glazing system, it shall be made apparent by some form of manifestation.

6.4.3.3. The manifestation employed should be of a sufficient size to make it immediately obvious.

6.4.3.4. It shall take the form of broken or solid lines, patterns or company logos or similar, positioned between 600 mm and 1500 mm above floor level at appropriate horizontal intervals. The manifestation should preferably be permanent, e.g. etching of the glazing, but alternatively, if applied materials are used they should be durable and not easily removed.

6.4.4. Overhead glazing

6.4.4.1. Glass used in overhead glazing shall be required to remain in position post-breakage.

6.4.4.2. Overhead glazing shall be laminated and include a post-breakage containment system, such that if the glass breaks the glass is held in place until it can be replaced.

6.4.4.3. Broken glass shall be replaced promptly.

6.4.4.4. Examples of post-breakage containment systems are:

a. Silicone structural adhesives
b. Mechanically fixed batten bars
c. Adhesively fixed batten bars
d. Polyester and acrylic foam tapes
e. Structural washers
f. Adhesive-backed polymeric film applied to glass in conjunction with one of the retention systems listed above.

6.4.4.5. Injury from objects falling through the glass are not considered in these requirements. A specific risk assessment should be conducted to evaluate this. However, consideration at design stage may enable selection of suitable glazing materials / measures to mitigate this situation.

6.4.4.6. This section does not consider the risk of injury to persons who may fall onto the non-vertical (sloping) overhead glazing.

6.4.4.7. CWCT TN66 shall be used to evaluate the safety and fragility of glazed roofing.

6.4.5. Glass Floors and Staircases

6.4.5.1. The use of glass in floors or staircases shall be limited to pedestrian foot traffic only. (see GGF data sheet 7.3: Guidelines for the use of glass in floors and stairs)

6.4.5.2. For the specification of the design floor loads for the specific use of the building the following standard shall be used.

a. EN 1991-1-1: 2002: Eurocode 1 –Actions on structures –General actions densities, self-weight, imposed loads for buildings.

b. Glass required to be walkable shall be designed in accordance with CWCT TN66 using the following standard in relation to the danger of slippage and minimum coefficients of friction. Slip resistance shall not depend on the use of specialized footwear.

c. BS 5395-1: 2010 Stairs. Code of practice for the design of stairs with straight flights and winders.

6.4.5.3. The strength of the supports shall be calculated by a competent structural engineer, with the deflection of the frame limited to an appropriate value for the glass type.

6.4.5.4. Consideration shall be given to the complete design process. The following list comprises a number of topics that shall be considered alongside the regulatory requirements. The list is not exhaustive but relates to the common considerations:

a. Imposed loadings from design code
b. Surface finish
c. Strength of supporting glazing system
d. Impact by falling or thrown objects
e. Exposure to solar radiation and water
f. Post-fracture behavior
g. Deflection

6.4.5.5. A risk analysis shall be based on the following:
a. Frequency of use
b. Potential for exposure to water and slipping
c. Potential for glazing breakage from impacts
d. Consequences of glazing failure, i.e. Post-breakage behavior of the glazing material.

6.4.5.6. The ability of a broken pane to remain in situ is dependent upon the loads being applied, the glass type, the temperature, the number of fractured plies and the type of interlayer considered in the construction.

6.4.6. Installation

6.4.6.1. The installation shall be carried out by General Directorate of Civil Defence – Kingdom of Bahrain and Ministry of Municipalities permitted installer or fabricator as per system manufacturer's installation instructions and shall comply with local regulations and the construction documents.

6.4.7. Installer Qualification

6.4.7.1. Installer and fabricator specializing in Glazing system installation and certified by the system manufacturer shall be listed with General Directorate of Civil Defence – Kingdom of Bahrain and Ministry of Municipalities.

6.4.7.2. The installer and fabricator license shall be based on the training and certification by the system manufacturer to install manufacturer's products as per specified listed system requirements.

6.4.8. Inspection

6.4.8.1. Special inspection shall be required for all Glazing system. Inspection shall take place in successive stages as installation progresses.

6.4.8.2. The manufacturer's guidelines shall be available to and used by the glazing specialist.

6.4.8.3. It is consultant's responsibility to recruit qualified glazing specialists to inspect the glazing systems or to hire the services of General Directorate of Civil Defence – Kingdom of Bahrain permitted house of expertise.

6.4.8.4. It is consultant's responsibility to ensure that installer's work is inspected during construction and installation at each stage.

6.4.8.5. Consultant or General Directorate of Civil Defence – Kingdom of Bahrain permitted house of expertise undertaking glazing inspections shall have the following qualifications.

a. Accredited to ISO/IEC 17020 or relevant IAS criteria or ICC specialist training and certification or equivalent international criteria acceptable to Ministry of Municipalities and General Directorate of Civil Defence – Kingdom of Bahrain.
b. 2 glazing specialists, qualified as per **Sub Section 6.4.9.**
c. 3 years experience in fire and life safety aspect of glazing systems' inspections.

6.4.9. Glazing Specialist Qualification

6.4.9.1. The glazing specialists of consultant's in-house team or Manufacturer's representative or General Directorate of Civil Defence – Kingdom of Bahrain permitted house of expertise, undertaking design, consultancy, inspection shall have the following qualifications.

a. Bachelor's degree in engineering
b. 5 years experience in glazing systems design and inspections
c. Training and certifications by the glazing system manufacturers.

6.4.9.2. The glazing specialists from consultants or manufacturers or house of expertise shall be registered and licensed by or General Directorate Civil Defence – Kingdom of Bahrain based on their qualifications as required by **Sub Section 6.4.9.1.** and written examination.

6.4.10. Acceptance of the installation

6.4.10.1. The main consultant and his hired façade consultant or house of expertise shall be responsible for the glazing design specifications, material selection, fabricator selection, initiation of laboratory tests, verification of test results, progressive inspection during construction and commissioning.

6.4.10.2. The main consultant, the Glazing system manufacturer, glazing system installer, glazing system fabricator, glazing specialist and the house of expertise shall jointly sign off the installation and provide final inspection report for or General Directorate of Civil Defence – Kingdom of Bahrain' acceptance as evidence of compliance.

6.4.11. Registration of the glazing

6.4.11.1. The glazing processor shall be responsible for glazing tests as required by Table**: - A.02-T18., TEST B., Safety and impact tests.** The glazing processor shall be registered with or General Directorate of Civil Defence – Kingdom of Bahrain along with his tested materials.

6.4.11.2. The glazing fabricator shall be responsible for glazing tests as required by Table**: - A.02-T18., TEST A., Fire rating of the glazing assembly.** The glazing

fabricator shall be registered with or General Directorate of Civil Defence – Kingdom of Bahrain along with his tested assemblies.

7. Roofing Systems

7.1. Intention

7.1.1. The provisions of this document shall specify the minimum requirements for the certification and listing, design, installation, inspection and maintenance of Roofing System to achieve acceptable levels of Fire safety of buildings.

7.1.2. The weather protection of buildings is not the scope or intention of this section. Weather protection aspect to buildings, such as protection from wind, water, seismic impact etc., shall comply with Ministry of Municipalities regulations and requirements.

7.1.3. The intention of this section is to ensure that flame spread on roofing is restricted.

7.2. Components of Roofing Systems

7.2.1. Roofing systems are composed of varying types of components such as Roof coverings, Organic or Glass Fiber, Asphalt felts, Metal Composite panels, Sandwich Panels, Photovoltaic Panels, Single Ply Membrane, Insulation, Support System etc.

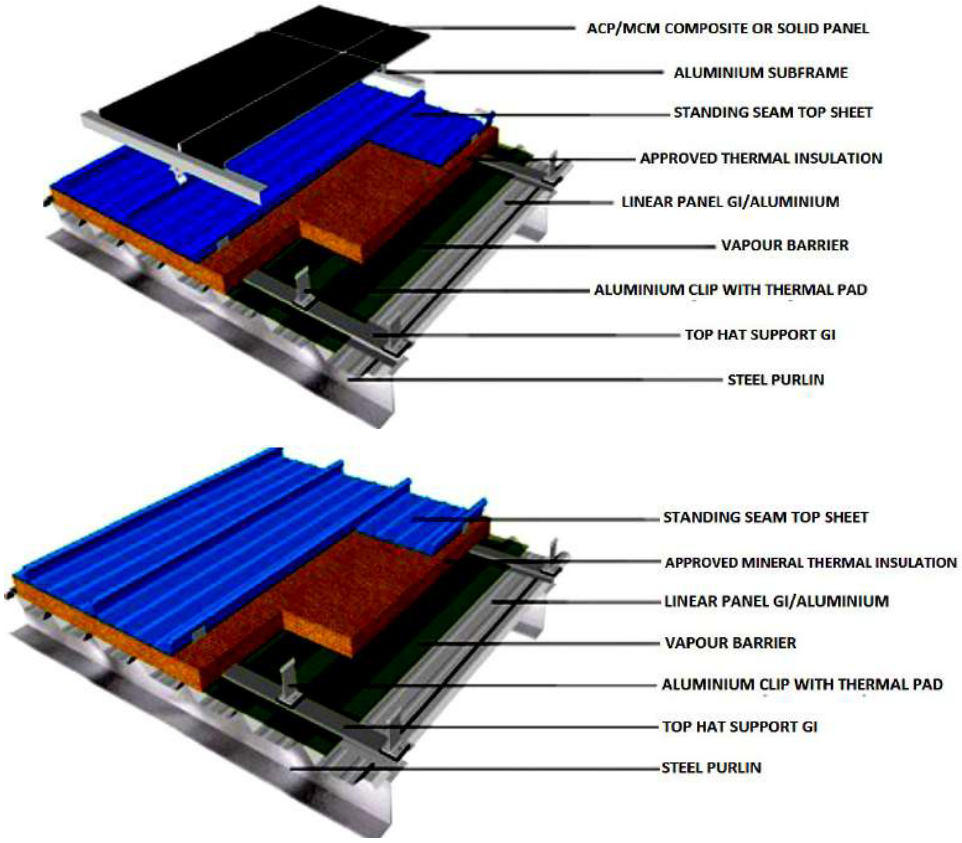


Figure:- A.02-F23.: Various components of Roofing System

7.3. Roofing System Testing and Acceptance

7.3.1. The roofing systems manufacturers/suppliers and their product systems shall be registered with Ministry of Municipalities and General Directorate of Civil Defence – Kingdom of Bahrain.

7.3.2. The performance requirements of roofing systems shall be classified based on the following criteria.

- **a.** Occupancy of the building.
- **b.** Sprinkler protection for the building.
- **c.** Distance and proximity to other buildings.
- **d.** Construction Type and Building materials used.

7.3.3. The roofing systems shall be certified and listed by a third party independent Testing and Certification body, permitted by General Directorate of Civil Defence – Kingdom of Bahrain.

7.3.4. Parties seeking permit for roof assemblies or rooftop structures shall furnish the test certificates, permitted certification numbers for the system as an assembly and not for the individual components.

7.3.5. Only companies with a valid commercial license will be eligible for General Directorate of Civil Defence – Kingdom of Bahrain permitted if products are tested and certified according to specifications and requirements of this code.

7.3.6. The entire roofing system including ornaments, trims and moldings with intended thickness, involved core, insulation, joints, seams, fasteners and wall arrangement shall be tested in accordance with any of the following standards:

7.3.7. Only Private Villas, Commercial Villas and Agricultural buildings are exempted from having fire rated/ listed roof assemblies or rooftop structures.

7.3.8. Roof coverings with following materials shall be allowed without testing and certification.

- **a.** Brick, masonry or concrete exposed roof deck
- **b.** Tiles/ Slates made up of concrete or clay
- **c.** Copper or ferrous sheets/shingles

7.4. Design, Installation, Inspection & Maintenance

7.4.1. Design/Specification/Submittals

7.4.1.1. It is consultant's responsibility to recruit roofing specialists to design roofing systems in full compliance with this code.

7.4.1.2. Consultant's roofing submittal to General Directorate of Civil Defence-Kingdom of Bahrain shall be during project design NOC application, along with architecture, fire alarm, firefighting and smoke control proposals.

7.4.1.3. Roofing System shall be specified in accordance with their test certifications as an assembly as per **Table: - A.02-T22**.

Table: - A.02-T22.: Roofing System Test requirements.			
OCCUPANCY AND TYPE OF BUILDING	**EXTERIOR FIRE EXPOSURE TO ROOFING ASSEMBLIES**	**INTERIOR OR UNDER DECK FIRE EXPOSURE TO ROOFING ASSEMBLIES**	**PLASTIC SKY LIGHTS ON ROOFING ASSEMBLIES**
1. NON SPRINKLERED BUILDINGS, **2. BUILDINGS WITHOUT FIRE SUPPRESSION SYSTEMS,** **3. BUILDINGS, LESS THAN 6 M FROM NEIGHBORING BUILDING,** **4. MALLS,** **5. ASSEMBLY,** **6. HOSPITAL,** **7. EDUCATIONAL,**	**ANY OF THE FOLLOWING** **Class A with ASTM E 108** **Class AA with BS 476 -3** **Class Broof t4 with EN 13501-5: +A1** **Class A with UL 790** **Class 1 with NFPA 276** **Pass with FM 4470 or FM 4471**	**ANY OF THE FOLLOWING** **CLASS I rating with FM 4450** **Pass as assembly with UL 1256** **Structural Metal panel Roof systems shall be tested with FM 4471** **Roof systems with modified bitumen and other types of membrane roof systems shall be tested with FM 4470**	**ANY OF THE FOLLOWING** **Class A with FM 4431** **Class A with ASTM E 84** **Class A with UL 723** **Class 1 with BS 476 –7** **Class A with EN 13501-1**
8. OTHER BUILDINGS AND OCCUPANCIES, NOT MEN- TIONED ABOVE **9. BUILDINGS WITH SPRINKLER PROTECTION** **10. BUILDINGS WITH FIRE SUPPRESSION SYSTEMS**	**ANY OF THE FOLLOWING** **Class B with NFPA 256** **Class B with ASTM E 108** **Class BB with BS 476 -3** **Class B roof t4 with EN 13501-5: +A1** **Class B with UL 790**		**ANY OF THE FOLLOWING** **Class B with FM 4431** **Class B with ASTM E 84** **Class B with UL 723** **Class 2 with BS 476 –7** **Class B with EN 13501-1**

7.4.1.4. For Roof recovering situations, where covering an existing roofing system with a new roofing system or Roof Replacement situations where removing an existing roof system and replacing it with a new system, the following methods shall apply.

a. Certified insulated systems may be installed over existing certified insulated systems when:

i. The new system is certified for use with the existing roof insulation type (glass fiber, perlite, wood fiber, foamed plastic, etc.

ii. The total thickness of insulation in both systems does not exceed the maximum specified for the new system being applied.

b. For installation over noncombustible decks, any certified insulated system utilizing minimum 1-in.-thick insulation (glass fiber, polyisocyanurate or perlite) may be used over any existing insulated system regardless of the type, provided the insulation in both systems does not exceed the maximum specified for the new system being applied.

c. The above classifications apply only to coverings composed of certified materials assembled as described in the individual manufacturer certifications; flashings and trimmings being the same as or not less than the equivalent of the roofing systems in each class, or of 16 oz. or heavier copper, No. 26 gauge or heavier galvanized steel, or 0.019 in. thick or heavier aluminum.

7.4.1.5. Roofing shall be designed by a roofing specialist designer and shall specify in accordance with their test certifications, as an assembly as per **Table: - A.02-T22.** And manufacturer's recommendations.

7.4.1.6. The system manufacturer shall provide a formal submittal to the Ministry of Municipalities and General Directorate of Civil Defence – Kingdom of Bahrain for product registration that will consist of the following.

a. Product Data – Manufacturer's Specifications, Technical Data and Material Safety Data Sheet for each material including the composition and limitations, if any.
b. Design Listings and certifications – System design listing or test certifications, including illustrations, from an accredited testing laboratory as per referenced standards that is applicable to each system configuration. Test reports without certification from accredited certification bodies is invalid.
c. Engineering Judgment (EJ) – Where there is deviation from a listed and certified system, on site, for a particular configuration, the manufacturer, specialist designer, roofing contractor and consultant shall jointly provide a site specific EJ.
d. Method Statement shall clearly define the manufacturer's installation instructions.
e. Statement of Manufacturer's standard warranty for minimum of 10 years.
f. An undertaking letter in understanding with General Directorate of Civil Defence – Kingdom of Bahrain, that supplying any material that is non-compliant with this code is illegal and punishable.

7.4.2. Installation

7.4.2.1. The installation shall be carried out by General Directorate of Civil Defence - Kingdom of Bahrain and Ministry of Municipalities permitted installer as per system manufacturer's installation instructions and shall comply with local regulations and the construction documents.

7.4.3. Installer Qualification

7.4.3.1. Installer specializing in Roofing system installation and certified by the system manufacturer shall be listed with Ministry of Municipalities and General Directorate of Civil Defence - Kingdom of Bahrain.

7.4.3.2. The installer license shall be based on the training and certification by the system manufacturer to install manufacturer's products as per specified listed system requirements.

7.4.4. Inspection

7.4.4.1. The manufacturer's guidelines shall be available to and used by the inspection personnel.

7.4.4.2. The consultant shall be responsible for progressive inspection and shall sign off the inspection reports.

7.4.5. Acceptance

7.4.5.1. The main consultant, the roofing system manufacturer, roofing system installer shall jointly sign off the installation and provide final inspection report for General Directorate of Civil Defence – Kingdom of Bahrain acceptance as evidence of compliance.

8. Construction Material Test Standards, Permits and Registration.

8.1. Acceptable Test Standards and criteria

8.1.1. All the Materials, Components, Systems, Assemblies, equipment, Products and accessories, referred to in this chapter with respect to construction and Life Safety, Fire Safety and Emergency Services shall be Listed, Permitted and Registered by the General Directorate of Civil Defence – Kingdom of Bahrain Material permit Department.

8.1.2. **There is no year of edition mentioned against any test standards. It is the intent of General Directorate of Civil Defence – Kingdom of Bahrain to convey to the customers seeking material tests and the test laboratories to follow the "LATEST EDITION OF THE TEST STANDARD, AS AND WHEN THEY ARE UPGRADED/REVISED/AMENDED, TO THE DATE."**

8.1.3. Fire resistance rating of Fire Walls/ Fire Barriers

i. EN 1365-1: fire resistance tests for loadbearing elements. part 1: walls.
ii. ASTM E 119, Standard Test Methods for Fire Tests of Building Construction and Materials
iii. EN 1364-3, Fire resistance tests for non-loadbearing elements. Curtain walling. Full configuration (complete assembly)
iv. EN 1364-4: Fire resistance tests for non-loadbearing elements - Part 4: Curtain walling - Part configuration
v. EN 1364-1, Fire resistance tests for non-loadbearing elements - Part 1: Walls;
vi. UL 263, Standard for Fire Tests of Building Construction and Materials.
vii. NFPA 251, Standard methods of tests of fire resistance of building construction and materials.
viii. BS 476-21: Fire tests on building materials and structures - part 21: Methods for the determination of the fire resistance of loadbearing elements of construction
ix. BS 476-22: Fire tests on building materials and structures - part 22: Methods for the determination of the fire resistance of non-loadbearing elements of construction
x. EN 1365-2 Fire classification of construction products and building elements. Classification using data from fire resistance tests, excluding ventilation services
x. UL 1709, Construction elements with or without load: Beams, pillars, slabs, sealings, lock gates, ducts, walls, curtain walls, etc.
xi. LPS 1208, LPCB fire resistance requirements for elements of construction used to provide Compartmentation.

8.1.4. Interior Wall and Ceiling Finish materials and ceiling plenum assembly

i. ASTM E 119, Standard Test Methods for Fire Tests of Building Construction and Materials
ii. UL 723, Standard for Test of Surface Burning Characteristics of Building Materials
iii. FM 4880, permit Standard for Class 1 Insulated Wall or Wall and Roof/ Ceiling Panels; Plastic Interior Finish Materials; Plastic Exterior Building Panels; Wall/Ceiling Coating Systems; Interior or Exterior Finish Systems.
iv. NFPA 286, Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.
v. EN 13823: Reaction to fire tests for building products - Building products excluding floorings exposed to the thermal attack by a single burning item.
vi. EN-ISO 11925-2: Reaction to fire tests - Ignitability of products subjected to direct impingement of flame - Part 2: Single-flame source test.
vii. EN-ISO 1182: Reaction to fire tests for products - Non-combustibility test
viii. EN-ISO 1716: Reaction to fire tests for products - Determination of the gross heat of combustion (calorific value)
ix. EN 13501-1: Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests.
x. BS 476 Part 7: Fire Tests on Building materials and structures; method of test to determine the classification of the surface spread of flame of products
xi. BS 476 Part 6: Fire Tests on Building materials and structures; method of test for fire propagation for products
xii. EN 1364-2, Fire resistance tests for non-loadbearing elements. Ceilings.
xiii. UL 1715, Standard for Fire Test of Interior Finish Material.

8.1.5. Expanded Vinyl Wall coverings

i. ASTM E 84, Standard Test Method of Surface Burning Characteristics of Building Materials
ii. UL 723, Standard for Test of Surface Burning Characteristics of Building Materials
iii. NFPA 265. Standard methods of fire tests for evaluating room fire growth con-contribution of textile or expanded vinyl wall coverings on full height panels and walls.
iv. EN 13823: Reaction to fire tests for building products - Building products excluding floorings exposed to the thermal attack by a single burning item.
v. EN-ISO 11925-2: Reaction to fire tests - Ignitability of products subjected to direct impingement of flame - Part 2: Single-flame source test.
vi. EN-ISO 1182: Reaction to fire tests for products - Non-combustibility test
vii. EN-ISO 1716: Reaction to fire tests for products - Determination of the gross heat of combustion (calorific value)
viii. EN 13501-1: Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests.
ix. BS 476 Part 7: Fire Tests on Building materials and structures; method of test to determine the classification of the surface spread of flame of products
x. BS 476 Part 6: Fire Tests on Building materials and structures; method of test for fire propagation for products
xi. EN 14390 Fire test - Large-scale room reference test for surface products

8.1.6. Interior Wall and Ceiling Coverings

i. NFPA 286, Standard methods of fire tests for evaluating contribution of wall

and ceiling interior finish to room fire growth

ii. ASTM E 84, Standard Test Method of Surface Burning Characteristics of Building Materials

iii. UL 723, Standard for Test of Surface Burning Characteristics of Building Materials.

iv. EN 1364-2: Fire resistance tests for non-loadbearing elements. Ceilings.

v. EN 13823: Reaction to fire tests for building products - Building products excluding floorings exposed to the thermal attack by a single burning item.

vi. EN-ISO 11925-2: Reaction to fire tests - Ignitability of products subjected to direct impingement of flame - Part 2: Single-flame source test.

vii. EN-ISO 1182: Reaction to fire tests for products - Non-combustibility test

viii. EN-ISO 1716: Reaction to fire tests for products - Determination of the gross heat of combustion (calorific value)

ix. EN 13501-1: Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests.

ix. BS 476 Part 7: Fire Tests on Building materials and structures; method of test to determine the classification of the surface spread of flame of products

x. BS 476 Part 6: Fire Tests on Building materials and structures; method of test for fire propagation for products

8.1.7. Interior Floor and Floor Coverings

i. CPSC 16 CFR, Part 1630

ii. NFPA 253, standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source

iii. ASTM E 648, Standard Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source

iv. EN 13501-1: Fire Classification of Construction products and building elements; classification using data from reaction to fire tests

v. EN ISO 9239-1 Reaction to fire tests for floorings -- Part 1: Determination of the burning behavior using a radiant heat source.

vi. DIN 4102-14 - Fire behavior of building materials and elements - Part 14: Determination of the burning behavior of floor covering systems using a radiant heat source

vii. ULc - S102.2, Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials and Assemblies.

8.1.8. Combustible Decorative Materials

i. NFPA **701, Fire test to textiles and films.**

ii. CAN/ULC-S109 Flame tests of flame-resistant fabrics and films

iii. EN 13823: Reaction to fire tests for building products - Building products excluding floorings exposed to the thermal attack by a single burning item.

iv. EN-ISO 11925-2: Reaction to fire tests - Ignitability of products subjected to direct impingement of flame - Part 2: Single-flame source test.

v. EN-ISO 1182: Reaction to fire tests for products - Non-combustibility test

vi. EN-ISO 1716: Reaction to fire tests for products - Determination of the gross heat of combustion (calorific value)

x. BS 476 Part 6: Fire Tests on Building materials and structures; method of test for fire propagation for products

xi. EN 13501-1: Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests.

xii. BS 476 Part 7: Fire Tests on Building materials and structures; method of test to determine the classification of the surface spread of flame of products

8.1.9. Textile Wall and Textile Ceiling Materials

i. ASTM E 84, Standard Test Method of Surface Burning Characteristics of Building Materials
ii. UL 723, Standard for Test of Surface Burning Characteristics of Building Materials.
iii. BS 476 Part 7: Fire Tests on Building materials and structures; method of test to determine the classification of the surface spread of flame of products
iv. BS 476 Part 6: Fire Tests on Building materials and structures; method of test for fire propagation for products
v. EN 13501-1 Fire classification of construction products and building elements. Classification using test data from reaction to fire tests

8.1.10. Carpets and Textile floor finish

i ASTM D 2859, Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials.
ii. EN 13823: Reaction to fire tests for building products - Building products excluding floorings exposed to the thermal attack by a single burning item.
iii. EN-ISO 11925-2: Reaction to fire tests - Ignitability of products subjected to direct impingement of flame - Part 2: Single-flame source test.
iv. EN-ISO 1182: Reaction to fire tests for products - Non-combustibility test
v. EN-ISO 1716: Reaction to fire tests for products - Determination of the gross heat of combustion (calorific value)
vi. EN 13501-1: Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests.
vii. ASTM E648, Standard test method for critical radiant flux of floor covering systems using a radiant heat source
viii. EN ISO 9239-1 Reaction to fire tests for floorings -- Part 1: Determination of the burning behavior using a radiant heat source.
ix. NFPA 253, Standard method of test for critical radiant flux of floor covering systems using a radiant heat energy source.
x. ULc - S102.2, Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials and Assemblies.

8.1.11. Thermal Barriers (Temperature rise shall not exceed 250°C on unexposed surface)

i. The average temperature rise of the unexposed surface shall not rise more than 250°C after 15 minutes of fire exposure as per ASTM E 119 or UL 263. The thermal barrier shall remain in place for not less than 15 minutes as per UL 1040 or UL 1715.
ii. NFPA 275, Standard Method of Fire Tests for the Evaluation of Thermal Barriers Used Over Foam Plastic Insulation
iii. EN 1364-1 Fire resistance tests for non-loadbearing elements. Walls

8.1.12. Through– penetration Fire stop System

i. ASTM E 814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops
ii. UL 1479, Standard for Safety for Fire Tests of Through-Penetration Fire Stop
iii. EN 1366-3: Fire resistance tests for penetration seals
iv. UL 263, Standard for Fire Tests of Building Construction and Materials.
v. FM 4990, Permitted standard for fire stopping.

8.1.13. Fire resistant Joint System

i. ASTM E 1966, Standard Test Method for Fire-Resistive Joint Systems
ii. UL 2079, Standard for Tests for Fire Resistance of Building Joint Systems.
iii. EN 1366-4: Fire resistance tests for service installations. Linear joint seals.
iv. FM 4990, Permitted standard for fire stopping.

8.1.14. Membrane Fire stop System

i. ASTM E 814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops
ii. UL 1479, Standard for Safety for Fire Tests of Through-Penetration Fire Stop
iii. EN 1366-3: Fire resistance tests for penetration seals
iv. UL 263, Standard for Fire Tests of Building Construction and Materials.
v. FM 4990, Permitted standard for fire stopping.
vi. EN 1366-4: Fire resistance tests for service installations. Linear joint seals

8.1.15. Fire resistance rated Glazing in Doors and Walls is acceptable with following

i. ASTM E 119, Standard Test Methods for Fire Tests of Building Construction and Materials
ii. **UL** 263, Standard for Fire Tests of Building Construction and Materials.
iii. EN 1364-1, Fire resistance tests for non-loadbearing elements - Part 1: Walls;
iv. EN 1634 - 1, Fire resistance test for door and shutter assemblies and openable windows
v. EN 15254-4: Extended application of results from fire resistance tests - Non-loadbearing walls - Part 4: Glazed constructions
vi. BS 476-22: Fire tests on building materials and structures - part 22: Methods for the determination of the fire resistance of non-loadbearing elements of construction.
vii. UL 10B, Standard for Fire Tests of Door Assemblies

8.1.16. Fire retardant coatings

i. ASTM E 276, Standard Test Method for Extended Duration Surface Burning Characteristics of Building Materials.
ii. EN 13381-4, Test methods for determining the contribution to the fire resistance of structural members - Part 4: Applied passive protection to steel members
iii. EN 13381-8, Test methods for determining the contribution to the fire resistance of structural members - Part 8: Applied reactive protection to steel members

8.1.17. Perimeter fire barrier system/Exterior curtainwall/floor intersection

i. ASTM E 2307, Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus
ii. UL 2079, Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-Story Test Apparatus,
iii. EN 1364-4 Fire resistance tests for non-loadbearing elements. Curtain walling. Part configuration
iv. EN 1364-3, Fire resistance tests for non-loadbearing elements. Curtain walling. Full configuration (complete assembly)

8.1.18. Glazing in door assembly

i. NFPA 252, Standard methods of fire tests of door assemblies.
ii. UL 10B/10C, Standard for Fire Tests of Door Assemblies/ Standard for Positive Pressure Fire Tests of Door Assemblies.
iii. EN 1634 - 1, Fire resistance test for door and shutter assemblies and openable windows
iv. BS 476-22: Fire tests on building materials and structures - part 22: Methods for the determination of the fire resistance of non-loadbearing elements of construction

8.1.19. Plastic skylights on roof assembly (See classification requirements Table: - A.02- T22)

i. FM 4431, Permitted standard for skylights.
ii. ASTM E 84, Standard Test Method of Surface Burning Characteristics of Building Materials.
iii. EN 13501-5: Fire classification of construction products and building elements - Part 5: Classification using data from external fire exposure to roofs tests
iv. UL 723, Standard for Test of Surface Burning Characteristics of Building Materials.
v. BS 476-7: Surface Flammability test to Building Material
vi. EN 13501-2 with Fire Test to Building Material - Classification
vii. CEN/TS 1187: Test methods for external fire exposure to roofs.
viii. ANSI/UL 790, Standard Test Methods for Fire Tests of Roof Covering.

8.1.20. Roof Assemblies (Exterior fire exposure, See classification requirements in Table 1.22.)

i. BS 476-3: Standard Test Methods for Fire Tests of Roof Coverings.
ii. EN 13501-5: Fire classification of construction products and building elements. Classification using data from external fire exposure to roofs tests.
iii. NFPA 276, Standard method of fire test for determining the heat release rate of roofing assemblies with combustible above-deck roofing components
iv. FM 4470, Permitted standard for single ply, polymer modified bitumen sheet, built-up roof (BUR) and liquid applied roof assemblies for use in Class 1 and non-combustible roof construction.
v. FM 4471, Permitted standard for Class 1 panel roofs.
vi. CEN/TS 1187: Test methods for external fire exposure to roofs.

vii. LPS 1505 Requirements and tests for the LPCB Permitted and listing of roofing systems - protection against fire from outside the building.

8.1.21. Roof Assemblies (Interior fire exposure, See classification requirements in Table 1.22.)

i. FM 4450, Permitted standard for Class 1 insulated steel roof deck roofs.
ii. UL1256, Standard for Fire Test of Roof Deck **Constructions**.
iii. FM 4471, Permitted standard for Class 1 panel roofs.

8.1.22. Roof Coverings

i. FM 4470, Permitted standard for single ply, polymer modified bitumen sheet, built-up roof (BUR) and liquid applied roof assemblies for use in Class 1 and noncombustible roof construction.
ii. ANSI/UL 790, Standard Test Methods for Fire Tests of Roof Covering.
iii. ASTM E 108, Standard Test Methods for Fire Tests of Roof Coverings.
iv. UL1256, Standard for Fire Test of Roof Deck **Constructions**.
v. NFPA 256, Standard methods of fire tests of roof coverings
vi. BS 476-3: Standard Test Methods for Fire Tests of Roof Coverings.
vii. CEN/TS 1187: Test methods for external fire exposure to roofs
viii. EN 13501-5: Fire classification of construction products and building elements - Part 5: Classification using data from external fire exposure to roofs tests
ix. LPS 1505 Requirements and tests for the LPCB permit and listing of roofing systems - protection against fire from outside the building.

8.1.23. Foam Plastic used in freezer rooms shall have flash and self-ignition not less than 4270 C with

i. ASTM D 1929, Standard Test Method for Determining Ignition Temperature of Plastics.
ii. LPS 1181 -2 Requirements and tests for sandwich panels and built up systems for use as internal constructions in buildings.

8.1.24. Factory manufactured or prefabricated panels with foam plastic insulation. (See Sandwich panels, Table: - A.02-T17.a, b,c for specific details)

i. NFPA285, Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components. (Exterior wall applications)
ii. EN 13823: Reaction to fire tests for building products - Building products ex-excluding floorings exposed to the thermal attack by a single burning item.
iii. EN-ISO 11925-2: Reaction to fire tests - Ignitability of products subjected to direct impingement of flame - Part 2: Single-flame source test
iv. EN-ISO 1182: Reaction to fire tests for products - Non-combustibility test and EN-ISO 1716: Reaction to fire tests for products - Determination of the gross heat of combustion (calorific value)
vi. EN 13501-1: Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests
vii. LPS 1181 -2 Requirements and tests for sandwich panels and built up systems for use as internal constructions in buildings.
viii. EN 13163 - Thermal insulation products for buildings - Factory made expanded

polystyrene (EPS) products - Specification

ix. EN 13164 - Thermal insulation products for buildings - Factory made extruded polystyrene foam (XPS) products - Specification

x. EN 13165 - Thermal insulation products for buildings - Factory made rigid polyurethane foam (PU) products - Specification

xi. EN 13166 - Thermal insulation products for buildings - Factory made phenolic foam (PF) products - Specification

xii. EN 13167 - Thermal insulation products for buildings - Factory made cellular glass (CG) products - Specification.

8.1.25. MCM/ ACP and core

i. See **Section A, Chapter 02**, **Table: - A.02-T14. a.**

8.1.26. MCM and ACP Panel Wall Systems as Assembly

i. See **Section A, Chapter 02**, **Table: - A.02-T14. b.**

8.1.27. EIFS/ETICS

i. See **Section A, Chapter 02, Table: - A.02-T15. a. and Table: - A.02-T15. b.**

8.1.28. PEWFS Wall System

i. See **Section A, Chapter 02, Table: - A.02-T16. a. and Table: - A.02-T16. b.**

8.1.29. Sandwich Panels

i. See **Section A, Chapter 02**, **Table: - A.02-T17. a., Table: - A.02-T17. b. and Table: - A.02-T17. c.**

8.1.30. Doors Assemblies shall satisfy any of the following

i. UL 10B/10C, Standard for Fire Tests of Door Assemblies/ Standard for Positive Pressure Fire Tests of Door Assemblies

ii. NFPA 252, Standard methods of fire tests of door assemblies

iii. EN 1634-1: Fire resistance and smoke control tests for door, shutter and, openable window assemblies and elements of building hardware. Fire resistance tests for doors, shutters and openable windows

iv. BS 476: Part 22, Methods of determination of fire resistance of non-load bearing elements of construction.

v. EN 1364-1: Fire resistance tests for non-loadbearing elements: Part 1 - Walls

8.1.31. Window Assemblies shall satisfy any of the following

i. UL 9, Standard for Fire Tests of Window Assemblies.

ii. NFPA 257, Standard on fire test for window and glass block assemblies.

iii. EN 1634-1: Fire resistance and smoke control tests for door, shutter and, openable window assemblies and elements of building hardware. Fire resistance tests for doors, shutters and openable windows.

iv. ASTM E 119, Standard Test Methods for Fire Tests of Building Construction and

Materials

8.1.32. Upholstered furniture

i. 16 CFR 1634 Flammability Test to Upholstered furniture.
ii. EN 1021-1, Fire test to upholstered furniture (Smoldering cigarette)
iii. BS 7176, Fire test to upholstered furniture for non-domestic seating.
iv. BS 5852: Methods of test for assessment of the ignitability of upholstered seating by smoldering and flaming ignition sources.
v. ASTM 1537, Standard Test Method for Fire Testing of Upholstered Furniture
vi. EN 1021-2, Fire test to upholstered furniture (Match flame)
vii. UL 1286, Standard for Office Furnishings

8.1.33. Fire Damper (90 minutes and 3-hour fire rated)

i. ANSI/UL 555, Standard for Fire Dampers.
ii. EN 1366-2 Fire resistance tests for service installations. Fire dampers.
iii. EN 13501-3: Fire classification of construction products and building elements - Part 3: Classification using data from fire resistance tests on products and elements used in building service installations: fire resisting ducts and fire dampers

8.1.34. Combination (Fire/Smoke) Damper (90 minutes and 3-hour fire rated)

i. ANSI/UL 555, Standard for Fire Dampers, and ANSI/UL 555S, Standard for Smoke Dampers.
ii. EN 1366-10 Fire resistance tests for service installations. Smoke control dampers.

iii. EN 13501-3: Fire classification of construction products and building elements - Part 3: Classification using data from fire resistance tests on products and elements used in building service installations: fire resisting ducts and fire dampers

8.1.35. Glazing System on non-load bearing wall/ Curtainwall system shall satisfy any of the following

i. ASTM E 119, Standard Test Methods for Fire Tests of Building Construction and Materials.
ii. EN 1364-3, Fire resistance tests for non-loadbearing elements. Curtain walling. Full configuration (complete assembly)
iii. UL 263, Standard for Fire Tests of Building Construction and Materials.
iv. NFPA 251, Standard methods of tests of fire resistance of building construction and materials.
v. EN 1364-1: fire resistance tests for non-loadbearing elements. part 1: walls.
vi. BS 476: Part 22, Methods of determination of fire resistance of non-load bearing elements of construction.

8.1.36. Glazing System on load bearing floor/roof shall satisfy any of the following

i. ASTM E 119, Standard Test Methods for Fire Tests of Building Construction and

Materials.

ii. UL 263, Standard for Fire Tests of Building Construction and Materials.
iii. NFPA 251, Standard methods of tests of fire resistance of building construction and materials.
iv. EN 1365-2: Fire resistance tests for loadbearing floor/roof.
v. BS 476-21: Fire tests on building materials and structures - part 21: Methods for the determination of the fire resistance of loadbearing elements of construction

8.1.37. Safety Glazing shall satisfy any of the following

i. EN 12600, Glass in building - Pendulum test - Impact test method and classification for flat glass.
ii. ANSI Z97, American National Standard for Safety Glazing Materials Used in Buildings -Safety Performance Specifications and Methods of Test
iii. CPSC 16 CR 1202
iv. For shower enclosures: EN 14428, Shower enclosures - Functional requirements and test methods

8.1.38. Structural Steelwork Test standards

i. BS 5950 The structural use of steelwork in buildings
ii. BS 5950-8: 2003 Structural use of steelwork in buildings – Part 8; Code of Practice for fire resistant design
iii. BS 476-20: 1987 Method for determination of the fire resistance of load bearing elements of construction (general principles)
iv. BS 476-21: 1987 Method for determination of the fire resistance of load bearing elements of construction
v. BS 476-23: 1987 Methods for determination of the fire resistance of the contribution of components to the fire resistance of a structure.

8.1.39. Structural Steelwork Test standards

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iv. BS 476-21: Method for determination of the fire resistance of load bearing elements of construction
v. BS 476-23: Methods for determination of the fire resistance of the contribution of components to the fire resistance of a structure.
vi. EN 1363-1, Fire resistance tests — Part 1: General requirements
vii. EN 1363-2, Fire resistance tests — Part 2: Alternative and additional procedures
viii. EN 1365-3, Fire resistance tests for loadbearing elements — Part 3: Beams
ix. EN 1365-4, Fire resistance tests for loadbearing elements — Part 4: Columns
x. EN 1993-1-1, Eurocode 3: Design of steel structures — Part 1-1: General rules and rules for buildings
xi. EN 1993-1-2, Eurocode 3: Design of steel structures — Part 1-2: General rules — Structural fire design
xii. EN 13381-4, Test methods for determining the contribution to the fire resistance of structural members - Part 4: Applied passive protection to steel members

xiii. EN 13381-8, Test methods for determining the contribution to the fire resistance of structural members - Part 8: Applied reactive protection to steel members.

8.1.40. Kiosks shall be Class A with any of the following

i. Particleboard conforming to Type PBU of ANSI A208.1., not less than 6.4 mm thick.
ii. Foamed plastics having a maximum heat release rate not greater than 100 kW when tested in accordance with UL1975 or in accordance with NFPA289, Standard Method of Fire Test for Individual Fuel Packages, using the 20-kW ignition source.
iii. Textile confirming to NFPA 701, Standard Methods of Fire Tests for Flame Propagation of Textiles and Films or **sub section 8.1.10.** of this chapter.
iv. Metal Composite Panels confirming to **Sub section 8.1.24.** of this chapter.

8.1.41. Membrane Structure shall be Class A with any of the following

i. ASTM E 84, Standard Test Method of Surface Burning Characteristics of Building Materials
ii. UL 723, Standard for Test of Surface Burning Characteristics of Building Materials.
iii. BS 476 Part 7: Fire Tests on Building materials and structures; method of test to determine the classification of the surface spread of flame of products
iv. EN 13501-1 Fire classification of construction products and building elements. Classification using test data from reaction to fire tests
v. NFPA 701, Fire test to textiles and films.

8.1.42. Tents shall be Class A with any of the following

i. NFPA 701, Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.
ii. EN 13501-1 Fire classification of construction products and building elements. Classification using test data from reaction to fire tests
iii. ASTM E 84, Standard Test Method of Surface Burning Characteristics of Building Materials
iv. UL 723, Standard for Test of Surface Burning Characteristics of Building Materials
iv. BS 476 Part 7: Fire Tests on Building materials and structures; method of test to determine the classification of the surface spread of flame of products

8.1.43. Air-Inflated Structure and Air-Supported Structure

i. Shall be designed and operated in accordance with ASCE/SEI 17, Air Supported Structures.

8.1.44. Advertising Billboards (Using Combustible Materials)

i. NFPA 701, Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.
ii. ASTM E 84, Standard Test Method of Surface Burning Characteristics of Building Materials

iii. UL 723, Standard for Test of Surface Burning Characteristics of Building Materials
iv. NFPA 265. Standard methods of fire tests for evaluating room fire growth contribution of textile or expanded vinyl wall coverings on full height panels and walls.

8.1.45. Non-Combustible Material for Cavity Fire Barrier (Groove sealants, Gaskets, Backer Rod and Vapour barrier systems)

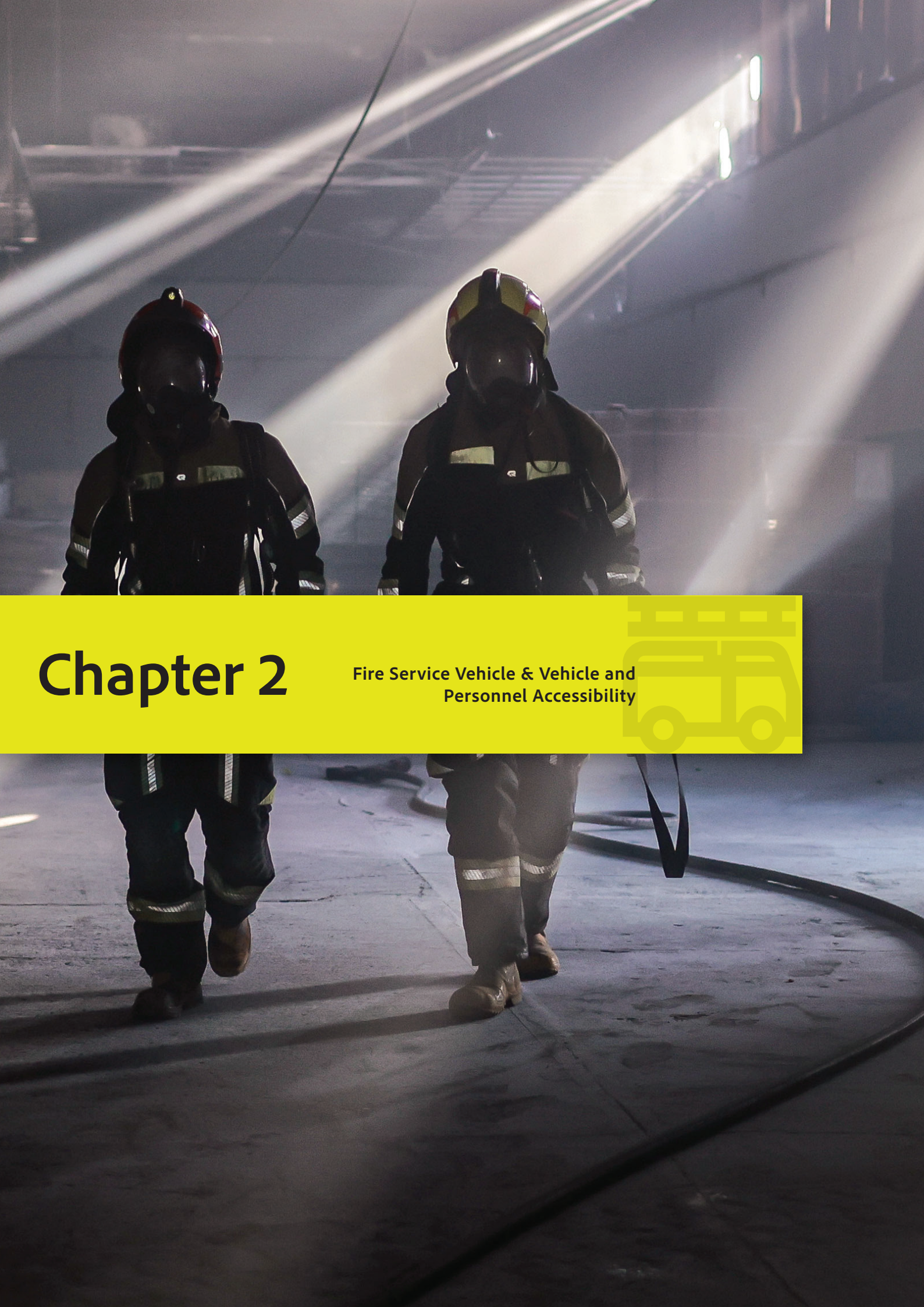
i. EN 13501-1, Class A1 or A2 (Fire classification of construction products and building elements. Classification using test data from reaction to fire tests)
ii. BS 476-4, Non-Combustible (Fire classification of construction products and building elements. Classification using test data from reaction to fire tests)
iii. ISO 1182, Non-Combustible (Fire classification of construction products and building elements. Classification using test data from reaction to fire tests)
iv. **Gaskets,** tested to EN 13501-1 and achieving class B-s2-d0 or C-s2-d0 shall be permitted.
v. **EPDM** products, Rubber sheeting and architectural carpets tested to EN 13501-1 and achieving class B-s2-d0 or C-s2-d0 shall be permitted.
vi. **Artificial Turf**. See **Chapter 01, Section 4, 4.5.6.4**. for test requirements.

8.1.46. Modular Homes/Offices

i. Class B, with ASTM E-84, Standard Test for Surface Burning Characters
ii. Class B with UL 723, Standard Test for Surface Burning Characters
iii. Limited Combustible, with FM 4880, Standard test for insulated wall panels

8.1.47. GRC/ GRFC/ GRP Panels

i. See **Section A, Chapter 02**, **Table: - A.02-T18. a. and Table: - A.02-T18. b.**



Chapter 2

Fire Service Vehicle & Vehicle and Personnel Accessibility

Chapter 2

Fire Service Vehicle & Vehicle and Personnel Accessibility



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1.0 SCOPE

1.1 This code provides general information on Fire Vehicles, Fire Boats, Fire Access roadways, Firefighters accessing requirements in and around the building, Necessity of Fire station and design.

1.2 To ensure General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain and their Firefighting trucks, vehicles and Fire Boats have permitted access way with desired clear dimensions and load carrying capacities to developments, buildings and gated subdivisions

1.3 To ensure proper access to buildings and Fire and Life Safety equipment are available for Fire Fighters.

1.4 To ensure sufficient water supply is available through fixed Fire Fighting Systems.

1.5 Definition of various types of fire Vehicles and Fire apparatus specification.

1.6 Fire Station design guidelines

2.0 Definitions

2.1. Fire Access Roadway

The road to the building or structure to allow access for General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain firefighting and Rescue apparatus.

2.2. Fire Service access level

Level where General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain Fire Appliances (Fire Truck/Engine) are deployed and where fire fighters have direct access into the building.

2.3. Fire Accessway

The path adjacent to the building or structure to allow operational setup for General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain firefighting and rescue apparatus such as Aerial Appliances.

2.4. Turning Facility

The Fire access Road arrangements such as T-Turn, V-turn, U-Turn, where General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain Fire Vehicles can make turns, usually to overcome dead ends.

2.5. Breeching inlet

A connection through which the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain fire department can pump supplemental water into the sprinkler system, standpipe, or other system, furnishing water for fire extinguishment or to supplement existing water supplies.

2.6. Landing Valve

A 65 mm diameter instantaneous water outlet normally located near the staircase for trained or General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain fire fighters to use during fire.

2.7. Hose Reel or Hose Rack

A 25 mm or 40 mm diameter instantaneous water outlet with a connected hose for trained occupants or General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain's fire fighters to use during fire.

2.8. Standpipe

The vertical portion of the system piping that delivers the water supply for hose connections (and sprinklers on combined systems), vertically from floor to floor. The term stand- pipe can also refer to the horizontal portion of the system piping that delivers the water supply for two or more hose connections (and sprinklers on combined systems) on a single level.

2.9. Fire Vehicle (Fire Fighting Apparatus)

Fire Vehicle or Fire Fighting Apparatus is designed for fire fighters and is used by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain's trained fire fighters to carry water and fight fires. These Vehicles are equipped with Water, pumps, extinguishing agents, extinguishers, Rescue and smoke venting tools and equipment. Please see **Sub Section 5**

2.10. Fire Boat

A fireboat is a vessel designed for firefighting and is staffed by trained General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain Fire fighters. Fire Boats are used by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain for rescue, firefighting platform on water and can also pump water to shore side firefighting operations.

Please see **Sub Section 5**

2.11. Berth

Berth is the term used in ports, harbors and water front for designated location where boats and vessels can be moored.

2.12. Mooring

Mooring is the term used for securing a boat or vessel to the berth utilizing thick ropes (Mooring lines) by fixing one end to the boat or vessel and the other end to fittings on deck or shore.

3. Fire Access for Fire Vehicles and Fire Fighters

3.1. Intention

3.1.1. The Fire Access requirements are to address the following.

3.1.1.1. General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain Firefighters need to be able to reach a fire quickly, with their equipment, if they are to successfully deal with a fire. This is even more important in a high rise building where the fire could be at a height of many meters from fire service access level.

3.1.1.2. Physical safety and lives of the fire-fighters and those of the occupants of the building, and the preservation of the building and its contents, can be jeopardized by delays in reaching the Fire scene.

3.1.1.3. Fire-fighting access to and into the building should be aimed at assisting the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain service in protecting life, protecting fire-fighters, reducing building losses, salvaging property and goods and minimizing environmental damage.

3.2. General Requirements

3.2.1. The Fire access roads and Fire access ways shall also consider Urban Infrastructure manuals and individual authority requirements in Bahrain.

3.2.2. The requirements in this chapter are minimum guidelines. It is consultant's responsibility to refer to international standards, General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain operational updates, General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain vehicle updates and adaptation of new technologies and strategies by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain.

3.2.3. The standards and documents referred for this chapter are **NFPA 1, NFPA 14, NFPA 24, NFPA 22, NFPA 20, British permitted document B5, General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain Fire Apparatus Specifications.**

3.3. Fire Access Roadways for Fire Vehicles

3.3.1. General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain Fire access Roadways shall be provided to every facility, every structure and every under construction buildings, except detached retail units, kiosks, store rooms, snack bars, rest rooms which are less than 100 m^2 and are remotely located from predominant occupancy.

3.3.2. General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain Fire department access roads shall consist of Roadways, Fire Lanes, Parking lot lanes, or a combination thereof. Such Fire Accessway shall comply with Table**: - A.01-T1.** specifications.

3.3.3. Fire access road shall be of concrete, asphalt or such solid surface acceptable to Bahrain Civil Defence.

3.3.4. When a bridge is required to be used as part of a fire department access road, it shall be constructed and maintained in accordance with Ministry of Municipalities and Road Transport Authority's recognized standards.

3.3.5. The bridge shall be designed for a live load sufficient to carry the imposed loads of fire Vehicle, as per **Table: - A.01-T1.**

3.3.6. Vehicle load limits shall be posted at both entrances to bridges.

Table:- A.01-T1: Fire Access Roadways and route specifications

REQUIREMENTS	FIRE ACCESS ROAD FOR STANDARD FIRE APPLIANCE	FIRE ACCESS ROAD FOR HIGH REACH FIRE APPLIANCE
Minimum weight carrying capacity of all-weather driving surface to withstand General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain Vehicle	41,000 kg	81,000 kg
Maximum Dead end	45 m	45 m
Minimum Unobstructed Width	6 m	6 m
Minimum Unobstructed Road Width between Kerbs	6 m	6 m
Minimum Width of Gateways	4.5 m	4.5 m
Minimum Unobstructed vertical clearance for any Grade	4.5 m	4.5 m
Maximum Road Grade	10%	10%
Minimum Turning Circle (Roundabout) Radius	12 m	12 m

3.4. Fire Access Roadway Gate

3.4.1. Fire access Roadway Gate width shall be 4500 mm.

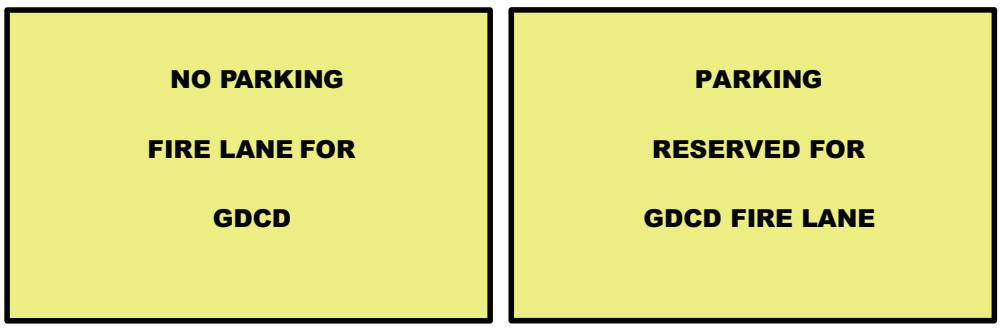
3.4.2. Gates shall be of swinging, sliding or lifting types.

3.4.3. Electric and automatic gates shall be equipped with a manual overriding facility such that General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain personnel can open the gate during power failures and emergencies.

3.4.4. Locks shall not be installed on Fire access road gates unless it is attended continuously by security guards or keys are located on-site and the gates may be readily unlocked.

3.5. Signage

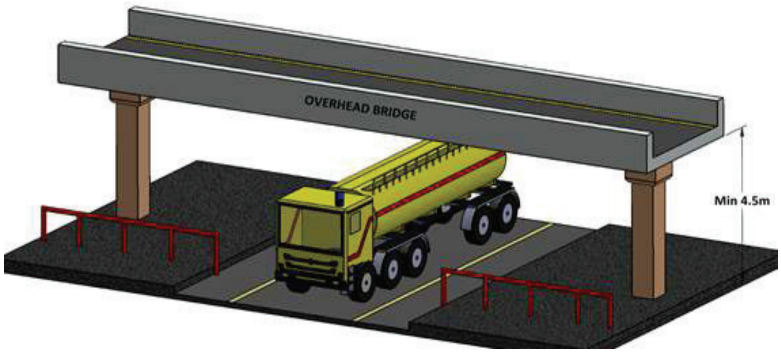
3.5.1. Fire access Roadways and Fire access sway shall be free of obstruction and designated parking for Fire vehicles shall be available at all times. Signs shall be provided with 'NO PARKING, FIRE LANE' and 'PARKING RESERVED OF GENERAL DIRECTORATE OF CIVIL DEFENCE (GDCD) - KINGDOM OF BAHRAIN' Signage. Size of wordings shall not be less than 50mm.



3.6. Fire Access way for Fire Vehicles

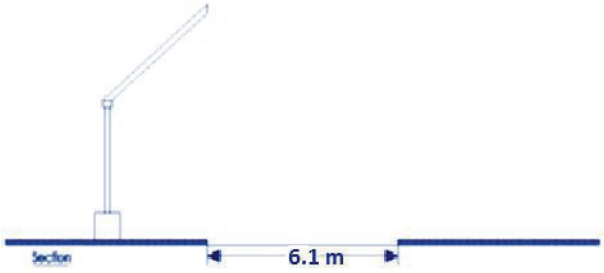
3.6.1. The access way shall have a minimum width of 6 m throughout. Such access way must be able to accommodate the entry and maneuvering of fire engine, extended ladders, pumping appliances, aerial appliances, turntable and / or hydraulic platforms.

3.6.2. Access way shall be provided to within 18 m of breeching inlet for all midrise and high- rise buildings that exceed the habitable height of 15 m.



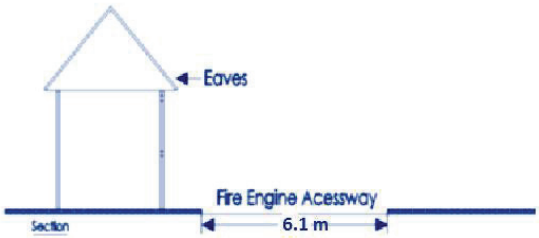
3.6.3. Overhead obstruction to access way could be entrance gate, link or bridges connecting buildings. However, vertical clearance of 4.5 m for the Access way shall be maintained. See Figure**: - A.01-F1.**

Figure:- A.01-F1: Vertical Clearance for Fire Vehicle



3.6.4. The security barrier, when lifted up, shall not obstruct the fire engine access way. Eaves of the security post or guard house shall not project into the fire engine access way. See **Figure: - A.01-F2. And A.01-F3.**

Figure:- A.01-F2: Security Barrier for Fire Vehicle



3.6.5. Access way provided on turfed area such as synthetic grass, composite material, sports surfaces must be marked with contrasting object (preferably reflective) that is visible at night. The markings are to be at an interval not more than 3 meters apart and shall be provided on both sides of the access way.

Figure:- A.01-F3: Security guard house eaves clearance

Table:- A.01-T2: Fire Vehicle Access Specifications

GENERAL DIRECTORATE OF CIVIL DEFENCE (GDCD) - KINGDOM OF BAHRAIN VEHICLE ACCESS SPECIFICATIONS	REQUIREMENTS
Maximum Parking distance of Vehicle from building entrance	15 m
Maximum Parking distance of Vehicle from Breeching inlet	18 m
Maximum Road Grade of Vehicle Access	10%

3.6.6. Access way and fire engine access road shall be kept clear of obstructions and other protruded parts of the building, plants, trees or other fixtures such that they do not obstruct the path between the access way and access openings of the building.

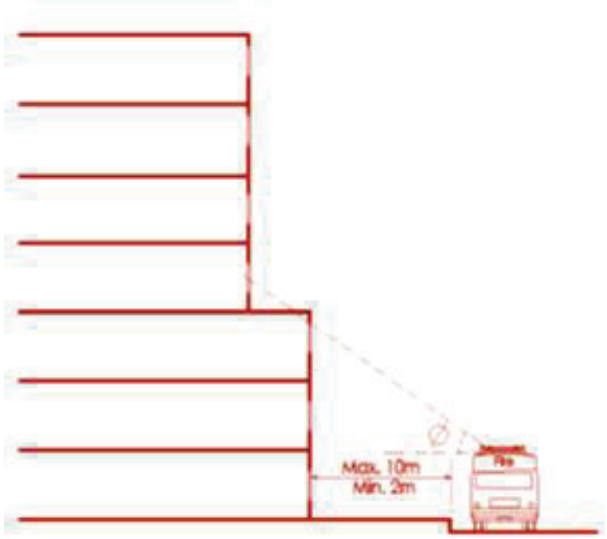


Figure: - A.01-F4: Obstruction to Fire Vehicle

Note: The podium edge is obstructing the reach of the boom of fire engine to 4th storey. Other obstructions could be roadside trees, entrance porch etc. To allow full extension of aerial ladders at a safe climbing or elevation angle Ø of 60 to 80 degrees, sufficient space is needed to position the fire engine. Such obstructions should be avoided for buildings without firefighting lifts and firefighting lobbies. Public road may be used as hard standing by fire engine, provided the edge of the public road to the facade of the building where access openings are located is not exceeding 10m. See **Figure: - A.01-F4.**

The fire engine shall be located at least 2m from the building, but not more than 10m away from the external wall or façade (including any overhead obstruction) of the building.

If the fire engine is located within 2m from the building, the aerial ladder when set-up would fall outside the safe working limit i.e. the inclination of the ladder would be too steep. If the fire engine is located more than 10m from the building, the effective reach of the aerial ladder would be reduced.

3.6.7. A suitable access pathway shall also be provided to enable fire-fighters to inspect all elevations of a building during or after a fire. A suitable pathway could be a paved or gravel path. Any such pathway should be a minimum of 1 m wide and Plants, Bushes, Walls or other features should not impede such pathway.

3.6.8. Fire Hydrants, where required as per **Section D, Chapter 04**, shall be located along the Fire Access Road and Fire Access way and installed as per **Section D, Chapter 04**, Yard Fire Hydrants.



FIRE TRUCK STAGING FOR ILLUSTRATION

3.7. Turning Facilities for Fire Vehicles

3.7.1. Maximum Dead End allowed on Fire Access way is 45 m. Where Fire Access way dead end exceeds 45 m, a Turning Facility shall be provided. Such Turning facility can be U- Turn, Y-Turn, T-Turn or Roundabout.

3.7.2. U-Turn and Roundabout

U-Turn and Roundabout specifications shall be as shown in **Figure: - A.01-F5.**

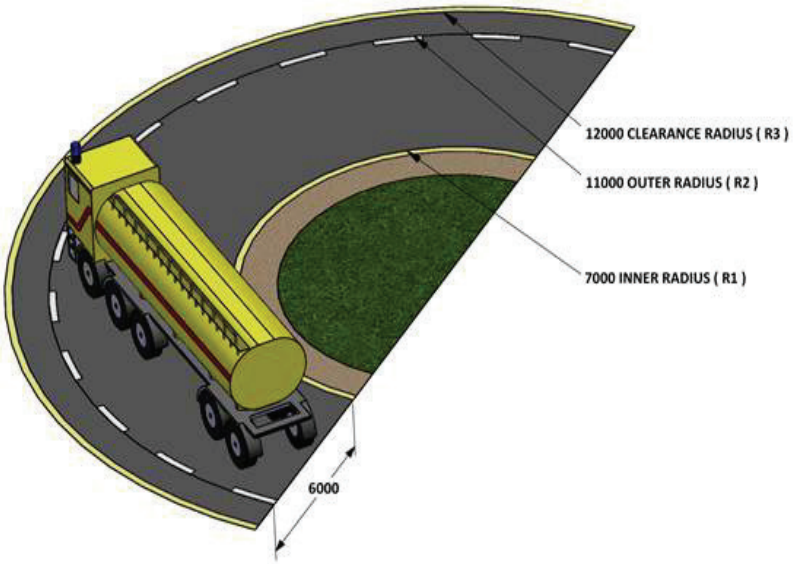


Figure: - A.01-F5: U-Turn specifications

3.7.3. T-Turn

T-Turn specifications shall be as shown in **Figure: - A.01-F6.**

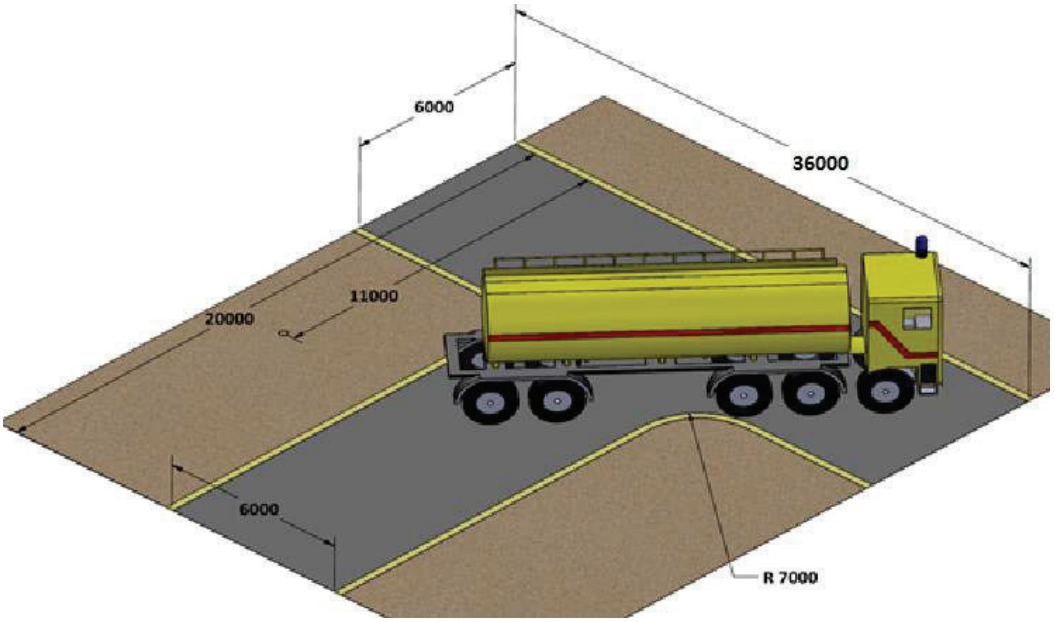


Figure: - A.01-F5: U-Turn specifications

3.7.4. Y-Turn

Y-Turn specifications shall be as shown in **Figure: - A.01-F7.**

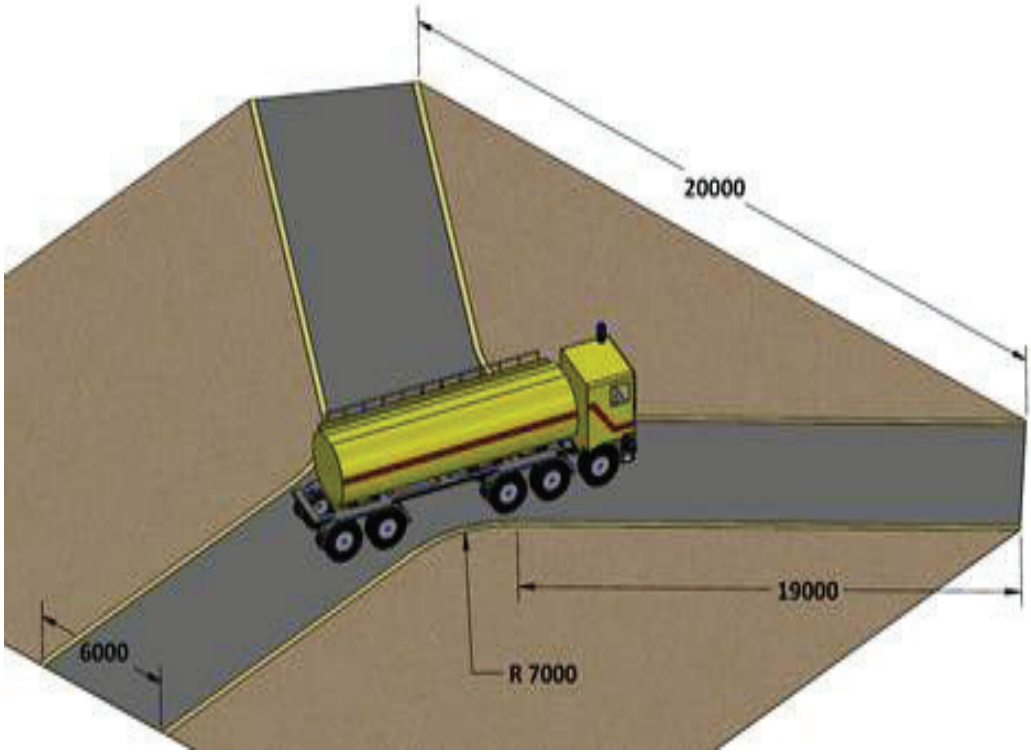


Figure: - A.01-F7.: Y-Turn specifications

3.8. Extent of Fire Vehicle Access around the building

3.8.1. The access sway shall have a minimum width of 6 m throughout. Such accessway must be able to accommodate the entry and maneuvering of fire engine, extended ladders, pumping appliances, aerial appliances, turntable and / or hydraulic platforms.

3.8.2. Accessway shall be positioned so that the nearer edge shall be not less than 2 m or more than 10 m from the building, measured horizontally. **EACH GENERAL DIRECTORATE OF CIVIL DEFENCE (GDCD) - KINGDOM OF BAHRAIN FIRE APPARATUS**

3.8.3. Commercial Villa (Group of Villas/ Housing Development)

a. For cluster housing developments (with shared communal facilities) fire engine accessway with a minimum 6 m width shall be provided to within a travel distance of 60 m from every point on the projected plan area of any building in the housing developments. See **Figure: - A.01-F10.** for illustrations.

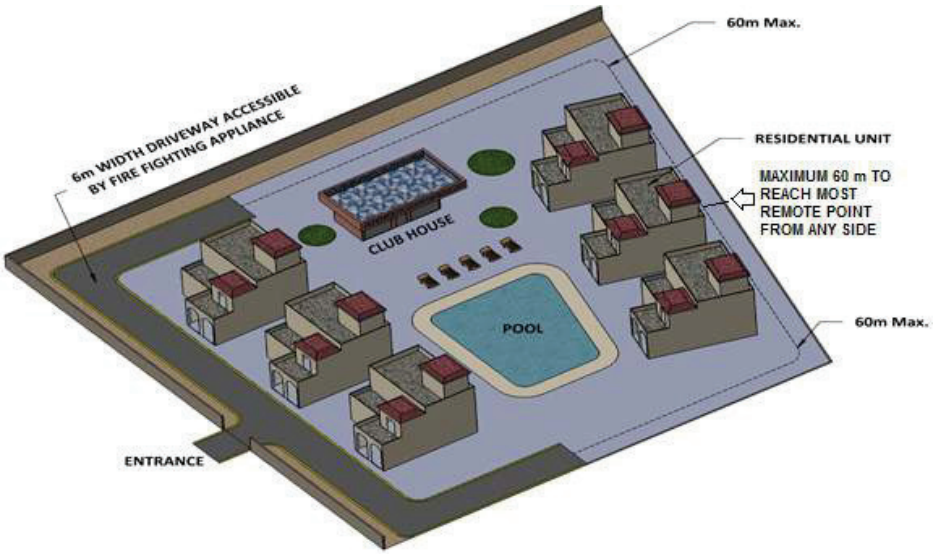


Figure: - A.01-F10: Maximum distance from Fire Access from most remote Residential Unit

3.8.4. Low-rise (Buildings with height less than 15 m)

a. For Low-rise buildings not exceeding the habitable height of 15 m, accessway will not be required. However, provision of fire engine access road having minimum 6 m width for Fire appliance will be required to within a travel distance of 45m of every point on the projected plan area of the building. See **Figure: - A.01-F11.**

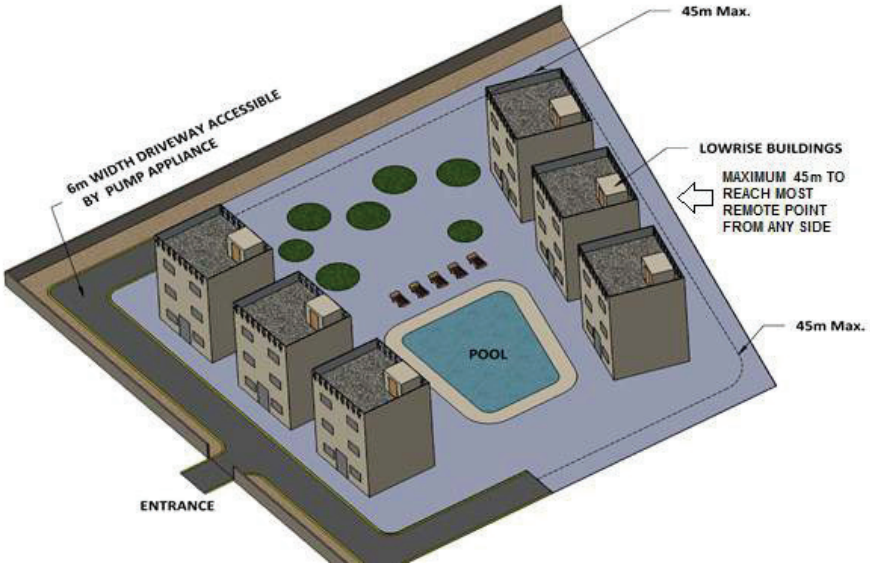


Figure: - A.01-F11: Maximum distance from Fire Access from most remote Low-rise building

3.8.5. Midrise buildings (Having height more than 15 m but less than 23 m and not Sprinkler protected)

a. For Midrise buildings exceeding the habitable height of 15 m, accessway shall be provided. Accessway shall be provided based on the gross floor area (including toilets, stores, circulation areas, etc.) of the building footprint projected onto ground level. For Midrise buildings without Sprinkler protection, the extent of Fire access shall be as shown in **Table: - A.01-T3.**

Table:- A.01-T3: Extent of Fire Vehicle Access for Midrise buildings without Sprinklers

AREA OF NON SPRINKLERED MIDRISE BUILDINGS	EXTENT OF FIRE ACCESS
Less than 2000 m2	Minimum of 1/6 perimeter (At least 15 m)
2000 m2 to 4000 m2	1/4 perimeter
4001 m2 to 8000 m2	1/2 perimeter
8001 m2 to 16,000 m2	3/4 perimeter
More than 16,000 m2	Whole perimeter (100%)

3.8.6. Midrise and Highrise buildings (Buildings having height 15 m to 90 m and Sprinkler protected)

a. For Midrise and Highrise buildings exceeding the habitable height of 15 m, accessway shall be provided. Accessway shall be provided based on the gross floor area (including toilets, stores, circulation areas, etc.) of the of the building footprint projected onto ground level. For Midrise and Highrise buildings with Sprinkler protection, the extent of Fire access shall be as shown in **Table: - A.01-T4.**

Table:- A.01-T4: Extent of Fire Vehicle Access for Midrise and Highrise buildings with Sprinklers

AREA OF SPRINKLERED MIDRISE AND HIGHRISE BUILDINGS	EXTENT OF FIRE ACCESS
Less than 4000 m2	Minimum of 1/6 perimeter (At least 15 m)
4001 m2 to 8000 m2	1/4 perimeter
8001 m2 to 16,000 m2	1/2 perimeter
16,001 m2 to 32,000 m2	3/4 perimeter
More than 32,000 m2	Whole perimeter (100%)

b. Where high-rise buildings are situated on the podiums, parking structures, architectural features with the tower façade more than 30 m of horizontal separation distance away from the fire access road, following shall apply to such high-rise buildings.

b.1. Fire access road shall extend and reach the high-rise tower perimeter above the podium. Such access shall be a minimum of ¼ (25 percent) of the tower perimeter and in compliance to this chapter.

b.2. Building façade shall comply with **Sub Section 3.8.10., b.1.**

3.8.7. Super Highrise buildings (Buildings having height more than 90 m), Malls, Theme Parks

a. For Super Highrise buildings, Malls and Theme Parks, accessway shall be provided. Accessway shall be provided irrespective of the area or height. The extent of Fire access shall be as per **Table: - A.01-T5.** but not less than as required in **Table: - A.01-T3 or Table: - A.01-T4.**

Table: - A.01-T6: Extent of Fire Vehicle Access for Industrial and Storage buildings without Sprinklers

SUPERHIGHRISE, MALLS, THEME PARKS	EXTENT OF FIRE ACCESS
Any Area or Height	3/4 perimeter

b. Where super high-rise buildings are situated on the podiums, parking structures, architectural features with the tower façade more than 30 m of horizontal separation distance away from the fire access road, following shall apply to such super high-rise buildings.

b.1. Fire access road shall extend and reach the super high-rise tower perimeter above the podium. Such access shall be a minimum of ¼ (25 percent) of the tower perimeter and in compliance to latest edition of **KINGDOM OF BAH- RAIN Fire and Life Safety Code of Practice, Chapter A.1. Fire Service vehicle and personnel accessibility specifications.**



INADEQUATE FIRE VEHICLE ACCESS ROAD WILL DELAY FIRE AND RESCUE OPERATIONS—FOR ILLUSTRATION

3.8.8. Storage and Industrial buildings without Sprinkler Protection

a. For all industrial and storage occupancies, accessway shall be provided for firefighting appliances. The provision of accessway shall be calculated based on the following gross cubical extent of the building. For Non-sprinklered industrial and storage buildings, Fire access shall be provided as per **Table: - A.01-T6.**

Table: - A.01-T6: Extent of Fire Vehicle Access for Industrial and Storage buildings without Sprinklers

VOLUME OF NON SPRINKLERED INDUSTRIAL AND STORAGE BUILDINGS	EXTENT OF FIRE ACCESS
Less than 28,400 m^3	Minimum of 1/6 perimeter (At least 15 m)
28,4001 m^3 to 56,800 m^3	1/4 perimeter
56,801 m^3 to 85,200 m^3	1/2 perimeter
85,201 m^3 to 113,600 m^3	3/4 perimeter
More than 113,600 m^3	Whole perimeter (100%)

3.8.9. Storage and Industrial buildings with Sprinkler Protection

a. For all industrial and storage occupancies, accessway shall be provided for firefighting appliances. The provision of accessway shall be calculated based on the following gross cubical extent of the building. For sprinklered industrial and storage buildings, Fire access shall be provided as per **Table: - A.01-T7.**

Table: - A.01-T7: Extent of Fire Vehicle Access for Industrial and Storage buildings with Sprinklers

VOLUME OF SPRINKLERED INDUSTRIAL AND STORAGE BUILDINGS	EXTENT OF FIRE ACCESS
Less than 56,800 m3	Minimum of 1/6 perimeter (At least 15 m)
56,801 m3 to 85,200 m3	1/4 perimeter
85,201 m3 to 113,600 m3	1/2 perimeter
113,001 m3 to 170,400 m2	3/4 perimeter
More than 170,400 m3	Whole perimeter (100%)

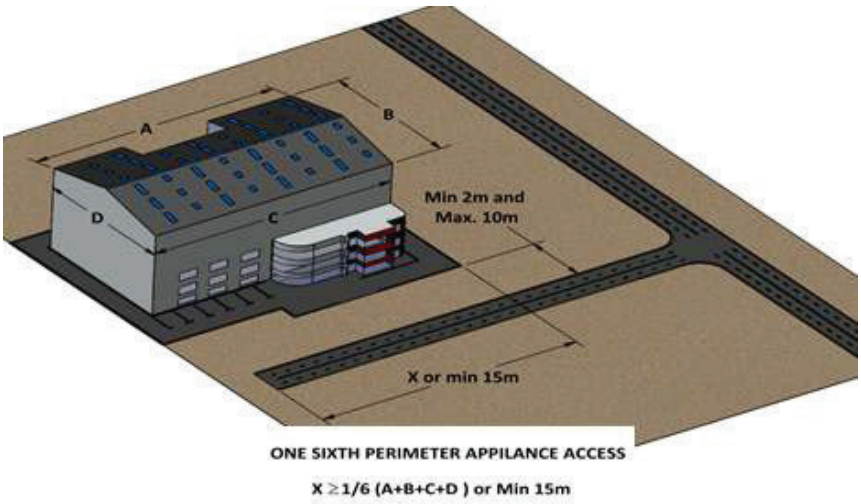


Figure: - A.01-F12: 1/6 perimeter Fire Access

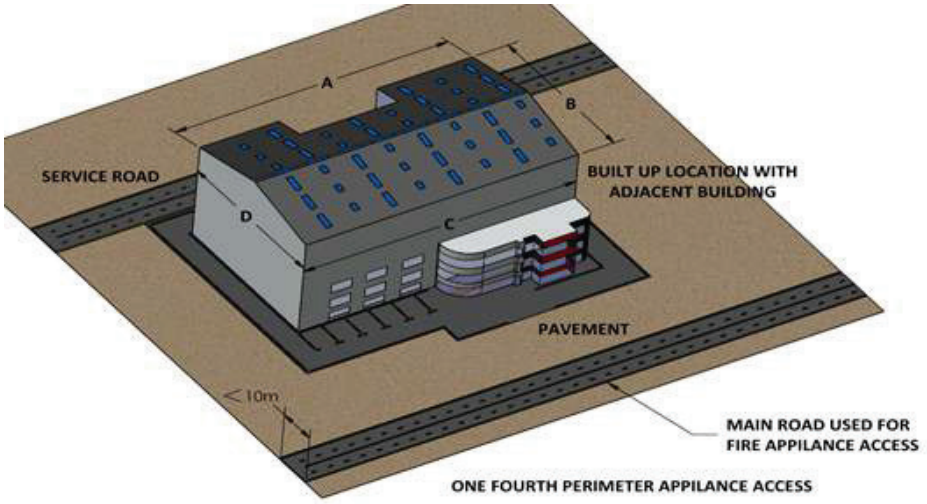


Figure: - A.01-F13: 1/4 perimeter Fire Access

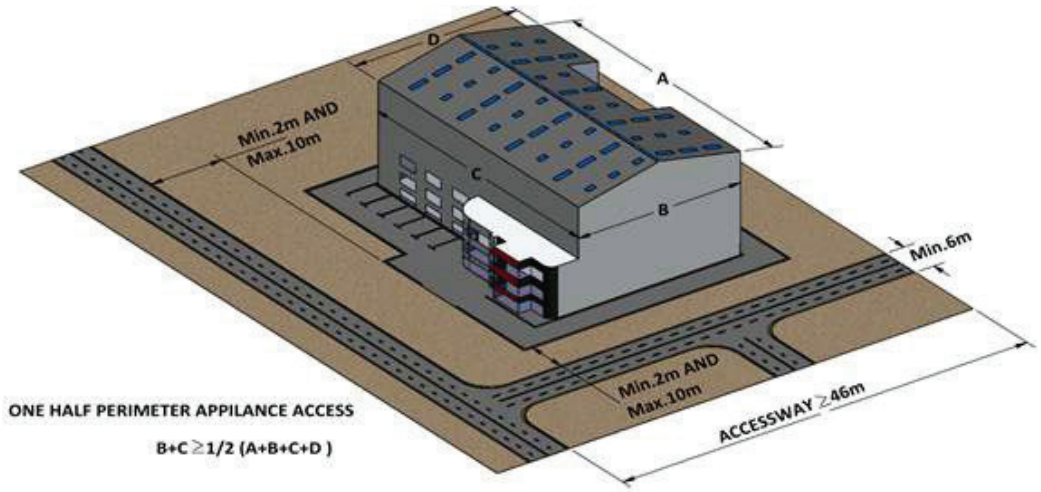


Figure: A.01-F14: 1/2 perimeter Fire Access

3.8.10. Waterfront Properties

a. For all water front properties, the fire access road shall comply with this chapter and **Table: - A.01-T8.**

Table: - A.01-T8: Extent of Fire Vehicle Access for Waterfront Properties

OCCUPANCY	EXTENT OF FIRE ACCESS
Commercial Villas	Maximum distance from Fire access road shall not exceed 60 m
Low rise buildings	Maximum distance from Fire access road shall not exceed 60 m
High rise buildings	Shall comply with Table: - A.01-T3 and Table: - A.01-T4. of this chapter
Super high rise buildings	Shall comply with Table: - A.01-T5. of this chapter

b. Where the water front properties, the fire access road does not comply with **Section 3.8.10.a.,** the **Section 3.8.10. b.1.** and **Section 3.8.10. b.2.** shall apply to such properties.

b.1. Fire Access Road

b.1.1. Minimum of ¼ (25 percent) of the building perimeter shall have fire access road in compliance to **Kingdom of Bahrain Fire and Life Safety Code of Practice 2024, Section A, Chapter 01. Fire Service vehicle and personnel accessibility.**

b.1.2. Fire truck staging area of 6 m wide and 12 m long shall be provided in compliance to latest edition of **KINGDOM OF BAHRAIN Fire and Life Safety Code of Practice, Chapter A.1. Fire Service vehicle and personnel accessibility specifications.**

b.1.3. All the water front properties which have only ¼ (25 percent) of the required Primary Fire access road in accordance **with Section 3.8.10.a.,** a secondary fire access road, in accordance with the following shall be provided.

i. 4.5 m wide, secondary fire access road shall be provided at the entire water side of the property.

ii. The secondary fire access road load carrying capacity shall not be less than 40,000 kg.

iii. Except for **b.1.3. i and b.1.3.ii.,** the secondary fire access road shall comply with latest edition of **KING DOM OF BAHRAIN Fire and Life Safety Code of Practice, Chapter A.1. Fire Service vehicle and personnel accessibility specifications.**

3.9. Access into the building for Fire Fighters

3.9.1. At fire service access level, General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain vehicles shall be able to approach and park to within 15 m and within sight of a suitable entrance which gives access to the Interior of the Building, a Firefighting Lift and associated staircases.

3.9.2. Breeching inlets should be visible from fire engine parking to avoid delay in locating them upon arrival of the fire crew. For better response, the distance from Fire vehicle parking to breeching inlet is limited to one hose length, 18m.

3.9.3. Emergency Command Center

a. An Emergency Command Centre as per **Section A, Chapter 02**, shall be provided in any building which is 'High-rise' with building height of 23 m, in Malls and Amusement Parks and Super high-rise buildings, having height more than 90 m.

b. Emergency Command Center essentially shall be on the building front side, along the Fire Accessway. Fire Command Centers at below grade or above discharge level are not acceptable.

c. The fire command center shall be separated from the remainder of the building by not less than a 1-hour fire barrier constructed in accordance with **Section A, Chapter 02**.

d. Fire Command Center shall be a minimum of 19 m^2 with minimum dimension of 3 m on any side. The entrance to the Command Center shall be on the exterior of the building along the Fire Accessway. Where such an entrance is not feasible, Fire Command center shall be at the Main entrance lobby of the building.

e. Mechanical Ventilation, as per **Section E, Chapter 01**, shall be provided for the Command Center.

f. An Emergency Command Centre shall be equipped with following features.

- **i.** Schematic building plans indicating the typical floor plan and detailing the building core, means of egress, fire protection systems, fire-fighting equipment and fire department access and the location of fire walls, fire barriers, fire partitions, smoke barriers and smoke partitions. etc.
- **ii.** The emergency voice evacuation alarm communication system control unit.
- **iii.** Two-Way fire department communications system.
- **iv.** Fire detection and alarm system annunciator.
- **v.** Annunciator unit visually indicating the location of the elevators and whether they are operational.
- **vi.** Status indicators and controls for HVAC and air distribution systems.
- **vii.** The firefighter's control panel, Smoke Control Panel (SCP) required by **Section E, Chapter 01** for smoke control systems installed in the building.
- **viii.** Access Control Systems schematic and Controls for unlocking stairway doors.
- **ix.** Fire pump status indicators.
- **x.** Sprinkler valve and waterflow detector display panels.
- **xi.** Emergency and standby power/Generator status indicators and manual start and transfer features.
- **xii.** Public Address system.
- **xiii.** Work table.
- **xiv.** Elevator fire recall switch.

3.9.4. Fire Lift

a. At least one Fire Lift in a dedicated shaft, as required by **Section A, Chapter 02.**, **Table 1.9.38.** shall be provided in any building which is 'Highrise' with 23 m or more in height, 'High Depth' with more than 2 basements, Malls and multi storey Amusement Parks. Additional lifts may share the same shaft, provided all the lifts comply with same degree of protection and features as the fire lift.

b. Minimum dimension of a Fire Lift car shall be adequate to accommodate an ambulance stretcher of 610 mm by 2134 mm with not less than 127 mm radius corners, in the horizontal, open position.

c. The fire lift shall have access to every habitable floor within the building. In Super High-Rise buildings having height more than 90 m from Fire access level, the fire lift shall be adjacent and accessible to an exit staircase and a firefighting lobby at each storey as required by Section **A, Chapter 02, Table 1.9.38.** and shown in **Figure: - A.01-F15.** Where a fire lift has a second entrance onto a floor, the second entrance is not required to open into a 1-hour lobby.

d. Fire lift shall be provided with an operational feature that would enable firemen to override earlier call which had been inadvertently made to the fire lift during an emergency.

e. This operational feature could be built into the lift control system or alternatively a separate by-pass switch could be provided. If the operational feature is built into the lift control, it is not mandatory to provide a separate by-pass switch.

f. A service lift mainly intended for the transport of goods, such as freight elevators shall not be designated as a fire lift. However, a fire lift complying to this section can be utilized for everyday function, such as passenger lifts or service lifts. Likewise, a service lift which com- plies with all the requirements of a fire lift as per this section, shall be permitted to be considered as a 'Fire Lift'.

g. The power supply to the lift shall be connected to a sub-main circuit exclusive to the lift and independent of any other main or sub-main circuit.

h. Wires or cables that provide normal and standby power, control signals, communication with the car, lighting, heating, air-conditioning, ventilation, and fire detecting systems to fire lift shall be protected by construction having a minimum 1-hour fire resistance rating or shall be circuit integrity cable having a minimum 1-hour fire resistance rating.

i. In a fire emergency when a fire detection devices or fire alarm systems is activated, if the ground floor is compromised with fire, all the passenger lifts shall be brought to the ground floor or egress level or alternative floor. Furthermore, lift doors shall remain open.

j. Every Fire Lift shall be equipped with 2-way communication devices to be used by Fire fighters during emergencies.

k. Where elevators are used for evacuation, such elevators shall have features as per **Chapter 3, Section 4.9.**

l. All fire lifts must be provided with water management, Protection of electrical equipment against water, Control and power supplies, and General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain Communications systems in accordance with sections 5.3 and 5.6-5.12 of BS EN 81-72 current edition.

3.9.5. Fire Lift Lobby (Fire Man's Lift Lobby)

a. All Super high-rise buildings (Having height greater than 90 m from the Fire access level) shall have "Fire Fighter's Lift Lobby" as per **Section A, Chapter 02., Table 1.9.38.** See Figure**: - A.01-F15.** The fire lift lobby shall be enclosed with a smoke barrier having a minimum 1-hour fire-resistance rating.

b. Before a fire can be fought by fire-fighters, they need a dedicated space where they gather their equipment such as lengths of hose, branches, door opening tools etc., before advancing to fight the fire. This requirement shall be fulfilled by a well-defined Fire Lift Lobby where both Fire exit Stair and Fire Lift can be accessed.

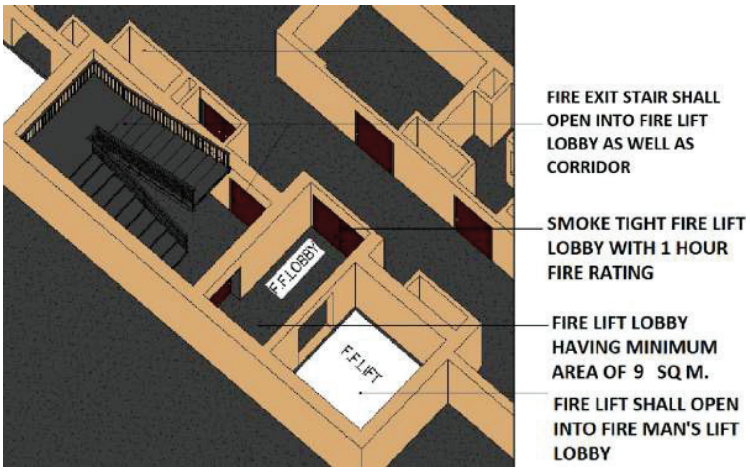


Figure: - A.01-F15: Fire Man's Lift Lobby

c. The firefighting lobby shall have a clear floor area of not less than 9 m^2 with a minimum dimension of 2440 mm.

d. Fire Lift Lobby shall be provided with a doorway that is protected with a 60 minutes fire door assembly.

e. The firefighting lobby shall be free of combustible materials and ignition sources.

f. There are no requirements for the Fire Lift lobby or the fire lift shaft to be pressurized when fire lift lobby according to this section is provided.

3.9.6. Fire Exit Stair

a. 2 Hour rated Fire Exit enclosure shall be available for the fire fighters to access the interior and upper floors of the building. Such exit stair shall be fully enclosed smoke proof space. The number of such Stairs shall be governed by **Section A**, **Chapter 3** and construction shall comply with **Section A, Chapter 2**.

b. Fire Exit Stair shall connect every habitable floor of the building and not less than one stair shall provide access to the roof where LPG Tanks are located.



3.10. Access to Fire Fighting Equipment for Fire Fighters

3.10.1. Yard Hydrant System

a. Consideration should be given to establish Public Fire Hydrant System as part of Kingdom of Bahrain. Ministry of Municipalities should stress on provision of Public Fire Hydrant System at all upcoming developments. General Directorate of Civil Defence (GDCD) makes it mandatory to provide Yard Fire Hydrants in all developments.

b. Yard Fire Hydrants shall be available for the Fire Fighters which essentially should be located along the Fire Accessway. These Yard Fire Hydrants are used by Fire fighters either to refill the Fire vehicle water tank or fight Fire using the hose connection from the Hydrants.

c. Such Yard Fire Hydrants shall be capable of delivering 500 gpm (US Gallons per minute) through a single Hydrant with two outlets, i.e., 250 gpm per outlet shall be available.

d. Minimum Pressure required for Private fire hydrant is 6.9 bars.

e. Two such Hydrants shall be considered for the Hydraulic calculations.

f. The design, calculations, Pipe sizes, Pump and Tank Capacities, Test requirements, distance between Hydrants, Material requirements etc. shall comply with **Section D, Chapter 02, Fire Pumps.**

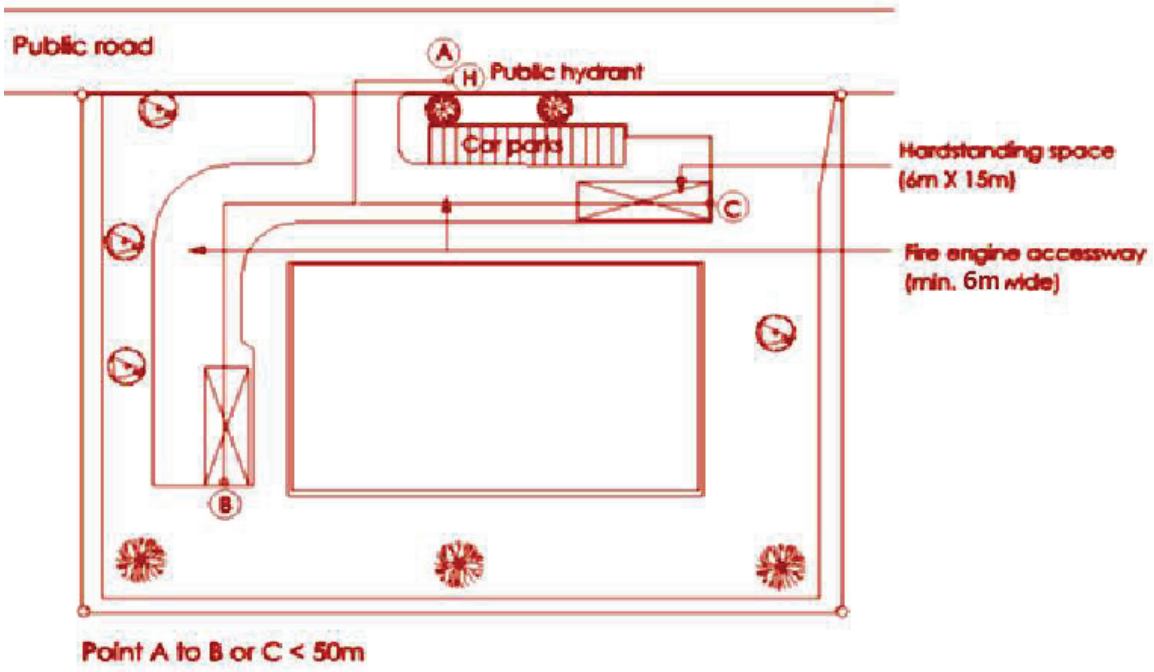


Figure: - A.01-F16: Distance from furthest point of private fire engine access way to a public hydrant

3.10.2. Breeching Inlets (General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain connections)

a. Breeching inlet (Fire department connections) shall be located on the street side of the buildings, near the building entrance and on the Fire Accessway. Breeching inlet shall be within 18 m from the Fire vehicle parking slot.

b. These breeching inlet connections shall be located and arranged such that hose lines can be readily and conveniently attached to the inlets without interference from any nearby objects, including buildings, fences, posts, trees or other fire department connections.

c. Breeching inlets shall consist of

i. Four 65 mm, (4-Way) direct coupling type fitting for wet riser.
ii. Two 65 mm, (2-Way) direct coupling type fitting for Sprinkler Riser.
iii. Two 65 mm, (2-Way) direct coupling type fitting for Dry riser.

d. Breeching inlets shall be equipped with caps to protect the system from the entry of debris.

e. Fire department connections shall be located not less than 457 mm nor more than 1219 mm above the finished ground level.

f. Each breeching inlet connection to Sprinkler/Wet riser/Dry riser systems shall be clearly designated by a sign as follows:

i. The sign shall have raised or engraved letters at least 25.4 mm in height on a plate or fitting.
ii. The sign shall be both in English and Arabic indicating the service for which the connection is intended and shall read, for example, as follows:

WATER TANK / SPRINKLER / WETRISER / DRYRISER

g. The design, calculations, Pipe and fitting sizes, Material requirements etc. shall comply with **Section D, Chapter 3 and Chapter 11, Breeching inlets (General Directorate of Civil Defence connections)**

3.10.3. Fire Hose Cabinet (FHC)

a. Fire Hose Cabinets (Hose Stations) complying to **Section D, Chapter 03** shall be available in all buildings for Fire Fighters.

b. Fire Hose Cabinets (FHC) shall be installed and clearly visible next to exit Stair and distributed in the corridors and circulation areas, in every floor of the building, designed and installed in accordance with **Section D, Chapter 3**.

c. Fire Hose Cabinets (FHC) shall be within 6 m from Stair door. FHC shall not be located inside the stair core. Installation of landing valve alone in the stair is not permitted as an alternative to the fire hose cabinet. FHC shall be an assembly as a unit as required by

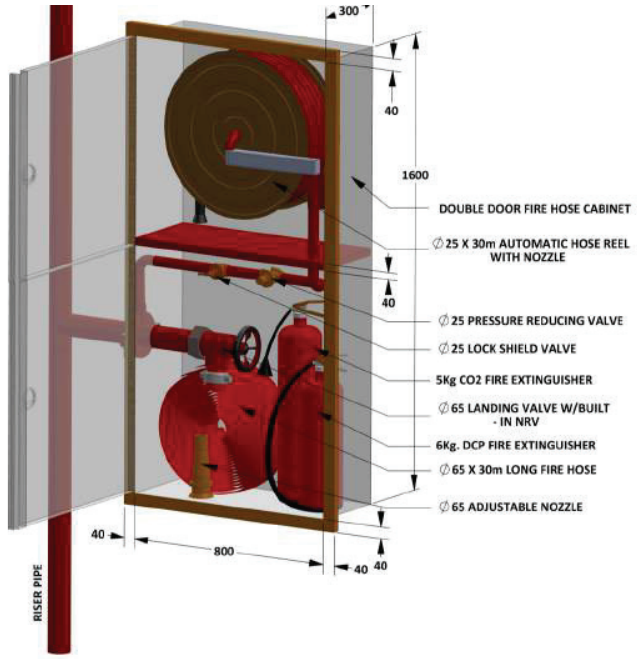


Figure:- A.01-F17: Typical Fire Hose Cabinet

d. Fire Hose Cabinets shall be available on both sides of "Horizontal Exits" next to the door.

e. Fire Hose Cabinets shall be available on the Roof where LPG Tanks, Air conditioning equipment, Heaters or Gymnasium are located.

f. Fire Hose Cabinets shall consist of the following.

- **i.** 65 mm Landing Valve outlet.
- **ii.** 40/25 mm outlet with Hose Reel/ Hose Rack.
- **iii.** CO2 Fire Extinguisher.
- **iv.** Dry Chemical Powder Fire Extinguisher.
- **v.** 65mm, 30 m Fire Hose with nozzle.

3.10.4. Fire Pump Room

a. Fire Pump Room, irrespective of its location, shall be accessible for Fire fighters. A clear visual layout showing location and way to Pump room shall be posted in the Emergency Command Center and Reception.

b. Pump Room shall be dedicated fire pump room housing the Main Electrical Fire Pump, Standby Diesel Fire Pump, Jockey Pump, Controller, Diesel fuel tank etc., as required by **Section D, Chapter 02, Fire Pumps.**

c. Pump Room shall have sufficient space around the installations to access the valves, Controllers and gauges.

3.10.5. Smoke Control Panel (SCP)

a. Smoke Control Panel (As designed, installed and required by **Section E, Chapter 01, (Smoke Control Systems**) shall be accessible for Fire fighters.

b. A clear visual layout showing location of Smoke Control Equipment, their intended function and manual switches shall be available for fire fighters at the Command Center or at constantly manned location where Smoke Control Panel is installed.

4.0 Fire Access for General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain Fireboats

4.1. Intention

4.1.1. The Requirements of Fire Access for General Directorate of Civil Defence Fire Boats are to address the following.

4.1.1.1. Projects with water front and without Fire Access Road, General Directorate of Civil Defence has included Fire Boats in its fleet to address fires in water front buildings, marinas and creek boats.

4.1.1.2. The requirements of this section shall provide the guidelines for docking facilities, dimensions and the access of General Directorate of Civil Defence from water front.

4.2. Access for Fire Boats from water front

4.2.1. Fire access for General Directorate of Civil Defence Fire Boats shall be provided on all water front developments such that Fire Boats can approach these developments from waterside. This provision shall be made irrespective of Fire Access Road available on land.

4.2.2. A dedicated Berth measuring 15 m long and 5 m wide shall be provided for the Fire Boat for docking during emergencies.

Table: - A.01-T9: Fire Access specifications for Fire Boats

BERTH REQUIREMENTS	STANDARD FIRE BOAT
BOAT	15 m
Minimum Unobstructed Length	5 m
Minimum Unobstructed Width	6 m

4.2.3. There shall be Mooring facility complete with permitted ropes, fixed fittings on the deck and platform.

4.2.4. The mooring bitt or cleats shall be corrosion resistant and secured to a foundation that is tied into an underdeck structure and is of adequate strength to carry the mooring loads.

4.2.5. This docking facility shall be within 45 m from any building and structure to be attended to, on the shore.

5.0 General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain Fire Apparatus Specifications

5.1. Fire Vehicles

5.1.1. Water Tender (SCANIA)



Table: - A.01-T10: Water Tender

VEHICLE ITEMS	SPECIFICATIONS
Length	8.64 M
Width	2.98 M
Height	3.17 M
Weight	18.200 KG
Wheel Base	
Front Axial Load	6700 KG
Rear Axial Load	11500 KG

5.1.2. Water Tender (IVECO)



Table: - A.01-T11.: Water Tender (IVECO)

VEHICLE ITEMS	SPECIFICATIONS
Length	8.5 M
Width	2.95 M
Height	3.35 M
Weight	
Wheel Base	
Front Axial Load	
Rear Axial Load	

5.1.3. Water Tender (MAN)



Table: - A.01-T12.: Water Tender (MAN)

VEHICLE ITEMS	SPECIFICATIONS
Length	8.0 M
Width	2.5 M
Height	3.10 M
Weight	18.600 KG
Front Axial Load	4.425 MM
Rear Axial Load	7500 KG

5.1.4. Water Tender (SCANIA)



Table: - A.01-T13.: Water Tender

VEHICLE ITEMS	SPECIFICATIONS
Length	8.69 M
Width	2.98 M
Height	2.89 M
Weight	19.000 KG
Front Axial Load	7500 KG
Rear Axial Load	11500 KG

5.1.5. Water Carrier (IVECO)



Table: - A.01-T14.: Water Carrier (IVECO)

VEHICLE ITEMS	SPECIFICATIONS
Length	9.10 M
Width	2.95 M
Height	3.90 M
Weight	
Front Axial Load	
Rear Axial Load	

5.1.6. Water Carrier (MAN)



Table: - A.01-T15.: Water Carrier (MAN)

VEHICLE ITEMS	SPECIFICATIONS
Length	10.1 M
Width	3.1 M
Height	3.8 M
Weight	33000 KG
Wheel Base	3.900 MM
Front Axial Load	8800 KG
Rear Axial Load	26000 KG

5.1.7. RIV (GMC)



Table: - A.01-T16.: RIV (GMC)

VEHICLE ITEMS	SPECIFICATIONS
Length	6.55 M
Width	2.62 M
Height	2.22 M
Weight	

5.1.8. RIV (FORD)



Table: - A.01-T17.: RIV (FORD)

VEHICLE ITEMS	SPECIFICATIONS
Length	8.39 M
Width	2.53 M
Height	3.15 M
Weight	10200 KG
Wheel Base	5.166 MM
Front Axial Load	5440 KG
Rear Axial Load	6350 KG

5.1.9. Foam Tender (SCANIA)



Table: - A.01-T18.: Foam Tender (SCANIA)

VEHICLE ITEMS	SPECIFICATIONS
Length	9.50 M
Width	2.70 M
Height	3.31 M
Weight	26100 KG
Wheel Base	
Front Axial Load	7100 K
Rear Axial Load	19000 KG

5.1.10. MMU (SCANIA)



Table: - A.01-T19.: MMU (SCANIA)

VEHICLE ITEMS	SPECIFICATIONS
Length	9.75 M
Width	2.96 M
Height	3.70 M
Weight	28100 KG
Front Axial Load	7100 KG
Rear Axial Load	21000 KG

5.1.11. Rescue Tender (SCANIA)



Table: - A.01-T20.: Rescue Tender (SCANIA)

VEHICLE ITEMS	SPECIFICATIONS
Length	7.98 M
Width	3.02 M
Height	3.38 M
Weight	18200 KG
Front Axial Load	6700 KG
Rear Axial Load	11500 KG

5.1.12. HP 27 METER (SCANIA)



Table: - A.01-T21.: HP 27 METER (SCANIA)

VEHICLE ITEMS	SPECIFICATIONS
Length	8.90 M
Width	3.04 M
Height	3.53 M
Weight	26100 KG
Front Axial Load	7100 K
Rear Axial Load	19000 KG

5.1.13. HP 53 METER (SCANIA)



Table: - A.01-T22.: HP 53 METER (SCANIA)

VEHICLE ITEMS	SPECIFICATIONS
Length	11.07 M
Width	3.05 M
Height	3.75 M
Weight	33000 KG
Front Axial Load	9000 KG
Rear Axial Load	9000 KG

5.1.14. HP 54 METER (SCANIA)



Table: - A.01-T23.: HP 54 METER (SCANIA)

VEHICLE ITEMS	SPECIFICATIONS
Length	11.07 M
Width	3.06 M
Height	3.75 M
Weight	33000 KG
Front Axial Load	9000 KG
Rear Axial Load	9000 KG

5.1.15. HP 112 METER (MERCEDES)



Table:- A.01-T24.: HP 112 METER (MERCEDES)

VEHICLE ITEMS	SPECIFICATIONS
Length	19.2 M
Width	2.7 M
Height	4.0 M
Weight	70760 KG
Front Axial Load	7100 K
Rear Axial Load	19000 KG

5.1.16. Rescue Boat



Table:- A.01-T25.: Rescue Boat

VEHICLE ITEMS	SPECIFICATIONS
Length	6.4 M
Width	2.39 M
Height	2.55 M

5.1.17. Rescue Boat



Table:- A.01-T26.: Rescue Boat

VEHICLE ITEMS	SPECIFICATIONS
Length	4.20 M
Width	1.72 M
Height	2.55 M

6.0 Fire Station

6.1. Intention

6.1.1. It is the practice of General Directorate of Civil Defence (GDCD) to respond to any fire emergency in the country within 8 minutes of receiving emergency call.

6.1.1. The above mentioned vision can only be fulfilled by having well equipped Fire stations throughout the cities, developments and industrial zones such that each area can be reached within 8 minutes during fire emergencies.

6.1.1. This section conveys briefly the Fire station requirements to be implemented when General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain demands Fire Stations to be built in new developments.

6.2. Necessity of a Fire Station

6.2.1. Necessity of a Fire Station to cover any locality shall be decided by the Bahrain Civil Defence. Every developers and builders shall coordinate with General Directorate of Civil Defence during planning stage to confirm and verify the need for Fire Station to be built in their developments.

6.2.2. The necessity of a Fire Station, along with ambition of responding to emergencies within 4 minutes, also depends on the Risk category of a particular region. This Risk analysis is carried out by the General Directorate of Civil Defence based on developer's submission of his project details.

6.2.3. Such project details shall include the following.

a. Satellite Map of the region
b. Setting out plans showing nature of buildings and occupancies.
c. Location of nearest General Directorate of Civil Defence (GDCD Fire Station to the development.
d. Information about special Risks to be considered such as involvement of explosive, hazardous and flammable material, Culturally high value structures, Historic buildings, critical infrastructure facilities etc.

6.3. Design

6.3.1. Fire station designs vary depending on the category of a fire station.

6.3.2. Categories of Fire station shall depend on Risk assessment of the locality that it caters to and the detailed information about the Fire apparatus that to be accommodated.

6.3.3. The fire stations are occupied at all times housing Fire fighters. Ensuring their comfort, safety and well-being are of high importance.

The following design intent shall be considered for an effective fire station.

a. Internal response time (Dispatch time)
b. Clear distinction between residential space and work space.
c. Ease and quick access between Residential, Vehicle bay, training, administrative, maintenance and recreational spaces.

6.3.4. The Fire station functional areas shall include the following but not limited to,

a. Control room
b. Enclosed Fire Apparatus Parking
c. Maintenance equipment/Store room.
d. Administrative Office room
e. Living room.
f. Bedroom.
g. Washroom with shower
h. Locker room
i. Kitchen
j. Pump room
k. Water Tank

6.3.5. The bedroom sizes, number of beds, living room sizes, fire apparatus enclosed parking sizes, equipment, Control room features, water tank and fire apparatus refilling features and requirements shall be discussed and confirmed with permitted from Civil Defence Operation department.

6.3.6. The roads and turning facilities, the surface finish etc. shall comply with **Sub Section 3 and Table: - A.01-T1.** of this chapter.

6.3.7. Refer to **Figure: - A.01-F18.** for a sample Fire station floor plan.

6.3.8. Fire station design shall be permitted by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain Operation Department.

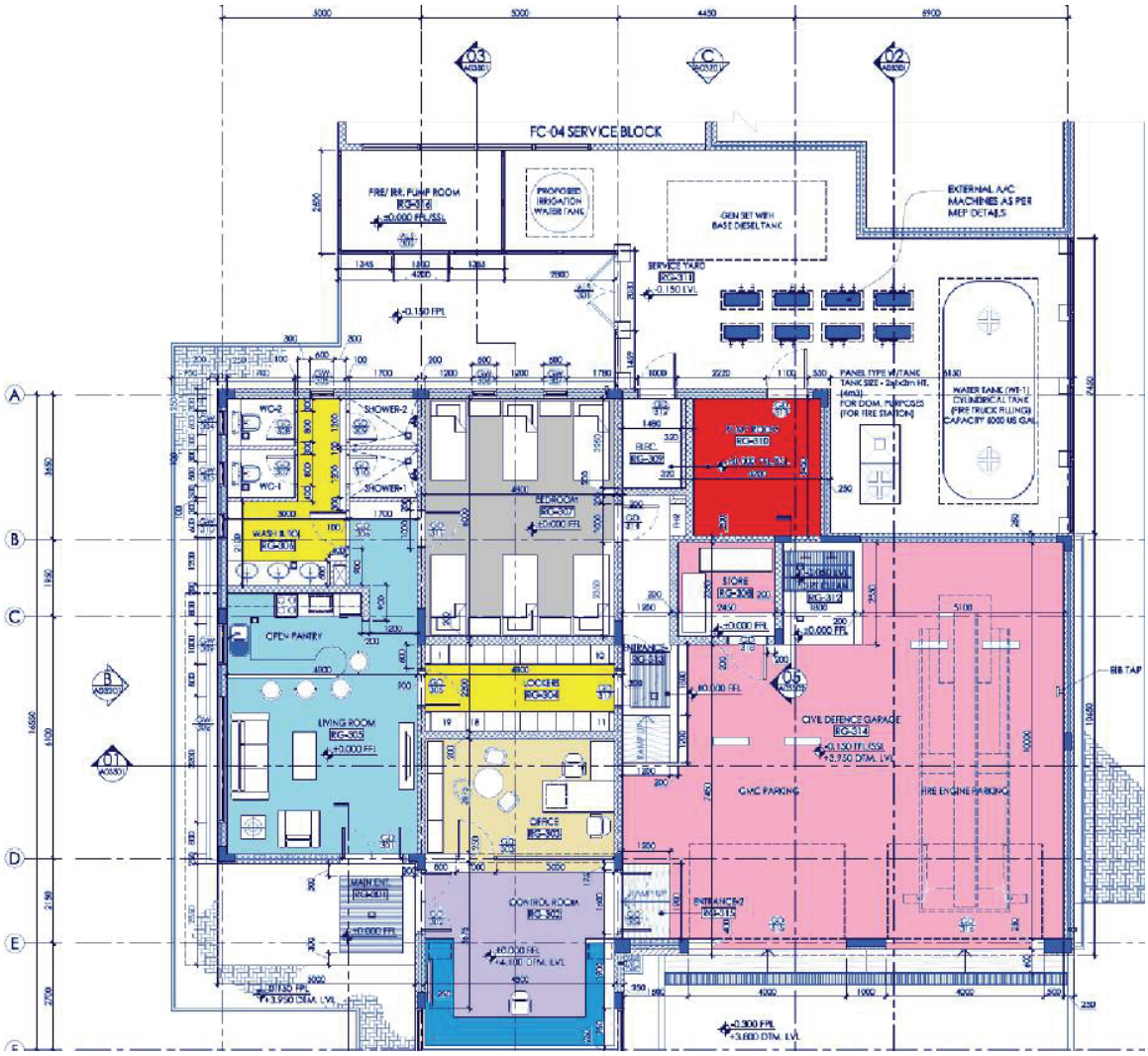
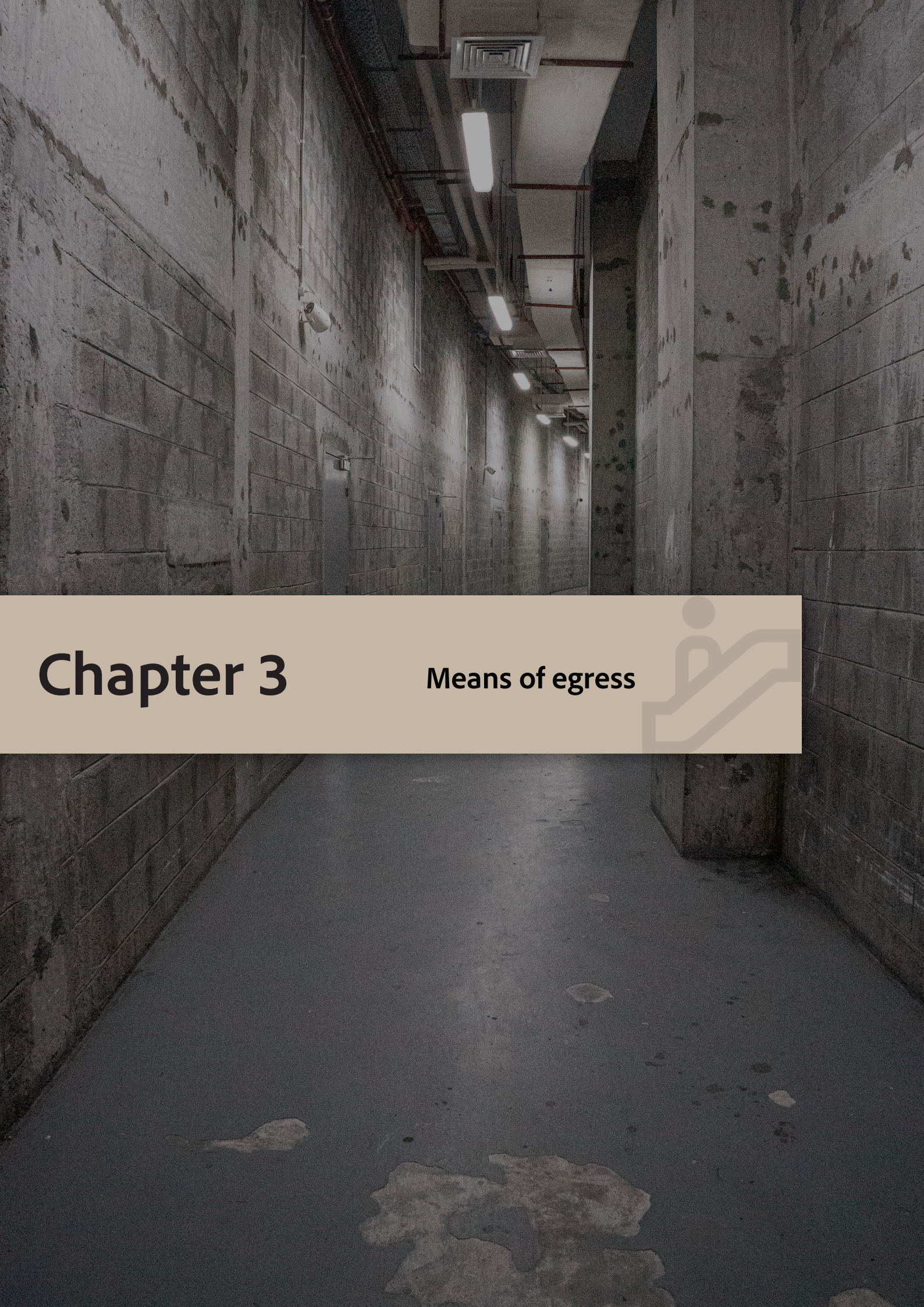


Figure: - A.01-F18: Sample floor plan of a Fire Station

7.0. Acceptable Test Standards and Criteria

- The standards and documents referred for this chapter are **NFPA 1, NFPA 14, NFPA 24, NFPA 22, NFPA 20,**
- British permitted document B5
- General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain
- For cladding or insulation materials supplier shall provide test evidence and certification to show the material / composite achieves Class A1 to fire performance test, EN 13501-1 and shall have self-ignition temperature of not less than 343°C when tested to ASTM D1929.
- Vapour barriers shall be aluminum foil or achieve class A2-s1-d0 to EN 13501-1.
- All fire lifts in accordance with sections 5.3 and 5.6-5.12 of BS EN 81-72 current edition.
- The fire lift lobby with a smoke barrier having a minimum 1-hour fire-resistance rating.



Chapter 3

Means of egress

Chapter 3

Means of egress

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1. Scope

1.1 This code establishes minimum criteria for the design of egress facilities so as to allow prompt escape of occupants from building or where desirable, into safe areas within the building.

1.2 Provide adequate number of Exits and corridors, restrict travel distances and provide building features such that people can carry out evacuation efficiently to point of safety, out of the building.

1.3 To enable designers to consider floor plans and exit widths that can accommodate people movement and evacuation fluently as per required Occupant Loads.

1.4 Specification for Exit, stairs, Corridors, Doors, Handrails, Access control, Lock, Latches, Travel distance, Dead end, common path, Occupants loads, Exit Allowances.

2. Definitions

2.1. Means of Egress

2.1.1. Shall
It is a mandatory requirement from General Directorate of Civil Defence (GDCD)- Kingdom of Bahrain

2.1.2. Should
It is a suggested requirement recommended by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain but not mandatory.

2.1.3. Listed
Permitted and registered by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain.

2.1.4. Means of Egress
A continuous and unobstructed way of travel from any point in a building or structure to a public way consisting of three separate and distinct parts: (1) the exit access, (2) the exit, and (3) the exit discharge.

2.1.5. Means of Escape
A way out of a building or structure that does not conform to the strict definition of means of egress but does provide an alternate way out.

2.1.6. Exit Access
That portion of a means of egress that leads to an exit.

2.1.7. Exit
That portion of a means of egress that is separated from all other spaces of the of building or structure by construction, location or equipment as required to provide a protected way of travel from Exit access to the exit discharge.

2.1.8. Exit Discharge
That portion of a means of egress between the termination of an exit and a public way.

2.1.9. Level of Exit Discharge.
The storey or level where required number of the building exits discharge to outside to finished ground level.

2.1.10. Horizontal Exit
A way of passage from one building to an area of refuge in another building on approximately the same level, or a way of passage through or around a fire barrier to an area of refuge on approximately the same level in the same building that affords safety from fire and smoke originating from the area of incidence and areas communicating therewith.

2.1.11. Accessible Means of Egress
A continuous and unobstructed means of egress that provides an accessible route to a public way.

2.1.12. Exit Enclosure
An Exit component that is separated from other spaces of a building or structure by fire resistance rated construction and opening protective, providing a protected path of egress travel in a vertical or horizontal direction to exit discharge or public way or outside building.

2.1.13. Exit Passageway
An Exit component that is separated from other spaces of a building or structure by fire resistance rated construction and opening protective, providing a protected path of egress travel in a horizontal direction to exit discharge or public way or outside building. Additional uses for the exit passageway include stair transfer in upper floors as well as to reduce travel distance to an exit by having an exit passageway lead to a stair of exit discharge.

2.1.14. Exit Corridor
An Exit component that may or may not be separated from other spaces of a building or structure by fire resistance rated construction and opening protective, providing a path of egress travel in a horizontal direction to exit or exit passageway.

2.1.15. Exit Access Doorway
A door or access point along the exit path from an occupied room, area or space Where the path of egress enters room, corridor, unenclosed exit access stair or un-closed exit access ramp.

2.1.16. Aisle Access way
The initial portion of an exit access that leads to an aisle.

2.1.17. Aisle Ramp
A ramp within a seating area of an assembly occupancy that directly serves rows of seating to the side of the ramp.

2.1.18. Egress Court
A court or yard which provided access to a public way for one or more Exits.

2.1.19. Public Way
A street, alley or other portion of land open to the outside air leading to a street, usually government property, that has been permanently dedicated to the public for public use and which has clear width and height of not less than 3 m.

2.1.20. Ramp
A walking surface that has a running slope steeper than 5% slope.

2.1.21. Smoke proof Enclosure
An enclosure designed to limit the entry and movement of products of combustion produced by a fire.

2.1.22. Lobby
An entrance or foyer in a building.

2.1.23. Elevator Lobby.
A landing from which occupants directly enter an elevator car(s) and into which occupants directly enter upon leaving an elevator car(s).

2.1.24. Vestibule
A small room next to an exit stair door and connecting it with the interior of the Building.

2.1.25. Storey
The portion of a building located between the upper surface of a floor and the upper surface of the floor or roof next above.

2.1.26. Storey's in Height.
The storey count starting with the level of exit discharge and ending with the highest occupiable storey height containing the occupancy considered.

2.2. Stair

2.2.1. Stair
Change in elevation, consisting of one or more risers.

2.2.2. Exit Stair
An Exit component that is separated from other spaces of a building or structure by fire resistance rated construction and opening protective, providing a protected path of egress travel in a vertical direction to exit discharge or public way or outside building.

2.2.3. Stairway
One or more flights of stairs, either exterior or interior, with necessary landings and Platforms connecting them to form a continuous and uninterrupted passage from one level to another.

2.2.4. Stairway, Exterior
A stairway that is open on at least one side, except for required structural columns, beams, handrails and guards. The adjoining open area shall be either yards, courts or public ways. The other sides of the exterior stairway need not be open.

2.2.5. Stairway, Interior
A stairway that does not meet the requirements of exterior stairway and serves the interior of the building.

2.2.6. Stairway, Spiral
A stairway having a closed circular form in its plan view with uniform section-shaped treads attached to and radiating from a minimum-diameter supporting column.

2.2.7. Scissor Stair
Two interlocking stairways providing two separate paths of egress located within one stairwell enclosure.

2.2.8. Aisle Stair
A stair within a seating area of an assembly occupancy that directly serves rows of seats to the side of the stair, including transition stairs that connect to an aisle or a landing.

2.2.9. Stair Tread
A stepping space in a stair flight to set the foot.

2.2.10. Stair Riser
The near-vertical element in a set of stairs, forming the space between a step and the next.

2.2.11. Stair Landing
The floor area at the top of a flight of stairs or between two flights of stairs.

2.2.12. Handrail
A horizontal or sloping rail intended for handhold and grasping by the hand for guidance or support.

2.2.13. Guard
A vertical protective barrier erected along elevated walking surfaces, exposed edges of stairways, balconies and similar areas that minimizes the possibility of fall from elevated surfaces to lower level.

2.3. Door

2.3.1. Door (Door Assembly)
Any combination of a door, frame, hardware, and other accessories that is placed in an opening in a wall that is intended primarily for access or for human entrance or exit.

2.3.2. Fire Door (Fire Door Assembly)
Any combination of a fire door, a frame, hardware, and other accessories that Together provides a specific degree of fire protection to the opening.

2.3.3. Horizontal Fire Door Assembly
A combination of a fire door, a frame, hardware, and other accessories installed in a horizontal plane, which together provide a specific degree of fire protection to a through-opening in a fire resistance–rated floor or roof.

2.3.4. Elevator Lobby Door
A door between an elevator lobby and another building space other than the elevator shaft.

2.3.5. Revolving Door
A door, especially at the entrance of a building, typically made of three or four rigid leaves of upright sections joined at right angles and rotating about a central upright axle.

2.3.6. Panic Hardware
A door-latching assembly incorporating an actuating member or bar that releases the latch bolt upon the application of a force in the direction of egress travel.

2.3.7. Fire Exit Hardware
A type of panic hardware that additionally provides fire protection where used as part of a fire door assembly.

2.3.8. Actuating Member or Bar
The activating mechanism of a panic hardware or fire exit hardware device located on the egress side of a door.

2.3.9. Automatic Closing Door
A door that normally is open but that closes when the automatic-closing device is activated.

2.4. Special Definitions

2.4.1. Common Path of Travel
The portion of exit access that must be traversed before two separate and distinct paths of travel to two exits are available.

2.4.2. Travel Distance to Exits
The portion of exit access that must be traversed before reaching an exit, which is measured along the natural path of travel on the floor or walking surface.

2.4.3. Dead end corridor
The portion of corridor that when traversed leads to no exit at the end that portion has to be traversed back to get to reach a choice of exits and is measured along the natural path of travel, on the floor or walking surface.

2.4.4. Occupant Load
The total number of persons that might occupy a building or portion thereof at any one time for whom number of exits and widths of such exits needs to be designed.

2.4.5. Occupant Load Factor
A designation of square meters per person based upon the use of a given space. It is used to determine occupant load by dividing the occupant load factor from the over-all square meters of an area. The occupant load in any building or portion thereof shall be not less than the number of persons determined by dividing the floor area assigned to that use by the pre- determined occupant load factor for that use. Where both gross and net area figures are given for the same occupancy, calculations shall be made by applying the gross area figure to the gross area of the portion of the building devoted to the use for which the gross area figure is specified and by applying the net area figure to the net area of the portion of the building devoted to the use for which the net area figure is specified.

2.4.6. Gross Floor Area
Total floor area within the inside perimeter of the outside walls of the building under consideration with no deductions for hallways, stairs, closets, thickness of interior walls, columns, elevator and building services shafts, or other features, but excluding floor openings associated with atriums and communicating spaces.

2.4.7. Net Area
The floor area within the inside perimeter of the outside walls, or the outside walls and fire walls of a building, or outside and/or inside walls that bound an occupancy or incidental use area requiring the occupant load to be calculated using net floor area under consideration with deductions for hallways, stairs, closets, thickness of interior walls, columns, or other features. Areas consumed by services, structural elements, shafts etc. are not included in the net area.

2.4.8. Refuge Area

An area that is either

a. A storey in a building where the building is protected throughout by a permit, supervised automatic sprinkler system and has not less than two accessible rooms or spaces separated from each other by smoke-resisting partitions.

b. A space located in a path of travel leading to a public way that is protected from the effects of fire, either by means of separation from other spaces in the same building or by virtue of location, thereby permitting a delay in egress travel from any level.

2.4.9. Elevator Evacuation System.

A system, including a vertical series of elevator lobbies and associated elevator lobby doors, an elevator shaft(s), and a machine room(s), that provides protection from fire effects for elevator passengers, people waiting to use elevators, and elevator equipment so that elevators can be used safely for egress.

3. Means of Egress

3.1. Intention

3.1.1. Means of Egress requirements in this chapter are to accomplish the following.

3.1.1.1. Provide adequate number of Exits and unobstructed means to access such exits, for the occupants of buildings to be able to evacuate to safety during fire emergencies.

3.1.1.2. Protect and improve survivability of occupants not intimate with initial fire development.

3.1.1.3. Provide building features such that safe crowd movement is ensured during emergencies.

3.2. General Requirements

3.2.1. Two means of egress, as a minimum, shall be provided in every occupied building or structure, section, and area where size, occupancy, and arrangement endanger occupants attempting to use a single means of egress that is blocked by fire or smoke. However, authority shall allow certain buildings with single mean of egress.

3.2.2. The two means of egress shall be arranged to minimize the possibility that both might be rendered impassable by the same emergency condition.

3.2.3. In every occupied building or structure, means of egress from all parts of the building shall be maintained free and unobstructed. Means of egress shall be accessible to the extent necessary to ensure reasonable safety for occupants having impaired mobility.

3.2.4. Every exit shall be clearly visible, or the route to reach every exit shall be conspicuously indicated. Each means of egress and its entirety, shall be arranged or marked so that the way to a place of safety is indicated in a clear manner.

3.2.5. The requirements of this chapter are minimum guidelines. It is consultants responsibility to refer to the international standards along with Bahrain Fire and Life Safety Code Of Practice and GDCD Engineering Judgement, for matters not covered by this code.

3.2.6. International codes and standards referred for this chapter are the latest editions of, **NFPA 101, NFPA 5000, SFPE Handbook, IBC and their referenced standards.**

3.2.7. No new construction shall be executed unless the building has been designed and permitted as per General Directorate of Civil Defence (GDCD) requirements.

3.2.8. No new construction shall be occupied in whole or in part unless the building has been designed, permitted, inspected and completion certificate is obtained as per General Directorate of Civil Defence (GDCD) requirements.

3.2.9. No modifications, alterations, extensions and change of usage to a building or structure shall be carried out unless such proposals have been designed, permitted, inspected and completion certificate is obtained as per General Directorate of Civil Defence (GDCD) requirements.

3.2.10. No under construction buildings or structures shall be occupied in whole or in part unless such proposals have been designed, permitted, inspected and completion certificate is obtained as per General Directorate of Civil Defence (GDCD) requirements.

4. Components of Means of Egress

4.1. General

4.1.1. The provisions of this section express the way of determining the design, construction, protection, location and arrangement of exit features to provide safe means of egress for occupants from all occupancies hereafter erected, altered or changed in an occupancy.

4.1.2. Such means of egress is categorized into distinct following sections.

a. The Exit Access
b. The Exit
c. The Exit Discharge

4.1.3. The egress is essentially achieved by combination of the following components of means of egress.

a. Doors
b. Stair
c. Corridors
d. Passage ways
e. Horizontal exits
f. Bridges between buildings
g. Ramps
h. Elevators and Escalators
i. Area of Refuge
j. Escape Slides and Ladders

4.1.4. General requirements for any components of Means of Egress shall comply with **Table:- A.03-T1.**

	Table:- A.03-T1 : General Requirements for Means of Egress
ITEMS	**REQUIREMENTS**
1. HEAD ROOM	i. Clear ceiling height of 2285 mm shall be available in means of egress. In not less than 50 % of ceiling area, Headroom of 2030 mm, without any obstructions, shall be available from finished floor (FFL) for any means of egress, in any occupancy, including industrial equipment access. ii. Head room on stairs shall not be less than 2030 mm, measured vertically above a plane, parallel to the most forward projection of the stair tread.
2. WALKING SURFACE	i. Walking surfaces in the means of egress shall be slip resistant under foreseeable conditions and be securely attached. ii. Walking surfaces shall be nominally level. iii. The slope of a walking surface in the direction of travel shall not exceed 1 in 20. iv. The slope perpendicular to the direction of travel shall not exceed 1 in 48. v. Horizontal projections such as structural elements, furnishings, fixtures etc. shall not project more than 102 mm over any walking surface between 686 mm to a height of 2030 mm from finished floor walking surface.
3. CHANGE IN LEVEL	i. Abrupt changes in elevation of walking surfaces shall not exceed 6.3 mm. ii. Changes in elevation above 6.3 mm to 13 mm, shall be beveled with a slope of 1 in 2. iii. Changes in elevation exceeding 13 mm but not in excess of 535 mm shall be considered a change in level and shall be achieved by either a ramp with maximum slope of 1 in 12 or stair with tread depth not less than 330 mm. iv. Changes in level in means of egress shall be achieved by an permit means of egress where the elevation difference exceeds 535 mm.
4. GUARDS	i. Guards shall be provided at the open sides of means of egress that elevate and exceed 760 mm above the floor or the finished ground level below. ii. The height of guards required shall be not less than 1065 mm high, measured vertically to the top of the guard from the finished walking surface.

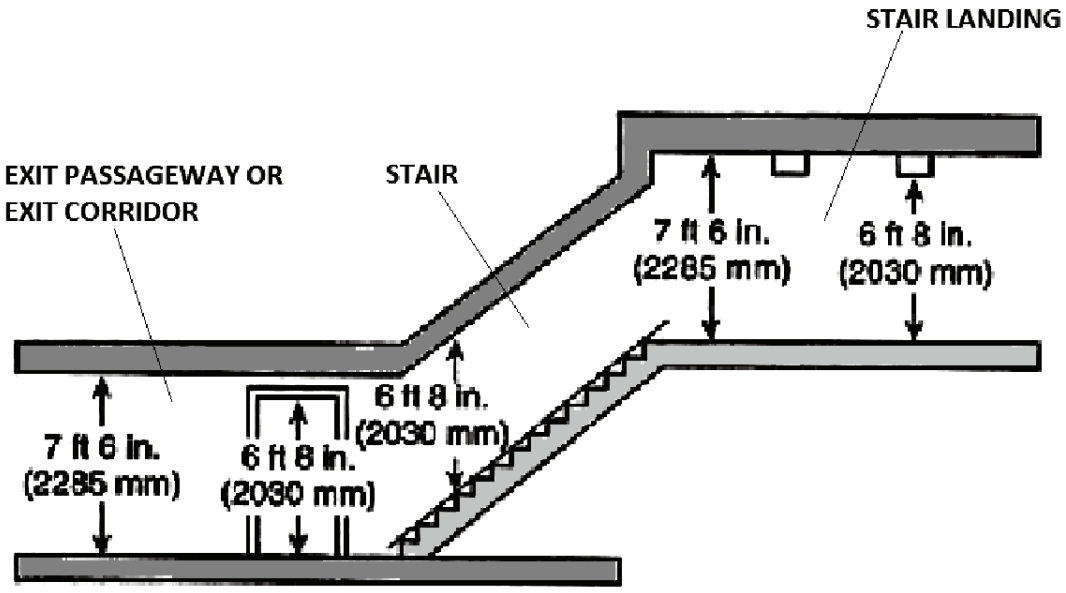


Figure:- A.03-F1.: Head room in means of egress

4.2. Doors (Door Assembly)

4.2.1. Every door and door assembly shall be designed and constructed so that the way of egress travel is obvious and direct. Other features such as décor and windows that, because of their physical appearance or design or the materials used in their Construction have the potential to be mistaken for doors shall be made inaccessible to the occupants by barriers or railings. Doors can be of several types. This section covers Standard doors, Revolving doors, Powered doors, Access controlled doors, Sliding doors and Rolling shutters.

4.2.2. Door assembly shall comply with **Table:- A.03-T1** and **Table:- A.03-T2.** However, type of Door al- lowed and modified if provided by individual occupancies as per **Section 6.**, shall override the requirements of **Table:- A.03-T2.**

Table:- A.03-T2: Doors (Door Assembly)

ITEMS	REQUIREMENTS
1. MEASURING CLEAR WIDTH OF DOOR	i. The measurement shall be taken at the narrowest point in the door opening. ii. The measurement shall be taken between the face of the door leaf fully open (For existing door assemblies) or open 90 degrees (For new swinging door assemblies) and the stop of the frame. iii. Projections of not more than 100 mm into the door opening width on the hinge side shall not be considered reductions in clear width, provided that such projections are for purposes of accommodating panic hardware or fire exit hardware and are located not less than 865 mm, and not more than 1220 mm, above the floor. iv. Projections exceeding 2030 mm above the floor shall not be considered reductions in clear width.

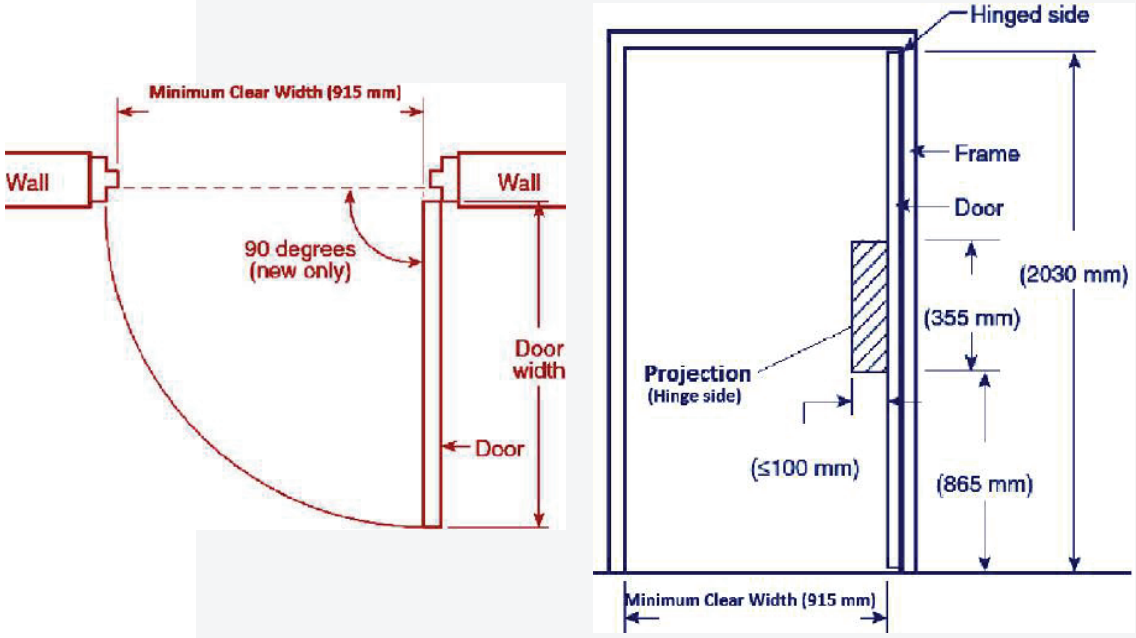


Figure:- A.03-F2.: Measuring Door Assembly width

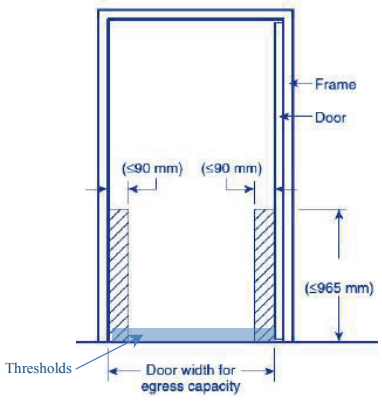
Table:- A.03-T2: Doors (Door Assembly)	
ITEMS	**REQUIREMENTS**
1. MEASURING CLEAR WIDTH OF DOOR	v. For measurement of Egress capacity width, Projections of not more than 90 mm on each side of door opening width shall not be considered reductions in clear width, provided that such projections are located not more than 965 mm above the floor.
2. MINIMUM DOOR WIDTH	i. Minimum Door width shall not be less than 915 mm or as per egress capacity Width requirements, whichever is higher. ii. Where a pair of door leaves is provided, one door leaf shall provide not less than 810 mm clear width opening. iii. Bathroom doors serving a room not exceeding 6.5 m^2 and not required to be accessible to persons with severe mobility impairments shall be not less than 710 In door leaf width. iv. Minimum door width of a balcony, not used for an assembly usage, shall not be less than 810 mm. v. Minimum Door widths as required by individual occupancies shall override
3. FLOOR LEVEL AT THE DOOR	i. The elevation of the floor surfaces on both sides of a door opening shall not vary by more than 13 mm. and it shall be maintained so for not less than width of widest door leaf. ii. Thresholds at door openings shall not exceed 13 mm in height.] iii. Where doors serve spaces that are not normally occupied, the floor level shall be permitted to be lower than that of the door opening but shall be not more than 205 mm lower.
4. DIRECTION OF THE DOOR LEAF SWING	i. Door leaves required to be of the side-hinged or pivoted-swinging type shall swing in the direction of egress travel where serving a room or area with an occupant load of 50 or more, or serving horizontal exit, or serving high hazard content room or serving an exit enclosure. ii. Doors serving Residential Units shall not be required to swing in the direction of egress. iii. Any door assembly in a means of egress shall be of the side-hinged or pivoted- swinging type, and shall be installed to be capable of swinging from any position to the full required width unless otherwise specified in other sections of this code.
	

Figure:- A.03-F3.: Measuring Door Assembly for Egress Capacity

Table:- A.03-T2: Doors (Door Assembly)	
ITEMS	**REQUIREMENTS**
5. FORCE TO OPEN	i. The door assembly shall be readily operable from the egress side without special knowledge or effort. ii. The forces required to fully open any door leaf manually in a means of egress shall not exceed **a.** 67 N (15 lbf) to release the latch, **b.** 133 N (30 lbf) to set any door leaf in motion, **c.** 67 N (15 lbf) to open any door leaf to the minimum required width.
6. DOOR LEAF ENCROACH-MENT	i. During its swing, any door leaf in a means of egress shall leave unobstructed, not less than one-half of the required width of an aisle, a corridor, a passageway, or a landing. ii. Any door, which needs to be held open, when fully open, in a means of egress shall not project more than 180 mm into the required width of an aisle, a corridor, a passageway, or a landing, unless the door leaf is equipped with an permitted self- closing device and is not required to swing in the direction of egress travel. iii. All hardware for door release shall have maximum projection or obstruction as per Table**: - A.03-T2.1. iii and v.**
7. LOCKS AND LATCHES	i. Locking type Door leaves shall be arranged to be opened readily from the egress side whenever the building is occupied. ii. Locks, if provided, shall not require a tool or special knowledge or effort for operation from the egress side. And a key is immediately available to any occupant inside the building when it is locked. iii. Stair enclosure door if allows access to roof, shall allow re-entry from the roof. iv. Door latch releasing mechanism shall be located not less than 865 mm from finished floor and not more than 1220 mm from finished floor.
8. ACCESS CONTROL	i. A sensor shall be provided on the egress side, arranged to unlock the door in the direction of egress upon detection of an approaching occupant. ii. Door locks shall be arranged to unlock in the direction of egress from a manual release device. Such manual release device, shall be obvious without special knowledge and capable of being operated with one hand in the direction of egress. iii. When operated, the manual release device shall result in direct interruption of power to the lock —independent of the locking system electronics — and the lock shall remain unlocked for not less than 30 seconds. iv. Loss of power to the listed releasing hardware automatically unlocks the door assembly in the direction of egress. See **Section 8** for Materials. v. An automatic release that is actuated with the initiation of the building fire alarm system shall be provided to unlock doors serving means of egress. vi. Every electrically operated door assembly in a stair enclosure serving more than Four stories, shall be provided with manual means to unlock such stair enclosure door assemblies to allow re-entry. vii. Access control mechanism shall unlock doors automatically when there is sprinkler activation, fire protective signaling system. viii. A mechanical push button shall be provided next to the access controlled door with clear signage, which when manually operated shall unlock door within 15 seconds. The manual release device shall be readily accessible and clearly identified by a sign that reads as follows: PUSH TO EXIT. ix. Fire Alarm system's manual call point's activation shall not unlock the access controlled doors.

Table:- A.03-T2: Doors (Door Assembly)

ITEMS	REQUIREMENTS
9. DELAYED EGRESS LOCKING SYSTEMS	i. Delayed Egress locking Systems shall be allowed only in fully sprinkler protected low and ordinary hazard category buildings. ii. Such door locks shall unlock in the direction of egress upon actuation of automatic sprinkler system OR 1 heat detector OR 2 smoke detectors. iii. Loss of power to the listed releasing hardware automatically unlocks the door assembly in the direction of egress. See **Section 8** for Materials. iv. Where swiping cards and finger prints are required to open doors, a mechanical release device shall be provided at the door with clear signage, which when manually operated with a force of not more than 67 N, shall unlock door within 15 seconds. The initiation of the release process shall activate an audible signal in the vicinity of the door opening.
10. ELEVATOR LOBBY DOOR LOCKS	i. Elevator Lobby exit doors shall be permitted to be electrically locked provided they are permitted and listed (See Section 8 for materials), the building is fully sprinkler protected, lobby is provided with automatic fire detection and alarm system, a Two-way communication system is provided between elevator lobby and central control room which is constantly staffed. ii. Loss of power, activation of sprinkler system, activation of water flow switch, activation of building fire alarm system shall unlock electrically locked elevator lobby doors. iii. Access controlled door locks as per **Table:- A.03-T2.8**. And Delayed Egress locks as per Table**: - A.03-T2.9.** Shall not be allowed for elevator lobby door locks.
11. HOISTWAY ENCLOSURE	i. Doors, other than hoist way doors and the elevator car door, shall be prohibited at the point of access to an elevator car unless such doors are readily openable from the car side without a key, tool, special knowledge or effort.
12. PANIC HARDWARE AND FIRE EXIT HARDWARE	i. Only permitted and listed fire exit hardware shall be used on fire protection-rated door assemblies. See Section 8 for Materials. ii. It shall consist of a cross bar or a push pad, the actuating portion of which extends across not less than one-half of the width of the door leaf. iii. It shall be located not less than 865 mm from finished floor and not more than 1220 mm from finished floor. iv. Doors provided with Panic or fire exit hardware, shall not be provided with any other locks.



Figure:- A.03-F4.: Panic Hardware height from the finished floor

Table:- A.03-T2: Doors (Door Assembly)

ITEMS	REQUIREMENTS
13. SELF CLOSING DOORS	i. Self-closing doors shall remain closed unless actuated by fire detection and alarm system or sprinkler activation of the building or opened manually. ii. Self-closing doors shall be able to open manually without any special tools and Knowledge. iii. Self-closing doors, held open by hold-open mechanism, shall become automatically self-closing upon release of hold-open devices, loss of power and when manually operated.
14. REVOLVING DOORS	i. Each revolving door assembly shall have a conforming side-hinged swinging door assembly in the same wall as the revolving door within 3050 mm of the revolving door, unless it is serving street floor elevator lobby and no stairway or other means of egress from within that building is not discharging from such revolving door. ii. Revolving door assemblies shall not be used within 3050 mm of the foot or the top of stairs or escalators. iii. Revolving door wings shall be capable of being collapsed into a book-fold position, creating an egress width of 915 mm, when applied a force not exceeding 130 lbf (580 N) to the wings within 75 mm of outer edge. iv. Each revolving door, when considered as a component of means of egress, shall not be credited for more than 50 % of required egress capacity and not more than 50 person capacity. v. Revolving door maximum speeds shall be as per **Table: - A.03-T3.**

Table:- A.03-T3: Revolving Door Maximum Speed

INSIDE DIAMETER	POWER DRIVEN SPEED CONTROL (RPM)	MANUAL SPEED CONTROL (RPM)
1. 1980 mm	11	12
2. 2135 mm	10	11
3. 2285 mm	9	11
4. 2440 mm	9	10
5. 2590 mm	8	9
6. 2745 mm	8	9
7. 2895 mm	7	8
8. 3050 mm	7	8

Table:- A.03-T2: Doors (Door Assembly)

ITEMS	REQUIREMENTS
15. TURNSTILES AND SIMILAR CONTROLLED PASSAGE MECHANISM.	i. Turnstiles and Similar Devices that restrict people travel and are used to collect fares or control entry into and from a building shall not be part of any means of egress. ii. Turnstiles having a clear width of 420 mm that turn freely in the direction of egress travel shall be permitted, provided a side-hinged swinging door assembly is available within 3050 mm of the Turnstile. iii. Turnstiles shall freewheel in the egress direction when primary power is lost or upon manual release by an employee assigned in the area. iv. Security access Turnstiles having maximum height of 990 mm and minimum clear width of 560 mm shall be allowed as part of means of egress, provided it is located in fully sprinkler protected area and given egress capacity of each turnstiles not more than 50 persons. v. Any security physical barrier that automatically retract or swing to an Unobstructed open position upon loss of power OR readily available manual release mechanism OR upon actuation from sprinkler activation OR upon actuation from fire protective signal shall be considered as component of means of egress.
16. DOOR IN FOLDING PARTITIONS	i. The entry and exit from folded partitioned space shall not be used by more than 20 persons unless such arrangements are accompanied by swinging exit doors. ii. The partitions shall be arranged so that they do not extend across any aisle or corridor used as an exit access to the required exits from the space. iii. Partitions shall confirm to interior finish requirements of **Section A Chapter 2, Construction. Sub Section 7.** iv. Partition shall have a simple method of release, and are capable of being opened quickly and easily by experienced persons in case of Emergency.



TURNSTILE FOR ILLUSTRATION



SECURITY TURNSTILE FOR ILLUSTRATION

Table:- A.03-T2: Doors (Door Assembly)	
ITEMS	**REQUIREMENTS**
17. HORIZONTAL SLIDING DOORS AND POWER-OPERATED SLIDING DOORS	i. Horizontal Sliding Doors shall be considered part of means of egress provided the door leaf is operable from either side without special knowledge or effort and carries signage on it indicating that it is sliding door. ii. The force required to operate the door leaf in the direction of travel is not more than 133 N (30 lbf) to set the leaf in motion and is not more than 67 N (15 lbf) to close the leaf or open it to the minimum required width. iii. Where fire ratings are required, sliding doors shall be tested and permitted as per **Section 8.** iv. Where door leaves are operated by power upon the approach of a person or are provided with power-assisted manual operation, the design shall be such that, in the event of power failure, the leaves open manually to allow egress travel or close when necessary to safeguard the means of egress. v. The feature for manual operation must work at all times, even when other features of the door assembly's mechanism such as the treadle, electric eye or sliding rail, have failed. vi. The door assembly shall be designed and installed so that, when a force is applied to the door leaf on the side from which egress is made, it shall be capable of swinging from any position to provide full use of the required width of the opening in which it is installed. vii. When the fire alarm is activated, the door of the main building must be opens automatically to facilitate the movement of escape. viii. A readily visible, durable sign in letters not less than 25 mm high on a contrasting background that reads as follows shall be located on the egress side of each door opening, "IN EMERGENCY, PUSH TO OPEN". ix. Sliding, power-operated door assemblies in an exit access serving an occupant load of fewer than 50 that manually open in the direction of door leaf travel, with door opening force not exceeding 133 N, shall not be required to have the swing- out feature. The required sign shall be in letters not less than 25 mm high on a contrasting background and shall read as, "IN EMERGENCY, SLIDE TO OPEN"

Table:- A.03-T2: Doors (Door Assembly)	
ITEMS	**REQUIREMENTS**
18. FIRE RESISTANCE RATING OF	i. Fire resistance rating of Doors, which open into exit corridors, exit access corridors and into exit stairs shall comply with **Table: - A.03-T3.a.** And **Table: - A.03-T3.b.** unless specified in individual occupancies as per **Sub Section 6.** ii. **Door fire rating is not required where located in non-fire rated walls.**

Table:- A.03-T3.a.: Fire Resistance Rating of Doors

DOOR LOCATION	DOOR FIRE RATING	SMOKE PROOF	SELF CLOSING	LATCHES AND LOCKS
1. Exit Stair	90 Minutes	Yes	Self-Closing	Latches Only
2. Exit Passageway	90 Minutes	Yes	Self-Closing	Latches Only
3. Exit Corridor of 1 hour fire rating	60 Minutes	Yes	Self-Closing	Latches Only
4. Exit Corridor of no fire rating	None	Not required	Not required	Latches Only
5. Service corridor of 1 hour fire rating	60 Minutes	Not required	Self-Closing	Table:- A.03-T2.
7. Service corridor of no fire rating	None	Yes	Not required	Table:- A.03-T2.
8. Elevator Lobby	60 Minutes	Yes	Self-Closing	Table:- A.03-T2.10.
9. Garbage room	60 Minutes	Yes	Self-Closing	Latches Only

Table:- A.03-T3.b.: Fire Resistance Rating of Unit Doors

MAIN DOORS OF UNITS IN ENCLOSED EXIT CORRIDOR	DOOR FIRE RATING	SMOKE PROOF	SELF CLOSING	LATCHES AND LOCKS
1. Apartment unit main door	60 Minutes	Not required	Not required	Table:- A.03-T2.7.
2. Residential unit main door	60 Minutes	Not required	Not required	Table:- A.03-T2.7.
3. Labor accommodation unit door	60 Minutes	Not required	Not required	Table:- A.03-T2.7.
4. Staff accommodation unit door	60 Minutes	Not required	Not required	Table:- A.03-T2.7.
5. Hotel unit main door	60 Minutes	Not required	Yes	Table:- A.03-T2.7.
6. Office unit main door	-None, if Sprinkler Protected -60 Minutes, if not Sprinkler Protected	Not required	Yes	Table:- A.03-T2
7. Kitchen door in residential/ Apartment	None	Not required	Not required	Table:- A.03-T2.7.
8. Unit doors in open external corridor	None	Not required	Not required	Table:- A.03-T2.7.
9. Education class room doors	-None, if Sprinkler Protected -60 Minutes, if not Sprinkler Protected	Not required	Yes	Table:- A.03-T2.

4.3. Stair

4.3.1. Stairs can be used as a component in the means of egress, whether interior or exterior to a building, serve multiple functions, allowing normal occupant movement among floors of building, providing egress during emergencies and fires and facilitating rescue and fire control operations by Fire fighters.

4.3.1. Exit Stair is that part of the means of egress which is separated from all other spaces of a building by a fixed and permanent noncombustible construction as required by **Section A**, **Chapter 02**, providing a protected way of travel to the Exit Discharge.

4.3.2. Stair shall comply with **Table:- A.03-T1** and **Table 3.5.** However, type of Stair allowed and modifications, if provided by individual occupancies as per **Sub Section 6,** shall override the requirements of **Table:- A.03-T4.**

Table:- A.03-T4: Stair

ITEMS	REQUIREMENTS
1. STAIR WIDTH	i. The minimum required width of an exit stair serving up to 2000 persons shall not be less than 1200 mm and shall satisfy the egress capacity. ii. The minimum required width of an exit stair serving more than 2000 persons shall not be less than 1420 mm and shall satisfy the egress capacity. iii. Stair width shall not decrease in width along the direction of egress travel. iv. The required width of a stair shall be measured from wall to the clear available width of the step. (See **Figure: - A.03-F6.a.**). The maximum projections of handrails allowed in this required width is 100 mm on each side, at a height of 865 mm—965 mm.
2. STAIR RISER HEIGHT	i. Maximum height of riser shall not exceed 180 mm; however, in residential buildings, it shall not exceed 170mm, and in service stairs, it shall not exceed 190mm. ii. Minimum height of riser shall not be less than 100 mm. iii. Riser heights shall be uniform throughout each stair flight between landings. iv. Where riser heights are adjusted to comply with acceptable stair treads,
3. STAIR TREAD DEPTH	i. Minimum stair tread depth shall not be less than 280 mm. ii. The tread slope shall not exceed 21 mm/meter (slope of 1 in 48) iii. Tread depth shall be uniform throughout the stair. The maximum difference of dimension allowed in a flight is 10 mm.
4. MINIMUM HEADROOM	i. Head room on stairs shall not be less than 2030 mm, measured vertically above a plane, parallel to the most forward projection of the stair tread.
5. LANDINGS	i. Maximum height between landings shall not be more than 3660 mm. ii. Every stair shall have landing at the door opening and landing width shall not be less than the required stair width. iii. Maximum landing area a stair door can encroach in its swing is one half of the required landing width. iv. Landing width shall not decrease in width along the direction of egress travel landing width shall not be required to exceed 1220 mm in the direction of travel, provided that the stair has a straight run. v. The landing slope shall not exceed 21 mm/meter (slope of 1 in 48).

	Table:- A.03-T4: Stair
ITEMS	**REQUIREMENTS**
6. SURFACES	i. Stair treads and landings shall be free of projections or lips that could trip stair users. ii. Stair treads and landings within the same stairway shall have consistent surface traction.

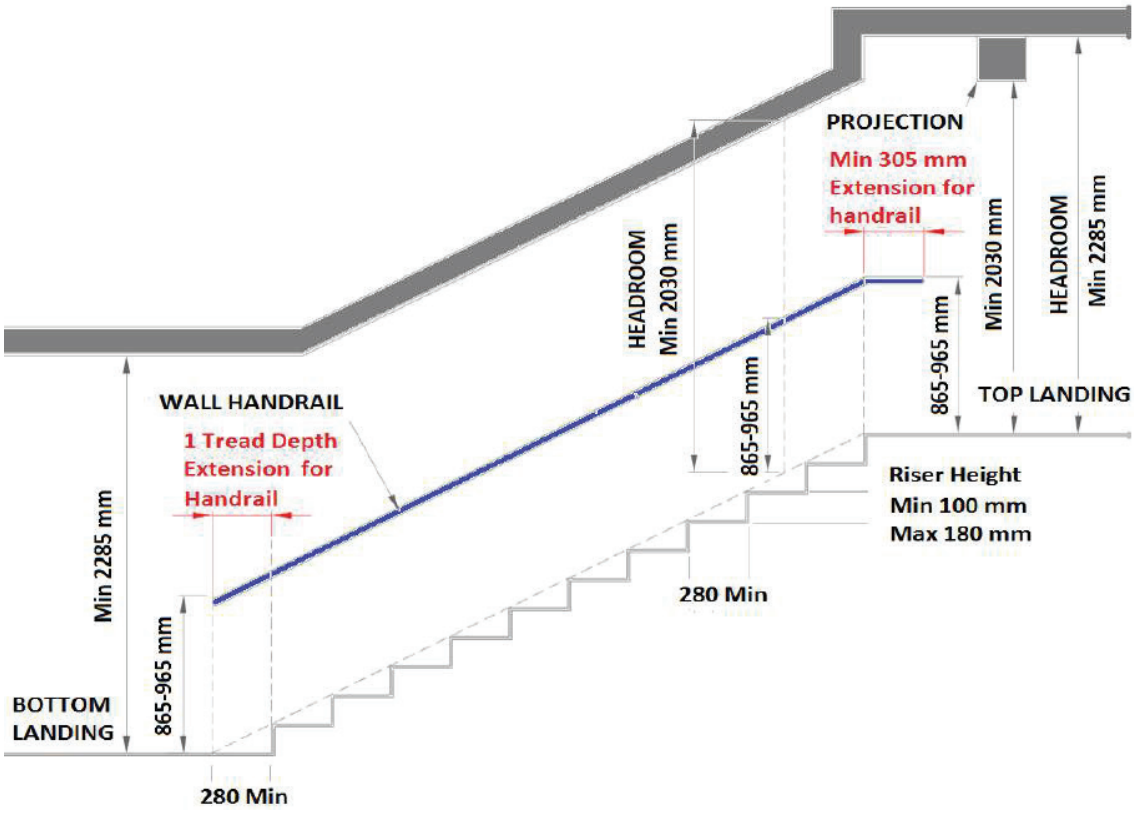


Figure:- A.03-F5.: Stair Specifications

	Table:- A.03-T4: Stair

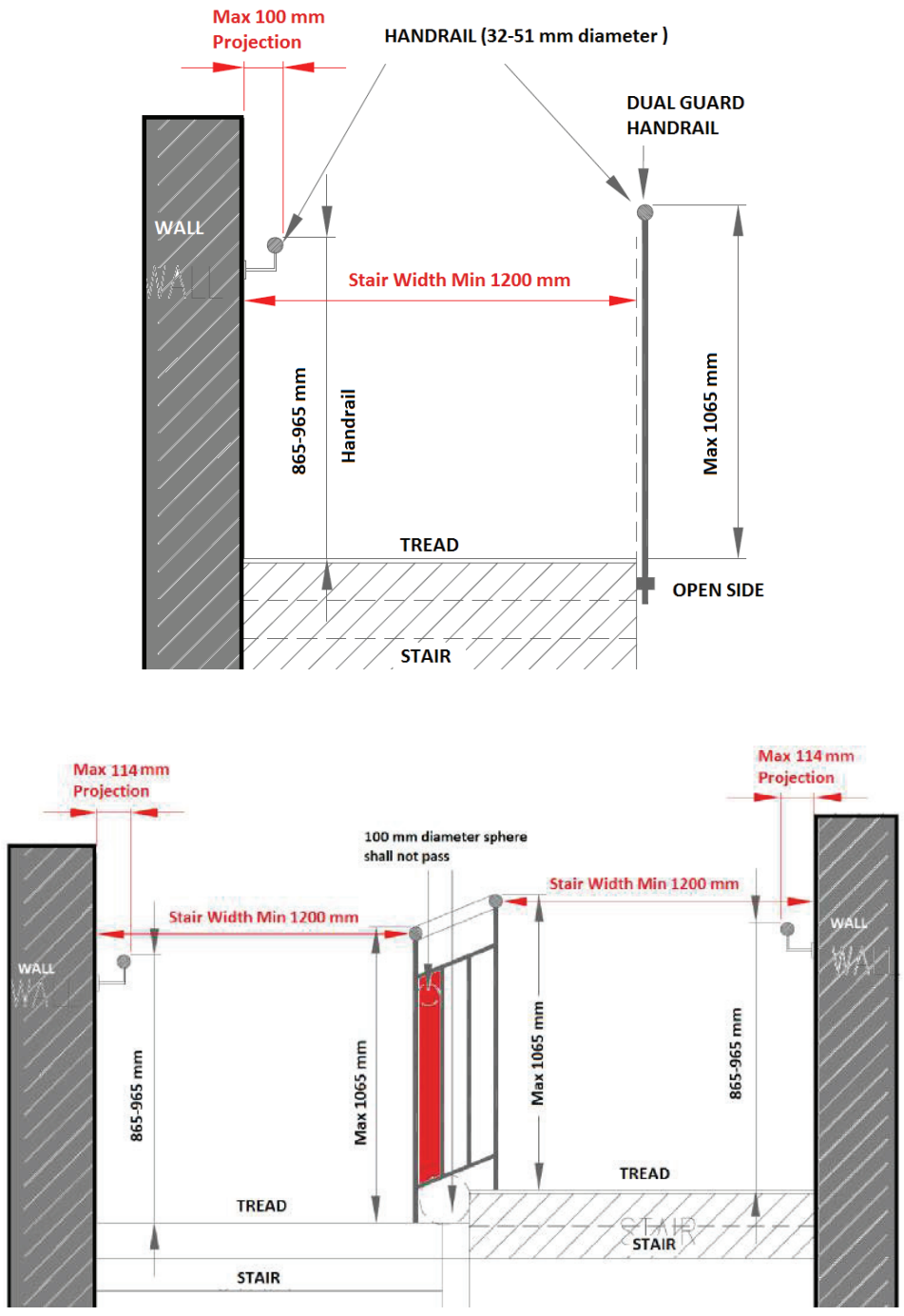
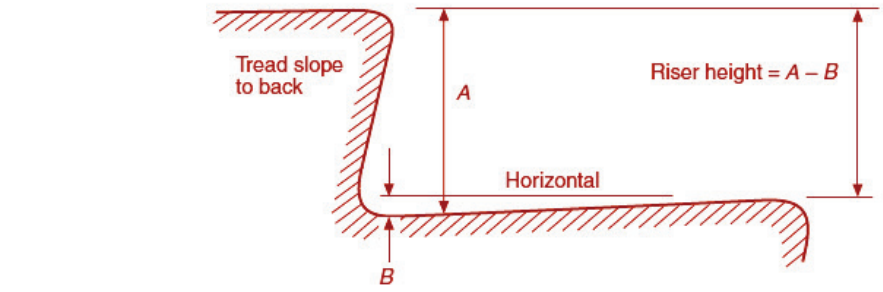
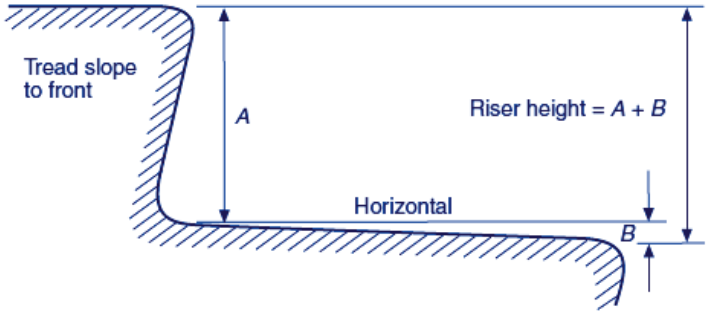


Figure:- A.03-F6.a.: Handrail projection, Stair Width Measurements





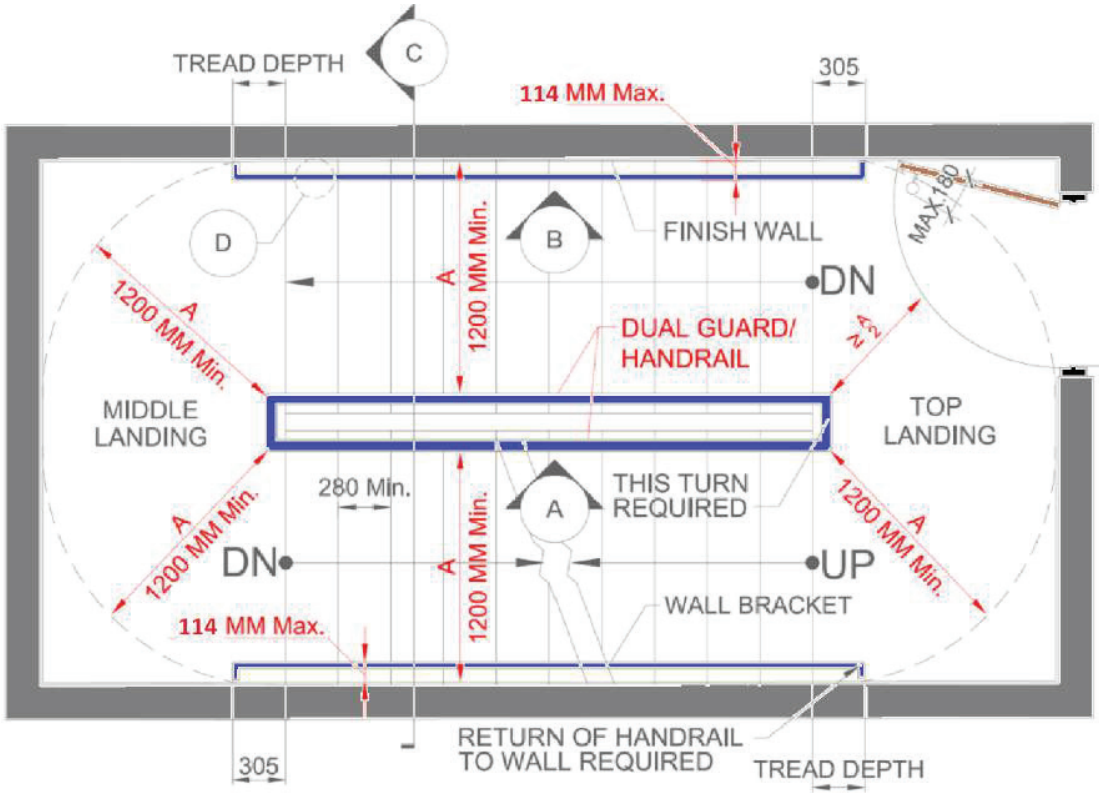
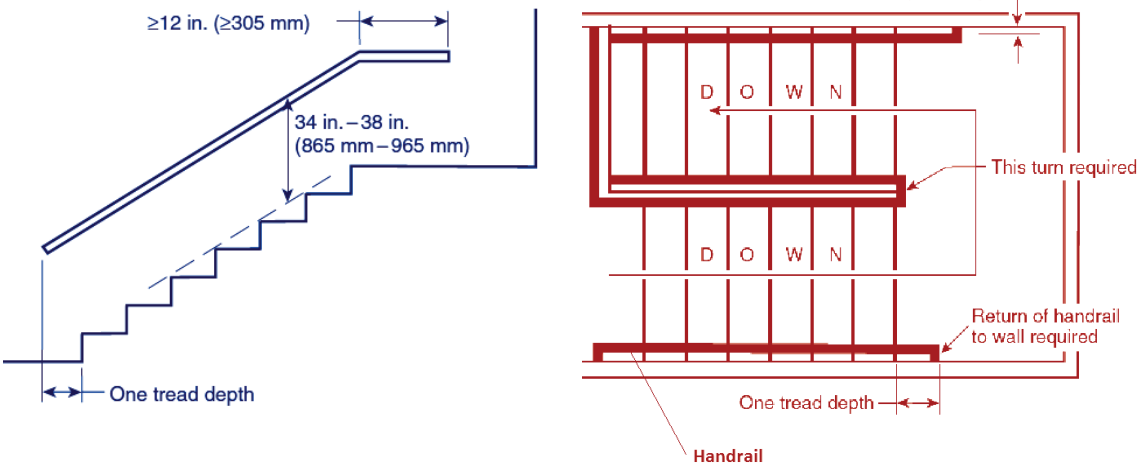
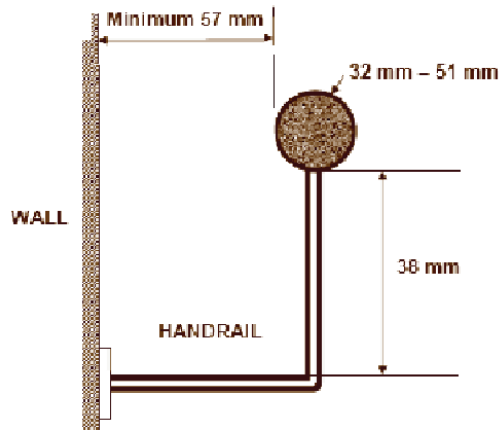


Figure:- A.03-F6.b.: Stair Risers, Stair Width, Door opening and Landing Measurements

Table:- A.03-T4: Stair	
ITEMS	**REQUIREMENTS**
7. STAIR SEPARATION FROM REST OF THE BUILDING AREAS	i. Every stair serving as an exit in Low rise buildings and Low depth underground or basement building (having height up to 15 m) shall be separated from rest of the building areas by a construction of at least block-work and ensure 2 hour fire resistance rating. ii. Every stair serving as an exit in Midrise building and High depth underground building (having height more than 15 m), High rise buildings and super high-rise buildings shall be separated from rest of the building areas by a construction of RCC (Reinforced Concrete) and ensure 2 hour fire resistance rating. iii. Separation shall extend vertically from the lowest level of the stair to a point 3 m above the top most landing of the stairs or to the roofline. iv. Elevators shall not be in a common shaft enclosure with stairway.
8. PENETRATIONS INTO STAIR SPACE	i. Space within the stair shall not be used for any other purpose than occupant exit and evacuation. ii. Space under the stair shall not be used for any other purpose unless such space is fully isolated from the stair with 2 hour fire resistance construction and entry/exit for such spaces shall not be through the stair enclosure enveloping that space. iii. Only penetrations allowed into Stair enclosure are Fire Hose and Sprinkler Piping, Fire protection piping valves, electrical conduits serving stair enclosure and fire detection and alarm system wiring enclosed in metal conduits. iv. Fire Hose Reel and Landing valve cabinets shall not be located in the stair enclosure. v. Pressurization ducting, AC units, Fan coil units, Ventilation ducts, water piping, heater piping, drainage piping etc., shall not be located in the stair
9. ILLUMINATION FOR STAIR	i. Exit stair shall be illuminated at all times that the building is occupied. Lighting control devices that turn lighting on and off based on occupant movement or presence shall be permitted. ii. Lighting control devices that dim the lighting levels within the exit enclosure shall not be installed unless they provide a minimum of 1 ft-candle (10.8 lux) of illumination within the exit enclosure measured at the walking surface. iii. Where stair is provided with Photo luminescent strips or marking, the lighting used to charge such Photo luminescent materials shall not be controlled by motion sensors. iv. Where stair is provided with window for illumination, such window pane shall be fixed, 2 hour fire resistance rated and non-operable.
10. HANDRAILS	i. Stairs shall have handrails on both sides. ii. Handrails on stairs shall be not less than 865 mm and not more than 965 mm, above the surface of the tread, measured vertically to the top of the rail from the leading edge of the tread. iii. The height of required handrails that form part of a guard shall be permitted to exceed 965 mm, but shall not exceed 1065 mm, measured vertically to the top of the rail from the leading edge of the tread. iv. Handrails shall be installed to provide a clearance of not less than 57 mm between the handrail and the wall to which it is fastened. v. Handrails shall be available within 760 mm of all portions of the required egress width. vi. Where intermediate handrails are provided because of the stair width exceeding 1750 mm, the minimum clear width between such handrails shall be 510 mm. along the natural path of travel.

Table:- A.03-T4: Stair	
ITEMS	**REQUIREMENTS**
HANDRAILS	vii. Handrails shall continue for the full length of each flight of stair. Inside handrails shall be continuous, graspable between flights at landings. viii. Inside handrails shall be continuous between flights at landings. ix. Handrails shall have circular cross section with an outside diameter of not less than 32 mm and not more than 51 mm. x. Handrail shape that is other than circular shall be with a perimeter dimension of not less than 100 mm, but not more than 160 mm, and with the largest cross-sectional dimension not more than 57 mm, provided that graspable edges are rounded so as to provide a radius of not less than 3.2 mm. xi. Handrail brackets shall not project horizontally beyond the sides of the handrail within 38 mm of the bottom of the handrail and provided that, for each additional 13 mm of handrail perimeter dimension greater than 100 mm, the vertical clearance dimension of 38 mm is reduced by 3.2







SOME HANDRAIL SHAPES FOR ILLUSTRATION (See Table:- A.03-T4.10.x.)

Figure:- A.03-F7.: Handrail Specifications

Table:- A.03-T4: Stair	
ITEMS	**REQUIREMENTS**
11. GUARDS	i. Guards shall be provided for every elevated means of egress, open landing for stairs where elevated surface is more than 760 mm from finished ground level. ii. Such guards shall not encroach the required clear width of the stair. iii. The height of guards shall be measured vertically to the top of the guard from the surface adjacent thereto. iv. Guards shall be not less than 1200 mm high. In case of stair or ramp handrails that form part of a guard, the height of the guard can be reduced to 1065 mm. v. Open guards, other than permitted existing open guards, shall have intermediate rails or an ornamental pattern up to a height of 865 mm, such that a sphere 150 mm in diameter is not able to pass through any opening. vi. The triangular openings formed by the riser, tread, and bottom element of a guardrail at the open side of a stair shall be of such size that a sphere 150 mm in diameter is not able to pass through the triangular opening. vii. See **Section A, Chapter 02, Sub Section.2.17.** for balcony railings, balustrade and fencing.

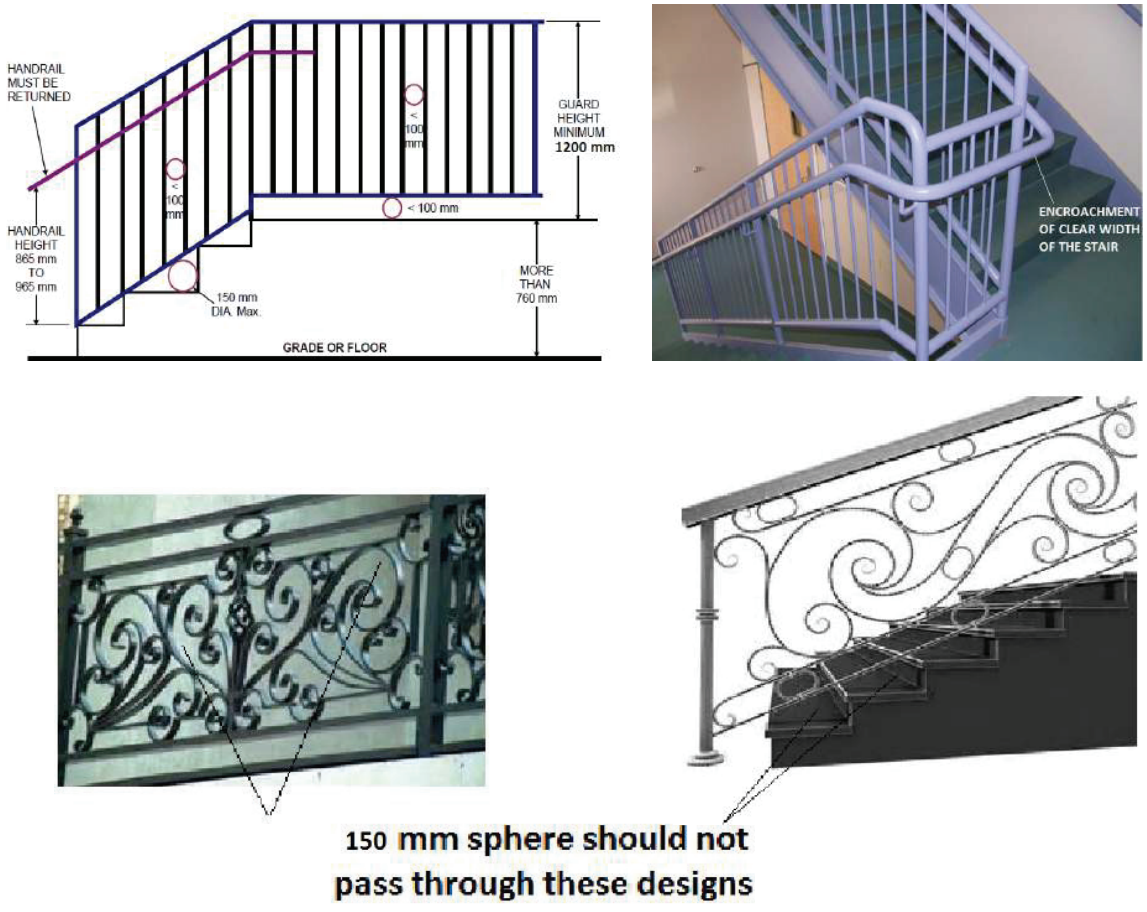


Figure:- A.03-F8.: Guard Specifications

Table:- A.03-T4: Stair	
ITEMS	**REQUIREMENTS**
12. STAIR AND FLOOR SIGNAGE	i. Every building shall be provided with a signage, indicating the floor level, wing of the building if any, and direction of egress. ii. Signage shall be in English and Arabic. iii. Signage shall be provided inside the stair enclosure at floor landings (Not mid landings), clearly visible for stair users and shall be located a minimum of 1220 mm above the floor landing, and the top of the signage shall be located a maximum of 2135 mm above the floor landing. iv. Lettering shall be a minimum of 25 mm high. v. Signage shall not be provided on the door leaf.
13. TREAD MARKING	i. Where contrasting marking is applied to stairs, such marking shall comply with the following: **a.** Exit stair treads shall incorporate a marking strip that is applied as a paint/coating or be a material that is integral with the nosing of each step. **b.** Surface-applied marking strips using adhesive-backed tapes shall not be used. **c.** The marking strip shall be installed along the horizontal leading edge of the step and shall extend the full width of the step. **d.** The marking strip shall have a minimum horizontal width of 25 mm and a maximum width of 51 mm. **e.** The marking strip shall be not more than 13 mm from the leading edge of each step and shall not overlap the leading edge of the step by more than 13 mm down the vertical face of the step.



Figure:- A.03-F9.: Stair Signage

Table:- A.03-T4: Stair	
ITEMS	**REQUIREMENTS**
14. OUTSIDE STAIR	i. An open outside Exit stair shall not be allowed to be provided in any building at more than 15 m from finished ground level till ceiling level. ii. Outside stairs more than 11 m above the finished ground level till ceiling level, shall be provided with an opaque visual obstruction not less than 1220 mm in height. iii. Outside stairs shall be separated from the interior of the building by construction with the 2 hour fire resistance rating with fixed or self-closing opening protectives. **Figure: - A.03-F11.** iv. Such separation shall extend vertically from the finished ground level to a point 3 m above the topmost landing of the stairs or to the roofline, whichever is lower. And horizontally separation shall extend for not less than 3 m. See **Figure: - A.03-F11.** v. Roof shall extend horizontally to each side of the stair for not less than the stair width. vi. Outside stairs, other than existing outside stairs, shall be not less than 50 percent open on one side. vii. Outside stairs and landings shall be designed to minimize water accumulation on their surfaces. viii. Outside stairs serving an exterior exit access balcony that has two remote outside stairways or ramps shall be permitted to be unprotected. See **Figure: - A.03-F10.** ix. Outside stairs serving not in excess of two adjacent stories, including the storey of exit discharge, shall be permitted to be unprotected where there is a remotely located second exit. See Note in **Figure: - A.03-F10.**

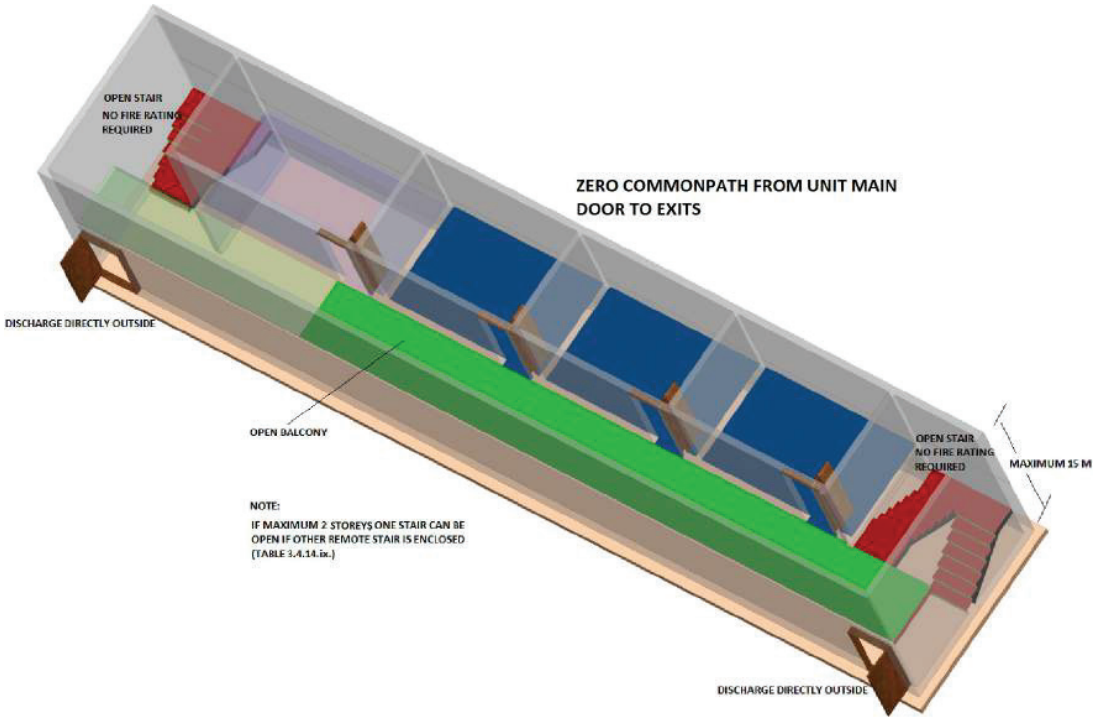


Figure:- A.03-F10.: Outside stair with exterior exit access balcony

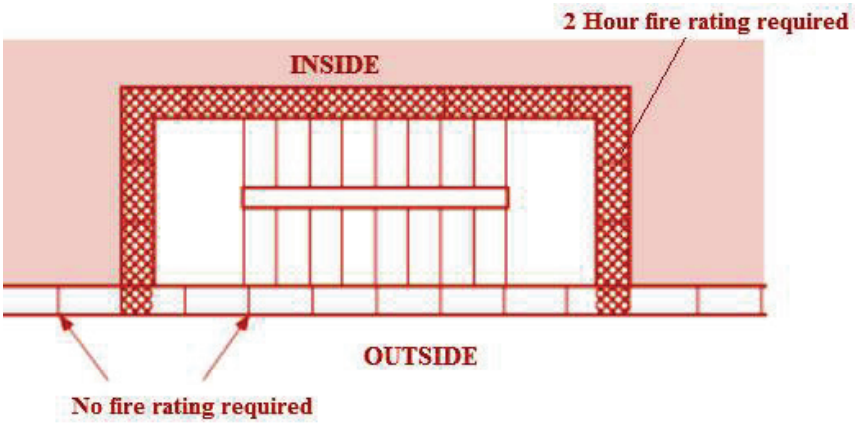


Figure:- A.03-F11.a.: Outside stair with exterior wall flushed with building wall

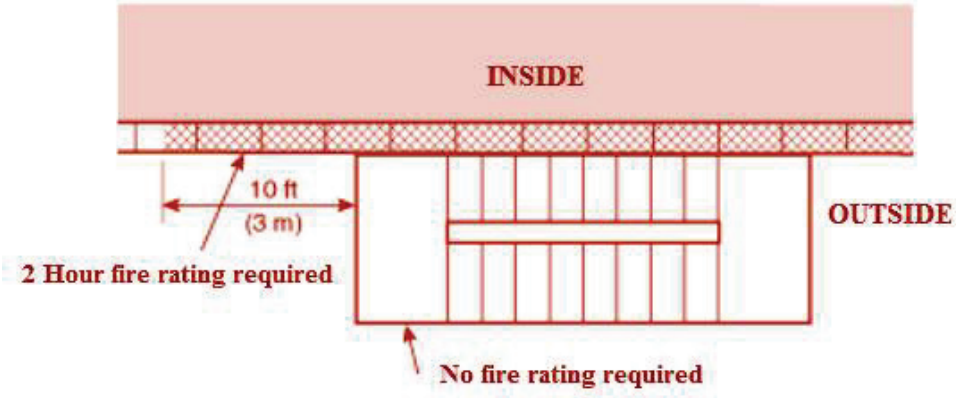


Figure:- A.03-F11.b.: Outside stair with exterior wall protruding outside the building

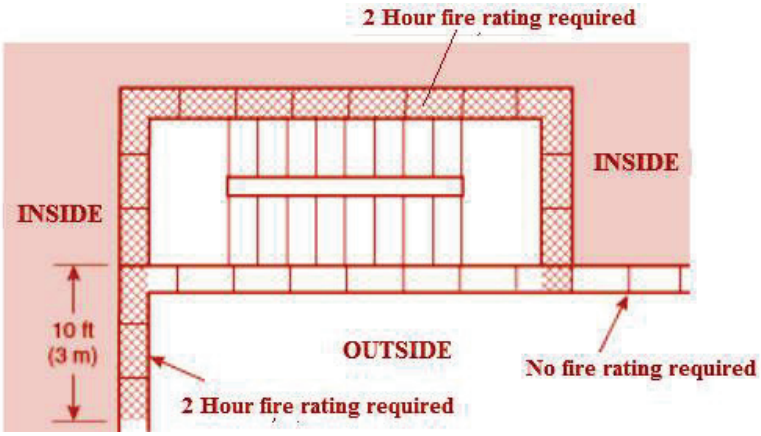


Figure:- A.03-F11.c.: Outside stair with exposed to adjacent building wall

Table:- A.03-T4: Stair	
ITEMS	**REQUIREMENTS**
14. OUTSIDE STAIR	i. All openings below an outside stair shall be protected with an assembly having not less than a 45 minutes fire protection rating. ii. Openings to the side of an outside stair within 3m should have a fire protection rating of 30 minutes. iii. Outside stairs shall be arranged to avoid any impediments to the use of the stairs by persons having a fear of high places. Outside stairs more than three stories in height or 11 m in height, shall be provided with an opaque visual obstruction not less than 1220 mm in height.

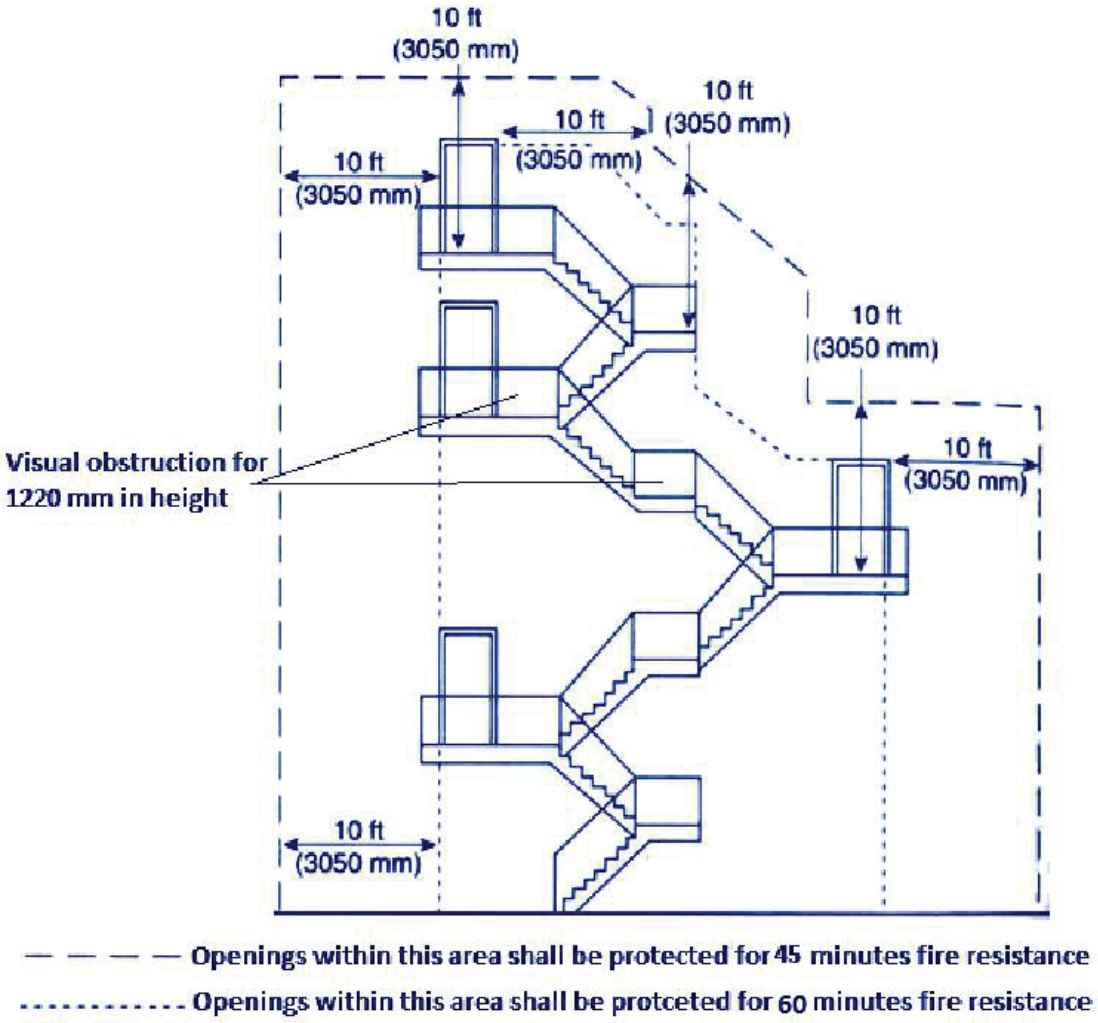
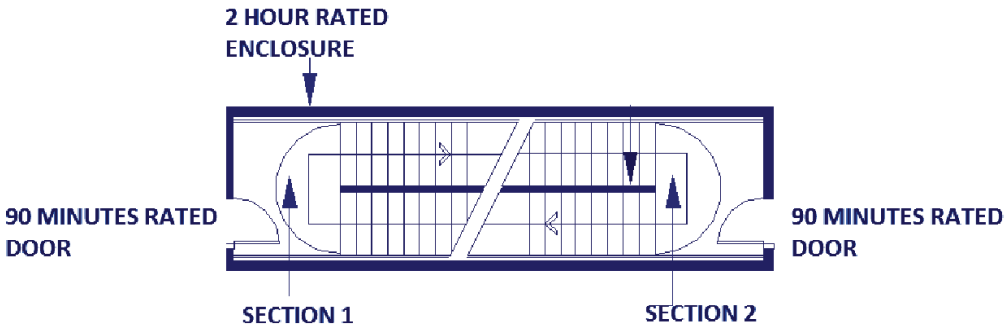


Figure:- A.03-F11.d.: Opening protection around Outside stair

Table:- A.03-T4: Stair	
ITEMS	**REQUIREMENTS**
15. SCISSOR OR INTERLOCKED STAIR	i. Interlocking or scissor stairs shall be considered as a single exit. ii. Scissor Stairs shall be enclosed by a 2 hour fire resistance rated construction, with block wall for non-high rise buildings and with RCC in High-rise buildings. iii. Both sections of a Scissor Stairs are not required to be fire separated from each other as the scissor stair is considered as a single exit. iv. Penetrations or communicating openings are allowed between two sections of Scissor Stairs. v. Doors shall be 90 minutes fire protection rated in Scissor Stairs.



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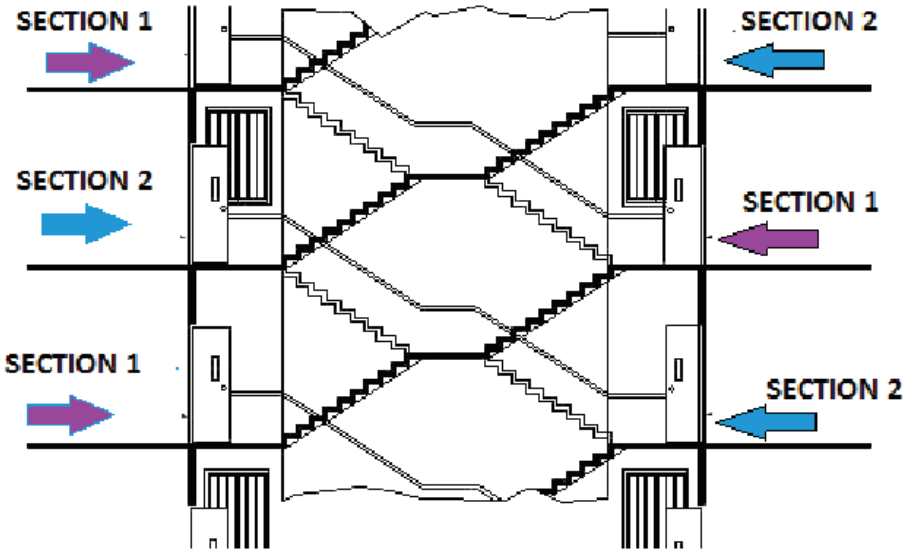


SECTION

Figure:- A.03**-F12.: Scissor or Interlocked Stair**

Table:- A.03-T4: Stair	
ITEMS	**REQUIREMENTS**
16. SPIRAL STAIR	i. Spiral Stairs are not allowed in means of egress except for the following. **a.** In Industrial occupancy to access equipment, mezzanine where equipment access is required, Control room to access equipment and process line floor. **b.** In Storage occupancy to access mezzanine which is only for storage and not office space. **c.** In Retail areas to access mezzanines where goods are stored. **d.** Private and Commercial Villa ii. The clear width of the stairs shall be not less than 660 mm. iii. The height of risers shall not exceed 240 mm. iv. The headroom shall be not less than 1980 mm. v. Treads shall have a depth not less than 190 mm at a point 305 mm from the narrower edge. vi. All treads shall be identical. vii. Handrails shall be provided as per **Table:- A.03-T4.10.** viii. The turn of the stairway shall be such that the outer handrail is at the right side of descending users.
17. WINDERS	i. Winders are not allowed in Means of egress except for the following. **a.** In Industrial occupancy to access equipment, mezzanine where equipment access is required, Control room to access equipment and process line floor. **b.** In Storage occupancy to access mezzanine which is only for storage and not office space. **c.** In Retail areas to access mezzanines where goods are stored. **d.** Private and Commercial Villa. ii. Winders can be used in open stairs which are not exit stairs. iii. Winders shall have tread depth of not less than 150 mm and tread depth of not less than 280 mm, at a point 305 mm from narrowest edge.
18. CURVED STAIRS	i. Curved Stairs are not allowed in Means of egress except for the following. **a.** In Industrial occupancy to access equipment, mezzanine where equipment access is required, Control room to access equipment and process line floor. **b.** In Storage occupancy to access mezzanine which is only for storage and not office space. **c.** In Retail areas to access mezzanines where goods are stored. **d.** Private and Commercial Villa ii. Curved Stairs can be used as open stairs which are not exit stairs. iii. Curved Stairs shall have tread depth of not less than 255 mm at a point 305 mm from narrowest edge.


CURVED STAIR


SPIRAL STAIR


WINDERS

Table:- A.03-T4: Stair	
ITEMS	**REQUIREMENTS**
19. EQUIPMENT ACCESS	i. Industrial Equipment Access shall comply with the following. **a.** Minimum Horizontal dimension of walkway, landing or platform shall be 560 mm. **b.** Minimum stair or ramp width shall be 560 mm. **c.** Minimum tread width shall be 560 mm. **d.** Minimum tread depth shall be 255 mm. **e.** Maximum riser height shall be 230 mm **f.** Maximum height between landings shall be 3660 mm. **g.** Minimum head room shall be 2030 mm. **h.** Minimum width of door opening shall be 560 mm. **i.** Railings height shall be 865 mm to 965 mm and shall be permitted to terminate directly above top and bottom risers.
20. STAIR TREAD, FLIGHTS AND ARRANGEMENT	i. Exit stair designs is preferred to be as per **Figure:- A.03-F13.a**. (Refer to **Figure:- A.03-F13.a.**) **a.** Regular flights and consistent dimensions of steps is acceptable. **b.** Consistent flights and consistent dimensions on all sides are acceptable. **c.** Consistent flights and consistent dimensions of steps are acceptable **d.** Direct exit at discharge level from under the stair flight. **e.** Two doors on opposite sides are acceptable if each door swing does not obstruct more than half of the required landing width. **f.** RCC Stairs with separate core but common RCC divider is acceptable only in low rise and midrise buildings provided whole stair complies with building construction type and separation distance. **g.** Straight run stairs are acceptable, provided maximum height between landings is 3660 mm. **h.** RCC Stairs with separate core but common RCC divider is acceptable only in low rise and midrise buildings provided whole stair complies with building construction type and separation distance between exits. **i.** Consistent flights with consistent dimensions of steps on opposite sides are acceptable. **j.** RCC Stairs with separate core but common RCC divider is acceptable only in low rise and midrise buildings provided whole stair complies with building construction type and separation distance between exits.

Table:- A.03-T4: Stair	
ITEMS	**REQUIREMENTS**
STAIR TREAD, FLIGHTS AND ARRANGEMENT	i. Exit stair designs shown in **Figure: - A.03-F13.b.** are not acceptable. (Refer to **Figure: - A.03-F13.b.**) **a.** Winders are not acceptable. **b.** Less than 3 steps at intermediate landings are not acceptable. **c.** Step riser height dimensions exceeding maximum variation of 10 mm within flight is not acceptable. **d.** Winders are not acceptable. **e.** Door in the middle of landing obstructing more than half of required landing width is not acceptable. **f.** Step riser height dimensions exceeding maximum variation of 10 mm within flight is not acceptable. **g.** Stair doors next to each other is not acceptable. **h.** Stair doors opening into each other and obstructing more than half of the required landing width is not acceptable. **i.** Step riser height dimensions exceeding maximum variation of 10 mm within flight are not acceptable **j.** Less than 3 steps not recommended but acceptable only from basement to ground floor or roof access from a floor below.

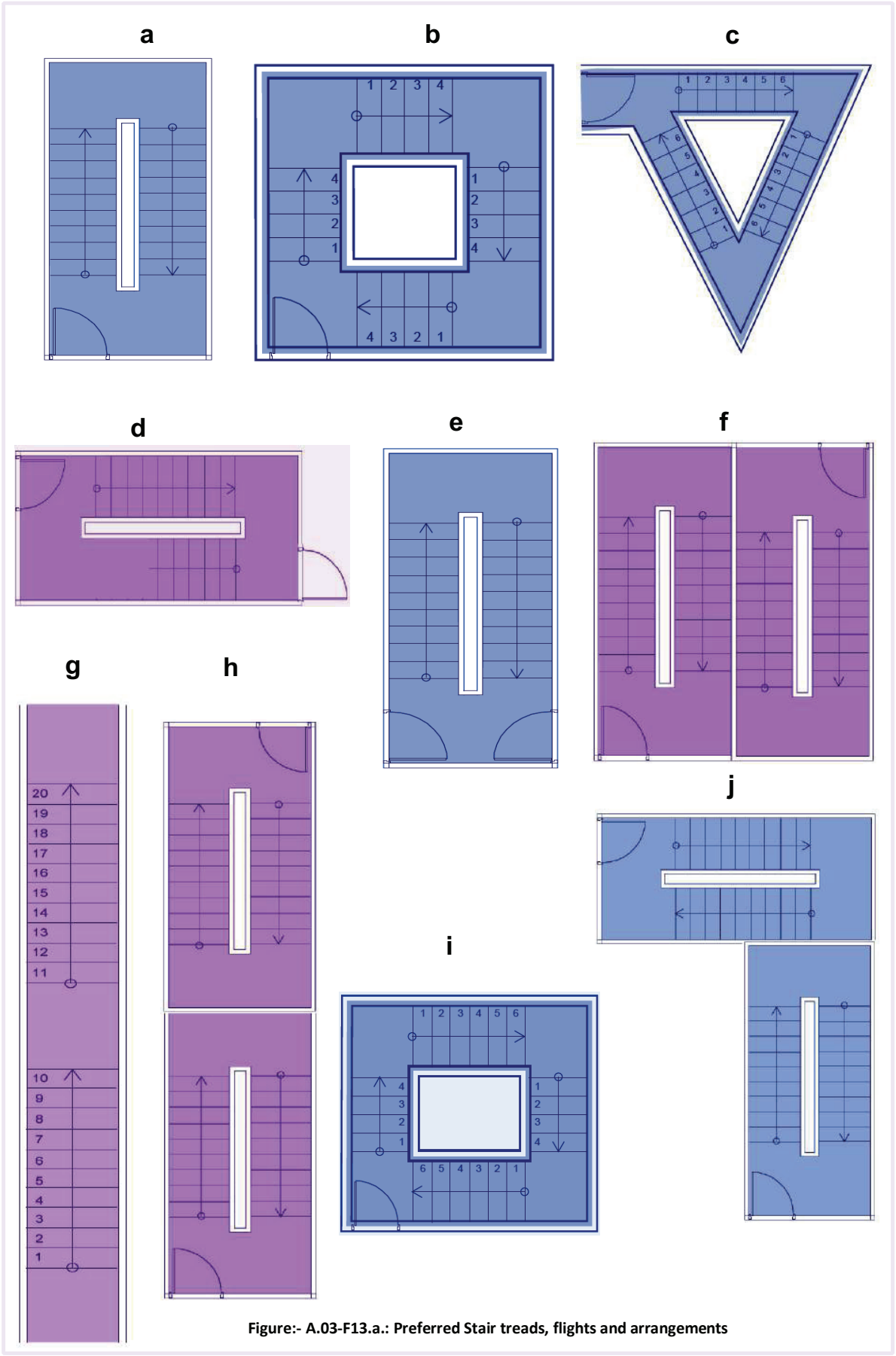


Figure:- A.03-F13.a.: Preferred Stair treads, flights and arrangements

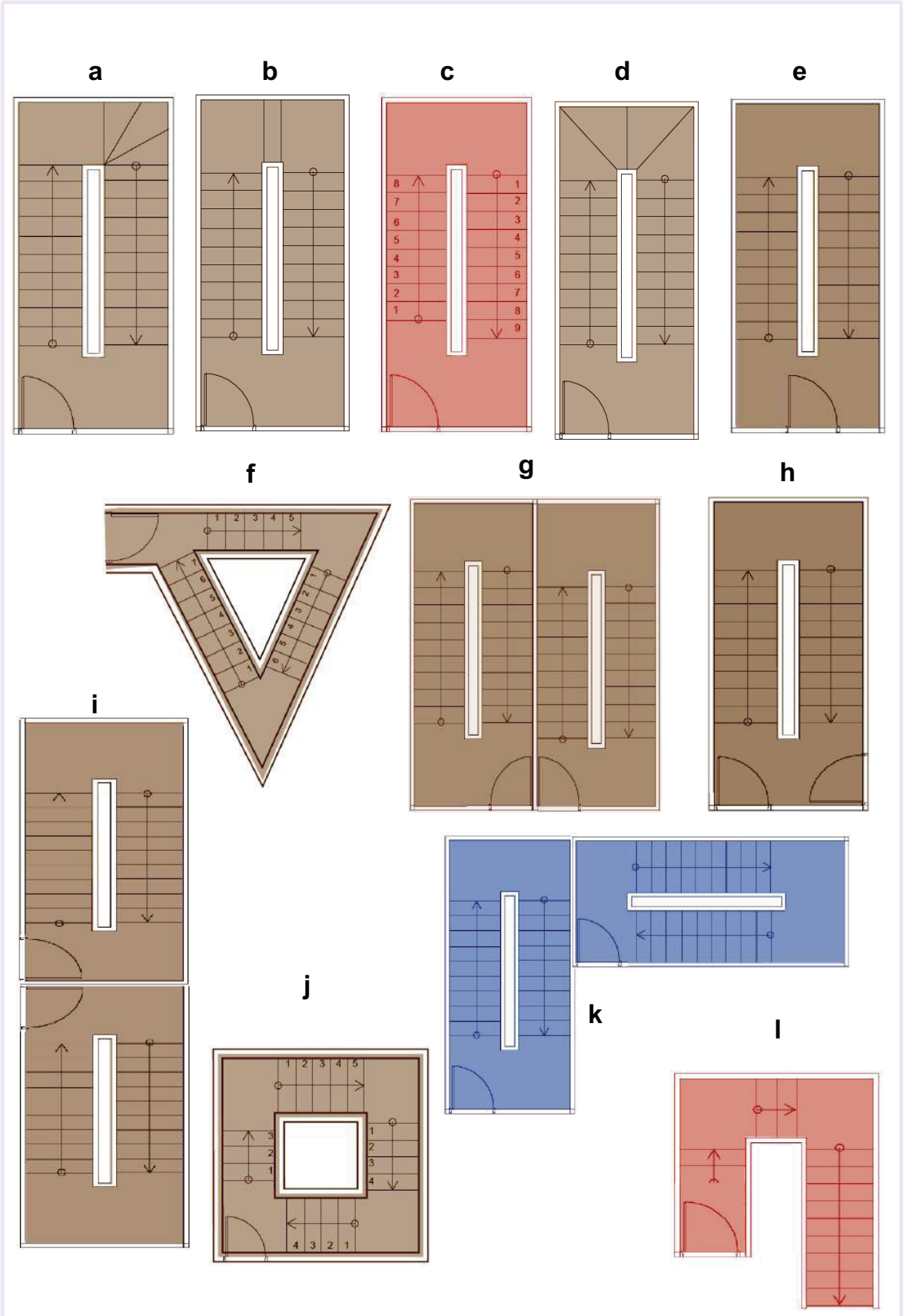


Figure:- A.03-F13.b.: Not acceptable Stair treads, flights and arrangements

4.4. Horizontal Exit

4.4.1. Horizontal exits shall be permitted to be substituted for other exits where the total egress capacity and the total number of the other non-horizontal exits leading outside the building is not less than half (50%) that required for the entire area of the building or connected buildings, unless otherwise permitted by Health care and detention occupancies.

4.4.2. Horizontal Exit shall comply with **Table:- A.03-T1** and **Table:- A.03-T6.** However, allowance of horizontal exits and modifications if provided by individual occupancies sections, shall override the requirements of **Table:- A.03-T6.**

Table:- A.03-T6: Horizontal Exits

ITEMS	REQUIREMENTS
1. COMPARTMENTS	i. Every Fire compartment considered as horizontal exit shall also have at least one or 50% of the required number of exits with required exit capacity that is not a horizontal exit. ii. ii. Any fire compartment not having an exit leading directly to outside shall be considered as part of an adjoining fire compartment with an exit leading to the outside.
2. FIRE RATING	i. Fire barriers separating areas or buildings, forming horizontal exits shall have Minimum of 2 hour fire resistance rating, continuous from ceiling to finished floor level of the areas it is separating. ii. The floors on which the horizontal exit fire barrier is omitted, shall be separated from the floor having horizontal exit by at least 2 hour fire resistance rating. iii. Vertical openings between the storey with horizontal exits and the open fire area storey shall be enclosed with 2 hour fire resistance rated construction. iv. Where fire barriers serving horizontal exits terminate at outside walls, and the outside walls are at an angle of less than 180 degrees for a distance of 3 m on each side of the horizontal exit. **a.** Such outside walls shall be 1 hour fire resistance rated with 45 minutes rated openings protectives, for a distance of 3 m on each side of the horizontal exits. **b.** Or one of the outside walls shall have a 2-hour fire resistance rating with opening protectives having a minimum 90 minutes fire protection rating, for a distance of 3 m from intersection with the horizontal exit.
3. EXIT TO OUTSIDE	i. Every horizontal exit shall be arranged such that there are continuously available paths of travel leading from each side of the horizontal exit to stairway or corridor or smoke proof enclosure or ramp, leading to outside the building.
4. LOCKS	i. Wherever either side of a horizontal exit is occupied the doors used in the horizontal exit shall be unlocked from the egress side.
5. FLOOR AREA	i. The floor area on either side of a horizontal exit shall be sufficient to hold the occupants of both floor areas and shall provide at least 0.28 m2 clear floor area per person.
6. PENETRATIONS	i. Ducts penetrating fire barrier with horizontal exit shall have listed fire dampers. ii. Penetration of ducts shall not be allowed without dampers in non-sprinkler protected buildings.

Table:- A.03-T6: Horizontal Exits	
ITEMS	**REQUIREMENTS**
7. DOORS	i. Doors shall be 90 minutes fire resistance rated. ii. Doors shall swing in the direction of egress. iii. Two-way swing fire doors with vision glass must have same rating as door shall be permitted. iv. All doors in horizontal exits shall be self-closing or automatic closing. v. All doors serving horizontal exit shall have permitted vision panel.
8. BRIDGES SERVING AS HORIZONTAL EXITS BETWEEN BUILDINGS	i. Bridges serving horizontal exits between buildings shall have fire barrier of 2 hour fire resistance rating extending vertically from ground or a point 3 m below the bridge to a point 3 m above the bridge or to the roofline, whichever is lower and horizontally for not less than 3 m to each side of the bridge. ii. Any opening in such fire barriers shall be protected with fire door assemblies or fixed fire window assemblies having a 45 minutes fire protection rating. iii. Where bridge connects buildings and serves egress in both directions, double egress doors shall be provided. iv. Every bridge width shall be as wide as the building doors it connects to but in no case shall be less than 1200 mm in width. v. Also see **Section A, Chapter 02, Table:- A.02-T9.52.**

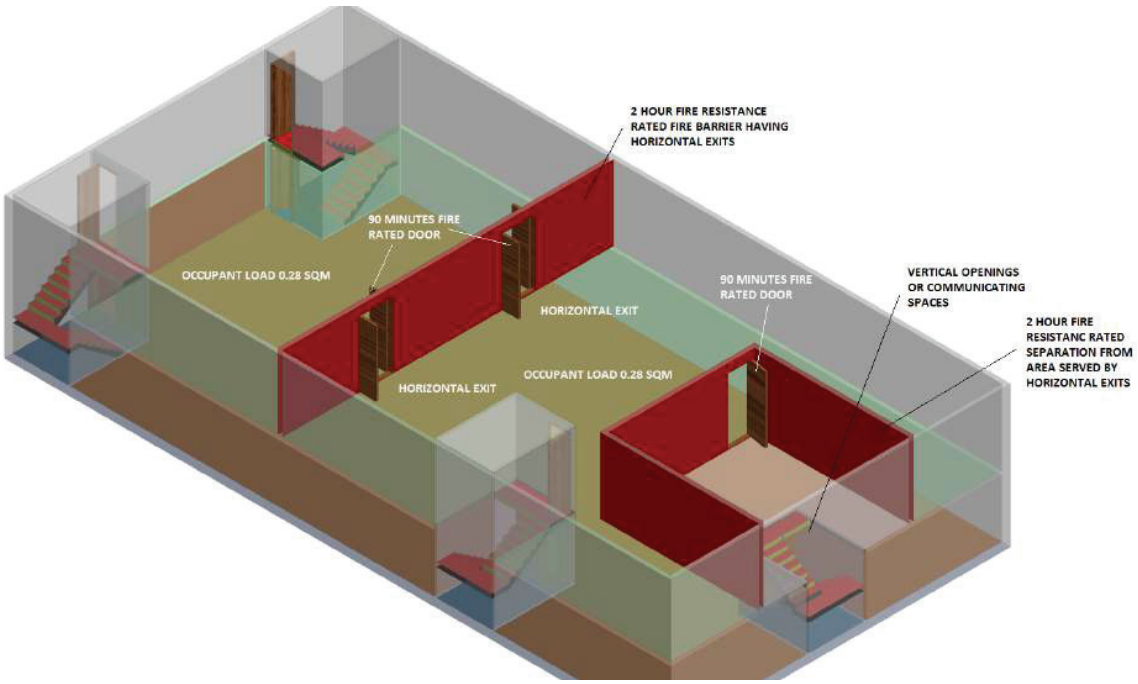


Figure:- A.03-F14.: Typical Fire Barrier with Horizontal Exits

4.5. Smoke proof Enclosures

4.5.1. Smoke proof enclosure in a means of egress is designed to limit the entry and movement of smoke and products of combustion produced by a fire. This can be achieved by using natural ventilation, by using mechanical ventilation incorporating a vestibule, or by pressurizing the stair enclosure.

4.5.2. Smoke proof enclosures shall comply with **Table:- A.03-T1** and **Table:- A.03-T7**. However, allowance of smoke proof enclosures and modifications if provided by individual occupancies sections, shall override the requirements of Table:**- A.03-T7.**

Table:- A.03-T7: Smoke proof Enclosures

ITEMS	REQUIREMENTS
1. FIRE RATING	i. A smoke proof enclosure shall be continuously enclosed by barriers having a 2-hour fire resistance rating from the highest point to the level of exit discharge. ii. When smoke proof enclosure discharges into exit corridor or passageway, the exit passageway shall be separated from the rest of the building by a 2-hour fire resistance rating.
2. ACCESS	i. Access to any smoke proof enclosure shall be through a vestibule or by way of an exterior balcony, unless the enclosure is pressurized.
3. VESTIBULE (LOBBY)	i. Where a vestibule is used, it shall be within the 2-hour-rated smoke proof enclosure and shall be considered part of the smoke proof enclosure. ii. Vestibule door separating outside area shall be 90 minutes fire rated. iii. Vestibule door connecting smoke proof enclosure shall be 30 minutes fire rated. iv. vestibule doors shall be air leak proof and self-closing or automatic closing by the activation of smoke detector located within 3 m of the vestibule door opening.
4. DIRECT DISCHARGE	i. Every smoke proof enclosure shall discharge into a public way, into a yard or court having direct access to a public way. ii. When smoke proof enclosure discharges into exit corridor or passageway, such exit passageways shall be without openings, other than the entrance to the smoke proof enclosure and the door opening to the outside yard, court, or public way. iii. When building is sprinkler protected, such direct discharge from smoke proof enclosure shall be 50% of the required number of exits and egress capacity.
5. BY NATURAL VENTILATION	i. Every vestibule using natural ventilation shall have a net area of not less than 1.5 m2 of opening in an exterior wall facing an exterior court, yard, or public space not less than 6 m in width. ii. Every vestibule using natural ventilation shall have a minimum dimension of not less than the required width of the corridor leading to it and a dimension of not less than 1830 mm in the direction of travel. See **Section E, Chapter 01. Sub Section 6.7.**
6. BY MECHANICAL VENTILATION	i. Every vestibule using mechanical ventilation shall have a dimension of not less than 1200 mm in width and not less than 1830 mm in the direction of travel. ii. The vestibule shall be provided with not less than one air change per minute and the exhaust shall be 150% of the supply. iii. Supply air shall enter and exhaust air shall discharge from the vestibule through separate tightly constructed dedicated ducts. iv. Supply air shall enter the vestibule at lower level, within 150 mm of the floor level. The top of the exhaust register shall be located not more than 150 mm below the top of the trap and shall be entirely within the smoke trap area. v. Door leaves, when in the open position, shall not obstruct such duct arrangements. See **Section E, Chapter 01. Sub Section 6.8.**

Table:- A.03-T7: Smoke proof Enclosures	
ITEMS	**REQUIREMENTS**
7. BY PRESSURIZATION	i. Smoke proof enclosures using pressurization shall use a permitted engineered system with a design pressure difference across the barrier of not less than 0.05 in. water column (12.5 N/m2) in sprinkler protected buildings, or 0.10 in. Water column (25 N/m2) in on sprinkler protected buildings, and shall be capable of maintaining these pressure differences under likely conditions of stack effect or wind. ii. The pressure difference across door openings shall not exceed that which allows the door leaves to begin to be opened by a force of 30 lbf (133 N) iii. See **Section E, Chapter 01. Sub Section 6.1.** For design details.

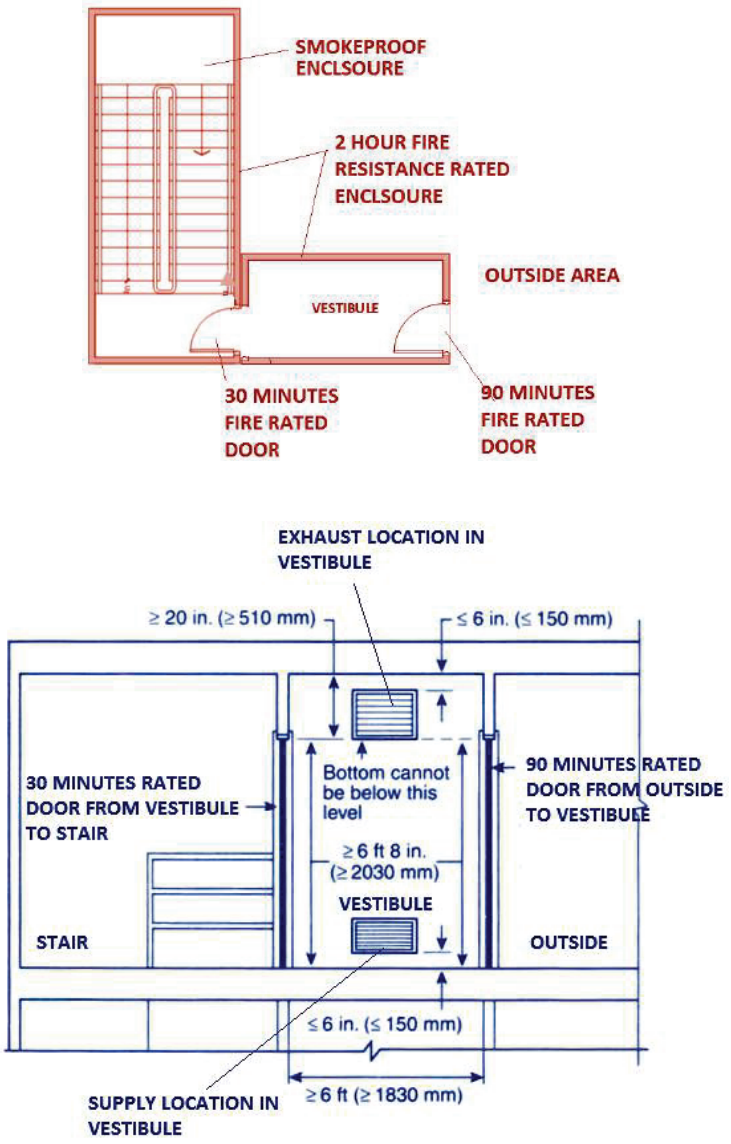


Figure:- A.03-F15.: Smoke proof Enclosure with Vestibule

4.6. Exit passageways

4.6.1. Exit passageways in a means of egress serves as a horizontal means of exit travel that is separated and protected from fire in a manner similar to an enclosed interior exit stair. An exit passageway can be used to preserve the continuity of the protected exit by connecting the stair that continues to the street floor.

4.6.2. Probably the most important benefit of an exit passageway is to serve as an extension of a protected stair where it is impractical to locate the stair on an exterior wall, by connecting to the exit of stair to transfer the occupants safely to an outside exit door.

4.6.3. Exit passageway also serve the buildings of extremely large area, such as shopping malls and some factories, where travel distances to reach exits would be too excessive to meet the restrictions, by connecting exit stairs at distances more than allowed travel distances.

4.6.4. Exit passageways shall comply with **Table:- A.03-T1** and **Table:- A.03-T8.** However, allowance of Exit passageways and modifications if provided by individual occupancies as per **Sub Section 6**, shall override the requirements of **Table:- A.03-T8.**

Table:- A.03-T8: Exit passageways

ITEMS	REQUIREMENTS
1. FIRE RATING	i. Every Exit passageways in Low depth and Low rise buildings (having height up to 15 m), shall be separated from rest of the building areas by a construction to ensure 1 hour fire resistance rating. ii. Every Exit passageways in High depth, Midrise and High rise buildings (having height more than 15 m), shall be separated from rest of the building areas by a construction to ensure 2 hour fire resistance rating. iii. Separation shall extend vertically from the finished floor level to the ceiling, providing complete enclosure for the exit corridor.
2. WIDTH	i. The width of an exit passageway shall be sized to accommodate the aggregate required capacity of all exits that discharge through it except for Malls where occupants loads of Mall and tenant spaces are not required to be aggregated. ii. Minimum of 1200 mm shall be provided for every exit corridor, unless the in- creased width is demanded by the egress width calculation based on occupant load and as required by the individual occupancies. iii. Exit corridor shall maintain a minimum width of 2/3 of the stair width, unless where stair widths are required to be higher based on egress capacity demands and shall not reduce in width along the egress path.
3. WINDOWS	i. Permitted and listed Fire rated windows shall be permitted to be installed on exit passageway walls only if the building is sprinkler protected.
4. VALID EXIT PASSAGEWAYS	i. Access to an exit shall not be through kitchens, storerooms, or other rooms or spaces subject to locking. See **Figure: - A.03-F16.c.** for not acceptable Exit passageways.

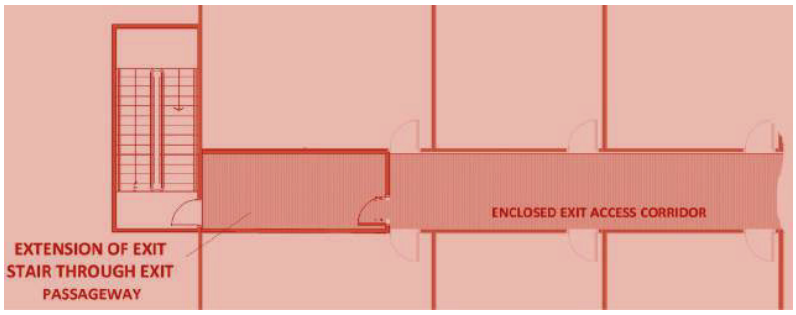


Figure:- A.03-F16.a.: Exit Passageway, an extension for Exit Stair to compensate for excess travel distance

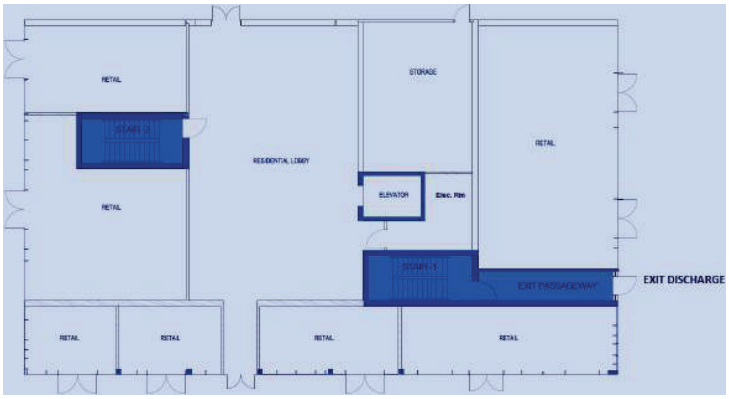


Figure:- A.03-F16.b.: Exit Passageway, an extension of Exit Stair to Exit Discharge

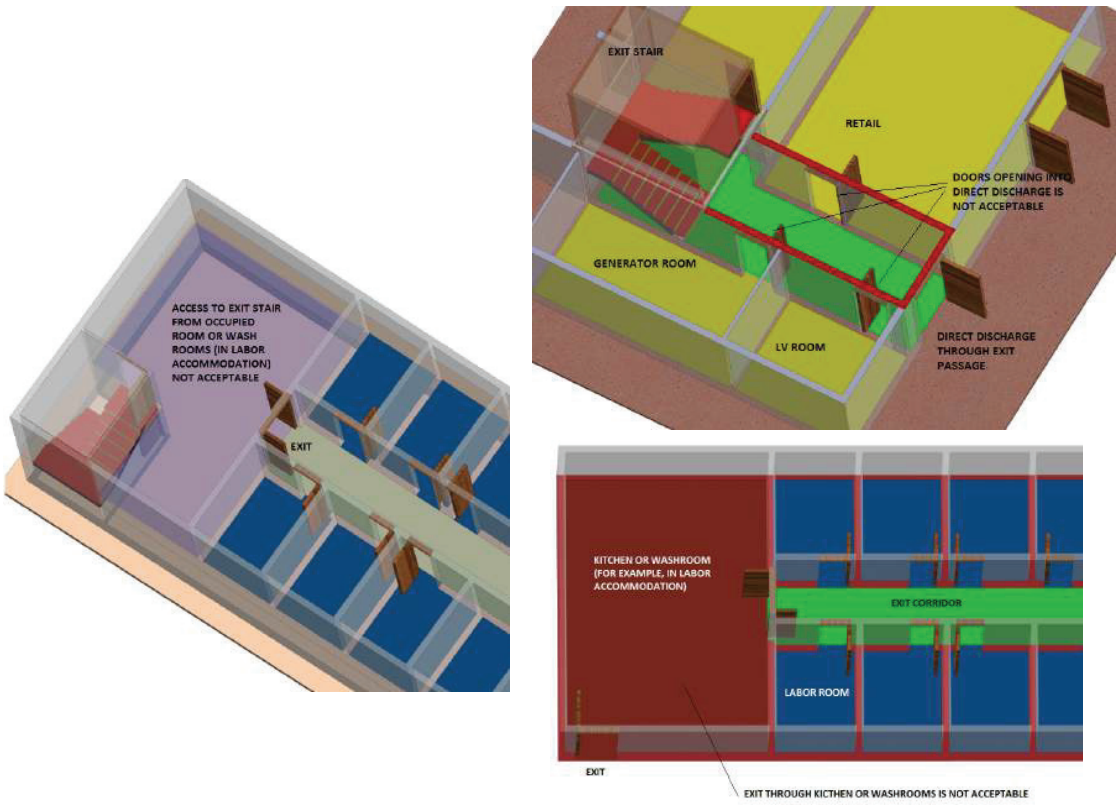


Figure:- A.03-F16.c.: Not acceptable Exit Corridors and Exit Passageways

4.7. Ramps

4.7.1. Ramps used as means of egress shall comply with **Table:- A.03-T1** and **Table:- A.03-T9.** However, allowance and modifications of ramps, if provided by individual occupancies as per **Section 7**, shall override the requirements of **Table:- A.03-T9.**

Table:- A.03-T9: Ramps

ITEMS	REQUIREMENTS
1. RAMP WIDTH	i. The minimum width of a ramp shall not be less than 1200 mm. ii. Ramp width shall not decrease in width along the direction of egress travel.
2. SLOPE	i. Maximum slope of a ramp shall not exceed 1 in 12 ratio. ii. Maximum cross slope of a ramp shall not exceed 1 in 48 ratio.
3. RISE	i. Maximum rise of a single ramp run shall not exceed 760 mm.
4. PROJECTIONS	i. Maximum projections allowed on ramp shall not exceed 114 mm at or below handrail height.
5. CONSTRUCTION	i. Ramps serving as means of egress shall be of permanent fixed construction. ii. Ramps shall be constructed of noncombustible or limited combustible material. iii. Where fire-retardant-treated wood is used for ramp construction, its height shall not exceed 760 mm and shall not have an area more than 277 m2 and it shall not occupy 50% of the room area it is serving.
6. LANDINGS	i. Landing shall have same width as that of ramp. ii. Ramp floor and landings shall be solid and without perforations. iii. Ramps shall have landings located at the top, at the bottom, and at door leaves opening onto the ramp. iv. The slope of the landing shall be not steeper than 1 in 48. v. Landing dimension shall not be less than 1525 mm in the direction of travel. vi. If ramp is not part of an accessible route and has straight run, the landing dimension shall not be less than 1220 mm in the direction of travel. vii. Any changes in ramp direction shall be made only at landing.
7. DROP-OFFS	i. Ramps and landings with drop-offs shall have curbs, walls, railings, or projecting surfaces that prevent people from traveling off the edge of the ramp. ii. Curbs or barriers shall be not less than 100 mm in height.
8. GUARDS AND HANDRAILS	i. Shall comply with **Table:- A.03-T4.10 and A.03-T4.11.**
9. ENCLOSURE	i. Shall comply with **Table:- A.03-T4.7.**
10. OUTSIDE RAMP	i. Outside ramps shall be arranged to avoid any impediments to their use by persons having a fear of high places. Outside ramps more than 11 m above the finished ground level shall be provided with an opaque visual obstruction not less than 1220 mm in height. ii. Outside ramps and landings shall be designed to minimize water accumulation on their surfaces.

4.8. Area of Refuge

4.8.1. Area of Refuge is not mandated by General Directorate of Civil Defence (GDCD). However, for super high rise buildings (having height more than 90 m), or any large complex buildings, if the overall fire strategy demands an area of refuge as part of the means of egress and an area of refuge for disabled occupants, the area of refuge shall comply with this section.

4.8.2. Area of Refuge is intended to provide temporary point of safety to allow delayed egress travel from any level in the building and also serve disabled occupants to have temporary refuge.

4.8.3. Area of Refuge used as means of egress shall comply with **Table:- A.03-T1** and **Table:- A.03-T10.**

Table:- A.03-T10: Area of Refuge

ITEMS	REQUIREMENTS
1. SEPARATION	i. Area of refuge shall be separated from rest of the story by a fire barrier having minimum of 1 hour fire resistance rating. ii. Ducts penetrating such barrier shall be provided with smoke actuated dampers.
2. DOORS	i. Doors serving area of refuge shall be 45 minutes fire rated, air leak proof, self-closing or automatic closing.
3. EXITS	i. An Area Of Refuge shall have protected stair access leading to an accessible storey that is one or more stories above or below a storey of exit discharge of the building, available which is not the same as access into to area of refuge, such that egress continues from area of refuge without requiring return to the building spaces through which travel to the area of refuge occurred. ii. The width of the protected stair required from area of refuge shall accommodate the occupant load that the area of refuge is designed. But in no case less than 1200 mm.
4. AREA	i. Area of refuge in a building shall be based on a clear fire strategy or a minimum area calculated based on occupants of 3 floors. ii. Area of refuge shall be sized to accommodate one wheelchair space of 760 mm × 1220 mm for every 200 occupants, or portion thereof, based on the occupant load served by the area of refuge. iii. iii. Such wheelchair spaces shall maintain the width of a means of egress to not less than that required for the occupant load served and to not less than 915 mm.
5. FIRE SYSTEMS	i. Area of refuge is preferred to be in fully sprinkler protected building. ii. Each elevator landing shall be provided with a two-way communication system, complete with using instructions in Arabic and English to seek assistance, contact numbers etc., for communication between the elevator landing and the fire command center or a central control point. Two way communication system shall have both audio and visual signals.
6. ELEVATOR	i. If area of refuge has an elevator and provides access from area of refuge to a public way, it shall be a fire fighter's lift in smoke proof shaft with fire fighters emergency operations as per ASME A17.1/CSA B44, Safety Code for Elevators and Escalators. ii. The power supply to elevator shall be protected against interruption from fire.
7. HORIZONTAL EXIT	i. If area of refuge is created by horizontal exit as per Table: - A.03-T6., smoke proof enclosure for elevator shaft is not required.
8. SIGNAGE	i. Every Area of refuge shall be identified by a sign, both in Arabic and English as "AREA OF REFUGE"

4.9. Elevator Evacuation

4.9.1. Use of elevators for emergency evacuation is inevitable in tall and super high rise buildings. International codes and standards are under development process to prescribe minimum requirements on elevators as means of egress.

4.9.2. General Directorate of Civil Defence (GDCD)has considered elevators as means of egress for delayed egress, phased evacuation and controlled evacuation under supervision of trained supervisor or GDCD Personnel during emergencies.

4.9.2. Elevators shall be considered as component of means of egress but shall not compensate For required number of exits nor required exit capacity.

4.8.3. Elevators used as means of egress shall comply with **Table:- A.03-T11.** Also see **Section A, Chapter 02, Table:-A.02-T9.38, Section A, Chapter 01, Section 3.9.4.**

Table:- A.03-T11: Elevator as Means of Egress

ITEMS	REQUIREMENTS
1. ASSISTED EVACUATION	i. Unless evacuation is assisted by facility management and General Directorate of Civil Defence (GDCD) rescue team, elevators shall not be used for evacuation, unless alternatives are permitted by General Directorate of Civil Defence (GDCD). ii. The elevator evacuation strategy, procedure, responsibilities of parties involved shall be preplanned and documented by facility management.
2. PREREQUISITES	i. Building shall be fully sprinkler protected. ii. Elevator shall be provided with a lobby. iii. Elevator shafts shall be pressurized. iv. Elevator shall have two-way communication system. v. Voice evacuation system shall be clearly audible in the elevator lobby. vi. Wiring for elevator equipment, elevator car lighting, and lobby pressurization shall be 2 hour fire rated.
3. WATER RESISTANCE	i. Elevators shall be water resistant and listed and permitted as per ASME A17.1/ CSA B44, Safety Code for Elevators and Escalators.
4. EMERGENCY POWER	i. Elevators shall have emergency power backup. ii. Shunt breakers shall not be installed on elevator systems.
5. CONFIGURATION	i. Elevators shall have over riding key feature which enables rescue teams to resume power supply to elevator, override the selection of destination floor, door opening, and door closure or Phase I recall to designated discharge floor. ii. Emergency Command Center shall be provided with the means to manually initiate a Phase I Emergency Recall of the occupant evacuation elevators in accordance with ASME A17.1/CSA B44. iii. During power failure, elevator shall return to designated discharge level. iv. The activation of smoke detectors or pre-action sprinkler system at the elevator machine room shall disable power supply and all features of elevator evacuation. And elevator shall not be available for evacuation.

4.10. Exit Discharge

4.10.1. Exit discharge or Discharge from exit is defined as providing building occupants with a safe path of travel from an exit to a public way.

4.10.2. Exits shall terminate directly, at a public way or at an exterior exit discharge, unless otherwise provided in **Table:- A.03-T12.**

4.10.3. Exit Discharge in means of egress shall comply with **Table:- A.03-T1** and **Table:- A.03-T12.**

Table:- A.03-T12.: Exit Discharge

ITEMS	REQUIREMENTS
1. NUMBER OF DIRECT DISCHARGE EXITS TO OUTSIDE	i. For sprinkler protected buildings, minimum of 50 % of the required number of exits, and minimum of 50 % of the required egress capacity, shall discharge directly to the outside of the building through yards, courts, open spaces or similar spaces to open to sky, leading to public way or directly to a public way. ii. For non-sprinkler protected buildings, 100% of the required number of exits, and 100% of the required egress capacity, shall discharge directly to outside the building through yards, courts, open spaces or similar spaces to open to sky, leading to public way or directly to a public way
2. DISCHARGE THROUGH INTERIOR OF BUILDING	i. In sprinkler protected buildings, not more than 50% of the required number of exit, and not more than 50% of required exit capacities are permitted to discharge through interior building areas such as lobbies and corridors. ii. The interia.09-tor exit discharge shall lead to a free and unobstructed way to the exterior of the building, and such way shall be readily visible and identifiable from the point of discharge from the exit.
3. LOCATION	i. Direct discharge shall be directly towards the public way and not at the back of the building where occupants still need to travel across the building exterior to reach point of safety of public way.
4. DISTANCE BETWEEN POINTS OF EXIT DISCHARGE	i. Exit discharges shall not be next to each other with common walls or fire walls. The points of Exit Discharges shall be separated from each other by a distance as per **Table:- A.03-T12.4.ii and iii.** ii. In sprinkler protected buildings, distance between point of exit discharges to outside shall not be less than 1/3 (One-third) of the largest measurement of building diagonal distance. iii. In non- sprinkler protected buildings, distance between point of exit discharges to outside shall not be less than 1/2 (One-half) of the largest measurement of building diagonal distance.
5. PROTECTION	i. An exit passageway that serves as a discharge from a stair enclosure shall be separated from other parts of the building by construction having the same fire resistance rating as those required for the stair enclosure. ii. Areas having exit discharge through interior building spaces shall be protected with sprinklers. iii. The entire area on the level of discharge shall be separated from areas below by construction having a fire resistance rating not less than that required for the exit enclosure. iv. Levels below the level of discharge in an atrium shall be permitted to be open to the level of discharge where such level of discharge is protected by sprinklers, fire rated construction and smoke partitions or an engineered smoke control system.

Table:- A.03-T12.: Exit Discharge	
ITEMS	**REQUIREMENTS**
6. DISCHARGE TO ROOF	i. Discharge to roof is allowed only if the building is sprinkler protected and a continuous and safe means of egress from the roof is available. Additionally, the roof/ceiling assembly construction shall have a fire resistance rating not less than that required for the exit enclosure.
7. SEPARATION AT LEVEL OF DISCHARGE	i. Stairs that continue to levels below the level of exit discharge, shall be interrupted at the level of exit discharge by partitions, walls or fences, such that occupants are guided outside the exit discharge and do not continue using stairs and miss the level of exit discharge.
8. MARKING	i. The exit discharge shall be arranged and marked to make clear the level of exit discharge, direction of egress to a public way. Stairs markings shall be arranged so as to make clear the level and direction of egress to a public way.

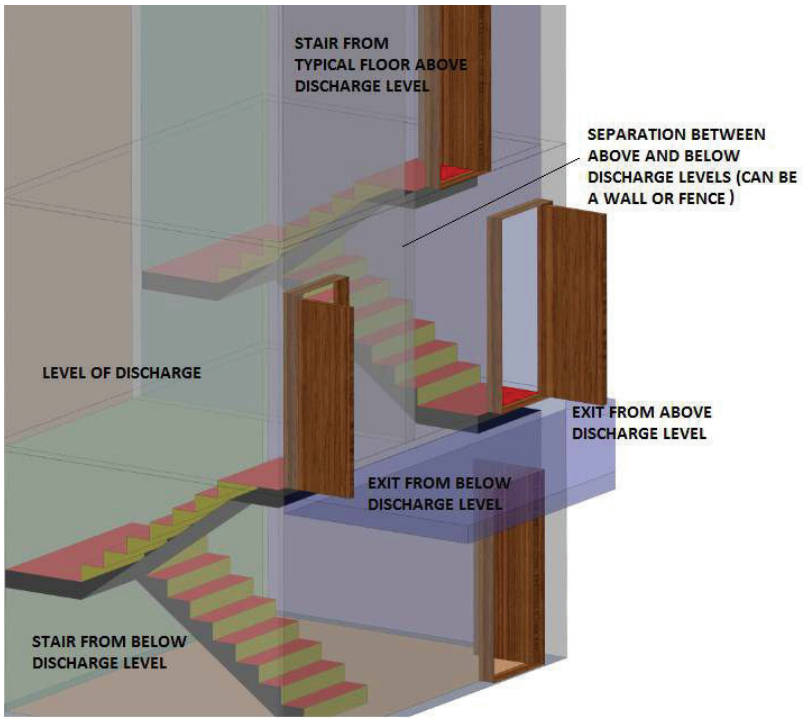


Figure:- A.03-F17.: Exit Separation between discharge from basement and discharge from floors above



Figure:- A.03-F18.: Exit Discharge Sign inside Stair enclosure at Exit Discharge Level

5. Capacity of Means of Egress

5.1. The Occupant Load

5.1.1. The Occupant Load is the total number of people or occupants that might occupy a building or portion thereof at any one time.

5.1.2. The occupant load in any building or portion thereof shall be not less than the number of persons determined by dividing the floor area assigned to that use by the occupant load factor for that use as specified in **Table:- A.03-T13.** All areas mentioned in table are "gross" unless mentioned as "net".

5.1.3. Where an exit serves more than one storey, only the occupant load of each storey considered individually shall be used in computing the required capacity of the exit at that storey, provided that the required egress capacity of the exit is not decreased in the direction of egress travel.

5.2. Egress Capacity

5.2.1. The total capacity of the means of egress for any storey, balcony, tier, or other occupied space shall be sufficient for the occupant load thereof.

5.2.2. Where more than one means of egress exist in a building, the means of egress shall be of such width and capacity that the loss of any one means of egress leaves available not less than 50% of the required capacity.

5.2.3. Where means of egress from a storey above and a storey below converge at an intermediate storey, the capacity of the means of egress from the point of convergence shall be not less than the sum of the required capacity of the two means of egress.

5.2.4. The required capacity of a corridor shall be based on the occupant load that utilizes the corridor for exit access divided by the required number of exits to which the corridor connects, but the corridor capacity shall be not less than the required capacity of the exit to which the corridor leads.

5.2.5. Where a single exit access leads to an exit, its capacity in terms of width shall be not less than the required capacity of the exit to which it leads.

5.2.6. Where more than one exit access leads to an exit, each exit shall have a width adequate for the number of persons it accommodates.

5.2.7. Where any required egress capacity from a balcony or mezzanine passes through the room below, that required capacity shall be added to the required egress capacity of the room in which it is located.

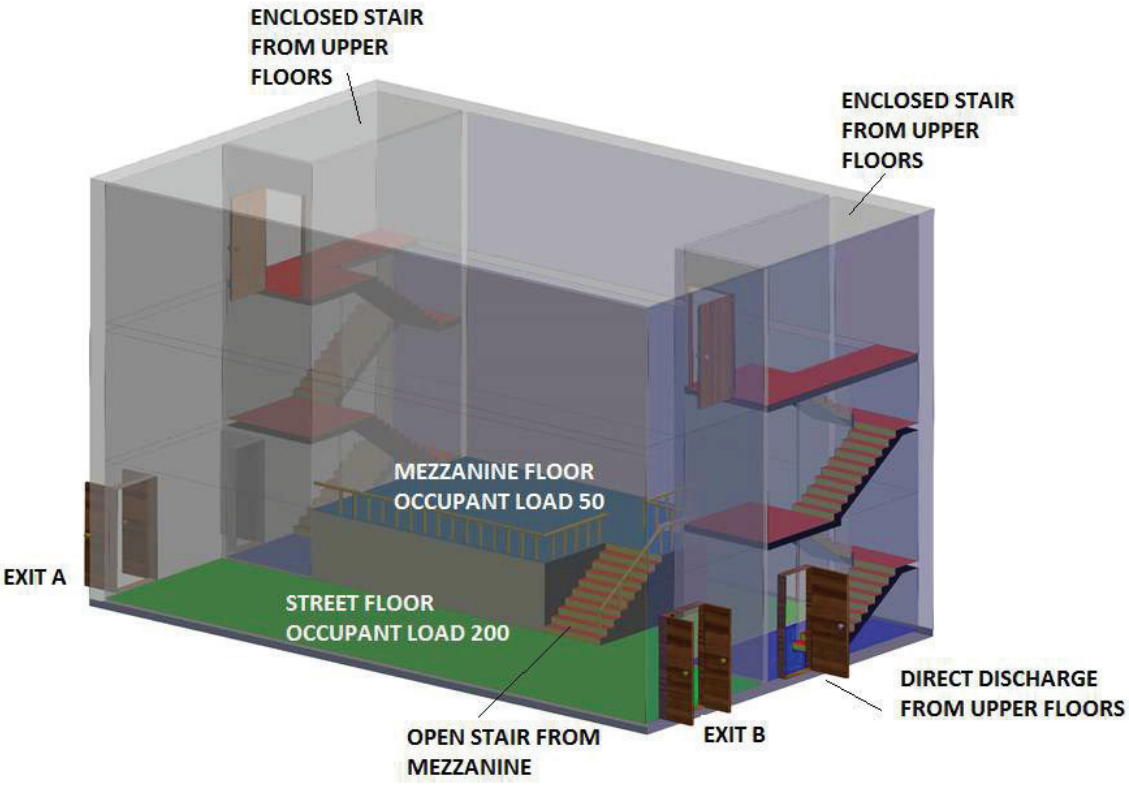


Figure:- A.03-F19.: Egress Capacity from mezzanine is added to the Building floor Capacity

5.2.8. Street floor exits shall be sufficient for the occupant load of the street floor plus the required capacity of stairs and ramps discharging through the street floor. However, in case of exits merging from above and below street level, the egress capacity of street floor occupants shall not be added to that of the merging exits.

5.2.9. The width of means of egress shall be measured in the clear at the narrowest point of the egress component under consideration.

5.2.10. Projections within the means of egress of not more than 114 mm on each side shall be permitted at a 965 mm height from finished floor level and below. In the case of stair and landing handrails forming part of a guard, such projections shall be permitted at a height of 1065 mm.

5.2.11. Means of egress shall be continuously maintained free of all obstructions or impediments to full instant use in the case of fire or other emergency.

5.2.12. Egress Capacities for various components and various occupancies shall be as per **Table:- A.03-T13.**

Table:- A.03-T13.: Occupant Load Factors and Exit Capacity Factors			
OCCUPANCY	**OCCUPANT LOAD FACTOR PER PERSON**	**STAIR WIDTH PER PERSON**	**RAMP WIDTH PER PERSON**
1. ASSEMBLY, GROUP A,B,C.			
i. Concentrated (Ballroom, Dance floor, etc.)	0.65 m^2, net	7.6 mm	5 mm
ii. Prayer rooms	0.9 m^2	7.6 mm	5 mm
iii. Less Concentrated, Outdoors etc. (Meeting rooms, Restaurant, Out-doors etc.)	1.4 m^2, net	7.6 mm	5 mm
iv. Bench Seating's,	455 mm linear	7.6 mm	5 mm
v. Fixed Seating's	Number of fixed seats	7.6 mm	5 mm
vi. Waiting Spaces in theaters, similar spaces	0.28 m^2	7.6 mm	5 mm
vii. Kitchens	9.3 m^2	7.6 mm	5 mm
viii. Library Stacks area	9.3 m^2	7.6 mm	5 mm
ix. Library Reading rooms	4.6 m^2, net	7.6 mm	5 mm
x. Swimming Pool	4.6 m^2 Water surface	7.6 mm	5 mm
xi. Swimming Pool Decks	2.8 m^2	7.6 mm	5 mm
xii. Exercise Room with Equipment	4.6 m^2	7.6 mm	5 mm
xiii. Exercise Room without Equipment	1.4 m^2	7.6 mm	5 mm
xiv. Stages	1.4, net	7.6 mm	5 mm
xv. Lighting and Access Catwalks	9.3, net	7.6 mm	5 mm
xvi. Casinos and Gaming areas	1 m^2	7.6 mm	5 mm
xvii. Skating Rinks	4.6 m^2	7.6 mm	5 mm
xviii. Food Court Seating areas	1.4 m^2	7.6 mm	5 mm
xix. Airport Concourse	9.3 m^2	7.6 mm	5 mm
xx. Airport Waiting areas	1.4 m^2	7.6 mm	5 mm
xxi. Airport Baggage Claim	1.9 m^2	7.6 mm	5 mm
xxii. Airport Baggage Handling	27.9 m^2	7.6 mm	5 mm
xxiii. Theater-Type Seating	Number of fixed seats	7.6 AB **See Table A.03-T17.3.**	5.6 C **See Table A.03- T17.3.**
xiv. Museum	5.0 m^2	7.6 mm	5 mm
2. BUSINESS, GROUP A,B,C.			
i. Regular Office areas	9.3 m^2	7.6 mm	5mm
ii. Concentrated Office areas	4.6 m^2	7.6 mm	5mm
iii. Air Traffic Control observation levels	3.7 m^2	7.6 mm	5mm
3. EDUCATIONAL, GROUP A,B,C.			
i. Classroom	1.9, net	7.6 mm	5 mm
i. Shops, Laboratories, Vocational etc.	4.6, net	7.6 mm	5 mm

Table:- A.03-T13.: Occupant Load Factors and Exit Capacity Factors			
OCCUPANCY	**OCCUPANT LOAD FACTOR PER PERSON**	**STAIR CAPACITY PER PERSON**	**RAMP CAPACITY PER PERSON**
4. HEALTHCARE GROUP A,B			
i. Inpatient treatment departments	22.3 m^2	7.6 mm	5 mm
ii. Sleeping departments	11.1 m^2	7.6 mm	5 mm
iii. Consultation departments	9.3 m^2	7.6 mm	5 mm
iv. Clinics	9.3 m^2	7.6 mm	5 mm
v. Limited Care	9.3 m^2	7.6 mm	5 mm
vi. Both sides of Smoke Compartment	2.8 m^2, net	7.6 mm	5 mm
5. HEALTHCARE GROUP C			
i. Ambulatory Health care	13 m^2	7.6 mm	5 mm
6. RESIDENTIAL GROUP A			
i. Apartments	18.6 m^2	7.6 mm	5 mm
7. RESIDENTIAL GROUP B, C			
i. Staff Accommodation, Hostels	18.6 m^2	7.6 mm	5 mm
i. Labor Accommodation	18.6 m^2	7.6 mm	5 mm
8. PRIVATE VILLA	None	None	None
9. COMMERCIAL VILLA	None	None	None
10. DETENTION , GROUP A,B,C.	11.1 m^2	7.6 mm	5 mm
11. HOTEL			
i. Hotel Apartments	18.6 m^2	7.6 mm	5 mm
i. Hotel Guest rooms	18.6 m^2	7.6 mm	5 mm
12. DAY CARE, GROUP A,B	3.3 m^2, net	10 mm	5 mm
13. MERCANTILE, GROUP A,B,C.			
i. Sales area on floor below street floor	2.8 m^2	7.6 mm	5 mm
ii. Sales area on street floor	2.8 m^2	7.6 mm	5 mm
iii. Sales area on floors above street floor	5.6 m^2	7.6 mm	5 mm
iv. Sales area on two or more street floors	3.7 m^2	7.6 mm	5 mm
v. Floors used only for offices	9.3 m^2	7.6 mm	5 mm
vi. Floors used for goods and not public	27.9 m^2	7.6 mm	5 mm

Table:- A.03-T13.: Occupant Load Factors and Exit Capacity Factors			
OCCUPANCY	**OCCUPANT LOAD FACTOR PER PERSON**	**STAIR CAPACITY PER PERSON**	**RAMP CAPACITY PER PERSON**
14. MALL, GROUP A,B			
i. Mall gross leasable area less than 14,000 m^2	2.8 m^2	7.6 mm	5 mm
ii. Mall gross leasable area of 14,000 m^2	3.3 m^2	7.6 mm	5 mm
iii. Increment of every 1,290 m^2 (Approx.)	0.1 m^2 added to 3.3 m^2 Max 5.1 m^2	7.6 mm	5 mm
15. STORAGE, GROUP A			
i. High Hazard Storage	27.9 m^2	18 mm	10 mm
16. STORAGE, GROUP B,C.			
i. Low and Ordinary Hazard Storage	27.9 m^2	7.6 mm	5 mm
17. INDUSTRIAL, GROUP A			
i. High Hazard content	9.3 m^2	18 mm	10 mm
18. INDUSTRIAL, GROUP B,C.			
i. General, Low Hazard	9.3 m^2	7.6 mm	5 mm
ii. Special Purpose	NA	7.6 mm	5 mm
19. PARKING, GROUP A,B			
i. Enclosed parking's	27.9 m^2	7.6 mm	5 mm
ii. Open parking's	27.9 m^2	7.6 mm	5 mm
20. PARKING, GROUP C			
i. Mechanical/Robotic parking's	46.5 m^2	7.6 mm	5 mm
21. ANIMAL HOUSING, GROUP A,B,C.	11.1 m^2	7.6 mm	5 mm

5.3. Number of Means of Egress

5.3.1. Minimum number of means of egress from any storey or portion thereof shall be as per **Table:- A.03-T14.**

Table:- A.03-T14.: Required Number of Means of Egress

CRITERIA	NUMBER OF EXITS
i. ANY BUILDING, FLOOR, STOREY	Minimum 2 Means of Egress
ii. OCCUPANT LOAD LESS THAN 500	Minimum 2 Exits
iii. OCCUPANT LOAD 500 - 1000	Not less than 3 Exits
iv. OCCUPANT LOAD MORE THAN 1000	Not less than 4 Exits
v. BALCONY, MEZZANINE,	Minimum 2 Means of Egress
vi. OCCUPANT LOAD MORE THAN 6000 AT OUTDOORS	Not less than 3 Exits
vii. OCCUPANT LOAD MORE THAN 9000 AT OUTDOORS	Not less than 4 Exits

5.4. Remoteness of Means of Egress

5.4.1. Exits shall be located, and exit access shall be arranged, so that exits are readily accessible at all times.

5.4.2. Where exits are not immediately accessible from an open floor area, continuous passage ways, aisles, or corridors leading directly to every exit shall be maintained and shall be arranged to provide access for each occupant to not less than two exits by separate ways of travel, unless single exits are permitted as per individual occupancies.

5.4.3. Exit access corridors shall provide access to not less than two permitted exits, unless single exits are permitted as per individual occupancies.

5.4.4. Exits, Exit access, or Exit Discharge shall be remotely located from each other and be arranged to minimize the possibility that more than one has the potential to be blocked by any one fire or other emergency condition.

5.4.5. Remoteness of Exit arrangement in buildings shall be as per **Table:- A.03-T15.a.**

Table:- A.03-T15.a.: Remoteness of Means of Egress

BUILDING	EXIT REMOTENESS	MEASUREMENT OF DISTANCE
i. LOWRISE, SPRINKLER PROTECTED	1/3 of floor diagonal	Shortest walking distance between exits
ii. LOWRISE, NON SPRINKLER PROTECTED	1/2 of floor diagonal	Shortest walking distance between exits
iii. MIDRISE, SPRINKLER PROTECTED	1/3 of floor diagonal	Shortest walking distance between exits
iv. MIDRISE, NON SPRINKLER PROTECTED	1/2 of floor diagonal	Shortest walking distance between exits
v. HIGHRISE, SPRINKLER PROTECTED	1/3 of floor diagonal	Straight line between center of exit doors
vi. SUPER HIGHRISE, SPRINKLER	1/3 of floor diagonal	Straight line between center of exit doors

5.4.6. Measurement of remoteness of Exit arrangement in buildings required by **Table:- A.03-T15.** for Low rise and Midrise buildings shall be as per **Figure:- A.03-F20.a.**

5.4.7. However, the allowance of measuring remoteness by walking distance between exits shall not apply where the arrangement of means of egress is blocked by any one fire or emergency condition which prevents the access to both the exits.

5.4.8. Required exit remoteness shall also be required where exits are connected by looped corridors or passageways.

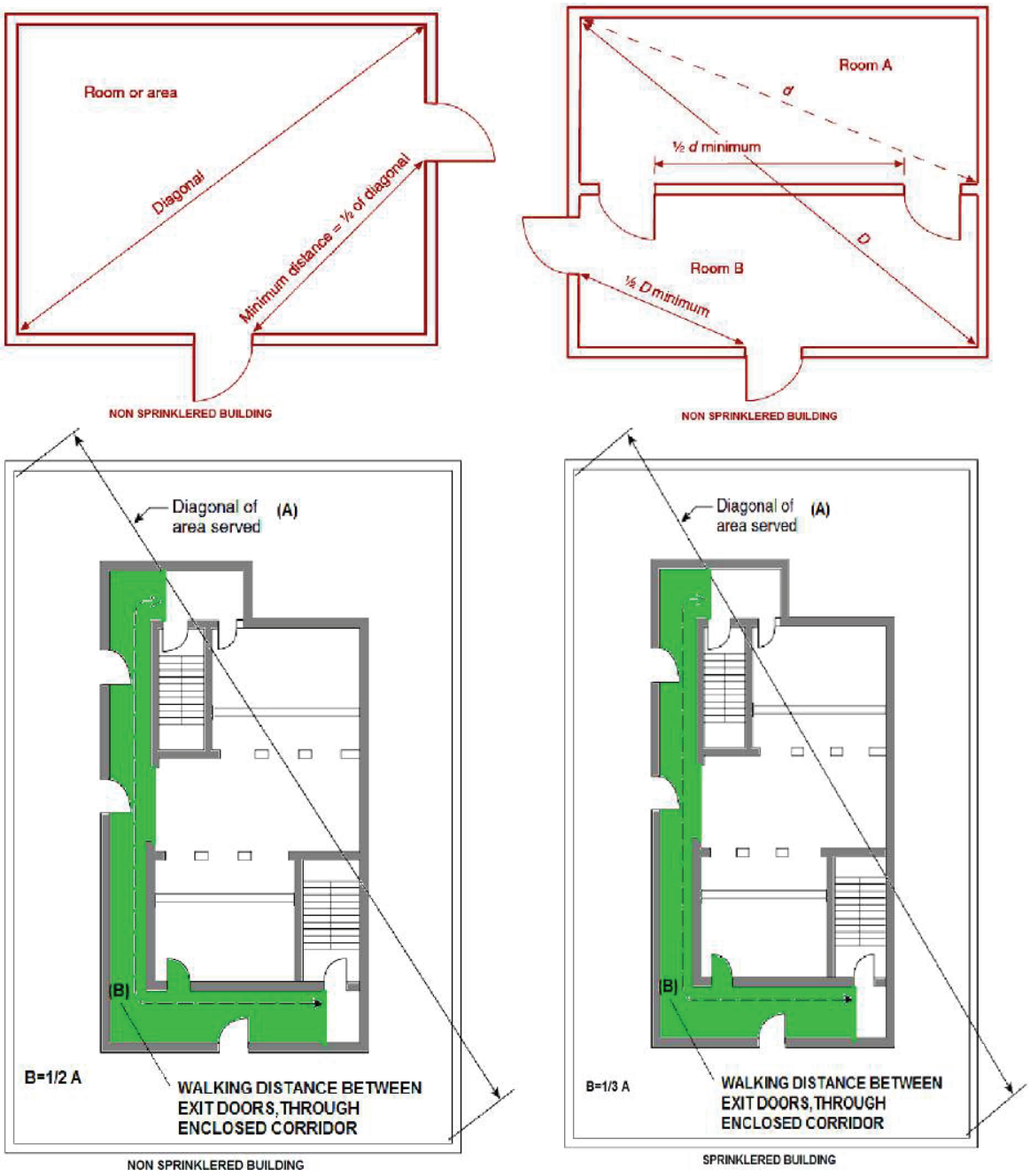


Figure:- A.03-F20.a.: Lowrise and Midrise building exit separation

5.4.9. Measurement of remoteness of Exit arrangement in buildings required by **Table A.03-T15.a.** for Super High rise and High rise buildings shall be as per **Figure:- A.03-F20.b.**

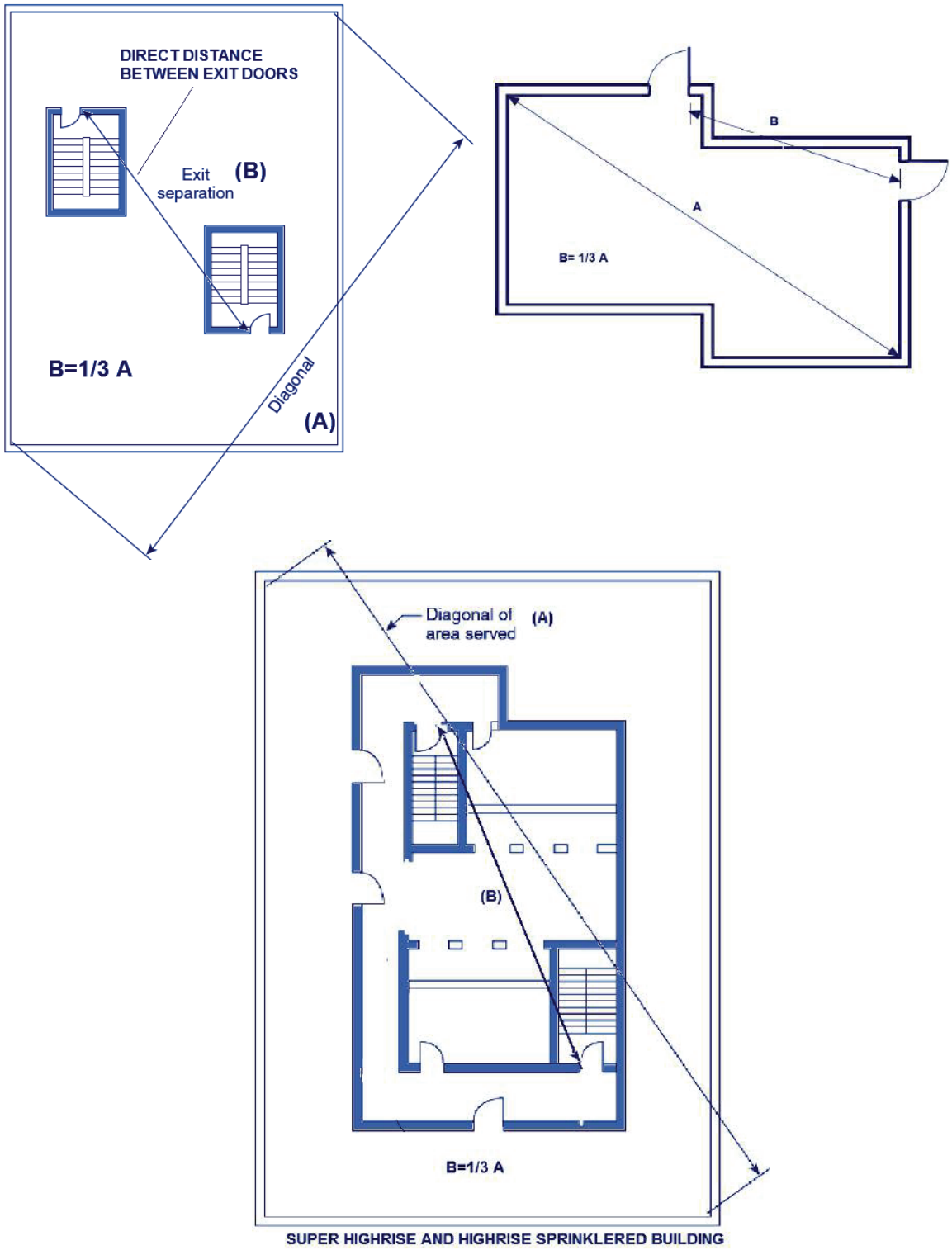


Figure:- A.03-F20.b.: Super Highrise, Highrise sprinkler protected building exit separation

5.4.10. Remoteness of exits as per **Table:- A.03-T15.a.** shall not apply to basements and podiums where the area is only used for parking vehicles, generator rooms, server rooms, battery rooms and service rooms, provided the travel distance requirements of 61m are met. The remoteness of stairs in such podiums and basements shall be as per **Table:- A.03-T15.b.**

5.4.11. Measurement of remoteness of Exit arrangement in buildings required by **Table:- A.03-T15.b.** for basements and podiums used for parking of vehicles shall be as per **Figure:- A.03-F20.c.**

Table:- A.03-T15.b.: Remoteness of Means of Egress at Basements and Podiums used for parking

BUILDING	EXIT REMOTENESS	MEASUREMENT OF DISTANCE
i. BASEMENT AND ENCLOSED PODIUM USED ONLY FOR VEHICLE PARKING AND SERVICE ROOMS, WITH SPRINKLER PROTECTION	Maximum of 61 m of travel path from most remote point to exit door. Dead end and Common path shall not exceed 15 m.	Walking distance from most remote parking lot, along the natural path of travel to an exit.
ii. BASEMENT AND ENCLOSED PODIUM USED ONLY FOR VEHICLE PARKING AND SERVICE ROOMS, NON-SPRINKLER PROTECTED	Maximum of 46 m of travel path from most remote point to exit door. Dead end and Common path shall not exceed 15 m.	Walking distance from most remote parking lot, along the natural path of travel to an exit.
iii. OPEN PODIUM USED ONLY FOR VEHICLE PARKING AND SERVICE ROOMS, SPRINKLER PROTECTED & NON PROTECTED	Maximum of 122 m of travel path from most remote point to exit door. Dead end and Common path shall not exceed 15 m.	Walking distance from most remote parking lot, along the natural path of travel to an exit.

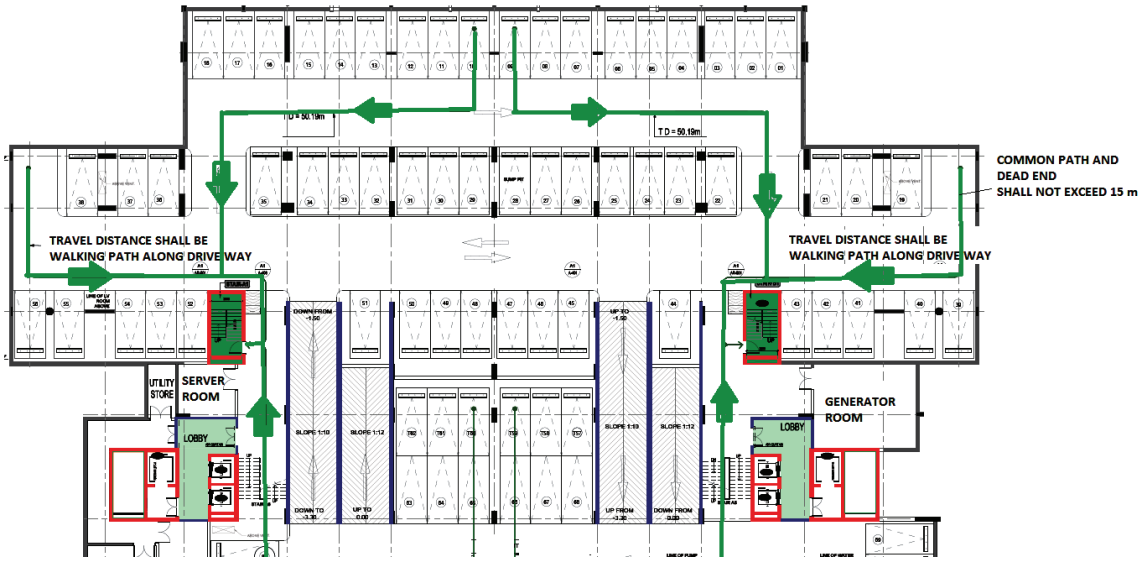


Figure:- A.03-F20.c.: Exit separation requirements for Basements and Podiums used for parking's

5.5. Common path, Dead end and Travel Distance

5.5.1. Exit access shall be arranged such that there are no dead ends or dead ends are within allowable length in corridors.

5.5.2. The travel distance to an exit shall be measured on the floor or other walking surface shall be along the centerline of the natural path of travel, starting from the most remote point subject to occupancy, terminating at the center of the doorway or other exits and keeping a distance of 305 mm clearance from corner, curves and obstructions.

5.5.3. Where measurement includes stairs, the measurement shall be taken in the plane of the tread nosing.

5.5.4. Limitations of Common path, Dead ends and Travel Distance in buildings shall be as per **Table:- A.03-T16.** Where **"S"** is building protected by sprinkler system, **"NS"** is building not protected with sprinkler system, "**NR"** is No Requirements and **"NA"** is Not Applicable.

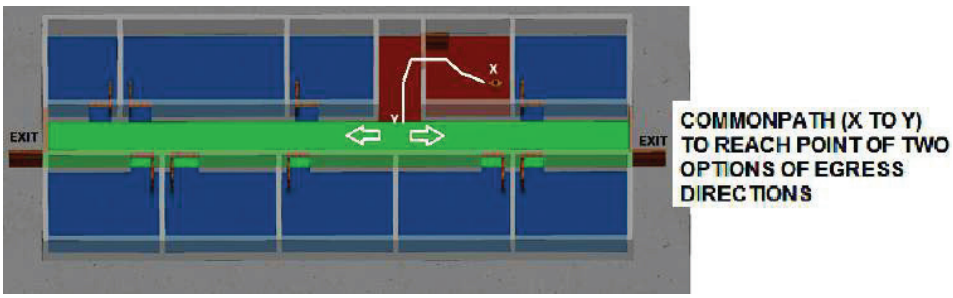


Figure:- A.03-F21.a.: Common path

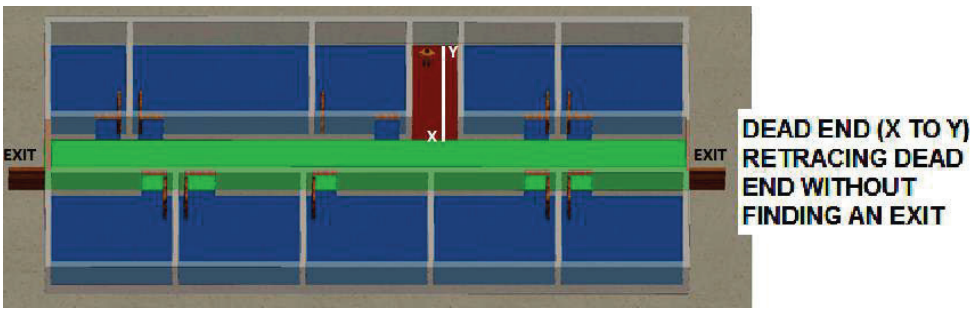


Figure:- A.03-F21.b.: Dead End

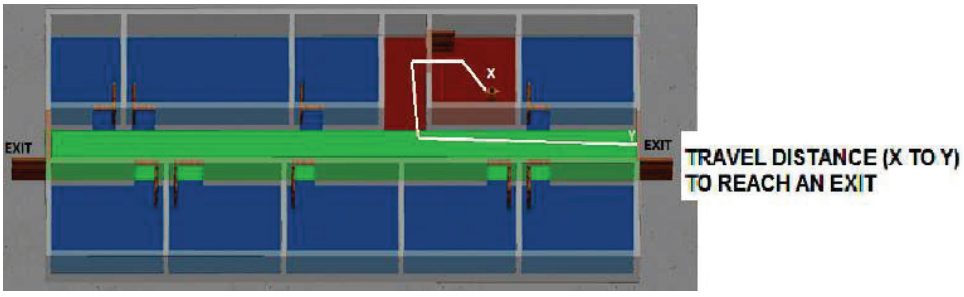


Figure:- A.03-F21.c.: Travel Distance

Table:- A.03-T16.: Common path, Dead end and Travel Distances			
OCCUPANCY	**COMMONPATH**	**DEAD END**	**TRAVEL DISTANCE**
1. ASSEMBLY, GROUP A,B,C.			
i. 50 people or less	S 23 m, NS 23 m	S 6.1 m, NS 6.1 m	S 76 m, NS 61 m
ii. More than 50 people	S 6.1 m, NS 6.1 m	S 6.1 m, NS 6.1 m	S 76 m, NS 61 m
iii. Smoke Protected Seating area	S 15 m, NS 6.1 m	S 21 rows of seats	S 122 m, NS 61 m
iv. Exhibition booth to Exit access	S 15 m, NS 15 m	S 0 m NS 0 m	S 15 m, NS 15 m
2. BUSINESS, GROUP A,B,C.			
i. Regular Office areas	S 30 m, NS 23 m	S 15 m, NS 6.1 m	S 91 m, NS 61 m
iii. Air Traffic Control observation levels			
3. EDUCATIONAL , GROUP A,B,C.			
i. Classroom	S 30 m, NS 23 m	S 15 m, NS 6.1 m	S 61 m, NS 46 m
i. Shops, Laboratories, Vocational etc.	S 30 m, NS 23 m	S 15 m, NS 6.1 m	S 76 m, NS 46 m
4. HEALTHCARE GROUP A,B			
i. Hospitals, Sleeping areas	S 30 m	S 9.1 m	S 61 m
ii. Clinics, Consultancy areas	S 30 m, NS 23 m	S 15 m, NS 6.1 m	S 91 m, NS 61 m
iii. Inside Suite to suite exit door	NA	NA	S 30 m, NS 30 m
iv. Inside Suite to exit /exit stair	NA	NA	S 61 m, NS 61 m
v. Any sleeping room to its main door	NA	NA	S 15 m, NS 15 m
5. HEALTHCARE GROUP C			
i. Ambulatory Health care	S 30 m, NS 23 m	S 15 m, NS 6.1 m	S 61 m, NS 46 m
6. RESIDENTIAL GROUP A			
i. Apartment Main door to exit	S 15 m, NS 10.7 m	S 15 m, NS 10.7 m	S 61 m, NS 30 m
ii. Within Apartment to Main door	S 38 m, NS 23 m	NA	S 38 m, NS 23 m
iii. Apartment Main door to Outside Stair	S 15 m, NS 10.7 m	S 15 m, NS 10.7 m	S 61 m, NS 30 m
iv. Other than dwelling units to Exit Stair	S 15 m, NS 10.7 m	S 15 m, NS 10.7 m	S 76 m, NS 61 m
7. RESIDENTIAL GROUP B, C			
i. Staff Accommodation, Hostels	S 15 m, NS 10.7 m	S 15 m, NS 10.7 m	S 76 m, NS 61 m
ii. Labor Accommodation	S 15 m, NS 10.7 m	S 15 m, NS 10.7 m	S 76 m, NS 61 m
8. PRIVATE VILLA	NA	NA	NA
9. COMMERCIAL VILLA	NA	NA	NA

Table:- A.03-T16.: Common path, Dead end and Travel Distances			
OCCUPANCY	**COMMONPATH**	**DEAD END**	**TRAVEL DISTANCE**
10. DETENTION , GROUP A,B,C.			
i. For Types II, III, IV	S 30 m, NS 15 m	S 15 m, NS 6.1 m	S 61 m, NS 46 m
ii. For Types V	S 30 m, NS 15 m	S 6.1 m, NS 6.1 m	S 61 m, NS 46 m
iii. Any room exit access door to Exit	S 30 m, NS 15 m	S 15 m, NS 6.1 m	S 46 m, NS 46 m
11. HOTEL			
i. Hotel guest room Main door to exit	S 15 m, NS 10.7 m	S 15 m, NS 10.7 m	S 61 m, NS 53 m
i. Within Guest room to Main door	NA	NA	S 38 m, NS 23 m
12. DAY CARE, GROUP A, B			
i. From any room door to exit door	S 30 m, NS 23 m	S 15 m, NS 6.1 m	S 46 m, NS 30 m
ii. From any point in room to exit door	S 30 m, NS 23 m	S 15 m, NS 6.1 m	S 61 m, NS 46 m
iii. From any point in room to room door	NA	NA	S 30 m, NS 15 m
13. MERCANTILE, GROUP A,B,C.			
i. For Class A,B,C	S 30 m, NS 23 m	S 15 m, NS 6.1 m	S 76 m, NS 46 m
ii. For Open air	S 0 m, NS 0 m	S 0 m, NS 0 m	NA
iii. High Hazard Mercantile	S 0 m, NS 0 m	S 15 m, NS 6.1 m	S 23 m, NS 23 m
14. MALL, GROUP A			
i. Covered Mall	S 30 m, NS 23 m	S 15 m, NS 6.1 m	S 120 m, NS 46 m
Ii. Within Tenant space, where provided with pedestrian way is provided as per Table:- A.03-T33.2.	S 30 m, NS 23 m	S 15 m, NS 6.1 m	S 76 m, NS 46 m
15. MALL, GROUP B			
i. Open Air Mall	S 0 m, NS 0 m	S 0 m, NS 0 m	NA
16. STORAGE, GROUP A			
i. High Hazard Storage	S 0 m, NS 0 m	S 0 m, NS 0 m	S 30 m, NS 23 m
17. STORAGE, GROUP B,C.			
i. Low Hazard Storage	S 30 m, NS 15 m	S 30 m, NS 15 m	S 122 m, NS 61 m
ii. Ordinary Hazard Storage	S 30 m, NS 15 m	S 30 m, NS 15 m	S 122 m, NS 61 m
iii. Aircraft Storage, ground floor	S 30 m, NS 15 m	S 15 m, NS 15 m	S 30 m, NS 23 m
iii. Aircraft Storage, Mezzanine floor	S 30 m, NS 15 m	S 15 m, NS 15 m	S 23 m, NS 23 m
18. INDUSTRIAL, GROUP A			
i. High Hazard content	S 0 m, NS 0 m	S 0 m, NS 0 m	S 23 m, NS 0 m

Table:- A.03-T16.: Common path, Dead end and Travel Distances			
OCCUPANCY	**COMMONPATH**	**DEAD END**	**TRAVEL DISTANCE**
19. INDUSTRIAL, GROUP B,C.			
i. General, Low Hazard	S 30 m, NS 15 m	S 15 m, NS 15 m	S 75 m, NS 61 m
ii. Special Purpose	S 30 m, NS 15 m	S 15 m, NS 15 m	S 122 m, NS 91 m
iii. Aircraft Servicing, ground floor	S 30 m, NS 15 m	S 15 m, NS 15 m	S 30 m, NS 23 m
iv. Aircraft Servicing, Mezzanine floor	S 23 m, NS 15 m	S 15 m, NS 15 m	S 23 m, NS 23 m
v. Mechanical Equipment room,	S 30 m, NS 15 m	S 15 m, NS 15 m	S 75 m, NS 61 m
vi. Boiler, Furnace room	S 30 m, NS 15 m	S 15 m, NS 15 m	S 75 m, NS 61 m
20. PARKING, GROUP A,C			
i. Enclosed parking	S 15 m, NS 15 m	S 15 m, NS 15 m	S 61 m, NS 46 m
ii. Open parking	S 15 m, NS 15 m	S 15 m, NS 15 m	S 122 m, NS 91 m
21. PARKING, GROUP C			
i. Mechanical/Robotic parking	S 15 m, NS 15 m	S 15 m, NS 15 m	S 60 m, NS 46 m
22. ANIMAL HOUSING, GROUP A,B,C.			
	S 30 m, NS 23 m	S 15 m, NS 6.1 m	S 91 m, NS 61 m

5.5.5. Measurement of Common path, Dead ends and Travel Distance

5.5.5.1. The common path, dead ends and travel distance to an exit shall be measured on the floor or other walking surface as follows:

a. Along the centerline of the natural path of travel, starting from the most remote point subject to occupancy.
b. Curving around any corners or obstructions, with a 305-mm clearance there from, terminating at center of the doorway or other point at which the exit begins.
c. Where open stairways or ramps are permitted as a path of travel, the distance shall include the travel on the stairway or ramp and the travel from the end of the stairway or ramp to an outside door or other exit in addition to the distance travelled to reach the stairway or ramp.
d. Where measurement includes stairs, the measurement shall be taken in the plane of the tread nosing.

6. Occupancy Specific Requirements

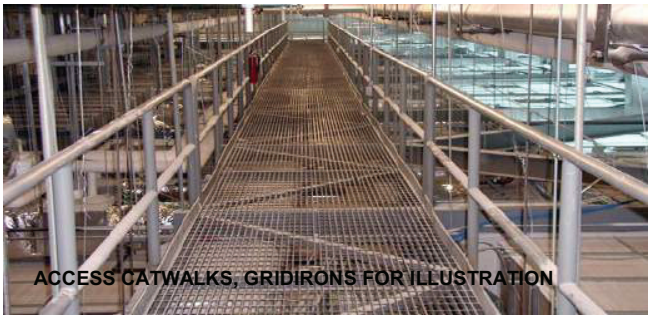
6.1. Assembly, Group A, B, C.

6.1.1. Descriptions of Group (A,B,C) classification shall be read in conjunction of **Section A, Chapter 02, Construction.**

6.1.2. The assembly occupancies shall comply with **Table:- A.03-T17.** Along with all other sections of this chapter. Where conflicts arise between this section and other sections of the Chapter or code, the requirements of this section shall prevail.

Table:- A.03-T17.: Assembly, Group A, B, C.

ITEMS	REQUIREMENTS
1. MAIN ENTRANCE AND EXIT	i. Every assembly occupancy shall be provided with a main entrance/exit. ii. The main entrance/exit shall be at the level of exit discharge or shall connect to a stairway or ramp leading to a street. iii. Each level of the assembly occupancy shall have access to the main entrance/exit. iv. The main entrance/exit shall be of a width that accommodates two-thirds (2/3) of the total occupant load in the following assembly occupancies. **a.** Dance halls **b.** Discotheques **c.** Nightclubs **d.** Assembly occupancies with festival seating. v. In assembly occupancies, other than those listed above, the main entrance/exit shall be of a width that accommodates one-half (1/2) of the total occupant load. vi. Where the main entrance/exit from an assembly occupancy is through a lobby or foyer, the aggregate capacity of all exits from the lobby or foyer shall be permitted to provide the required capacity of the main entrance/exit, regardless of whether all such exits serve as entrances to the building. vi. In assembly occupancies where there is no well-defined main entrance/exit, exits shall be permitted to be distributed around the perimeter of the building, provided that the total exit width furnishes not less than 100 percent of the width needed to accommodate the permitted occupant load.
2. SINGLE EXIT PERMISSION	i. Balconies or mezzanines having an occupant load not exceeding 50 shall be permitted to be served by a single means of egress, and such means of egress shall be permitted to lead to the floor below. ii. Balconies or mezzanines having an occupant load exceeding 50 - but not exceeding 100, shall have not less than two remote means of egress, but both such means of egress shall be permitted to lead to the floor below. iii. A second means of egress shall not be required from lighting and access catwalks, galleries, and gridirons above stage where a means of escape to a floor or a roof is provided. Such single exit width shall not be less than 560 mm.



ACCESS CATWALKS, GRIDIRONS FOR ILLUSTRATION

Table:- A.03-T17.: Assembly, Group A, B, C.	
ITEMS	**REQUIREMENTS**
3. THEATER TYPE SEATING (THEATER, CINEMA, AUDITORIUM, CONCERT HALLS)	i. Minimum clear width of aisles and other means of egress serving theater type seating where aisle riser exceeds 178 mm in height, stair width shall be multiplied by factor A, as 7.6 X A. Where A= 1+ (Riser height-7)/125. ii. Where stair is not having handrail within 760 mm of horizontal distance, the stair width shall be additionally multiplied by factor B, as 7.6 X B. Where B=1.25. iii. Where ramps are steeper than 1 in 10 slope, ramp width shall be multiplied by a factor C, as 5.6 X C. Where C is 1.10. iv. See Smoke protected assembly seating, **Table: - A.03-T17.20.** For reduced egress capacities. Also see **Section E**, **Chapter 01, and Section 3.1.17.** For
4. AISLE ACCESSWAYS SERVING SEATING NOT AT TABLES	i. Aisles Access ways serving seating not at tables and having access to aisle from only one side shall comply with **Figure:- A.03-F22.a.** And aisles accessed by both sides of the Access ways shall comply with **Figure:- A.03-F22.b.** See Smoke protected assembly seating, **Table:- A.03-T17.20.** For reduced restrictions on seating arrangements. ii. Where aisle access ways or aisles converge to form a single path of egress travel, the required egress capacity of that path shall be not less than the combined required capacity of the converging aisle access ways and aisles.

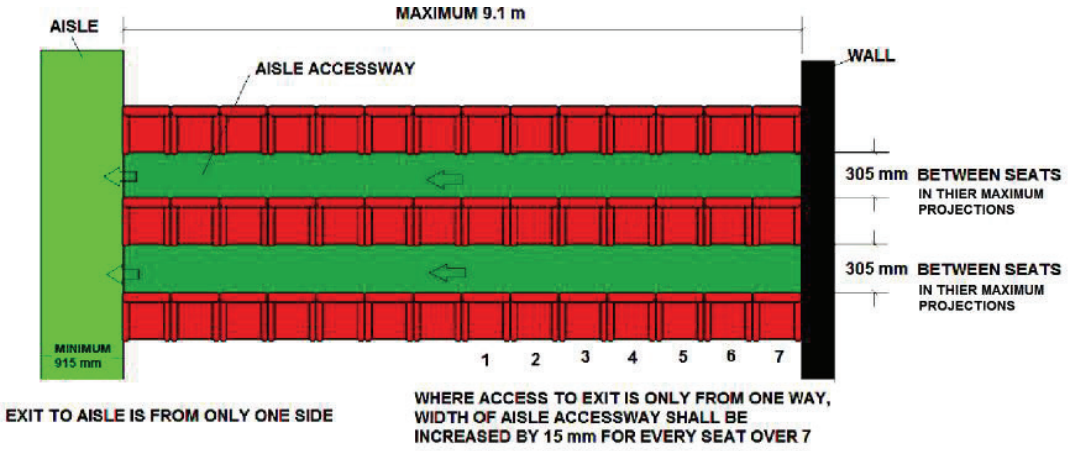


Figure:- A.03-F22.a.: Aisle Access from only one side

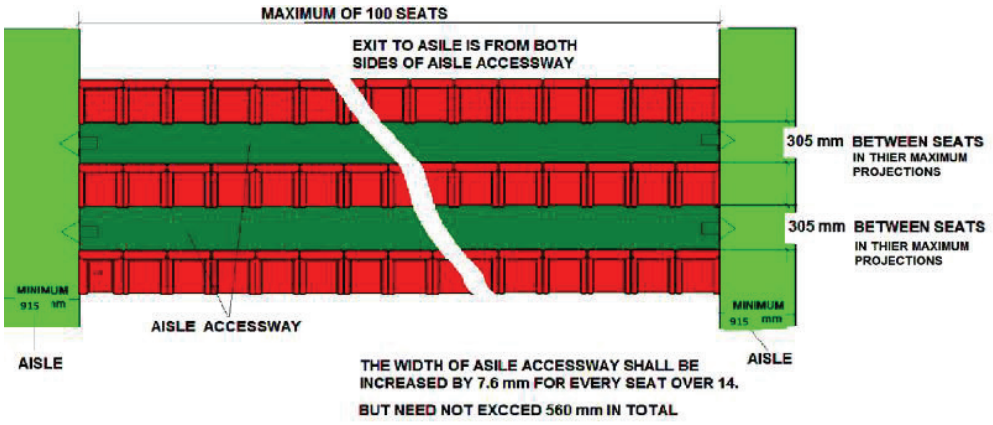


Figure:- A.03-F22.b.: Aisle Access from only one side

Table:- A.03-T17.: Assembly, Group A, B, C.	
ITEMS	**REQUIREMENTS**
5. AISLE SERVING SEATING NOT AT TABLE.	i. Minimum aisle width serving seating on both sides shall not be less than 1200 mm. ii. Minimum aisle width serving seating on only one side shall not be less than 915 mm. iii. Minimum aisle width serving not more than 50 people shall not be less than 915 mm. iv. Minimum 585 mm between seating and handrail, when aisle or ramp is sub divided by a handrail.
6. AISLE DEAD END	i. Maximum dead end in an aisle is 6.1 m. in length.
7. AISLE RAMP	i. Aisles having slope 1 in 20 to 1 in 8 shall consist of a ramp.
8. AISLE STAIR	i. Aisles steeper than 1 in 8 slope shall consist of a Stair. ii. The tread depth shall not be less than 280 mm. Treads shall be uniform in depth and extend to full width of aisle. iii. Aisle riser shall not be less than 100 mm and shall not exceed 205 mm in height. Riser height shall be uniform throughout the aisle stair.
9. AISLE LANDING	i. Where the path of travel on a stair, an aisle stair, or aisle ramp continues to another stair of different rise or tread depth, another aisle stair of different rise or tread depth, or another aisle ramp of different slope, there shall be a landing whose depth is equal to or greater than the width of the aisle stair or ramp. ii. No landing is required between aisle ramps of different slopes. iii. No landing shall be required between an aisle ramp and an aisle Access way or between an aisle stair and an aisle Access way.
10. AISLE HANDRAIL	i. Ramped aisles having a gradient exceeding 1 in 20 and aisle stairs shall be provided with handrails at one side or along the centerline. ii. Where seating exists on both sides of the aisle, the handrails shall be non-continuous with gaps or breaks of 560 mm- 915 mm in width, at intervals not exceeding five rows to facilitate access to seating and to allow crossing from one side of the aisle to the other.

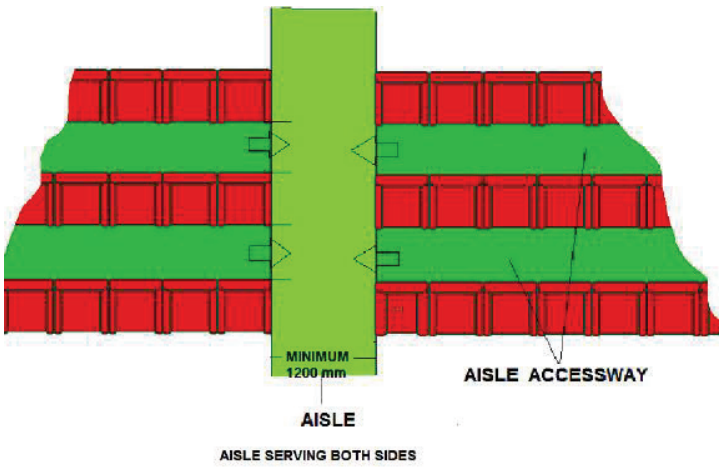


Figure:- A.03-F22.c.: Aisle Serving both sides

Table:- A.03-T17.: Assembly, Group A, B, C.	
ITEMS	**REQUIREMENTS**
11. AISLE ACCESS-WAYS SERVING SEATING AT TABLES	i. Aisles Access ways serving seating at tables shall comply with **Figure: - A.03-F22.d.** ii. The path of travel along the aisle access way shall not exceed 11 m from any seat to the closest aisle or egress doorway.
12. AISLE SERVING SEATING AT TABLES	i. Aisles serving seating at tables shall comply with **Figure: - A.03-F22.d.** ii. Minimum width of an aisle serving more than 50 people shall not be less than 1120 mm and serving less than 50 people shall not be less than 915 mm.

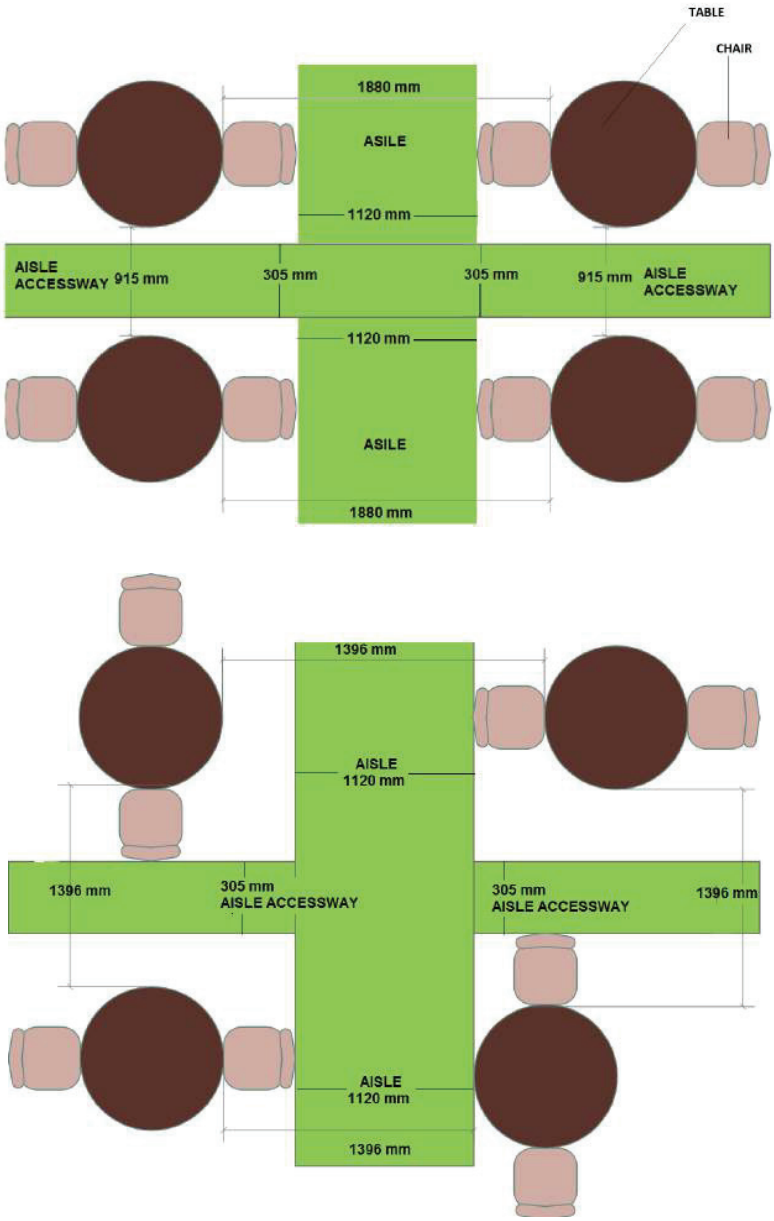


Figure:- A.03-F22.d.: Aisle and Aisle Accessway serving Tables

Table:- A.03-T17.: Assembly, Group A, B, C.	
ITEMS	**REQUIREMENTS**
13. STAGES, PROSCENIUM AND ACCESSORY SPACES	i. Stage and platform is permitted to be of any type of construction, unless the space beneath permanent platform and stage is used for storage or any other purpose other than equipment wiring or plumbing, where such floor construction shall not be less than 1 hour fire resistance rated. ii. Legitimate stages shall be constructed of materials required for Type I buildings, except that the area extending from the proscenium opening to the back wall of the stage, and for a distance of 1830 mm beyond the proscenium opening on each side, shall be permitted to be constructed of steel or heavy timber covered with a wood floor not less than 38 mm in actual thickness. iii. Legitimate stages shall be completely separated from the seating area by a proscenium wall of not less than 2-hour fire-resistive, noncombustible construction with 20 minutes opening protection of listed and permitted fire curtain, actuated by both manual and automatic detection. iv. The proscenium wall shall extend not less than 1220 mm above the roof of the auditorium in combustible construction. v. Workshops, storerooms, permanent dressing rooms, and other accessory spaces greater than 93 m2, contiguous to stages shall be separated from each other and other building areas by 1-hour fire resistance–rated construction and protected openings.
14. PROJECTION ROOM	i. Every projection room shall be of permanent construction consistent with the building construction type. ii. Film or video projectors or spotlights utilizing light sources that produce particulate matter or toxic gases, or light sources that produce hazardous radiation, without protective shielding shall be located within a projection room separated from rest of the building with 1 hour fire resistance rating. iii. The room shall have a floor area of not less than 7.4 m2 for a single machine and not less than 3.7 m2 for each additional machine, with clear working space of 760 mm around machines and rear. iv. The projection room and the rooms appurtenant to it shall have a ceiling height of not less than 2285 mm. v. Each projection room for safety film shall have not less than one out-swinging, Self-closing door not less than 760 mm wide and 2030 mm high. vi. The aggregate of ports and openings for projection equipment shall not exceed 25 percent of the area of the wall between the projection room and the auditorium, and though no opening protection is required, all openings shall be provided with glass or other permitted material so as to completely close the opening. vii. Each projection room shall be permitted to store films and a maximum of 4 flammable liquid containers of non-breakable type with a maximum capacity of 0.5L per container.



PROSCENIUM FOR ILLUSTRATION



PROJECTION ROOM FOR ILLUSTRATION

Table:- A.03-T17.: Assembly, Group A, B, C.	
ITEMS	**REQUIREMENTS**
15. GRAND-STANDS	i. Grandstand shall comply with **Figure: - A.03-F22.e.** ii. Where the front footrest of any grandstand is more than 610 mm above the floor, railings or guards not less than 825 mm above such footrests shall be provided. iii. Cross aisles located within the seating area shall be provided with rails not less than 660 mm high along the front edge of the cross aisle, where the next seat has no backs or the back is less than 610 mm above cross aisle.
16. WOODEN GRAND-STANDS	i. Wooden grandstands shall be erected 3 m away from any buildings. ii. Maximum floor area of a wooden grandstand shall not exceed 900 m^2. iii. Maximum length of a wooden grandstand shall not exceed 61 m. iv. Where groups of wooden grandstands are erected, maximum 3 grandstands of individual grandstand area of maximum 900 m2 with separation distance of 6 m between each other are allowed. v. Where more of such group of grandstands are required, each group shall not be less than 15 m apart. vi. Where these area separations are not possible, 1 hour fire resistance rated walls shall be erected between grandstands. vii. Where the grandstand is constructed entirely of labeled fire resistance rated wood that has passed the standard rain test ASTM D 2898, all the area restrictions shall be allowed to be doubled subject to General Directorate of Civil Defence (GDCD) permit.
17. OPENING GAPS	i. Any opening gaps between seats, between seats and foot rests, between seats and aisle or between aisles and cross aisles shall not be greater than 100 mm in dimension.







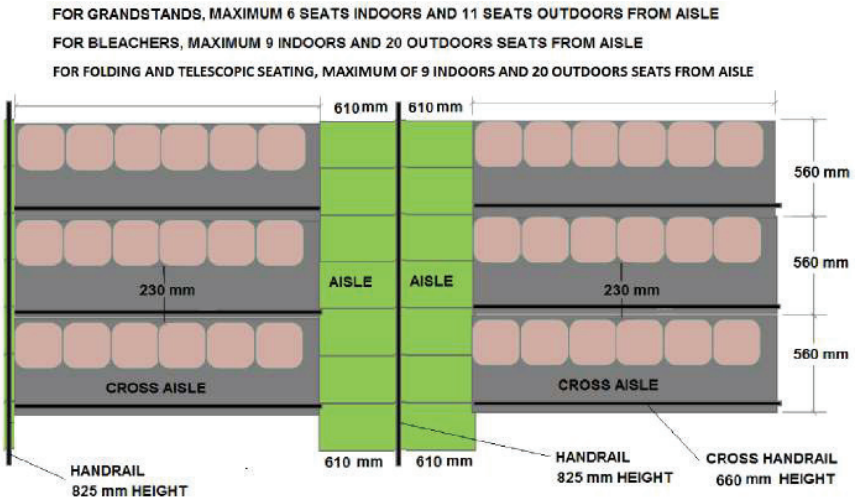


Figure:- A.03-F22.e.: Indoor Grandstand

Table:- A.03-T17.: Assembly, Group A, B, C.	
ITEMS	**REQUIREMENTS**
18. WALKING SURFACE	i. Flooring for the surface of steps and ramps forming the aisles or gangways shall be finished using non-slip materials. ii. Illumination of steps shall be such that each step is clearly visible when the general lighting is switched off. Where the emergency lighting of the hall or auditorium is able to provide sufficient lighting to the steps, separate emergency power supply to illuminate the steps would not be required. iii. For changes of level, steps shall not be used to overcome differences in level in aisles or aisle access way unless the slope exceeds 1 in 8.
19. WAITING SPACES IN ASSEMBLY	i. In theaters and other assembly occupancies where seats are not available, persons are allowed to wait in a lobby or similar space until seats or space is available. ii. Such use of a lobby or similar space shall not encroach upon the required clear width of exits. iii. Exits for waiting spaces shall be in addition to the exits specified for the main auditorium area and shall conform in construction and arrangement to the general rules for exits given in this chapter.
20. TWO EXIT DOORS REQUIREMENT	i. Rooms exceeding 280 m^2 in area requires 2 exit doors from that room, remotely located as per **Sub Section 5.4.**
21. EXITS FROM OPEN PODIUM	i. Assembly occupancies having open podiums for assembly purposes, shall ensure 2 exits remotely located as per **Sub Section 5.4.** ii. Such required 2 exits shall be any of the following. **a.** Exits leading back into building, to the building exit stairs. **b.** Enclosed exit stairs to exterior discharge from the podium. **c.** Open or outside exterior stairs as per **Table:- A.03-T4. 14.,** discharging directly outside to public way. **d.** d. Combinations of above options a, b, and c.

Table:- A.03-T17.: Assembly, Group A, B, C.

ITEMS	REQUIREMENTS
22. SMOKE PROTECTED ASSEMBLY SEATING	i. Assembly seating in a smoke protected area shall have the benefit of reduced egress capacity, reduced restrictions of seating arrangement, provided Life Safety Evaluation is submitted to General Directorate of Civil Defence (GDCD) for permitted. ii. All means of egress serving a smoke-protected assembly seating area shall be provided with smoke control system as per Section E, Chapter 01, and Section 2.13. To achieve the level of smoke at not less than 1830 mm above the floor of the means of egress. iii. For smoke protected Assembly Seating, minimum clear widths of aisles, aisle Access ways, aisle stairs, aisle ramps shall be as per Table:- A.03-T18.a. And Table: - A.03-T18.b. iv. Smoke-protected assembly seating shall be permitted to have a common path of travel of 15 m from any seat to a point where a person has a choice of two directions of egress travel. v. In smoke-protected assembly seating, the dead ends in aisle stairs shall not exceed a distance of 21 rows, unless the seats served by the dead-end aisle are not more than 40 seats from another aisle. vi. In smoke-protected assembly seating, Travel distance from any seat to nearest entrance to concourse shall not exceed 122m. vii. The travel distance from the entrance to the vomitory portal or from the egress concourse to an permitted egress stair, ramp, or walk at the building exterior shall not exceed 61 m.

Table:- A.03-T18.a.: Smoke Protected Assembly Seating based on Total seats

ITEMS	TOTAL SEATS PRESENT	FOR AISLE AT ONLY ONE END	FOR AISLE AT BOTH ENDS
1. WITH 305 MM OF CLEAR WIDTH OF AISLE ACCESSWAY	i. <4000	7 Seats per row	14 Seats per row
	ii. 4000 - 6999	7 Seats per row	15 Seats per row
	iii. 7000– 9999	8 Seats per row	16 Seats per row
	iv. 10,000–12,999	8 Seats per row	17 Seats per row
	v. 13,000–15,999	9 Seats per row	18 Seats per row
	vi. 16,000–18,999	9 Seats per row	19 Seats per row
	vii. 19,000–21,999	10 Seats per row	20 Seats per row
	viii. >22,000	11 Seats per row	21 Seats per row

Table:- A.03-T18.b.: Smoke Protected Assembly Seating based on aisle access way width

ITEMS	AISLE ACCESSWAY WIDTH	FOR AISLE AT ONLY ONE END	FOR AISLE AT BOTH ENDS
1. FOR INCREASED AISLE ACCESSWAY WIDTH	i. 300 mm– 324 mm	7	14
	ii. 325 mm– 349 mm	8	16
	iii. 350 mm– 374 mm	9	18
	iv. 375 mm– 399 mm	10	20
	v. 400 mm– 424 mm	11	22
	vi. 425 mm– 449 mm	12	24
	vii. 450 mm– 474 mm	12	26
	viii. 475 mm– 499 mm	12	28
	ix. 500 mm and more	12	as per Travel Distance limitation

6.2. Business, Group A, B, C.

6.2.1. The Business occupancies shall comply with **Table: - A.03-T19.** Along with all other sections of this chapter. Where conflicts arise between this section and other sections of the Chapter or code, the requirements of this section shall prevail.

Table:- A.03-T19.: Business, Group A, B, C.

ITEMS	REQUIREMENTS
1. SINGLE EXIT DOOR PERMISSION	i. A single exit door shall be permitted for a room or area with a total occupant load of less than 100 persons, provided the exit discharges directly to outside at level of exit discharge and such travel to outside is not more than 30 m. ii. If stair is involved, it shall be either enclosed interior stair or outside stair with total travel distance to outside, including travel distance within the stair, shall not exceed 30 m. iii. A single outside stair shall be permitted to serve multiple stories, provided such stairs are not more than 4570 mm in height from the fire access level. iv. Rooms exceeding 280 m^2 in area requires 2 exit doors from that room, remotely located as per **Section 4.4.**
2. SINGLE EXIT STAIR PERMISSION	i. A single exit Stair, separate to each storey shall be permitted for Low-rise building with a total occupant load of less than 30 persons per floor, provided the exit stair discharges directly to outside at level of exit discharge and such travel to outside is not more than 30 m. ii. Such a stair, if interior, shall be fully enclosed and shall not serve any other stories. iii. Such a stair, if exterior and it is an outside stair, shall be permitted to serve all stories. iv. A single means of egress shall be permitted from a mezzanine within a business occupancy, provided that the common path of travel does not exceed (S 30 m, NS 23 m) v. A single open Stair shall be permitted for a 2 storey, Single tenant, fully sprinkler protected building, provided that full travel distance to outside including the travel distance within stair does not exceed 30 m.

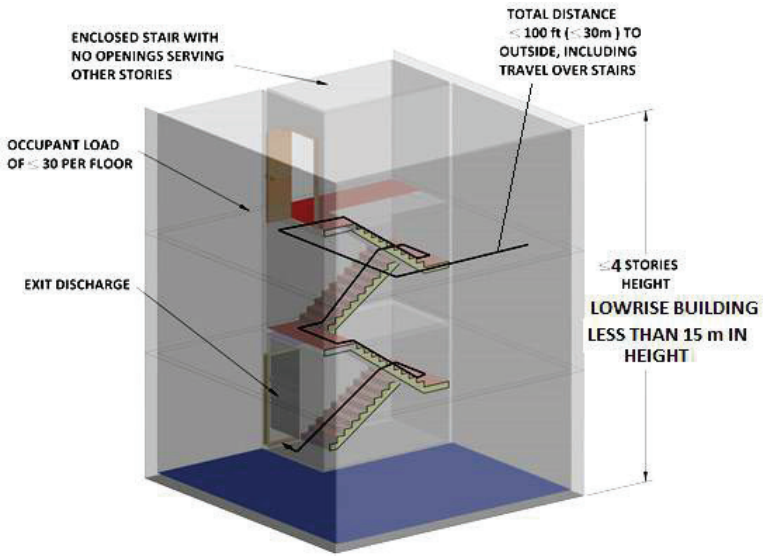


Figure:- A.03-F23.: Single Exit Permission in Business Occupancy

6.3. Educational, Group A, B, C.

6.3.1. Educational, Group A (Nurseries, Kindergarten, Preschool, Talent Centers for Kids)

6.3.1.1. The Educational Group A occupancies shall comply with **Table:- A.03-T20.** Along with all other sections of this chapter. Where conflicts arise between this section and other sections of this Chapter or code, the requirements of this section shall prevail.

Table:- A.03-T20.: Educational, Group A (Nurseries, Kindergarten, Preschool, Talent Centers)

ITEMS	REQUIREMENTS
1. CLASS ROOMS	i. Rooms normally occupied by preschool, kindergarten, or first-grade students (Generally, children below 6 years of age) shall be located on a level of exit discharge, leading to outside. ii. Rooms normally occupied by second-grade students (Generally, children between 6 - 8 years of age) shall not be located more than one storey above a level of exit discharge, leading to outside. iii. Where children up to 6 years of age are situated in rooms located above level of discharge and children between 6 - 8 years of age are situated in rooms at second storey above level of discharge, shall be provided with dedicated means of egress directly to outside, independent of the building means of egress or the users. iv. Aisles shall be not less than 760 mm wide.
2. CORRIDOR	i. Corridors shall not be less than 1830 mm in width. ii. Enclosed Corridor walls shall be smoke partitions, separating other parts of the school. iii. Corridor shall be 1 hour fire rated if building is not sprinkler protected.
3. EXIT DOORS	i. Any door in a required means of egress from an area having an occupant load of 100 or more persons shall be permitted to be provided with a latch or lock only if the latch or lock is panic hardware or fire exit hardware. ii. Access controlled doors are permitted.
4. SINGLE EXIT STAIR PERMISSION	i. Single Exit Stair is not permitted. ii. Minimum of 2 exits stair shall be provided, such that they shall be accessible from every part of every storey and mezzanine, complying with the distance permitted as common path of travel.
5. TWO EXIT DOORS REQUIREMENT	i. Every room or space larger than 93 m^2 shall have 2 separate exit access doors, remote from each other as per **Sub Section 5.4**, leading to corridor, which has two exit stairs in opposite directions.
6. RESCUE WINDOW IN NON SPRINKLER PROTECTED BUILDINGS	i. Every room or space greater than 23 m2 used for classroom or other educational purposes or normally subject to student occupancy in a non-sprinkler protected building shall have at least one window with a fixed breakable glass, having an area not less than 510 mm in width and 610 mm in height, located not more than 1120 mm above the floor for emergency rescue. ii. Such window shall be on the exterior wall of the room, accessible from public way to the General Directorate of Civil Defence (GDCD) rescue team.
7. OTHER SAFETY PRECAUTIONS	i. Clothing and personal effects shall not be stored in corridors unless building is sprinkler protected. ii. Artwork, craftwork and teaching materials shall not exceed 20% in non-sprinkler protected building and 50% in sprinkler protected building, of the wall area. iii. Open flame cooking, cooking gas storage, open flame activity, fireworks are not allowed.

Table:- A.03-T20.: Educational, Group A (Nurseries, Kindergarten, Preschool, Talent Centers)	
ITEMS	**REQUIREMENTS**
8. DOORS	i. Every closet, locker door latch shall be such that children can open the door from inside the closet. ii. Every bathroom door shall be designed to allow opening from the outside during an emergency when locked. iii. At all times, the Group A educational occupancy is occupied, all locking devices that impede or prohibit egress or that cannot be easily disengaged shall be prohibited.
9. EXISTING OCCUPANCIES CHANGING TO EDUCATION-AL, GROUP A OCCUPANCY.	i. Existing occupancies, especially 2 storey Private Villas changing their usage to Educational, Group A occupancy shall comply with all the requirements of Table A.03-T20. Except requirements for corridor width. ii. Where single exit stair exists, the required two exit stair shall be achieved by providing additional outside open stair, either masonry or steel, directly to the outside at discharge level of the ground floor. iii. Class rooms shall not be located on upper floors. iv. Upper floors shall be occupied for offices, Staff room, storage, health checkup etc.

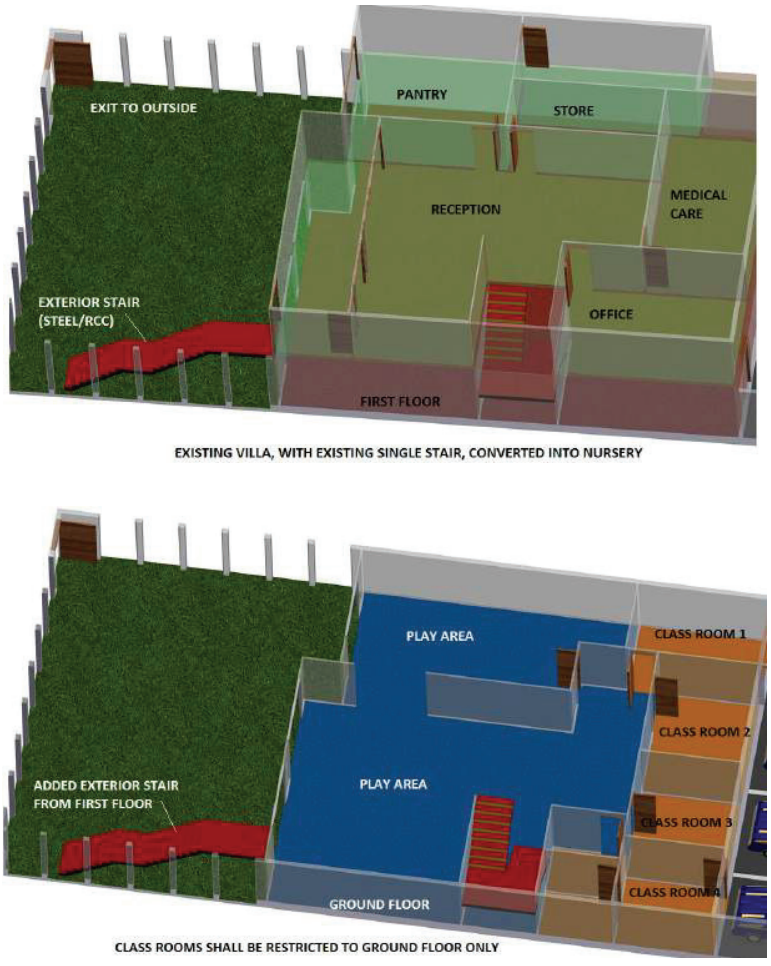


Figure:- A.03-F24.: Nursery and Preschool Class room and Exit arrangements

6.3.2. Educational, Group B, C. (Schools and Colleges)

6.3.2.1. The Educational Group B, C occupancies shall comply with **Table: - A.03-T21.** Along with all other sections of this chapter. Where conflicts arise between this section and other sections of this Chapter or code, the requirements of this section shall prevail.

Table:- A.03-T21.: Educational, Group B, C. (Schools and Colleges)

ITEMS	REQUIREMENTS
1. CLASS ROOMS	i. Every room that is normally subject to student occupancy shall have an exit access door leading directly to an enclosed exit access corridor, open exit access corridor or exit door to outside or exit stair. ii. One room shall be permitted to intervene between a normally occupied student room and an exit access corridor, provided the travel from a room served by an intervening room to the corridor door or exit shall not exceed (S 30 m, NS 23 m). iii. Aisles shall be not less than 760 mm wide.
2. CORRIDOR	i. Corridors shall not be less than 1830 mm in width where classrooms are situated on only one side of the corridor. ii. Corridors shall not be less than 3000 mm in width where classrooms are situated on both sides of the corridor. iii. Corridors shall be looped unless exit stairs are located at both extreme ends of the exit corridor. iv. Enclosed Corridor walls shall be smoke partitions, separating other parts of the school, if the building is sprinkler protected throughout. Otherwise the corridor shall have 1-hour fire resistance rating.
3. EXIT DOORS	i. Any door in a required means of egress from an area having an occupant load of 100 or more persons shall be permitted to be provided with a latch or lock only if the latch or lock is panic hardware or fire exit hardware. ii. Access controlled doors are permitted. iii. Doors that swing into an exit access corridor shall be arranged to prevent interference with corridor travel.
4. TWO EXIT DOORS REQUIRE-MENTS	i. Every room or space larger than 93 m^2 shall have 2 separate exit access doors, remote from each other as per **Sub Section 5.4**, leading to corridor, which has two exit stairs in opposite directions.
5. SINGLE EXIT STAIR PERMIS-SION	i. Single Exit Stair is not permitted. ii. Minimum of 2 exits stair shall be provided, such that they shall be accessible from Every part of every storey and mezzanine, complying with the distance permitted as common path of travel.
6. OPEN STAIR	i. Open stairs in educational occupancies are allowed but not considered as exit stairs. Where open stairs are provided, they shall be separated from exit corridors with glazing or smoke proof enclosures as per **Sub Section 4.5.,** as required for similar vertical openings, with the exception of an open and unobstructed communicating space connecting three floors or less, an atrium, or a convenience
7. RESCUE WINDOW IN NON SPRIN-KLERED BUILDINGS	i. Every room or space greater than 23 m2 used for classroom or other educational purposes or normally subject to student occupancy in a non- sprinkler protected building shall have at least one window with a fixed breakable glass, having an area not less than 510 mm in width and 610 mm in height, located not more than 1120 mm above the floor for emergency rescue. ii. Such window shall be on the exterior wall of the room, accessible from public way to the Civil Defence rescue team.

Table:- A.03-T21.: Educational, Group B, C. (Schools and Colleges)	
ITEMS	**REQUIREMENTS**
8. LABORATORY	i. Laboratory using flammable material shall be separated from the rest of the area with 1 hour fire resistance rated wall. ii. Flammable gas used for laboratory shall be designed and installed in accordance with **Section F, Chapter 01. Preventive requirements of hazardous materials**
9. OTHER SAFETY PRECAUTIONS	i. Clothing and personal effects shall not be stored in corridors unless building is Sprinkler protected. ii. Artwork, craftwork and teaching materials shall not exceed 20% in non-sprinkler protected building and 50% in sprinkler protected building, of the wall area.
10. EXITS FROM OPEN PODIUM	i. Educational occupancies having open podiums for assembly purposes, shall ensure 2 exits remotely located as per **Sub Section 5.4.** ii. Such required 2 exits shall be any of the following. **a.** Exits leading back into building, to the building exit stairs. **b.** Enclosed exit stairs to exterior discharge from the podium. **c.** Open or outside exterior stairs as per **Table:- A.03-T4., 14.,** discharging directly outside to public way. **d.** Combinations of above options a, b, and c.

6.4. Healthcare, Group A, B, C.

6.4.1. Healthcare, Group A, B. (Hospitals and Clinics)

6.4.1.1. The Healthcare Group A, B occupancies shall comply with **Table:- A.03-T22.** along with all other sections of this chapter. Where conflicts arise between this section and other sections of this Chapter or code, the requirements of this section shall prevail.

6.4.1.2. The Healthcare Group A, B occupancies shall be designed, constructed, maintained, and operated to minimize the possibility of a fire emergency requiring the evacuation of occupants.

6.4.1.3. Extensions, expansions of existing healthcare occupancies shall be separated from any existing structure not conforming to the provisions of this chapter by a fire barrier having not less than a 2-hour fire resistance rating.

Table:- A.03-T22.: Healthcare, Group A, B. (Hospitals and Clinics)

ITEMS	REQUIREMENTS
1. CORRIDOR	i. Aisles, corridors and ramps required for exit access in a inpatient areas of hospital or nursing home shall be not less than 2440 mm in clear and unobstructed width. See **Figure:- A.03-F25.a. and 3.25.b.** for obstructions permitted in such corridors. ii. Aisles, corridors and ramps required for exit access in a non-inpatient areas, psychiatric care, and limited care areas shall not be less than 1830 mm in clear width. See **Figure:- A.03-F25.c.** for obstructions permitted in such corridors.] iii. Aisles, corridors and ramps serving exit access in outpatient, consultations, and pharmacy areas shall not be less than 1200 mm in clear width. iv. The doors in corridor shall swing 180 degrees and shall project no more than

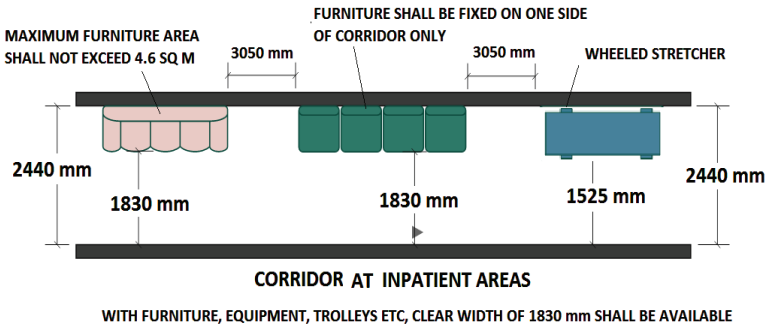


Figure:- A.03-F25.a.: Permitted re obstructions in 2440 mm Corridor

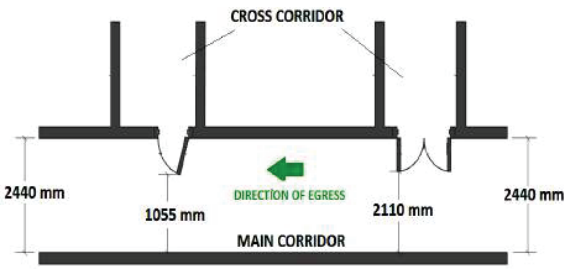


Figure:- A.03-F25.b.: Permitted Obstructions in 2440 mm

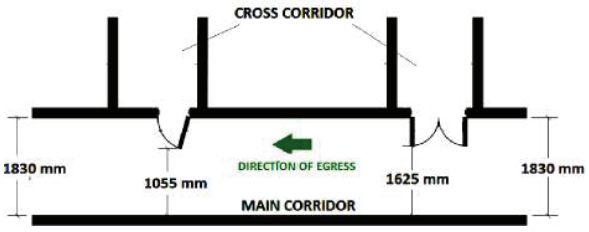


Figure:- A.03-F25.c.: Permitted Obstructions in 1830 mm

Table:- A.03-T22.: Healthcare, Group A, B. (Hospitals and Clinics)	
ITEMS	**REQUIREMENTS**
1. CORRIDOR	i. Every corridor shall provide access to not less than two permitted exits without passing through any intervening rooms or spaces other than corridors or lobbies. ii. Every habitable room shall have an exit access door leading directly to an exit access corridor, except suites and rooms having direct discharge to outside. iii. Patient sleeping rooms with not more than 8 patient beds shall be permitted to pass through one intervening room to the exit corridor. iv. All corridor walls shall be smoke partitions, extending fully up to ceiling.

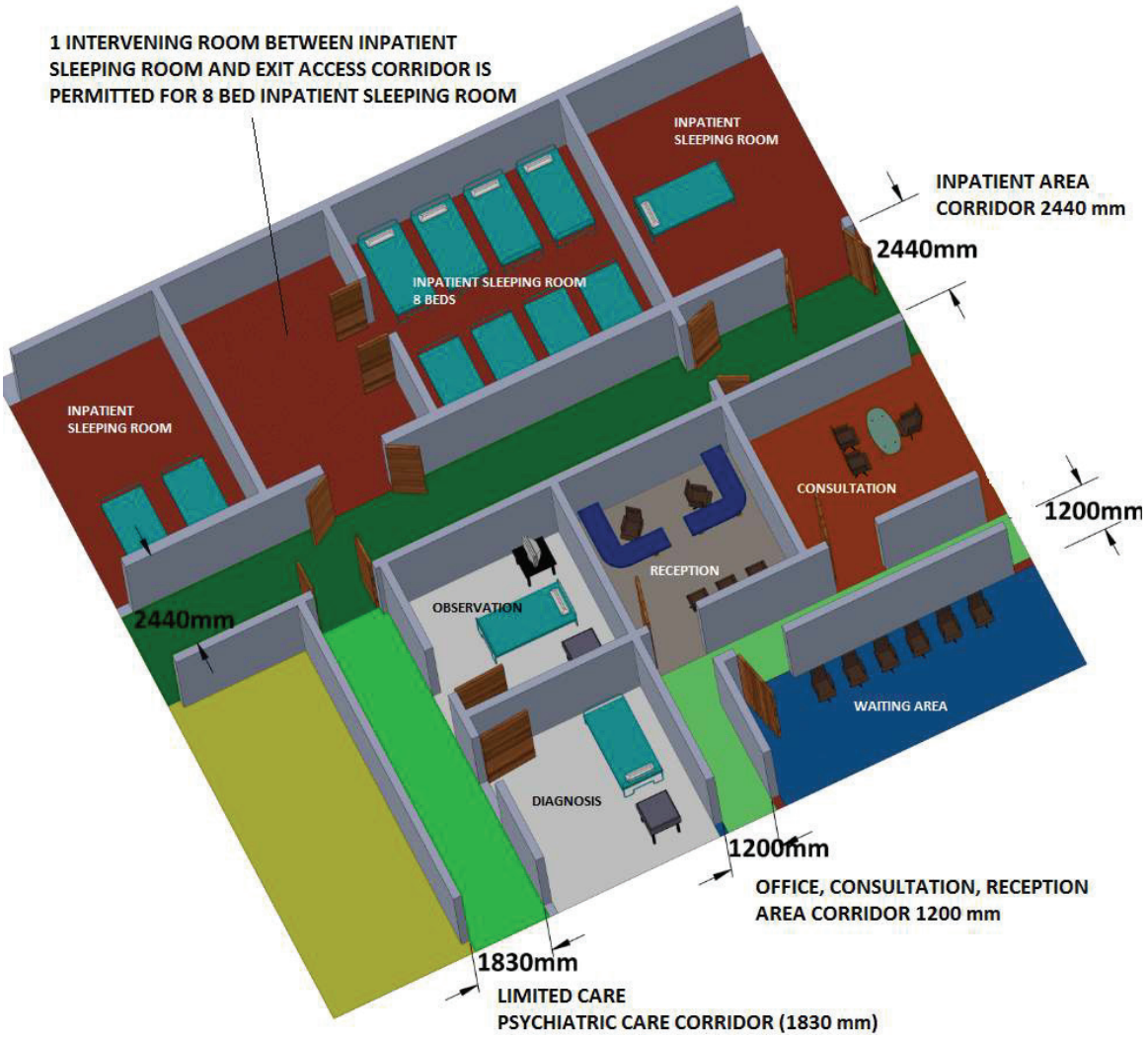


Figure:- A.03-F26.: Healthcare occupancy Corridor width Requirements

Table:- A.03-T22.: Healthcare, Group A, B. (Hospitals and Clinics)	
ITEMS	**REQUIREMENTS**
2. SPACES OPEN TO EXIT CORRIDOR	i. Unlimited spaces and areas shall be permitted to be open to the exit corridor, provided such spaces and exit corridor are in the same smoke compartment and such spaces comply with the following requirements. ii. Unlimited spaces and areas are permitted to be open to Exit corridor, unless they are patient sleeping rooms, treatment rooms or hazardous areas. iii. Waiting areas having aggregate area not exceeding 56 m2 shall be allowed to be open to the exit corridor. iv. Gift shops, pharmacies and retail shops not exceeding 46 m2 shall be permitted to be open to exit corridor or lobby. v. Nurse Stations shall be permitted to be open to exit corridor. vi. Cooking and kitchens are not allowed to be open to exit corridor. vii. Louvered door openings of Hazardous content rooms, Medical gas storage rooms etc. shall not open into exit corridors. viii. However, arrangement of the permitted open spaces shall not obstruct the minimum width required for exit corridor. Exit shall be clearly marked and visible and shall not be confusing with permitted open spaces.

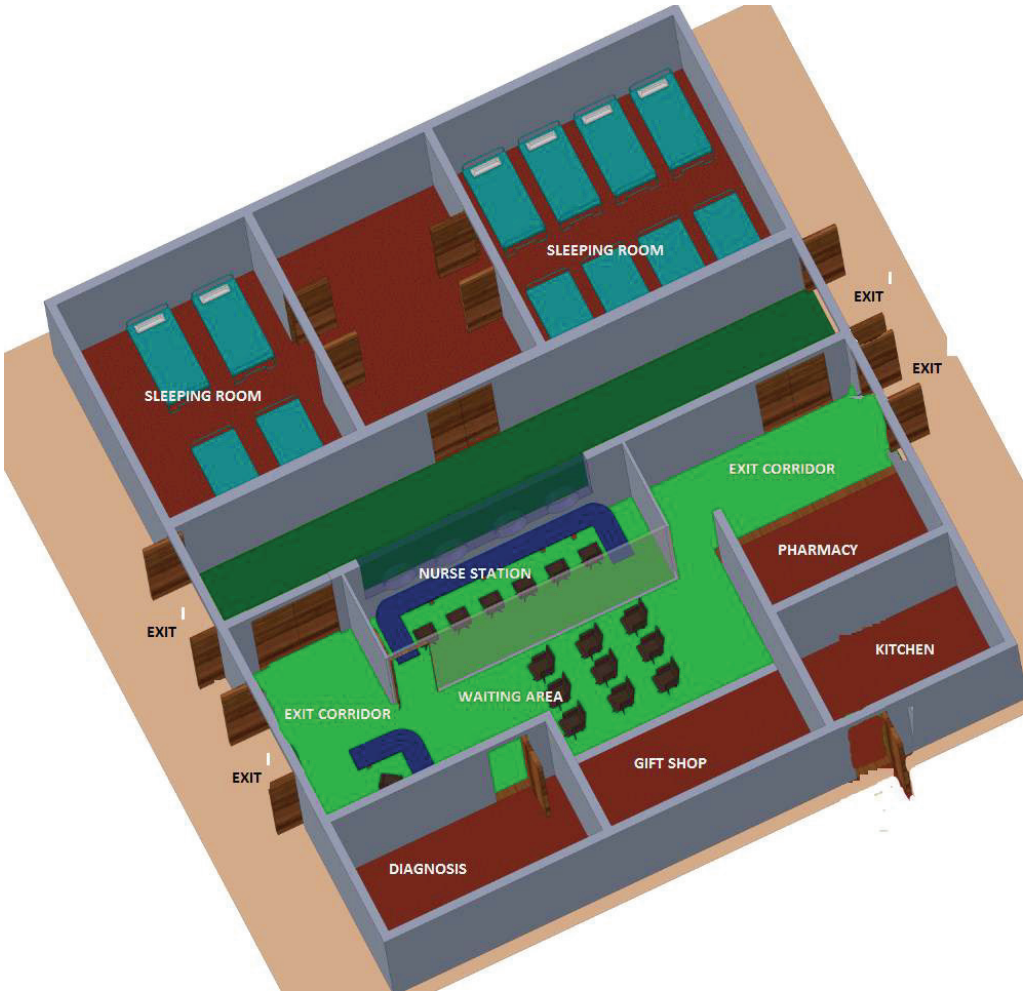


Figure:- A.03-F27.: Permitted Open Spaces in the exit Corridor

Table:- A.03-T22.: Healthcare, Group A, B. (Hospitals and Clinics)	
ITEMS	**REQUIREMENTS**
3. EXIT DOOR SPECIFICATION	i. Doors in the exit corridor shall not be required to be fire rated but shall be with self-closing devices to resist the passage of smoke, with not more than 25 mm gap between floor covering and the bottom of the door. In case of doors protecting pass-through openings a clearance between the bottom of the door and the sill shall not exceed 3 mm. ii. Locks shall not be installed on patient sleeping rooms. Restricting entry into patient rooms from corridor by access control operated by staff is allowed. Any Arrangement shall not prevent patients from egress through such doors. iii. Door-locking arrangements shall be permitted where the clinical needs of patients require specialized security measures, safety, protective measures or where patients pose a security threat, provided that staff can readily unlock doors at all times. iv. Any door in an exit passageway, stairway enclosure, horizontal exit, smoke barrier, or hazardous area enclosure (except boiler rooms, heater rooms, and mechanical equipment rooms) shall be permitted to be held open only by an automatic release device. The automatic sprinkler system and the fire alarm system, and the manual activation shall be arranged to initiate the closing action of all such doors, at all levels automatically throughout the smoke compartment or throughout the entire facility. v. Horizontal sliding doors that are not automatic closing shall be limited to a single leaf and shall have a latch or other mechanism that ensures that the doors will not rebound into a partially open position if forcefully closed. vi. Horizontal-sliding doors serving an occupant load of fewer than 10 shall be permitted, provided that the area served by the door has no high hazard contents, the door is readily operable from either side without special knowledge or effort, the force required to operate the door complies, the door assembly complies with any required fire protection rating and, where rated, is self- closing or automatic closing by means of smoke detection. Where corridor doors are required to latch, the doors are equipped with a latch or other mechanism that ensures that the doors will not rebound into a partially open position if forcefully closed. vii. A single door in horizontal exit shall be permitted, provided exit serves one direction egress only and has a width not less than 1055 mm in clear width. viii. A horizontal exit involving a corridor 2440 mm or more in width and serving as a means of egress from both sides of the doorway shall have a pair of swinging doors arranged to swing in opposite directions from each other, with each door having a clear width of not less than 1055 mm, or by a special-purpose horizontally sliding accordion or folding door assembly. ix. A horizontal exit involving a corridor 1830 mm or more in width and serving as a means of egress from both sides of the doorway shall have a pair of swinging doors arranged to swing in opposite directions from each other, with each door having a clear width of not less than 810 mm, or by a special-purpose horizontally sliding accordion or folding door assembly. x. Doors in Smoke barriers shall be substantial doors such as nonrated 44 mm thick solid-bonded wood-core doors, or shall be of construction that resists fire for a minimum of 20 minutes.

Table:- A.03-T22.: Healthcare, Group A, B. (Hospitals and Clinics)	
ITEMS	**REQUIREMENTS**
4. SINGLE EXIT PERMISSION	i. Single Exit is not permitted. ii. Not less than two separate exits shall be accessible from every part of every storey. iii. Not less than two exits shall be accessible from each smoke compartment, and egress shall be permitted through an adjacent compartment(s), provided that the two required egress paths are arranged so that both do not pass through the same adjacent smoke compartment of fire origin. iv. Every corridor shall provide access to not less than two permitted exits with- out passing through any intervening rooms or spaces other than corridors or lobbies.
5. TWO EXIT DOORS REQUIREMENTS	i. Sleeping rooms of more than 93 m2 shall have not less than two exit access doors remotely located from each other. ii. Non-sleeping rooms of more than 230 m2 shall have not less than two exit access doors remotely located from each other. iii. Sleeping suites of more than 93 m2 shall have not less than two exit access doors remotely located from each other. iv. Suites with area more than 230 m2 having non-sleeping risk shall have two exit access doors remotely located from each other.
6. SUITES FOR PATIENT CARE	i. Suites shall be separated from other suites and other areas of the healthcare occupancies with a smoke barrier extending from floor to ceiling. ii. Suites for patients sleeping shall be provided with constant staff supervision. iii. Suites shall have direct access to exit corridor or horizontal exit. iv. Sleeping suites of more than 93 m2 shall have not less than two exit access doors remotely located from each other. v. Suites for patient sleeping shall not have area more than 930 m^2. vi. Suites having non-sleeping risk shall not have area more than 1390 m^2.
7. SMOKE COMPARTMENT	i. Every floor of health care, Group A, B occupancies, having healthcare activity shall be divided into minimum of 2 smoke compartments, not exceeding 2100 m2 in area. The smoke barrier shall be 1 hour fire resistance rated. ii. If the area is an atrium separated in accordance with applicable requirements, in which case the smoke compartment limitation shall be permitted to be unlimited. iii. Windows in smoke barrier shall be fixed fire rated window assemblies. iv. Vision panels in smoke compartment doors shall be of fire rated glazing in permitted frames and bottom of the vision panel shall not be more than 1090 mm from finished floor.
8. EXITS FROM PODIUM	i. Healthcare occupancies having open podiums for assembly purposes, shall ensure 2 exits remotely located as per **Sub Section 5.4.** ii. Such required 2 exits shall be any of the following. **a.** Exits leading back into building, to the building exit stairs. **b.** Enclosed exit stairs to exterior discharge from the podium. **c.** Open or outside exterior stairs as per **Table: - A.03-T4., 14.** Discharging directly outside to public way. **d.** Combinations of above options a, b, and c.

Table:- A.03-T22.: Healthcare, Group A, B. (Hospitals and Clinics)	
ITEMS	**REQUIREMENTS**
9. HAZARDOUS AREA SEPARATION	i. Boiler and Heater rooms shall be separated by fire barriers having 1 hour fire resistance rating. ii. Bulk and central Laundry shall be separated by fire barriers having 1 hour fire resistance rating. iii. Plant maintenance, paint shops shall be separated by fire barriers having 1 hour fire resistance rating. iv. Soiled linen rooms with more than 64 gal (242 L) of soiled linen shall be separated by fire barriers having a 1-hour fire resistance rating. v. Garbage rooms shall be separated by fire barriers having 1 hour fire resistance rating. vi. Storage rooms larger than 9.3 m2 shall be separated by fire barriers having 1 hour fire resistance rating. vii. Medical gas rooms shall be 1 hour fire rated enclosure with 1 hour fire door.
10. MEDICAL GAS (SECTION F CHAPTER 1 CLAUSE 3.4)	i. Only gas cylinders, reusable shipping containers, and their accessories shall be permitted to be stored in closed rooms containing central supply systems or gas cylinders ii. No flammable materials, cylinders containing flammable gases, or containers Containing flammable liquids shall be stored in rooms with medical gas cylinders. iii. Cylinders not in use shall have their valve protection caps secured tightly in place. iv. Cylinders containing compressed gases and containers for volatile liquids shall be kept away from radiators, steam piping, and sources of heat. v. Gas storage room locations shall be chosen to permit access by delivery vehicles and management of cylinders such that proximity to loading docks, access to elevators etc. are taken into consideration. vi. Indoor locations for oxygen, nitrous oxide, and mixtures of these gases shall not be exposed to: **a.** Areas involved in critical patient care **b.** Anesthetizing locations **c.** Locations storing flammables **d.** Rooms containing open electrical contacts or transformers **e.** Storage tanks for flammable or combustible liquids **f.** Kitchens **g.** Engines vii. Medical gas rooms shall be provided with mechanical ventilation to prevent accumulation of gases. viii. Cylinders, whether full or empty, shall not be stored in enclosures containing medical air compressor sources and medical vacuum supply systems. ix. Oxygen bulk units and storage shall be 3 m away from parking, public sidewalk, doors and windows. x. Oxygen bulk units and storage shall be 15 m away from patient areas and public assembly points. xi. Oxygen bulk units and storage shall be 7.6 m away from flammable liquids, gases and material tanks. xii. Medical gas Piping shall be in shafts and shall not be installed in kitchens, elevator shafts, elevator machine rooms, areas with open flames, electrical service equipment over 600 volts.

6.4.2. Healthcare, Group C (Ambulatory Healthcare)

6.4.2.1. The Healthcare Group C, the Ambulatory Healthcare occupancies shall comply with **Table:- A.03-T23.** Along with all other sections of this chapter. Where conflicts arise between this section and other sections of this Chapter or code, the requirements of this section shall prevail.

6.4.2.2. The Healthcare Group C, the Ambulatory Healthcare facilities shall be designed, constructed, maintained, and operated to minimize the possibility of a fire emergency requiring the evacuation of occupants.

Table:- A.03-T23.: Healthcare, Group C. (Ambulatory Healthcare)

ITEMS	REQUIREMENTS
1. CORRIDOR	i. Aisles, corridors and ramps required for exit access shall be not less than 1200 mm in clear and unobstructed width. ii. Where aisles, corridors and ramps required for exit access is 1830 mm in width, projections not more than 150 mm from the corridor wall, above the handrail height, shall be permitted for the installation of hand-rub dispensing units.
2. SINGLE EXIT	i. Single Exit is not permitted. ii. Not less than two separate exits shall be accessible from every part of every storey. iii. Not less than two exits shall be accessible from each smoke compartment, and egress shall be permitted through an adjacent compartment(s), provided that the two required egress paths are arranged so that both do not pass through the same adjacent smoke compartment of fire origin.
3. TWO EXIT DOORS REQUIREMENT	i. Every room or space larger than 232 m2 shall have 2 separate exits, remote from each other as per **Sub Section 5.4.**
4. HAZARDOUS AREAS	i. Boiler and Heater rooms shall be separated by fire barriers having 1 hour fire resistance rating. ii. Bulk and central Laundry shall be shall be separated by fire barriers having 1 hour fire resistance rating. iii. Plant maintenance, paint shops shall be separated by fire barriers having 1 hour fire resistance rating. iv. Soiled linen or trash collection receptacles shall not exceed 32 gal (121 L) in capacity unless they comply with applicable requirements in international codes. v. Garbage rooms shall be separated by fire barriers having 1 hour fire resistance rating. vi. Storage rooms larger than 9.3 m2 shall be separated by fire barriers having 1 hour fire resistance rating. vii. Medical gas rooms shall be 1 hour fire rated enclosure with 1 hour fire door.

Table:- A.03-T23.: Healthcare, Group C. (Ambulatory Healthcare)	
ITEMS	**REQUIREMENTS**
5. SEPARATION	i. Ambulatory health care occupancies shall be separated from other tenants and occupancies with 1 hour fire resistance rated construction and minimum of 44 mm thick doors. ii. Doors shall be constructed of not less than 44 mm thick, solid-bonded wood core or the equivalent and shall be equipped with positive latches, and shall be self-closing and shall be kept in the closed position, except when in use.
6. SMOKE COMPARTMENT	i. Every floor of health care, Group C, Ambulatory healthcare occupancies, **a.** Having area more than 900 m^2 per story shall be divided into minimum of 2 smoke compartments, not exceeding 2000 m^2 in area. The smoke barrier shall be 1 hour fire resistance rated. ii. The area of an atrium separated in accordance with applicable requirements shall be permitted to be unlimited. iii. Windows in smoke barrier shall be fixed fire rated window assemblies. iv. Vision panels in smoke compartment doors shall be of fire-rated glazing in permitted frames. The glazing and bottom of the vision panel shall not be more than 1090 mm from the finished floor.

6.5. Residential, Group A, B, C.

6.5.1. Residential, Group A. (Apartments, Flats, Residential Units)

6.5.1.1. The Residential Group A, (Apartments, Flats and Residential Units) occupancies shall comply with **Table:- A.03-T24.** Along with all other sections of this chapter. Where conflicts arise between this section and other sections of this Chapter or code, the requirements of this section shall prevail.

Table:- A.03-T24.: Residential, Group A. (Apartments, Flats, Residential Units)

ITEMS	REQUIREMENTS
1. MULTIPLE OCCUPANCY	i. No dwelling unit of an apartment building shall have its sole means of egress pass through any non-residential building occupancy of the same building, unless building is sprinkler protected and egress is not through hazardous content locations. ii. No dwelling unit of an apartment building shall have its sole means of egress pass through any nonresidential occupancy of the same building, unless such egress is separated from non-residential occupancies by 1 hour fire resistance rated corridor and egress is not through hazardous content locations. iii. No dwelling unit of an apartment building shall have its sole means of egress pass through any nonresidential occupancy of the same building, unless nonresidential occupancy is fully sprinkler protected as per chapter 9.
2. SINGLE EXIT STAIR PERMISSION	1. **APPLICABLE TO NEW LOWRISE RESIDENTIAL BUILDINGS** i. Single exit stair OR scissor stair shall be permitted, if all the following conditions are met. **a.** Building has maximum height of 15 m (Low-rise building). **b.** Typical floor area of the building does not exceed 500 m^2. **c.** Maximum number of dwelling units in a floor does not exceed 6. **d.** Travel distance from dwelling unit door to exit stair does not exceed 10.7 m. **e.** Exit stair is 2 hour fire rated enclosure, has minimum width of 1200 mm and discharges directly to outside at the discharge level. **f.** The exit corridor accessing the single exit stair is 1 hour fire rated. ii. Single exit stair shall be permitted, if all the following conditions are met. **a.** Single exit stair is an outside stair, enclosed or open. **b.** Building has maximum height of 15 m (Low-rise building). **c.** Maximum number of dwelling units in a floor does not exceed 2. **d.** Travel distance from dwelling unit door to exit stair does not exceed 10.7 m. iii. Single exit stair shall be permitted, provided all the following conditions are met. **a.** Building has maximum height of 15 m (Low-rise building). **b.** Dwelling unit has direct access to the interior exit stair and the exit stair serves only that dwelling unit. **c.** Exit stair is 2 hour fire rated enclosure, has minimum width of 1200 mm.
3. CORRIDOR	i. Corridor shall be minimum of 1200 mm in width. ii. Corridor shall be separated from other areas of the building by 1 hour fire resistance rated construction. iii. Grilles and louvers shall be prohibited in walls or doors of exit access corridors.

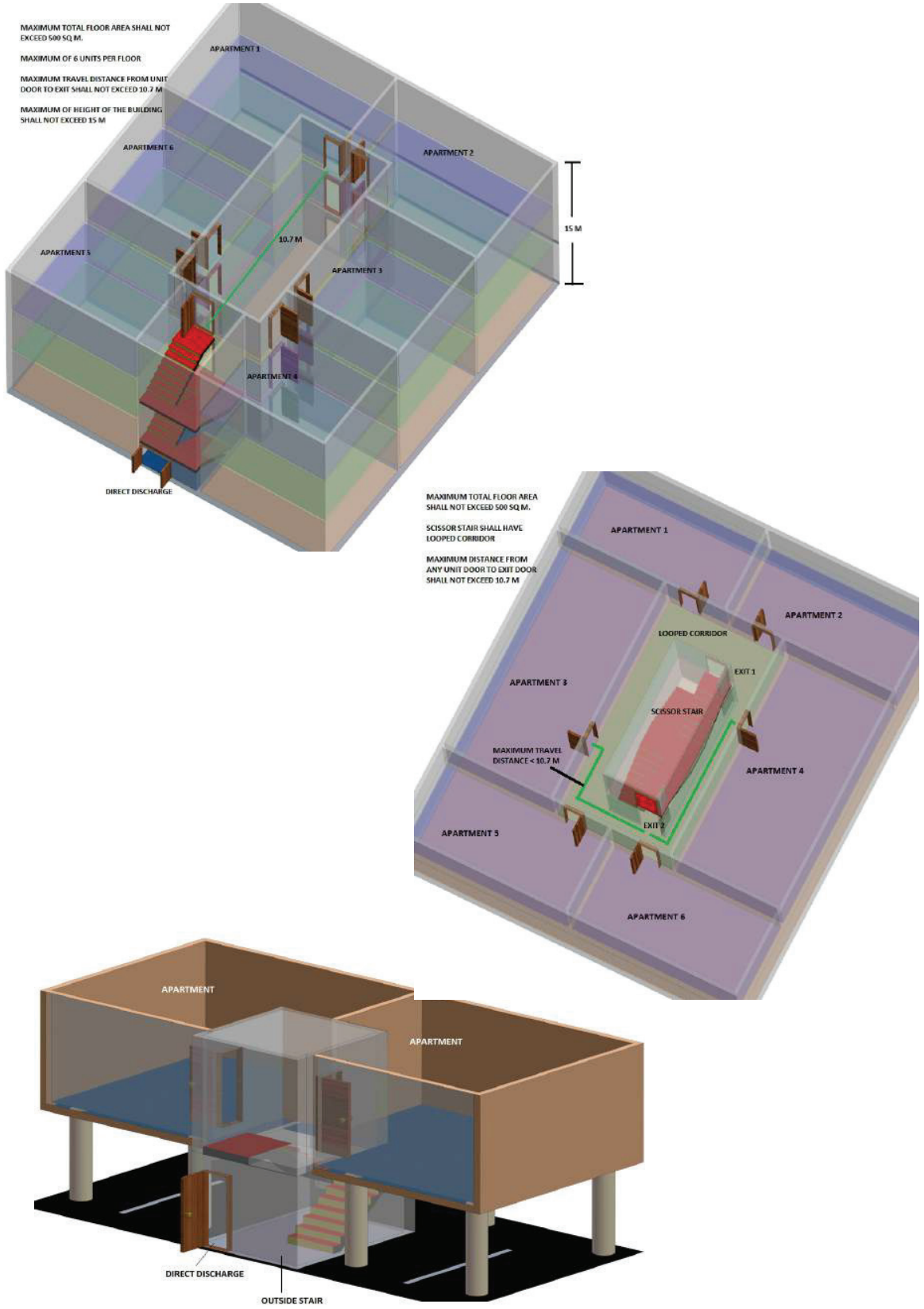


Figure:- A.03-F29.: Single Exit Stair Permission in Residential Apartments

Table:- A.03-T24.: Residential, Group A. (Apartments, Flats, Residential Units)	
ITEMS	**REQUIREMENTS**
4. SEPARATION	i. Dwelling units shall be separated from each other by walls and floors constructed as fire barriers having a minimum of 1 hour fire resistance rating.
5. HAZARDOUS AREA SEPARATION	i. Boiler and Heater rooms shall be separated by fire barriers having 1 hour fire resistance rating and sprinklers shall be provided. ii. Bulk and central Laundry shall be shall be separated by fire barriers having 1 hour fire resistance rating. And sprinklers shall be provided. iii. Plant maintenance, paint shops shall be separated by fire barriers having 1 hour fire resistance rating and sprinklers shall be provided. iv. Soiled linen rooms shall have 1 hour fire resistance rating and shall be sprinkler protected. Garbage rooms shall be separated by fire barriers having 1 hour fire resistance rating and sprinklers shall be provided. **a.** Garbage chutes shall have 2 hour fire resistance rating. **b.** Storage rooms outside dwelling units shall be separated by fire barriers having 1 hour fire resistance rating or sprinklers shall be provided. **c.** On roof LPG tanks shall be provided with fixed deluge water spray system referring to section F chapter 1 Preventive Requirements For Hazardous Materials
6. DOORS	i. Doors in bedrooms or internal rooms shall not be less than 810 mm in width ii. The main exit door for the unit or apartment shall not be less than 915 mm in clear width. iii. Bathroom doors shall not be less than 710 mm, unless they are serving persons with severe mobility impairments, where the required width shall not be less than 810 mm. iv. Minimum door width of a balcony, not used for assembly, shall not be less than 810 mm. v. Balcony and terrace access shall be restricted with door having child lock or latch. vi. Window opening shall be restricted to 100 mm opening with windows safety latch. (**See Section A, Chapter 02, Section 3.17. Balcony, Terrace, Windows and Balustrades)** vii. Every closet door latch shall be such that children can open the door from inside the closet. viii. Every bathroom door shall be designed to allow opening from the outside during an emergency when locked. ix. At all times, the Flat is occupied, all locking devices that impede or prohibit egress or that cannot be easily disengaged shall be prohibited.
6. REMOTENESS OF EXITS	i. The remoteness of exit stairs required by **Sub Section 5.4. Remoteness of Exits** does not apply to Residential Apartments, provided all the following conditions are met. **a.** Exit corridor is not looped **b.** Every Apartment door is arranged such that the common path and dead ends are zero. **c.** Exit stairs are available on opposite sides of every apartment door. **d.** Travel distance from guest room door to exit stair is less than 30 m.
7. EXITS FROM PODIUM	i. Residential occupancies having open podiums for assembly purposes, shall ensure 2 exits remotely located as per **Sub Section 5.4.** Where required common path and travel distances are non-complaint. ii. Such required 2 exits shall be any of the following. **a.** Exits leading back into building, to the building exit stairs. **b.** Enclosed exit stairs to exterior discharge from the podium. **c.** Open or outside exterior stairs as per **Table:- A.03-T4., 14.,** discharging directly to public way outside **d.** Combinations of above options a, b, and c.

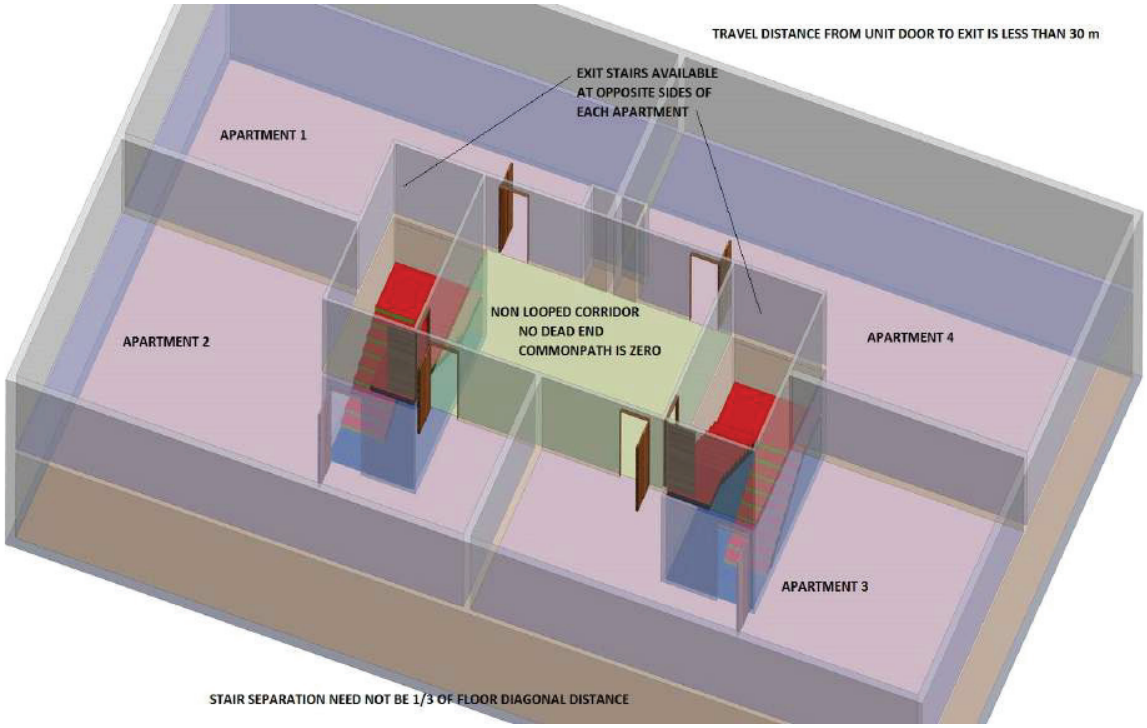


Figure:- A.03-F30.: Non applicability of Stair remoteness of 1/3 diagonal of floor area.

6.5.2. Residential, Group B. (Staff Accommodation, Hostels, Residential Board and care)

6.5.1.1. The Residential Group B, (Staff Accommodation, Hostels, Residential Board and care) occupancies shall comply with **Table:- A.03-T25.** Along with all other sections of this chapter. Where conflicts arise between this section and other sections of this Chapter or code, the requirements of this section shall prevail.

Table:- A.03-T25.: Residential, Group B. (Staff Accommodation, Hostels, Residential Board and care)

ITEMS	REQUIREMENTS
1. MULTIPLE OCCUPANCY	i. No dwelling unit shall have its sole means of egress pass through any non- residential or non-healthcare occupancy of the same building. ii. No Residential, Group B occupancy shall be located above a nonresidential or non-health care occupancy, unless the Residential, Group B occupancy and exits therefrom are separated from the nonresidential or non-health care occupancy by construction having a minimum 2-hour fire resistance rating.
3. CORRIDOR	i. Every sleeping room, living space, dining area shall have access to exit corridor. ii. Corridor shall be minimum of 1200 mm in width. iii. Corridor shall be separated from other areas of the building by 1 hour fire resistance rated construction. iv. Grilles and louvers shall be prohibited in corridors.
4. SEPARATION	i. Sleeping rooms shall be separated from each other by walls and floors constructed as fire barriers having a minimum of 1 hour fire resistance rating. ii. Sleeping rooms shall be separated from corridor by walls and floors constructed as fire barriers having a minimum of 1 hour fire resistance rating. iii. Cross-corridor openings in smoke barriers shall be protected by a pair of swinging doors.
5. SINGLE EXIT PERMISSION	i. Single exit shall not be permitted. ii. 2 exits shall be available from every part of every floor.
6. SMOKE COMPARTMENT	i. Floors exceeding 2000 m2 shall be subdivided into minimum of 2 smoke compartments, not exceeding 61 m travel distance from any point to reach a door in the smoke barrier.
7. HAZARDOUS AREA SEPARATION	i. Boiler and Heater rooms shall be separated by fire barriers having 1 hour fire resistance rating and sprinklers shall be provided. ii. Bulk and central Laundry shall be shall be separated by fire barriers having 1 hour fire resistance rating. And sprinklers shall be provided. iii. Plant maintenance, paint shops shall be separated by fire barriers having 1 hour fire resistance rating and sprinklers shall be provided. iv. Soiled linen rooms shall have 1-hour fire resistance rating and shall be sprinkler protected. v. Garbage rooms shall be separated by fire barriers having 1 hour fire resistance rating and sprinklers shall be provided. vi. Garbage chutes shall have 2 hour fire resistance rating. vii. Storage rooms outside dwelling units shall be separated by fire barriers having 1 hour fire resistance rating and sprinklers shall be provided. viii. On roof LPG tanks shall be provided with fixed deluge water spray system referring to section F chapter 1 Preventive Requirements For Hazardous Materials

6.5.3. Residential, Group C. (Labor Accommodation)

6.5.1.1. The Residential Group C, (Labor Accommodation) occupancies shall comply with **Table: - A.03-T26.** Along with all other sections of this chapter. Where conflicts arise between this section and other sections of this Chapter or code, the requirements of this section shall prevail.

Table:- A.03-T26.: Residential, Group C. (Labor Accommodation)

ITEMS	REQUIREMENTS
1. MULTIPLE OCCUPANCY	i. No labor room shall have its sole means of egress pass through any nonresidential occupancy of the same building. ii. No labor rooms shall be located above a non-residential building, unless the labor accommodation and exits there from are separated from the nonresidential occupancy by construction having a minimum 1-hour fire resistance rating.
2. CORRIDOR	i. Every labor room, living space, dining area shall have access to exit corridor either enclosed internal or external open corridor. ii. Corridor shall be minimum of 1200 mm in width. **a.** Corridor shall be separated from other areas of the building by 1 hour fire resistance rated construction, unless it is an open corridor.] **b.** Grilles and louvers shall be prohibited in corridors.
3. SEPARATION	i. Labor rooms shall be separated from each other by walls and floors constructed as fire barriers having a minimum of 1 hour fire resistance rating. ii. Sleeping rooms shall be separated from enclosed internal corridor by walls and Floors constructed as fire barriers having a minimum of 1 hour fire resistance rating. iii. Kitchen is allowed on any floor provided, it is separated from rest of the area by 1 hour fire resistance rated construction.
4. SINGLE EXIT PERMISSION	i. Single exit shall not be permitted. ii. 2 enclosed exits shall be available from every part of every floor.
5. HAZARDOUS AREA SEPARATION	i. Boiler and Heater rooms shall be separated by fire barriers having 1 hour fire resistance rating and sprinklers shall be provided. ii. Bulk and central Laundry shall be shall be separated by fire barriers having 1 hour fire resistance rating. And sprinklers shall be provided. iii. Plant maintenance, paint shops shall be separated by fire barriers having 1 hour fire resistance rating and sprinklers shall be provided. iv. Garbage rooms shall be separated by fire barriers having 1 hour fire resistance rating and sprinklers shall be provided. v. Garbage chutes shall have 2 hour fire resistance rating. vi. Storage rooms outside dwelling units shall be separated by fire barriers having 1 hour fire resistance rating or sprinklers shall be provided. vii. On roof LPG tanks shall be provided with fixed deluge water spray system referring to section F chapter 1 Preventive Requirements For Hazardous Materials

6.6. Villa.

6.6.1 Commercial Villa.

6.6.1.1 The Commercial Villa occupancies shall comply with **Table:- A.03-T28**. Along with all other sections of this chapter. Where conflicts arise between this section and other sections of this Chapter or code, the requirements of this section shall Prevail.

Table:- A.03-T28.: Commercial Villa

ITEMS	REQUIREMENTS
1. MULTIPLE OCCUPANCY	i. No commercial villa shall have its sole means of egress pass through any nonresidential occupancy of the same building. ii. No commercial villa shall have its sole means of egress pass through any nonresidential occupancy of the same building, unless such egress is separated from nonresidential occupancies by 1 hour fire resistance rated corridor and egress is not through hazardous content locations. iii. No commercial villa shall have its sole means of egress pass through any nonresidential occupancy of the same building, unless nonresidential occupancy is fully sprinkler protected as per **Section D, Chapter 05 and Chapter 11**.
2. SEPARATION	i. Commercial villas shall be separated from each other by a 2 hour fire resistance rated construction.
3. EXITS	i. Every sleeping room and every living area of a private villa shall have primary, means of escape (Which can be a door, stairway or ramp providing a means of unobstructed travel to the outside.) and a secondary means of escape. If the villa is sprinkler protected, the secondary means of escape shall not be required. ii. However, General Directorate of Civil Defense (GDCD) highly recommends second primary escape in addition to **Table:- A.03-T28.3.i.** A means of egress through roof from where a fixed stair either steel or concrete or spiral stair leading to the ground shall be acceptable as second primary means of escape. iii. Where any floor within villa exceeds 400 m2, two primary means of escape remote from each other shall be provided. iv. The secondary means of egress can be any of the following. **a.** Door, Stairway or ramp, remote from primary exit, leading to outside. **b.** A passage through an adjacent non-lockable space, set back area, remote from primary exit and leading to outside. **c.** A permanent stair reaching to roof and from roof an outside stair, either spiral, steel or standard, leading to level of discharge remote from primary exit. **d.** An operable window on the exterior wall, measuring not less than 510 mm in width and 610 mm in height, with a clear opening not less than 0.53 m^2, and having its bottom not more than 6100 mm from finished ground floor. v. Spiral stairs, winders and open stairs shall be permitted in other than access and exit from basements. vi. Basements shall have standard enclosed exit stair leading to discharge level.
4. DOOR	i. Every closet door latch shall be such that children can open the door from inside the closet. ii. Every bathroom door shall be designed to allow opening from the outside during an emergency when locked. iii. At all times, the villa is occupied, all locking devices that impede or prohibit egress or that cannot be easily disengaged shall be prohibited.
5. CORRIDOR/ HALLWAY	i. Hallway shall be minimum of 915 mm in width and a clear headroom of 2030 mm without obstructions.

6.7. Detention and Correctional, Group A, B, C.

6.7.1. *The* Detention and Correctional, Group A, B, C occupancies shall comply with **Table:- A.03-T29.** Along with all other sections of this chapter. Where conflicts arise between this section and other sections of this Chapter or code, the requirements of this section shall prevail.

6.7.2. The Detention and Correctional occupancies shall be designed, constructed, maintained, and operated to minimize the possibility of a fire emergency requiring the evacuation of occupants.

6.7.3. Extensions, expansions of existing Detention and Correctional occupancies shall be separated from any existing structure not conforming to the provisions of this chapter by a fire barrier having not less than a 2-hour fire resistance rating.

Table:- A.03-T29.: Detention and Correctional

ITEMS	REQUIREMENTS
1. HORIZONTAL EXIT	i. Horizontal exits shall be permitted to comprise 100 percent of the exits required, provided that a secondary exit, other than a horizontal exit, located in another (not necessarily adjacent) fire compartment is accessible without re- turning through the compartment of fire origin.
2. CORRIDORS	i. Minimum aisle, ramp and corridor width shall be 1220 mm. ii. Every sleeping room shall have a door leading directly to an exit access corridor, unless the intervening room, if any, is a day room, group activity room or other common space.
3. SINGLE EXIT PERMISSION	i. Single exit shall not be permitted. ii. 2 enclosed exits shall be available from every part of every floor. iii. Not less than one exit shall be accessible from each fire compartment and each smoke compartment into which residents are potentially moved in a fire emergency, with the exits arranged so that egress is possible without returning through the zone of fire origin.
4. TWO EXIT DOORS REQUIREMENT	i. Every room or space larger than 280 m^2 shall have 2 separate exits, remote from each other as per **Sub Section 5.4**.
5. EXIT DISCHARGE	i. Exit discharge shall be permitted to be into fenced or walled court yard, provided not more than 2 such court yard walls are common to the building walls from which egress is being made. ii. Such enclosed yards or courts used for exit discharge in accordance shall be of sufficient size to accommodate all occupants at a distance of not less than 15 m, from the building while providing a net area of 1.4 m2 per person. iii. Exit discharge shall be permitted to be into a fire compartment separated from other compartments by 1 hour fire resistance rated construction, and not more than 50 percent of the exits discharge into a single fire
6. DOORS	i. Doors to resident sleeping rooms shall not be less than 710 mm in width, unless they are serving persons with severe mobility impairments, where the required width shall not be less than 810 mm. ii. Doors in means of egress shall be permitted to be locked, remotely operated, access controlled, power operated provided staff is available at all times to unlock the doors during emergencies.

Table:- A.03-T29.: Detention and Correctional	
ITEMS	**REQUIREMENTS**
7. SMOKE COMPARTMENT	i. Every floor of Detention and Correctional occupancies, having detention and correction activity shall be divided into minimum of 2 smoke compartments, not exceeding 200 residents for each compartment. The smoke barrier shall be 1 hour fire resistance rated. ii. Smoke compartment area shall be such that Travel distance from any point in a room to smoke barrier door shall not exceed 61 m. iii. Compartments shall also be permitted to be achieved by building separation from resident areas by 2 hour fire resistance rated construction OR Horizontal exits OR Smoke compartments discharging directly to outside fenced yard OR Secured open area with holding space located 15 m from housing area, providing 1.4 m^2 refuge area per person. iv. Windows in smoke barrier shall be fixed fire rated window assemblies. v. Vision panels in smoke compartment doors shall be of fire rated glazing in permitted frames. The bottom of the vision panel shall not be more than 1090 mm from finished floor.

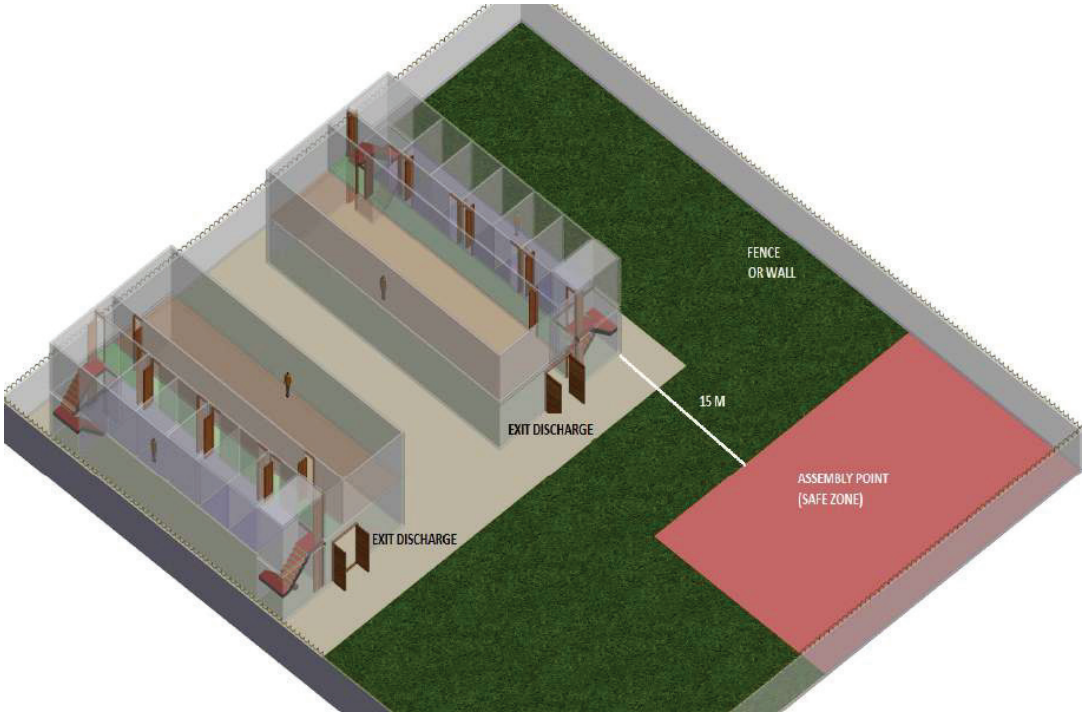


Figure:- A.03-F31.: Acceptable exit discharge in Detention and Correctional facility

6.8. Hotel, Group A, B, C.

6.8.1. The Hotel, Group A, B, C. (Hotels, Hotel Apartments, Resorts, Dormitories, Motels) occupancies shall comply with **Table: - A.03-T30.** Along with all other sections of this chapter. Where conflicts arise between this section and other sections of this Chapter or code, the requirements of this section shall prevail.

Table:- A.03-T30.: Hotel, Group A, C. (Hotels, Hotel Apartments, Resorts, Dormitories, Motels)

ITEMS	REQUIREMENTS
1. MULTIPLE OCCUPANCY	i. No Guest room or guest suite or dormitory sleeping room shall have its sole means of egress pass through any nonresidential occupancy of the same building. ii. No Guest room or guest suite or dormitory sleeping room shall have its sole means of egress pass through any nonresidential occupancy of the same building, unless such egress is separated from non-residential occupancies by 1 hour fire resistance rated corridor and egress is not through hazardous con- tent locations. iii. No Guest room or guest suite or dormitory sleeping room shall have its sole means of egress pass through any nonresidential occupancy of the same building, unless nonresidential occupancy is fully sprinkler protected as per **Section D, Chapter 05 and Chapter 11**.
2. CORRIDORS	i. Minimum common exit corridor width shall be 1200 mm. ii. Corridor shall have 1 hour fire resistance rated construction. iii. Every sleeping room or suite shall have a door leading directly to an exit access corridor, unless the intervening room, if any, is a day room, group activity room or other common space. iv. Transoms, louvers, or transfer grilles shall be prohibited in walls or doors of exit access corridors.
3. SINGLE EXIT PERMISSION	i. Single exit shall not be permitted. ii. 2 enclosed exits shall be available from every part of every floor.
4. TWO EXIT DOORS REQUIREMENTS	i. Any guest room or any guest suite or dormitory sleeping room larger than 185 m^2, shall have 2 exit access doors remotely located from each other as per **Sub Section 5.4**.
5. SEPARATION	i. Each hotel guest room, including guest suites, and dormitory room shall be separated from other guest rooms or dormitory rooms by walls and floors constructed as fire barriers having a minimum 1-hour fire resistance rating. ii. Kitchen shall be separated from rest of the hotel area by 1 hour fire resistance rated construction.
6. EXIT DISCHARGE	i. Exit discharge shall be permitted to be into fenced or walled court yard, provided not more than 2 such court yard walls are common to the building walls from where egress is being made. ii. Such enclosed yards or courts used for exit discharge in accordance shall be of sufficient size to accommodate all occupants at a distance of not less than 15 m, from the building while providing a net area of 1.4 m^2 per person. iii. Exit discharge shall be permitted to be into a fire compartment separated from other compartments or building by 1 hour fire resistance rated construction.

Table:- A.03-T30.: Hotel, Group A, C. (Hotels, Hotel Apartments, Resorts)	
ITEMS	**REQUIREMENTS**
7. DOORS	i. Balcony and terrace access shall be restricted with door having child lock or latch. ii. Window opening shall be restricted to 100 mm opening with windows safety latch. (See Section A, Chapter 02, sub section 2.17. Balcony, Terrace and Windows). iii. Doors in resident or guest sleeping rooms or internal rooms shall not be less than 810 mm in width. iv. The main exit door for the unit shall not be less than 915 mm in clear width. v. Bathroom doors shall not be less than 710 mm, unless they are not serving persons with severe mobility impairments, where the required width shall not be less than 810 mm. vi. Minimum door width of a balcony, not used for assembly, shall not be less than 810 mm.
8. EXIT DISCHARGE	i. The distance of travel from the termination of the exit enclosure to an exterior door leading to a public way through enclosed corridor shall not exceed 30 m.
9. HAZARDOUS AREA SEPARATION	i. Boiler and fuel fired Heater rooms shall be separated by fire barriers having 1 hour fire resistance rating and sprinklers. ii. Employee locker rooms shall be separated by fire barriers having 1 hour fire resistance rated construction. iii. Gift shops shall be separated by fire barriers having 1 hour fire resistance rated construction and sprinklers. iv. Bulk and central Laundry shall be shall be separated by fire barriers having 1 hour fire resistance rating and sprinklers. v. Plant maintenance, paint shops shall be separated by fire barriers having 1 hour fire resistance rating and sprinklers. vi. Soiled linen rooms shall have 1-hour fire resistance rating and shall be sprinkler protected. vii. Garbage rooms shall be separated by fire barriers having 1 hour fire resistance rating and sprinklers. Garbage chutes shall have 2 hour fire resistance rating. viii. Storage rooms shall be separated by fire barriers having 1 hour fire resistance rating and sprinklers. ix. LPG tanks shall be provided with deluge water spray system.
10. FURNISHINGS	i. Draperies, curtains, and other similar loosely hanging furnishings and decorations shall meet the flame propagation performance criteria and shall be listed and permitted by General Directorate of Civil Defence (GDCD). See **Sub Section 8** for material permitted. ii. Upholstered Furniture, Mattresses, Carpets shall be listed and permitted by General Directorate of Civil defence. See **Sub Section 8** for material permits.

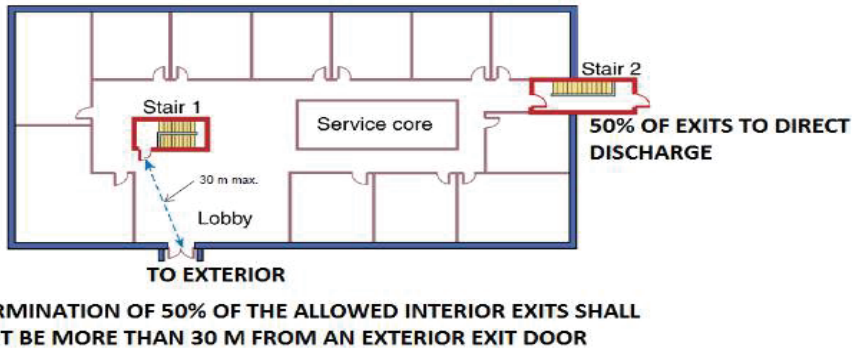


Figure:- A.03-T32.: Termination of Interior Exit Stairs in Hotels

Table:- A.03-T30.: Hotel, Group A, C. (Hotels, Hotel Apartments, Resorts)	
ITEMS	**REQUIREMENTS**
11. REMOTENESS OF EXITS	i. The remoteness of exit stairs required by **Sub Section 5.4. Remoteness of Exits does** not apply to Hotels, Hotel Apartments, provided all the following conditions are met. **a.** Exit corridor is not looped **b.** Every guest room doors are arranged such that the common path and dead ends are zero. **c.** Exit stairs are available on opposite sides of every guest room door. **d.** Travel distance from guest room door to exit stair is less than 30 m.
12. EXITS FROM PODIUM	i. Hotel occupancies having open podiums for assembly purposes, shall ensure 2 exits remotely located as per **Sub Section 5.4.** Such required 2 exits shall be any of the following. **a.** Exits leading back into building, to the building exit stairs. **b.** Enclosed exit stairs to exterior discharge from the podium. **c.** Open or outside exterior stairs as per **Table: - A.03-T4., 14.,** discharging directly outside to public way. **d.** Combinations of above options a, b, and c.

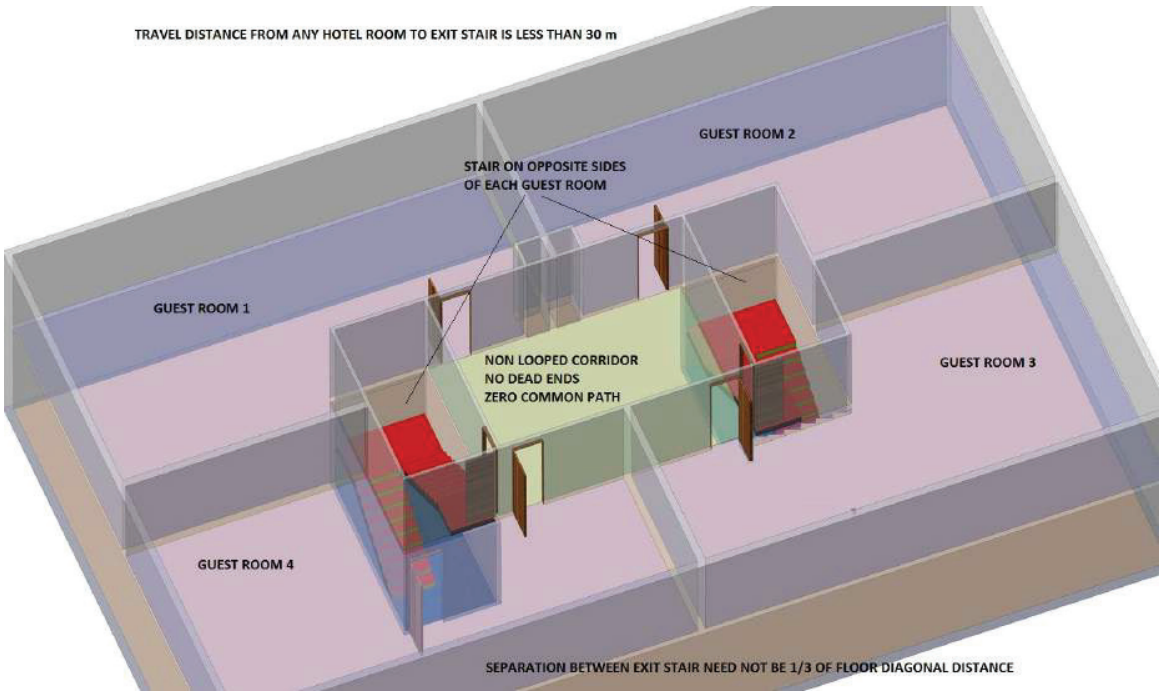


Figure:- A.03-T33.: Non applicability of Stair remoteness of 1/3 diagonal of floor area.

6.9. Daycare, Group A, B.

6.9.1. The Day care, Group A, B. (Child day care, Old age day care, Adult day care) occupancies shall comply with **Table:- A.03-T31.** along with all other sections of this chapter. Where conflicts arise between this section and other sections of this Chapter or code, the requirements of this section shall prevail.

Table:- A.03-T31.: Day Care, Group A, B. (Child day care, Old age day care, Adult day care)

ITEMS	REQUIREMENTS
1. MULTIPLE OCCUPANCY	i. Where day care occupancies are situated in other occupancies, and if the two exit accesses from a day-care occupancy enter the same corridor as other occupancy (such as an apartment occupancy, Residential occupancy, or hotel occupancy) the exit accesses shall be separated in the corridor by a 1 hour smoke partition which is located so that it has an exit on each side. ii. No Day care room shall have its sole means of egress pass through any nonresidential occupancy of the same building, unless nonresidential occupancy is fully sprinkler protected as per **Section D, Chapter 05 and Chapter 11**.
2. CORRIDORS	i. Minimum common exit corridor width shall be 1200 mm. ii. Corridor shall have 1 hour fire resistance rated construction if building is not Sprinkler protected. iii. Every Day care room shall have a door leading directly to an exit access corridor. iv. Transoms, louvers, or transfer grilles shall be prohibited in walls or doors of exit access corridors.
3. SINGLE EXIT PERMISSION	i. Single exit shall not be permitted. ii. 2 enclosed exits shall be available from every part of every floor
4. TWO EXIT DOORS REQUIREMENT	i. Any Day care room larger than 185 m^2, shall have 2 exit corridor access doors remotely located from each other as per **Sub Section 5.4.**
5. RESCUE WINDOW IN NON SPRINKLERED BUILDINGS	i. Every day care room or space, in non- sprinkler protected buildings, normally subject to ii. client occupancy shall have at least one window with a fixed breakable glass, having area clear opening not less than 510 mm in width and 610 mm in height and 0.5 m2 in area, located not more than 1120 mm above the floor for an emergency rescue, Such window shall be on the exterior wall of the room, accessible from public way to the General Directorate of Civil Defence
6. DOORS	i. Balcony and terrace access shall be restricted with door having child lock or latch. ii. Window opening shall be restricted to 100 mm opening with windows safety latch. (**See Section A, Chapter 02, Sub Section 3.17. Balcony, Terrace and Windows**) iii. Every closet door latch shall be such that children can open the door from in-side the closet. iv. Every bathroom door shall be designed to allow opening from the outside during an emergency when locked. v. At all times, the Day care occupancy is occupied, all locking devices that imped or prohibit egress or that cannot be easily disengaged shall be prohibited.
7. SMOKE COMPARTMENT	i. Child day care and old age day care (Day care, Group A) occupancies shall be located within one storey above level of exit discharge. If day care, group A occupancies are located two or more levels above the level of exit discharge, each floor shall be subdivided into minimum of 2 smoke compartments with smoke barrier having 1 hour fire resistance rated construction.

6.10. Mercantile, Group A, B. C

6.10.1. The Mercantile, Group A, B. and C (Retail, Wholesale, Supermarkets, Stores, Services) occupancies shall comply with **Table:- A.03-T32.** along with all other sections of this chapter. Where conflicts arise between this section and other sections of this Chapter or code, the requirements of this section shall prevail.

Table:- A.03-T32.: Mercantile, Group A, B. and C (Retail, Wholesale, Supermarkets, Stores)

ITEMS	REQUIREMENTS
1. MULTIPLE OCCUPANCY	i. In other than bulk merchandising mercantile occupancies, atrium walls shall be permitted to serve as part of the separation required for creating separated occupancies on a storey-by-storey basis from nonhazardous spaces and other occupancies.
2. CORRIDORS	i. Where exit access in class A Mercantile is through a corridor, such corridor shall be 1525 mm in width and separated from other parts of building by 1 hour fire resistance rated construction, if building is not sprinkler protected.
3. AISLES	i. Aisles in Class C Mercantile, Supermarkets ((Having area <280m^2, and single storey) shall not be less than 915 mm in clear width. ii. Aisles in Class B Mercantile, Supermarkets, Hypermarkets (Having area <2800m^2, and <3 storey) shall not be less than 1200 mm in clear width. iii. Aisles in Class A Mercantile, Hypermarkets (Having area >2800m^2, and >3 storey) shall not be less than 1525 mm in clear width. iv. Aisles leading to each exit shall be required, and the aggregate width of such aisles shall be not less than the required width of the exit.
4. EXITS	i. Not less than 50 % of the exits shall be reached without passing through check out or cash counters. ii. Where wheeled carts or buggies are used by customers, adequate provision shall be made for the transit and parking of such carts to minimize the possibility that they might obstruct means of egress. iii. Not more than 50% of the exits access through store rooms, packing, loading and unloading areas with aisles of not less than 1200 mm in width shall be permitted, provided that the building is fully sprinkler protected, the store room is not subject to locking, the path of travel through the storeroom shall be defined, direct, and continuously maintained in an unobstructed condition. iv. Exits through kitchen shall not be permitted.
5. SINGLE EXIT PERMISSION	i. Single exit shall not be permitted. ii. Inside open stairs or inside open ramps shall not be permitted to serve as a component of the required means of egress system for more than one floor. iii. 2 enclosed exits shall be available from every part of every floor. And shall be Independent of any open stair. iv. A single means of egress shall be permitted in Class C, Mercantile (Having area <280m^2), provided that the travel distance does not exceed (S 30 m, NS 23 m) measured to nearest exit directly to outside or to mall. v. A single means of egress shall be permitted from a mezzanine of any mercantile occupancy, provided that the common path does not exceed (S 30 m, NS 23 m) measured to outside or to the mall.

Table:- A.03-T32.: Mercantile, Group A, B and C (Retail, Wholesale, Supermarkets, Stores)	
ITEMS	**REQUIREMENTS**
6. OPEN SPACES WITH CLOSELY SPACED SPRINKLERS	i. In class A and B mercantile occupancies protected with a sprinkler system, unprotected vertical openings shall be permitted between any two floors or among the street floor, the first adjacent floor below, and the adjacent floor (or mezzanine)above, provided the occupancy does not contain high hazard contents ii. In class C mercantile occupancies protected with a sprinkler system, unprotected openings shall be permitted between the street floor and the mezzanine, provided the does not contain high hazard contents.
7. SEPARATION	i. Parking structures shall be separated from mercantile occupancy with fire barrier having a minimum 2-hour fire resistance rating. ii. Openings in such separated parking structures shall not be required to be protected if the parking is enclosed and the parking and building are sprinkler protected, the openings do not exceed 25 percent of the area of the fire barrier in which they are located, are used as a public entrance and for associated sidelight functions, means are provided to prevent spilled fuel from accumulating adjacent to the openings and entering the building, and the openings are protected as a smoke partition with no minimum fire protection rating required. iii. When the openings in such separated parking structures are not protected per previous item, the parking shall have physical mean to prevent vehicles from being parked or driven within 3 m of the openings. iv. High hazard content areas shall be separated from other parts of the building by 1 hour fire resistance rated construction. v. Kitchens shall be separated from other parts of the building by 1 hour fire resistance rated construction.
6. EXITS FROM PODIUM	i. Mercantile occupancies having open podiums for assembly purposes, shall ensure 2 exits remotely located as per **Sub Section 5.4.** ii. Such required 2 exits shall be any of the following. a. Exits leading back into building, to the building exit stairs. b. Enclosed exit stairs to exterior discharge from the podium. c. Open or outside exterior stairs as per **Table:- A.03-T4.14.,** discharging directly outside to public way. d. Combinations of above options a, b, and c.

6.11. Mall

6.11.1 Covered Mall, Group A.

6.11.1.1 The Mall, Group A, (Covered Mall) occupancies shall comply with **Table:- A.03-T33.** along with all other sections of this chapter. Where conflicts arise between this section and other sections of this Chapter or code, the requirements of this section shall prevail.

Table:- A.03-T33.: Mall, Group A, (Covered Mall)

ITEMS	REQUIREMENTS
1. MULTIPLE OCCUPANCY	i. The mall building shall be treated as a single building for the purpose of calculation of means of egress and shall be subject to the requirements for appropriate occupancies.
2. MALL PEDESTRIAN WAY	i. Mall pedestrian way shall be not less than 6100 mm wide in its narrowest dimension. ii. On each side of the mall floor area, the mall shall be provided with an unobstructed exit access of not less than 3050 mm in clear width parallel to, and adjacent to, the mall tenant front. iii. Exit access of 3050 mm is acceptable only where tenant spaces open to such exit access on only one side. Where exit access caters to tenant spaces on its both sides, the exit access shall not be less than 6100 mm. iv. Transoms, louvers, or transfer grilles shall be prohibited in walls or doors of exit access corridors.
3. EXITS	i. Minimum width of exit shall not be less than 1675 mm. ii. Every floor of a mall shall be provided with the number of means of egress as required by occupant load and capacity, with not less than two means of egress remotely located from each other available from any point in the mall. iii. Class A and Class B mercantile occupancies connected to a mall shall be provided with the number of means of egress as required by occupant load and capacity, with not less than two means of egress remotely located from one an- other. iv. Each individual anchor building shall have its 100 % means of egress independent of the mall. v. Each individual major tenant of a mall shall have a minimum of 50% of its required means of egress independent of the mall. vi. Each Assembly occupancy within mall having an occupant load of more than500 shall have a minimum of 50% of its required means of egress independent of the mall.
4. CORRIDORS AND EXIT PASSAGEWAYS	i. Minimum width of exit access corridors and passageways shall not be less than that required for the occupant load it is serving but in no case, not less than 1675 mm. ii. Exit passageways in a mall building shall be permitted to accommodate the occupant loads independently from either occupant load assigned from only mall or largest occupant load assigned from a single tenant space.
5. KIOSKS	i. The minimum horizontal separation between kiosks or groups of kiosks shall not be less than 6 m. ii. The minimum pedestrian way and exit access way available from any side of the kiosk shall not be less than 1.5 m. iii. Each kiosk, or group of kiosks, or similar structure shall have a maximum area of 18 m2. iv. See **Section A, Chapter 02, Table A.02-T9.48** And material permitted requirement in **Sub Section 8.1.40 (Section A, Chapter 2)**

Table:- A.03-T33.: Mall, Group A, (Covered Mall)	
ITEMS	**REQUIREMENTS**
6. SEPARATION	i. The wall dividing the tenant spaces shall have a 1-hour fire-resistance-rated and such separation shall extend from the floor to the floor deck above, to the roof, or to the ceiling where the ceiling is constructed to limit the transfer of smoke. ii. No separation is required between tenant front and the mall pedestrian way. iii. Corridors and exit passageways shall be separated from equipment rooms, service elevators, and janitor closets by 1 hour fire resistance and construction.

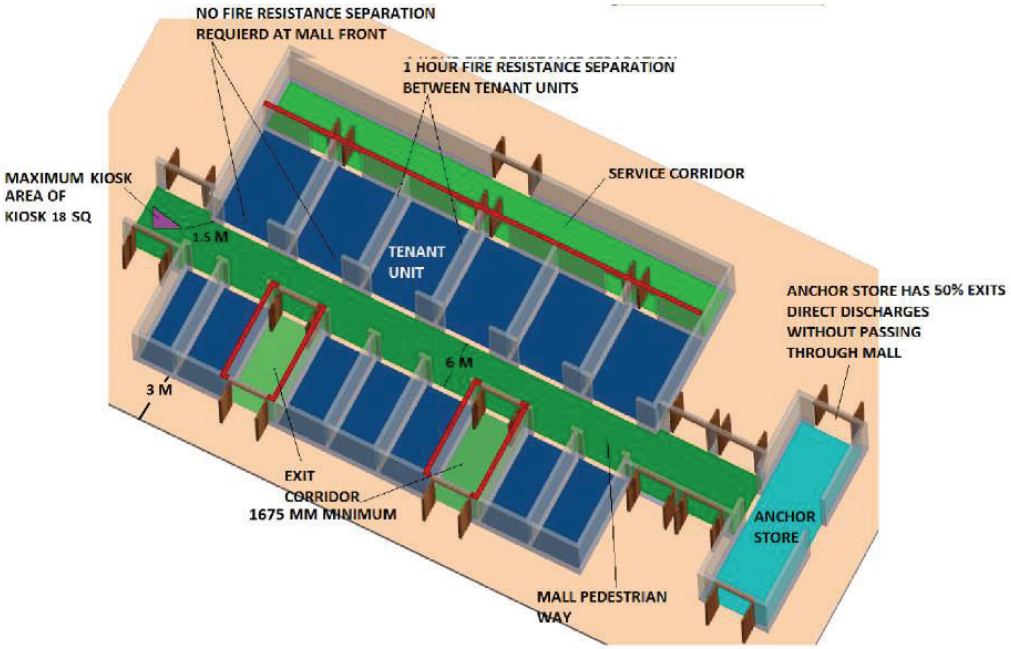


Figure:- A.03-F34.: Mall

6.11. Mall

6.11.2 Open Mall, Group B

6.11.2.1 The Mall, Group B, (Open Mall) occupancies shall comply with **Table: - A.03-T34.** Along with all other sections of this chapter. Where conflicts arise between this section and other sections of this Chapter or code, the requirements of this section shall prevail.

Table:- A.03-T34.: Mall, Group B, (Open Mall)

ITEMS	REQUIREMENTS
1. MULTIPLE OCCUPANCY	i. The open mall building shall be treated as a single building for the purpose of calculation of means of egress and shall be subject to the requirements for appropriate occupancies.
2. OPEN MALL PEDESTRIAN WAY	i. Mall pedestrian way shall be unroofed serving multiple tenants, roofed or un- roofed in ground only or not more than 3 levels. ii. Mall pedestrian way shall not be less than 3 m wide in its narrowest dimension. iii. On each side of the mall floor area, the mall shall be provided with an unobstructed exit access of not less than 3 m in clear width parallel to, and adjacent to, the open mall tenant front.
3. EXITS	i. Minimum width of exit shall not be less than 1675 mm. ii. Dead end shall be zero. iii. Common path shall be zero. iv. Every level of a open mall shall be provided with the number of means of egress as required by occupant load and capacity, with not less than two means of egress remotely located from each other available from any point in the open mall. v. Circulation at above grade shall be permitted to include exterior balconies, exterior corridors, and exterior open stairs leading to exit discharging at exterior grade, outside the open mall.
4. CORRIDORS AND EXIT PASSAGEWAYS	i. Minimum width of exit access corridors and passageways, service corridors shall not be less than that required for the occupant load it is serving but in no case, not less than 1200 mm. ii. Exit passageways in a mall building shall be permitted to accommodate the occupant loads independently from the largest occupant load assigned from any single tenant space.
5. KIOSKS	i. The minimum horizontal separation between kiosks or groups of kiosks, and other structures within the mall shall be 3 m. ii. Each kiosk, or group of kiosks, or similar structure shall have a maximum area of 28 m2. iii. See Section A, Chapter 02, Table 1.9.48. And material permit requirement in Section 8.1.39.

6.12. Storage, Group A, B, C. (Warehouse, Logistics)

6.12.1. The Storage, Group A, B, C. (Warehouse, Logistics) occupancies shall comply with **Table: - A.03-T35.** Along with all other sections of this chapter. Where conflicts arise between this section and other sections of this Chapter or code, the requirements of this section shall prevail.

Table:- A.03-T35.: Storage, Group A, B, C. (Warehouse, Logistics)

ITEMS	REQUIREMENTS
1. MULTIPLE OCCUPANCY	i. Incidental offices, showrooms, dining rooms and Kitchens shall be permitted inside the storage occupancies, provided they are separated from storage areas by 1 hour fire resistance rated construction.
2. STAIRS	i. Noncombustible grated stair treads and noncombustible grated landing floors shall be permitted. ii. Industrial equipment access stairs and Spiral stairs shall be permitted, provided it is used only to access storage spaces and not offices. iii. Industrial equipment access doors, walkways, platforms, ramps, and stairs that serve as access for the involved equipment or storage space shall be permitted.
3. DOORS	i. Roller shutters are not permitted as exit doors. A swing exit door shall be provided as a means of egress.
4. HORIZONTAL EXIT	i. Horizontal exit barrier shall have two fire door assemblies of which one is per-mitted to be an automatic sliding fire door or automatic rolling fire shutter.
5. SINGLE EXIT PERMISSION	i. Single exit is permitted in storage areas, provided stored content is not high hazard content and total travel distance to outside the building does not exceed (S 30 m, NS 15 m). ii. Single exit from mezzanine is permitted, provided stored content is not high hazard content and the travel distance to outside the building does not exceed (S 30 m, NS 15 m). iii. Single exit from Office areas in warehouse shall be permitted, provided the total travel distance from any point in the office to outside, including travel on stair does not exceed (S 30 m, NS 15 m). iv. All high hazard content areas, storage areas, logistics shall be provided with not less than 2 exits remotely located as per **Sub Section 5.4** of this chapter.
6. CORRIDORS AND EXIT PASSAGEWAYS	i. Where exit access corridors, passageways and service corridors are provided, minimum width shall not be less than 1200 mm. ii. Where racks and shelf are provided, they shall be installed 1200 mm away from the structure walls. iii. Minimum width between racking or shelf shall not be less than 915 mm.
7. SEPARATION	i. Multi-tenant warehouses or group of warehouses shall be separated from each other by 1 hour fire resistance rated construction. See **Section A, Chapter 02, Table A.02-T9.31.** ii. Exit access corridors where provided, in non-sprinkler protected storage occupancies, shall be separated from other parts of the building by 1 hour fire resistance rated construction.

6.13. Industrial, Group A, B, C. (Process, Manufacturing, Workshops)

6.13.1. The Industrial, Group A, B, C. (Process, Manufacturing, Workshops) occupancies shall comply with **Table:- A.03-T36.** Along with all other sections of this chapter. Where conflicts arise between this section and other sections of this Chapter or code, the requirements of this section shall prevail.

Table:- A.03-T36.: Industrial, Group A, B, C. (Process, Manufacturing, Workshops)

ITEMS	REQUIREMENTS
1. MULTIPLE OCCUPANCY	i. Incidental offices, showrooms, dining rooms and Kitchens shall be permitted inside the industrial occupancies, provided they are separated from industrial areas by 1 hour fire resistance rated construction.
2. STAIRS	i. Noncombustible grated stair treads and noncombustible grated landing floors shall be permitted. ii. Industrial equipment access stairs and Spiral stairs shall be permitted, provided it is used only to access equipment and not offices. iii. Industrial equipment access doors, walkways, platforms, ramps, and stairs that serve as access for the involved equipment or storage space shall be permitted.
3. DOORS	i. Roller shutters are not permitted as exit doors. A swing exit door shall be provided as a means of egress.
4. HORIZONTAL EXIT	i. Horizontal exit barrier shall have two fire door assemblies of which one is permitted to be an automatic sliding fire door or automatic rolling fire shutter.
5. SINGLE EXIT PERMISSION	i. Single exit is not permitted. ii. 2 exits shall be provided from every storey or level or section as per **Section 5.4** of this chapter. iii. Not less than 1 exit shall be provided such that exit can be reached without traversing to another story. iv. Single exit is permitted in storage areas, Equipment access provided it is not High hazard content area and total travel distance to outside the building does not exceed (S 30 m, NS 15 m). v. Single exit from Office areas in industrial occupancy shall be permitted, provided the total travel distance from any point in the office to outside, including travel on stair does not exceed (S 30 m, NS 15 m). vi. All high hazard content areas shall be provided with not less than 2 exits remotely located as per **Sub Section 5.4** of this chapter.
6. CORRIDORS AND EXIT PASSAGEWAYS	i. Where exit access corridors, passageways and service corridors are provided, minimum width shall not be less than 1200 mm. ii. Where racks and shelf are provided, they shall be installed 1200 mm away from the structure walls. iii. Minimum width between racking or shelf shall not be less than 915 mm.
7. SEPARATION	i. Multi-tenant factories, group of factories shall be separated from each other by 1 hour fire resistance rated construction. See **Section A, Chapter 02, Table A.02-T9.31.** ii. Exit access corridors where provided, in non-sprinkler protected industrial occupancies, shall be separated from other parts of the building by 1 hour fire resistance rated construction.

6.14. Parking, Group A, B

6.14.1. The vehicle parking in either above ground, enclosed or underground structure shall comply with **Table: - A.03-T37.** Along with all other sections of this chapter. Where conflicts arise between this section and other sections of this Chapter or code, the requirements of this section shall prevail.

Table:- A.03-T37.: Parking Structure (Open, Enclosed and Robotic)

ITEMS	REQUIREMENTS
1. MULTIPLE OCCUPANCY	i. Parking structures within 3 m of a building shall be separated by fire barrier having a minimum 2-hour fire resistance rating. ii. Such fire separation is not required if the parking structure is separated by 3 m or more from adjacent building and is attached only via open vehicle bridge or open pedestrian walkway or balconies. iii. Repair activities inside the parking structure is permitted provided the occupancy shall not include motor fuel-dispensing facilities. iv. Any occupancy other than parking, situated in parking area shall be separated smoke resistant walls and partitions.
2. OPEN PARKING	i. Each parking level shall have permanent wall openings open to the atmosphere, for an area of not less than 0.4m^2 for each linear meter of its exterior perimeter. ii. Such openings shall be distributed over 40 percent of the building perimeter surface or uniformly over each of at least two opposing sides. iii. Interior wall lines and column lines shall be at least 20% open, with openings distributed to provide ventilation. iv. Any part of the carpark shall be within 30 m of the permanent natural ventilation opening on the perimeter surface.
3. ROBOTIC OR AUTOMATIC PARKING	i. The operator shall remain in the area and shall have full control of the automated facilities, including means of egress. ii. At least two means of egress remote from each other shall be provided which can be Fire Personnel access. iii. Horizontal walkways for access shall be provided at intervals of 6 m vertically and 30 m horizontally.
4. SINGLE EXIT PERMISSION	i. Single exit is not permitted. ii. 2 exits shall be provided from every storey or level or section as per **Sub Section 5.4, Table:- A.03-T15.b.** of this chapter. iii. In 1 level below or 1 level above discharge level of parking, vehicle ramp shall be considered as one of the means of egress, provided no shutters or doors are in- stalled in such ramps.
5. FUEL DISPENSING	i. Where fuel dispensing is located within parking areas, Exits shall lead to the outside of the building on the same level or to stairs, with no upward travel permitted, unless direct outside exits are available from that floor. ii. Any storey below the storey at which fuel is being dispensed shall have exits leading directly to the outside via outside stairs or doors at the finished ground level.
6. FLOORING	i. Floor surfaces shall be of noncombustible material. ii. Floors shall be graded and equipped with drains.
7. CARBON MONOXIDE DETECTION	i. Carbon monoxide detection shall be provided in all enclosed parking structures such CO detection system shall be electrically operated, complete with control panel and interfacing with ventilation system.
8. EXIT SIGNS	i. Exit signs shall be distinguishable from Vehicle Exit route and emergency Exit directions for people.

6.15. Road, Rail, Tram, Tunnels / Station

6.15.1 Road and Rail Tunnel

6.15.1.1 The Road and Rail Tunnels shall comply with **Table: - A.03-T38.** Along with all other sections of this chapter. Where conflicts arise between this section and other sections of this Chapter or code, the requirements of this section shall prevail.

Table:- A.03-T38.: Road and Rail Tunnel

ITEMS	REQUIREMENTS
1. EMERGENCY EXITS	i. Emergency exits not less than 1200 mm in width shall be provided throughout the tunnel spaced not more than 300 m apart. ii. Where tunnels are divided by a minimum of 2-hour fire-rated construction or where tunnels are in twin bores, cross-passageways between the two compartments of tunnels, not farther than 200 m apart shall be provided. iii. Cross-passageways shall be permitted to be used in lieu of emergency exit stairways to the surface where train ways in tunnels are divided by a minimum of 2 hour–rated fire walls or where train ways are in twin bores. iv. An emergency egress walkway with a minimum clear width of 1120 mm shall be provided on each side of the cross-passageways.
2. SIGNAGE	i. Reflective, Photo luminescent or lighted directional signs indicating the distance to the two nearest emergency exits shall be provided on the side walls at distances of no more than 25 m. ii. Exit signs shall be distinguishable from Vehicle Exit route and emergency Exit directions for people.
3. HAZARDOUS MATERIALS	i. Control of hazardous materials shall comply with the requirements of Code of Practice for the Management of Dangerous Goods in the Bahrain.
4. CARBON MONOXIDE DETECTION	i. Carbon monoxide detection shall be provided in the Tunnel. Such CO detection system shall be electrically operated, complete with control panel and interfacing with ventilation system.
5. CCTV	i. Tunnels exceeding 90 m in length shall be provided with CCTV system.
6. SAFETY PROVISIONS	i. Where the tunnel length equals or exceeds 240 m, such tunnels shall be provided with Fire Access, Automatic Fire Detection system, Wet Riser System, Fixed Fire Water Suppression system, Portable Fire Extinguishers, Emergency Ventilation systems, Emergency Lighting, Emergency power supply as per relevant chapters of this code. ii. Additionally, telephones, Drainage system, Traffic Control Systems and Emergency Response procedures shall be provided for tunnels exceeding 1000 m in length.

6.15. Road, Rail, Tram, Tunnels / Station

6.15.2 Rail and Tram Station

6.15.2.1 Rail and Tram Stations shall comply with **Table: - A.03-T39.** Along with all other sections of this chapter. Where conflicts arise between this section and other sections of this Chapter or code, the requirements of this section shall prevail.

Table:- A.03-T39.: Rail and Tram Stations

ITEMS	REQUIREMENTS
1. OCCUPANT LOAD	i. The occupant load for a station shall be based on the train load of trains simultaneously entering the station on all tracks in normal traffic direction plus the simultaneous entraining load awaiting trains
2. EMERGENCY EXITS	i. At least two means of egress remote from each other shall be provided from each station platform. ii. Where means of egress routes from separate platforms converge, the subsequent capacity of the egress route shall be sufficient to maintain the required evacuation time from the incident platform. iii. A common path of travel from the platform ends shall not exceed 25 m (82 ft.) or one car length, whichever is greater. iv. The maximum travel distance on the platform to a point at which a means of egress route leaves the platform shall not exceed 100 m. v. Within underground or enclosed train ways, the maximum distance between exits shall not exceed 762 m. vi. A minimum clear width of 1200 mm (47 in.) shall be provided along all platforms, corridors, and ramps serving as means of egress. vii. Doors and other openings through the separations shall be 90 minutes fire rated. viii. Power substation door shall be 3 hour fire rated. ix. Where a fire door is required to be open, it shall be automatic closing type. x. Horizontal sliding platform screen or platform edge doors shall be permitted to separate the platform from the train ways in stations provided that the doors permit emergency egress from the train to the platform regardless of the stopping position of the train., the doors provide egress when a force not exceeding 220 N (49 lb) is applied from the train side of the doors. And the doors are designed to withstand positive and negative pressures caused by passing trains.
3. ESCALATORS	i. Escalators shall be permitted as a means of egress in stations provided that the escalators are constructed of noncombustible materials, Escalators running in the direction of egress shall be permitted to remain operating and Escalators running reverse to the direction of egress shall be capable of being stopped remotely or manually. ii. Escalators shall not account for more than half of the means of egress capacity at any one level.
4. SIGNAGE	i. Reflective, Photo luminescent or lighted directional signs indicating the distance to the two nearest emergency exits shall be provided on the side walls at distances of no more than 25 m. ii. Exit signs shall be distinguishable from other signage in the stations.
5. EVACUATION TIME	i. The station also shall be designed to permit evacuation from the most remote point on the platform to a point of safety in 6 minutes or less.
6. CCTV	i. Stations shall be provided with CCTV system.

7. Design, Installation, Inspection and Maintenance of Means of Egress

7.1. General

7.1.1. The building owner, his appointed representative and the facility management is responsible to ensure that all the components of means of egress are installed, inspected, maintained and repaired to serve their intended purpose during emergencies.

7.1.2. The building means of egress components such as doors, corridors, and stairs shall be inspected daily to ensure they are not obstructed, and are not blocked at all times the building is occupied.

7.2. The Doors

7.2.1. Testing and Acceptance

7.2.1.1. Doors and opening protectives shall be tested as "Door Assembly" by General Directorate of Civil Defence permitted laboratories and certified by General Directorate of Civil Defence (GDCD) permitted certification bodies. Acceptable test standards shall be as per **Section 8. Material Test Standards.**

7.2.1.2. Individual hardware such as locks, hinges, vision panels etc. or door core materials, panels shall not be registered by General Directorate of Civil Defence (GDCD)**.** Only the final end product, the Door Assembly as intended shall be registered by General Directorate of Civil Defence.

7.2.1.3. All door and opening protectives manufacturers shall be registered with General Directorate of Civil Defence (GDCD). No door assembly shall be sold or distributed in Bahrain without General Directorate of Civil Defence (GDCD) certification and license.

7.2.2. Design/ Specification/ Submittals

7.2.2.1. Door proposals, assignment of appropriate fire rating at locations intended to achieve required fire protection, latches and arrangements shall be the responsibilities of the design consultant**.**

7.2.3. Installation

7.2.3.1. The installation of door assemblies shall be carried out by General Directorate of Civil Defence (GDCD) permitted installer as per door manufacturer's installation instructions and shall comply with local regulations and the construction documents.

7.2.4. Installer Qualification

7.2.4.1. The General Directorate of Civil Defence (GDCD) license to the door installer is based on the training and certification by the door assembly manufacturer to install manufacturer's products as per specified listed system requirements.

7.2.5. Inspector Qualification

7.2.5.1. Inspection shall be done by General Directorate of Civil Defense (GDCD) personnel or to hire General Directorate of Civil Defence (GDCD) permitted House of Expertise or Consultant or House of Expertise, undertaking inspections shall be trained by door manufacturers.

7.2.5.2. Inspection shall be carried out in accordance with standard international inspection criteria and Bahrain and GDCD engineering judgement Life Safety Code of Practice.

7.2.6. Inspection

7.2.6.1. The following door assemblies shall be inspected and tested annually.

- **a.** Door leaves equipped with panic hardware or fire exit hardware.
- **b.** Door assemblies in exit enclosures
- **c.** Electrically controlled egress doors
- **d.** Door assemblies with special locking arrangements.

7.2.6.2. A written record of the inspections and testing shall be signed and kept for inspection by the General Directorate of Civil Defence (GDCD).

7.2.6.3. Door assemblies shall be visually inspected from both sides of the opening to assess the overall condition of the door assembly.

7.2.6.4. As a minimum, the following items shall be verified.

- **a.** Door labeling shall be verified to confirm the fire rating, valid test certifications and test standards it was tested.
- **b.** Floor space on both sides of the openings is clear of obstructions, and door leaves open fully and close freely.
- **c.** Forces required to set door leaves in motion and move to the fully open position do not exceed the requirements of **Sub Section 4.2.** of this chapter.
- **d.** Latching and locking devices comply with requirements of **Sub Section 4.2.**
- **e.** Releasing hardware devices are installed in accordance with **Sub Section 4.2.**
- **f.** Door leaves of paired openings are installed in accordance with **Sub Section 4.2.**
- **g.** Door closers are adjusted properly to control the closing speed of door leaves in accordance with accessibility requirements.
- **h.** Projection of door leaves into the path of egress does not exceed the encroachment permitted by **Sub Section 4.2.**
- **i.** Powered door openings operate in accordance with **Sub Section 4.2.**
- **j.** Signage is intact and legible.

k. Security devices that impede egress are not installed on openings.
l. Ensure door hardware marking is present and intact.
m. Emergency lighting on access-controlled egress doors and doors equipped with delayed-egress locking systems is present and functioning.
n. Door openings not in proper operating condition shall be repaired or replaced without delay
o. Door openings and the surrounding areas shall be kept clear of anything that could obstruct or interfere with the free operation of the door.
p. Blocking or wedging of doors in the open position shall be prohibited.
q. Self-closing and automatic closing devices shall be kept in working condition at all times.

8. Material Test Standards, Permits and Registration.

8.1. Acceptable Test Standards and criteria

8.1.1. All the Materials, Systems, Assemblies, equipment, Products and Accessories, referred to in this chapter with respect to Life Safety, Fire Safety and Emergency Services shall be Listed, permitted and Registered by the General Directorate of Civil Defence (GDCD).

8.1.2. **There is no year of edition mentioned against any test standards. It is the intent of General Directorate of Civil Defence (GDCD) to convey to the customers seeking laboratory tests and the test laboratories to follow the "LATEST EDITION OF THE TEST STANDARD, AS AND WHEN THEY ARE UPGRADED/REVISED/AMENDED, TO THE DATE"**

8.1.3. **Fire resistance rated Door Assemblies shall satisfy any of the following tests as per specifications required by the code.**

i. UL 10B/10C, Standard for Fire Tests of Door Assemblies/ Standard for Positive Pressure Fire Tests of Door Assemblies.
ii. UL 1784, Standard for Air Leakage Tests of Door Assemblies and Other Opening Protectives
iii. NFPA 252, Standard methods of fire tests of door assemblies.
iv. EN 1634-1: Fire resistance and smoke control tests for door, shutter and, openable window assemblies and elements of building hardware. Fire resistance tests for doors, shutters and openable windows.
v. EN 1634-2: Fire resistance and smoke control tests for door, shutter and openable window assemblies and elements of building hardware - Part 2: Fire resistance characterization test for elements of building hardware
vi. EN 1634-3: Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware - Part 3: Smoke control test for door and shutter assemblies
vii. EN 14600: Door sets and openable windows with fire resisting and/or smoke control characteristics - Requirements and classification
viii. EN 15269-1: Extended application of test results for fire resistance and/or smoke control for door, shutter and openable window assemblies, including their elements of building hardware - Part 1: General requirements
ix. EN 15269-2: EXAP – Part 2: Fire resistance of hinged and pivoted steel door sets and openable windows

x. EN 15269-3: EXAP – Part 3: Fire resistance of hinged and pivoted timber door sets and openable timber framed windows
xi. prEN 15269-4: EXAP – Part 4: Fire resistance of hinged and pivoted glazed door sets and shutter assemblies.
xii. prEN 15269-5: EXAP – Part 5: Fire resistance of hinged and pivoted metal framed glazed door sets and openable windows
xiii. prEN 15269-6: EXAP – Part 6: Fire resistance of timber sliding doors
xiv. EN 15269-7: EXAP – Part 7: Fire resistance for steel sliding door sets
xv. prEN 15269-8: EXAP – Part 8: Fire resistance of timber horizontally folding doors.
xvi. pr EN 15269-9: EXAP – Part 9: Fire resistance of steel horizontally folding doors
xvii. EN 15269-10: EXAP – Part 10: Fire resistance of steel rolling shutter assemblies
xviii. prEN 15269-11: EXAP – Part 11: Fire resistance of operable fabric curtains
xix. EN 15269-20: EXAP – Part 20: Smoke control for hinged and pivoted steel, timber and metal framed glazed door sets
xx. EN 15725: Extended application reports on the fire performance of construction products and building elements
xxi. EN 16034 – Pedestrian door sets, industrial, commercial, garage doors, and openable windows. Product standard, performance characteristics. Fire resisting and/or smoke control characteristics
xxii. BS 8214, Code of Practice for Fire door assemblies.
xxiii. BS ISO 12472, Fire resistance of timber door assemblies.

8.1.4. Hardware for Electric Door

i. ANSI/UL 294, Standard for Access Control System Units.
ii. EN 1155: Building hardware - Electrically powered hold-open devices for swing doors - Requirements and test methods.
iii. EN 13633: Electrically controlled panic exit systems, for use on escape routes - Requirements and test methods
iv. EN 13637: Building hardware. Electrically controlled exit systems for use on escape routes. Requirements and test methods
v. BS EN 60730-2-12, Automatic electrical controls for household and similar use. Particular requirements for electrically operated door locks.
vi. BS EN 14637:2007 - Building hardware. Electrically controlled hold-open systems for fire/smoke door assemblies. Requirements, test methods, application and maintenance.

8.1.5. Panic Hardware and Fire Exit Hardware

i. ANSI/UL 305, Standard for Safety Panic Hardware
ii. ANSI/BHMA A156.3, Exit Devices.
iii. EN 1125: Building hardware - Panic exit devices operated by a horizontal bar, for use on escape routes - Requirements and test methods
iv. EN 179: Building hardware - Emergency exit devices operated by a lever handle or push pad, for use on escape routes - Requirements and test methods
vii. EN 13633: Electrically controlled panic exit systems, for use on escape routes - Requirements and test methods
ix. EN 1125, Building hardware. Panic exit devices operated by a horizontal bar, for use on escape routes. Requirements and test methods.

8.1.6. Power-assisted swinging door assemblies

i. BHMA/ANSI A156.19, American National Standard for Power Assist and Low Energy Power Operated Doors.

8.1.7. Fire resistance rated Window Assemblies shall satisfy any of the following

i. UL 9, Standard for Fire Tests of Window Assemblies.
ii. UL 1784, Standard for Air Leakage Tests of Door Assemblies and Other Opening Protectives
iii. NFPA 257, Standard on fire test for window and glass block assemblies.
iv. EN 1634-1: Fire resistance and smoke control tests for door, shutter and, openable window assemblies and elements of building hardware. Fire resistance tests for doors, shutters and openable windows.
v. EN 1634-2, Fire resistance and smoke control tests for door, shutter and openable window assemblies and elements of building hardware. Fire resistance characterization test for elements of building hardware.
vi. EN 1634-3: Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware - Part 3: Smoke control test for door and shutter assemblies
vii. EN 15269-1, Extended application of test results for fire resistance and/or smoke control for door, shutter and openable window assemblies, including their elements of building hardware. General requirements.
viii. EN 15269-3, Extended application of test results for fire resistance and/or smoke control for door, shutter and openable window assemblies, including their elements of building hardware. Fire resistance of hinged and pivoted timber door sets and openable timber framed windows.
ix. EN 15269-5, Extended application of test results for fire resistance and/or smoke control for door, shutter and openable window assemblies, including their elements of building hardware. Fire resistance of hinged and pivoted metal framed glazed door sets and openable windows.
x. EN 14600: Door sets and openable windows with fire resisting and/or smoke control characteristics - Requirements and classification

8.1.8. Fire resistance rated Glazing in Doors and Walls is acceptable with any of the following

i. ASTM E 119, Standard Test Methods for Fire Tests of Building Construction and Materials
ii. UL 263, Standard for Fire Tests of Building Construction and Materials.
iii. EN 1364-1, Fire resistance tests for non-loadbearing elements - Part 1: Walls;
iv. EN 1634 - 1, Fire resistance test for door and shutter assemblies and openable windows.
v. EN 15254-4: Extended application of results from fire resistance tests - Non-Loadbearing walls - Part 4: Glazed constructions.
vi. BS 476-22: Fire tests on building materials and structures - part 22: Methods for the determination of the fire resistance of non-loadbearing elements of construction.
vii. UL 10B/10C, Standard for Fire Tests of Door Assemblies.

8.1.9. Glazing in door assembly is acceptable with any of the following

i. NFPA 252, Standard methods of fire tests of door assemblies.
ii. UL 10B/10C, Standard for Fire Tests of Door Assemblies/ Standard for Positive Pressure Fire Tests of Door Assemblies.
iii. EN 1634 - 1, Fire resistance test for door and shutter assemblies and openable windows.
iv. BS ISO 3009:2003 - Fire resistance tests. Elements of building construction. Glazed elements.

8.1.10. Safety Glazing shall satisfy any of the following

i. EN 12600, Glass in building - Pendulum test - Impact test method and classification for flat glass.
ii. ANSI Z97, American National Standard for Safety Glazing Materials Used in Buildings -Safety Performance Specifications and Methods of Test
iii. CPSC 16 CR 1202
iv. For shower enclosures: EN 14428, Shower enclosures - Functional requirements and test methods
v. BS EN ISO 12543-2, Glass in building. Laminated glass and laminated safety glass. Laminated safety glass.

8.1.11. Upholstered furniture is acceptable with any of the following

i. 16 CFR 1634 Flammability Test to Upholstered furniture.
ii. EN 1021-1, Fire test to upholstered furniture (Shouldering cigarette)
iii. BS 7176, Fire test to upholstered furniture for non-domestic seating.
iv. BS 5852: Methods of test for assessment of the ignitability of upholstered seating by smoldering and flaming ignition sources.
v. ASTM E1537, Standard Test Method for Fire Testing of Upholstered Furniture
vi. EN 1021-2, Fire test to upholstered furniture (Match flame)
vii. UL 1286, Standard for Office Furnishings
viii. ASTM F 851, Standard Test Method for Self-Rising Seat Mechanisms.
ix. ASTM E1353, Standard Test Methods for Cigarette Ignition Resistance of Components of Upholstered Furniture

8.1.12. Combustible Decorative Materials is acceptable with any of the following

- **i.** NFPA 701, Fire test to textiles and films.
- **ii.** CAN/ULC-S109 Flame tests of flame-resistant fabrics and films
- **ii.** EN 13823: Reaction to fire tests for building products - Building products excluding floorings exposed to the thermal attack by a single burning item.
- **iv.** EN-ISO 11925-2: Reaction to fire tests - Ignitability of products subjected to direct impingement of flame - Part 2: Single-flame source test.
- **v.** EN-ISO 1182: Reaction to fire tests for products - Non-combustibility test
- **vi.** EN-ISO 1716: Reaction to fire tests for products - Determination of the gross heat of combustion (calorific value)
- **vii.** BS 476 Part 6: Fire Tests on Building materials and structures; method of test for fire propagation for products
- **viii.** UL 1975, Standard for Fire Tests for Foamed Plastics Used for Decorative Purposes.
- **ix.** BS EN 15102, Decorative wall coverings. Roll and panel form.
- **x.** BS 5438, Methods of test for flammability of vertically oriented textile fabrics and fabric assemblies subjected to a small igniting flame.
- xi. BS 5867-2, Fabrics for curtains, drapes and window blinds. Flammability requirements. Specification.
- **xii.** BS EN ISO 6940, Textile fabrics. Burning behavior. Determination of ease of ignition of vertically oriented specimens.
- **xiii.** BS EN ISO 6941, Textile fabrics. Burning behavior. Measurement of flame spread properties of vertically oriented specimens.
- **xiv.** BS EN 1624, Textile and textile products. Burning behavior of industry and technical textiles. Procedure to determine the flame spread of vertically oriented specimens.
- **xv.** BS EN 1625, Textile and textile products. Burning behavior of industry and technical textiles. Procedure to determine the ignitability of vertically oriented Specimens.

8.1.13. Carpets and Textile floor finish is acceptable with any of the following

- **i** ASTM D 2859, Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials.
- **iii.** EN 13823: Reaction to fire tests for building products - Building products excluding floorings exposed to the thermal attack by a single burning item.
- **iii.** EN-ISO 11925-2: Reaction to fire tests - Ignitability of products subjected to direct impingement of flame - Part 2: Single-flame source test.
- **iv.** EN-ISO 1182: Reaction to fire tests for products - Non-combustibility test
- **v.** EN-ISO 1716: Reaction to fire tests for products - Determination of the gross heat of combustion (calorific value)
- **vi.** EN 13501-1: Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests.
- vi. ASTM E648, Standard test method for critical radiant flux of floor covering systems using a radiant heat source
- **viii.** EN-ISO 9239-1: Reaction to fire tests for floorings - Part 1: Determination of the burning behavior using a radiant heat source.
- **ix.** NFPA 253, Standard method of test for critical radiant flux of floor covering systems using a radiant heat energy source.

viii. EN ISO 9239-1 Reaction to fire tests for floorings -- Part 1: Determination of the burning behavior using a radiant heat source.
ix. BS 4790, Method for determination of the effects of a small source of ignition on textile floor coverings (hot metal nut method).
x. BS 4841-6, Rigid polyisocyanurate (PIR) and polyurethane (PUR) products for building and end-use applications. Specification for laminated boards with auto-adhesively or separately bonded facings for use as thermal insulation for floors.
xi. BS 6307, Method of determination of the effects of a small source of ignition on textile floor coverings (methenamine tablet test).
xii. EN 1365-2, Fire resistance tests for loadbearing elements. Floors and roofs.
xiii. EN 1366-6, Fire resistance tests for service installations. Raised access and hollow core floors.
xiv. EN 1399, Resilient floor coverings. Determination of resistance to stubbed and burning cigarettes.
xv. ULc - S102.2, Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials and Assemblies.

8.1.14. Kiosks shall be acceptable with any of the following

i. Particleboard conforming to Type PBU of ANSI A208.1., not less than 6.4 mm thick.
ii. Foamed plastics having a maximum heat release rate not greater than 100 kW when tested in accordance with UL1975 or in accordance with NFPA289, Standard Method of Fire Test for Individual Fuel Packages, using the 20 kW ignition source.
iii. Textile confirming to NFPA 701, Standard Methods of Fire Tests for Flame Propagation of Textiles and Films or **Section A, Chapter 02, Sub Section 8.1.10.**
iv. Metal Composite Panels confirming to **Section A, Chapter 02, Sub Section 8.1.24.**
v. BS EN 16755, Durability of reaction to fire performance. Classes of fire-retardant treated wood products in interior and exterior use applications.

8.1.15. Egress Path Marking

i. ANSI/UL 1994, Standard for Luminous Egress Path Marking Systems.

8.1.16. Exhibit booth is acceptable with any of the following

i. NFPA 703, Standard for Fire Retardant–Treated Wood and Fire-Retardant Coatings for Building Materials.
ii. NFPA 701, Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.
iii. NFPA 289, Standard Method of Fire Test for Individual Fuel Packages, using the 20 kW ignition source

8.1.17. Mattresses

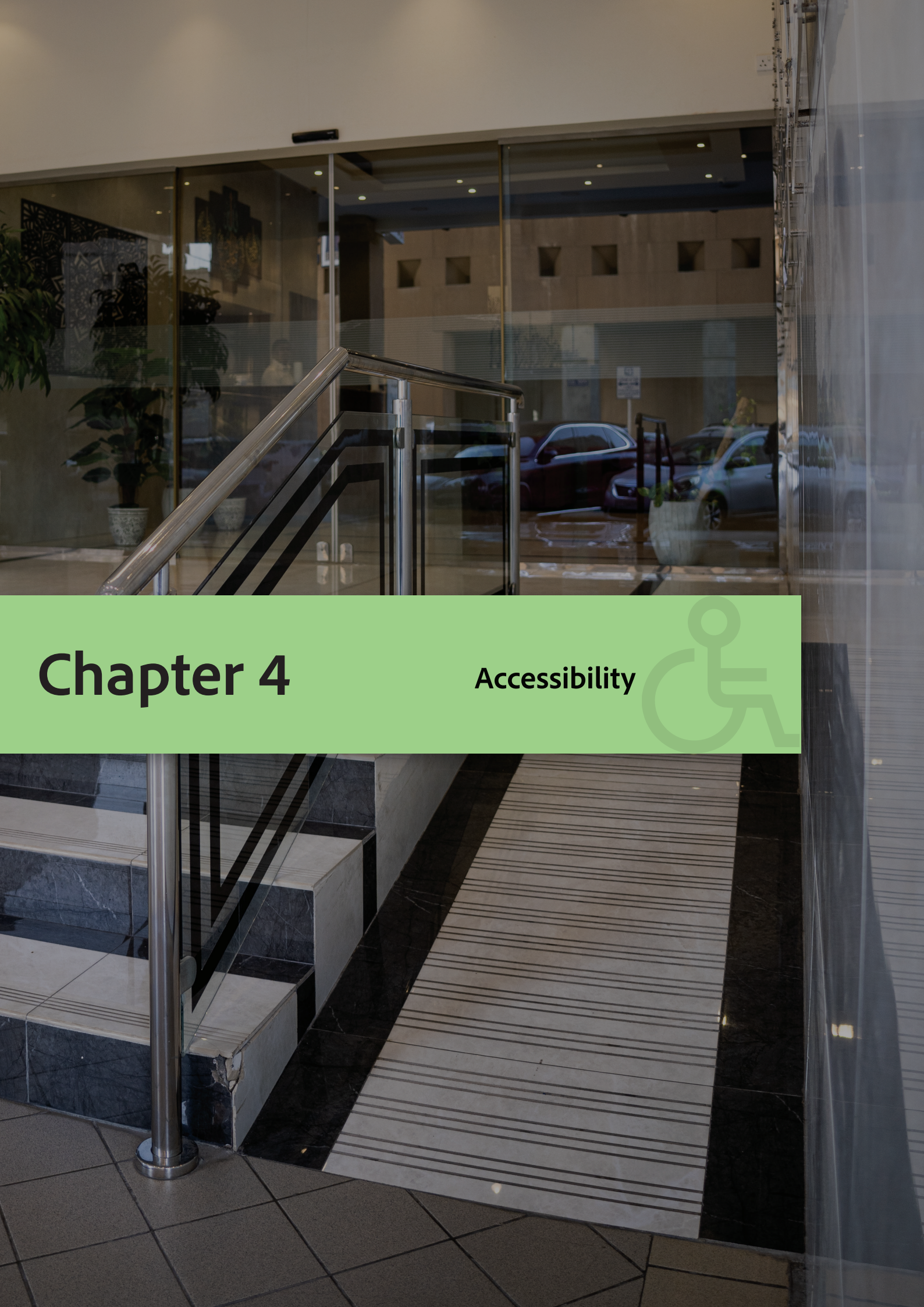
i. 16 CFR 1632, "Standard for the Flammability of Mattresses and Mattress Pads"
ii. 650°F (343°C) or greater when tested in accordance with ASTM D 1929, Standard Test Method for Determining Ignition Temperatures of Plastic.
iii. Class B, ASTM E 84, Standard Test Method for Surface Burning Characteristics of Building Materials, or ANSI/UL 723, Standard for Test for Surface Burning Characteristics of Building Materials.
iv. BS 6807, Methods of test for the ignitability of mattresses with primary and secondary sources of ignition.
v. BS 6807, Methods of test for assessment of ignitability of mattresses, upholstered divans and upholstered bed bases with flaming types of primary and secondary sources of ignition.
vi. BS 7175, Methods of test for the ignitability of bedcovers and pillows by smouldering and flaming ignition sources.
vii. BS 7177, Specification for resistance to ignition of mattresses, mattress pads, divans and bed bases.
viii. BS EN ISO 12952-1, Textiles. Assessment of the ignitability of bedding items. Ignition source. Smouldering cigarette.
ix. BS EN ISO 12952-2, Textiles. Assessment of the ignitability of bedding items. Ignition source. Match-flame equivalent.
x. BS EN 579-1, Furniture. Assessment of the ignitability of mattresses and upholstered bed bases. Ignition source: smouldering cigarette.
xi. BS EN 579-2, Furniture. Assessment of the ignitability of mattresses and upholstered bed bases. Ignition source: match flame equivalent.
xii. EN 13501-1: Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests.
xiii. ASTM E1590, Standard test method for fire testing mattresses.

8.1.18. Elevators

i. ASME A17.1/CSA B44, Safety Code for Elevators and Escalators.
ii. BS 5655-6, Lifts and service lifts. Code of practice for the selection, installation and location of new lifts.
iii. PD ISO/TR 25743:2010 - Lifts (elevators). Study of the use of lifts for evacuation during emergency.

8.1.19. Exit Signs

BS 5499-4, Safety signs. Code of practice for escape route signing.



Chapter 4

Accessibility

Section A

Chapter 4

Accessibility



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1. Scope

1.1. Definitions of Accessibility terminology

1.2. Design guidelines of various accessibility requirements in a building for emergency egress

1.3. Guideline on Emergency Evacuation Plan for people with determination

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1.5. To ensure Bahrain buildings are as accessible to disabled people as they are for everyone so that they can maneuver as naturally as everyone else during emergencies.

2. Definitions

2.1. General

2.1.1. Shall

It is a mandatory requirement by general directorate of General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain.

2.1.2. Should

It is a suggested requirement recommended by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain but not mandatory.

2.1.3. Listed

Permitted and registered by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain.

2.1.4. Accessible

A site, building, a facility or portion thereof, exterior or interior, public or private spaces having features in their design and construction that enable people with determination to maneuver easily.

2.1.5. Accessible Route

A continuous, unobstructed path that provides "accessibility" as defined above.

2.1.6. Circulation Path

An exterior or interior way of passage from one place to another for pedestrians.

2.1.7. Common Use

Interior or exterior "circulation paths," rooms, spaces, or elements that are not for public use and are made available for the shared use of two or more people.

2.1.8. Detectable Warning

A standardized surface feature built into or applied to walking surfaces or other elements to warn visually impaired persons of hazards on a circulation path.

2.1.9. Employee Work Area

All or any portion of a space used only by employees and only for work. Corridors, toilet rooms, kitchenettes and break rooms are not employee work areas.

2.1.10. Public Entrance

An entrance that is not a service entrance or a restricted entrance.

2.1.11. Public-Use Areas

Interior or exterior rooms or spaces that are made available to the general public.

2.1.12. Restricted Entrance

An entrance that is made available for common use on a controlled basis, but not public use, and that is not a service entrance.

2.1.13. Self Service Storage Facility

Real property is designed and used for the purpose of renting or leasing individual storage spaces to customers for the purpose of storing and removing personal property on a self-service basis.

2.1.14. Service Entrance

An entrance intended primarily for the loading, unloading of goods or services.

2.1.15. Type A Unit

A dwelling unit or sleeping unit designed and constructed for accessibility in accordance with this code and the provisions for Type A units in ICC A117.1.

2.1.16. Type B Unit

A dwelling unit or sleeping unit designed and constructed for accessibility in accordance with this code and the provisions for Type B units in ICC A117.1.

2.1.17. TTY

A **TTY** is a special **device** that lets people who are deaf, hard of hearing, or speech-impaired use the **telephone** to communicate, by allowing them to type messages back and forth to one another instead of talking and listening. A **TTY** is required at both ends of the conversation in order to communicate.

3. Accessibility

3.1. Intention

3.1.1. The Accessibility requirements of General Directorate of Civil Defence (GDCD) –Kingdom of Bahrain are to address the following.

3.1.2. To provide “ACCESSABILITY” to all Bahraini people who are physically challenged, inline with Bahrain's 2030 vision of making Bahrain the most “Accessible” country in the world for “people with disability”.

3.1.3. To make sites, buildings, structures, facilities, elements and spaces, both exterior or interior, both public and personal, accessible to people with determination so that they can maneuver, evacuate and find refuge as naturally as everyone.

3.2. Scope

3.2.1. Only accessible routes, doors, elevators, Stairs, refuge areas and parking are addressed in this chapter as 'Accessible Means of Egress'. Other accessible requirements for Utilities, recreational facilities, Furnishing and Equipment etc., where required by designers to comply with 'Accessible compliant buildings' shall be as per NFPA 5000 and ICC ANSI A117.1 (Accessible and Usable Buildings and Facilities).

3.3. Accessibility Concept

3.3.1. Physical disability, or severe mobility impairment, is the "the ability to move to stairs but without the ability to use the stairs." as per ADA (Americans with Disability Act)

3.3.2. ANSI A117.1 defines the technical criteria as to "make sites, facilities, buildings and elements accessible to and usable by people with such physical disabilities as the inability to walk, difficulty walking, reliance on walking aids, blindness and visual impairment, deafness and hearing impairment, incoordination, reaching and manipulation disabilities, lack of stamina, difficulty interpreting and reacting to sensory information, and extremes of physical size."

3.3.3. The Accessibility scope is broadly inclusive of all aspects of construction that affect the ability of people with determination to approach, enter, utilize a facility and evacuate the facility. The term "facility" includes not only the building and structures, but also the site on which they are located. Features of a site, such as parking areas and paths of travel from a public way to a structure, affect accessibility and are, therefore, within the scope.

3.3.4. The Accessibility requirements required by this code of practice are minimum guidelines. It is the architect and consultants responsibility to design and implement these requirements along with **Ministry of Municipalities, NFPA 5000** and **ICC/ANSI A117.1**. requirements.

4. Details of Accessibility Features

4.1. Accessible Route

4.1.1. The requirements of Accessible Route shall be as per **Table A.04-T1.**

ITEMS	REQUIREMENTS
1. WALKING SURFACE	i. Walking surface shall not have slope steeper than 1:20. ii. Floor surfaces shall be stable, firm, and slip resistant. iii. Exposed edges of carpet shall be fastened to the floor and shall have trim along the entire length of the exposed edge. iv. Changes in level greater than 6.4 mm in height and not more than13 mm maximum in height shall be beveled with a slope not steeper than 1:2. Changes in turning space shall not be permitted. v. Changes in level greater than 13 mm in height shall be ramped, as per **Table A.04-T1.7. Ramp.**
2. TURNING SPACE	i. The turning space shall be allowed to be a circular space with a 60-inch (1525 mm) minimum diameter. ii. The turning space shall be allowed to be a T-shaped space within a 1525 mm minimum square, with arms and base 915 mm minimum in width. Each arm of the T shall be clear of obstructions 305 mm minimum in each direction, and the base shall be clear of obstructions 610 mm minimum. iii. The clear floor space shall be1220 mm minimum in length and 760 mm minimum in width.
3. PROTRUDING OBJECTS	i. Objects with leading edges more than 685 mm and not more than 2030 mm above the floor shall protrude100 mm maximum horizontally into the circulation path. (Handrails shall be permitted to protrude 115 mm maximum.) ii. Vertical clearance shall be 2030 mm minimum. Rails or other barriers shall be provided where the vertical clearance is less than 2030 mm. The leading edge of such rails or barrier shall be located 685 mm maximum above the floor. iii. Where a forward reach is unobstructed, the high forward reach shall be1220 mm maximum and the low forward reach shall be 380 mm minimum above the floor. iv. Where a high forward reach is over an obstruction, the clear floor space shall extend beneath the element for a distance not less than the required reach depth over the obstruction. The high forward reach shall be1220 mm maximum above the floor where the reach depth is 510mm maximum. Where the reach depth exceeds 510 mm, the high forward reach shall be 1120 mm maximum above the floor, and the reach depth shall be 635 mm maximum. v. Where a clear floor space complying with Section 305 allows a parallel approach to an element and the edge of the clear floor space is 255 mm maximum from the element, the high side reach shall be1220 mm maximum and the low side reach shall be 380 mm minimum above the floor. vi. Where a clear floor space allows a parallel approach to an element and the high side reach is over an obstruction, the height of the obstruction shall be 865 mm maximum above the floor and the depth of the obstruction shall be 610 mm maximum. The high side reach shall be1220 mm maximum above the floor for a reach depth of 255 mm maximum. Where the reach depth exceeds 255 mm, the high side reach shall be1170 mm maximum above the floor for a reach depth of 610 mm maximum.

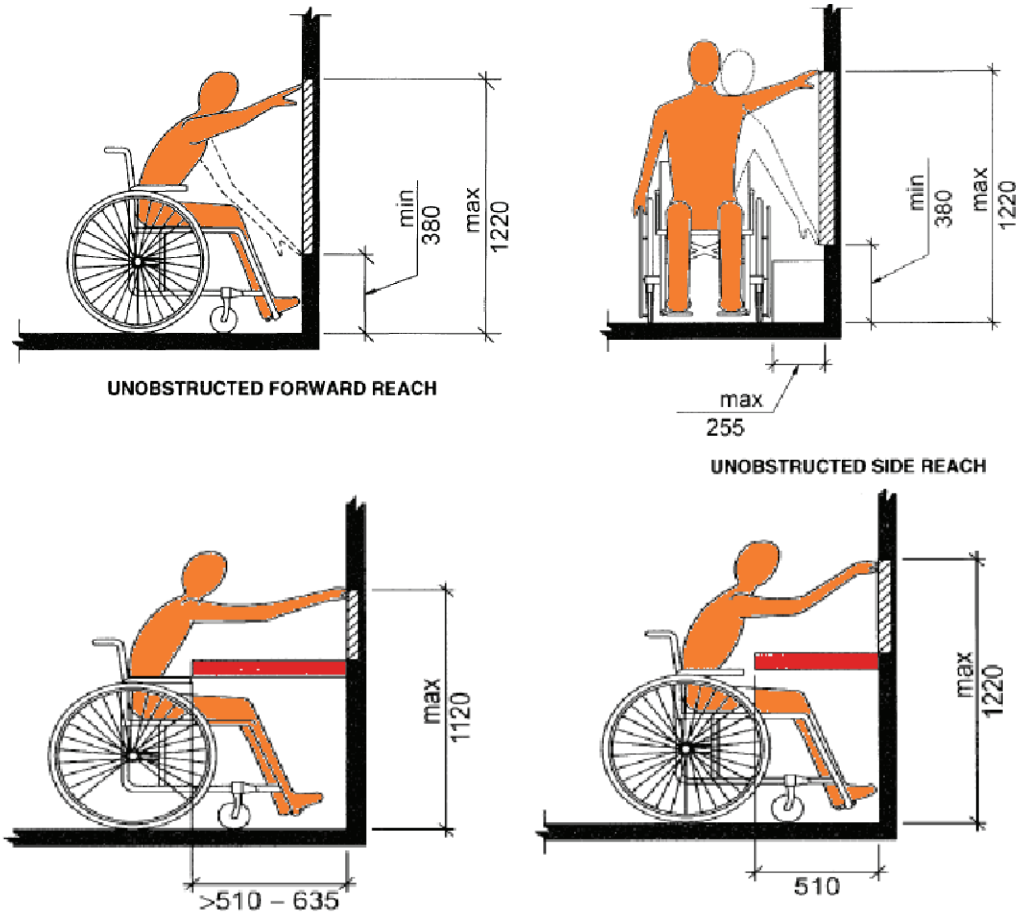


Figure A.04-F1.: High Reach, Forward Reach, Side Reach Dimensions in mm

Table A.04-T1 : Accessible Routes Requirement

ITEMS	REQUIREMENTS
4. CLEAR WIDTH	i. Clear width of an accessible route shall be 915 mm. ii. Where an accessible route makes a 180 degree turn around an object that is less than 48 inches (1220 mm) in width, clear widths shall be 1065 mm minimum approaching the turn, 1220 mm minimum during the turn, and 1065 mm minimum leaving the turn. iii. An accessible route with a clear width less than 1525 mm shall provide passing spaces at intervals of 61 m maximum. Passing spaces shall be either a 1525 mm minimum by 1525 mm minimum space, or an intersection of two walking surfaces that provide a T-shaped turning space, provided the base and arms of the T-shaped space extend 1220 mm minimum beyond the intersection.
5. DOORS	i. Minimum clear width of the doorway or at least one of the active leafs of doorways with two leaves shall be 915 mm as per Sec. A Chapter 3. Means of egress. ii. Door closers and door stops shall be permitted to be1980 mm minimum above the floor. iii. Minimum maneuvering clearances at manual swinging doors shall comply with Table A.04-T1.a. and shall include the full clear opening width of the doorway. iv. Minimum maneuvering clearances at sliding and folding doors shall comply with Table A.04-T1.b.

Table A.04-T1.a.: Maneuvering clearance distances at Manual Doors

APPROACH DIRECTION	DOOR SIDE	PERPENDICULAR TO	PARELLEL TO DOORWAY
1. FROM FRONT	Pull Side	1525 mm	455 mm
2. FROM FRONT	Push Side	1220 mm	0 mm
3. FROM HINGE SIDE	Pull Side	1525 mm	915 mm
4. FROM HINGE SIDE	Pull Side	1370 mm	1065 mm
5. FROM HINGE SIDE	Push Side	1065 mm	560 mm
6. FROM LATCH SIDE	Pull Side	1220 mm	610 mm
7. FROM LATCH SIDE	Push Side	1065 mm	610 mm

Table A.04-T1.b.: Maneuvering clearance distances at Sliding and Folding Doors

APPROACH DIRECTION	PERPENDICULAR TO DOORWAY	PARELLEL TO DOORWAY
1. FROM FRONT	1220 mm	0 mm
2. FROM NON LATCH SIDE	1065 mm	560 mm
3. FROM LATCH SIDE	1065 mm	610 mm

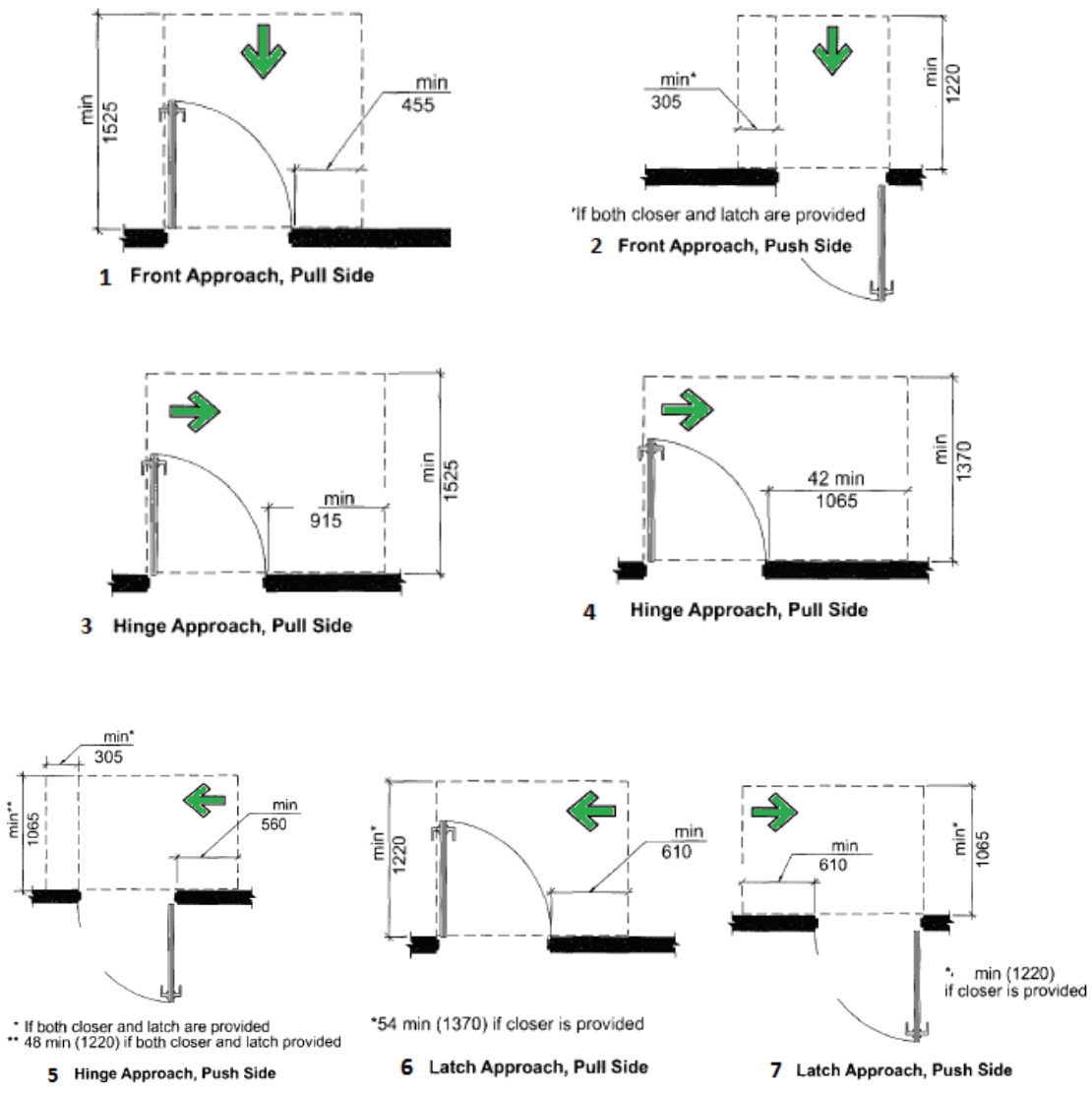


Figure A.04-F2.: Maneuvering Clearance Distances at Manual Swinging Doors in mm

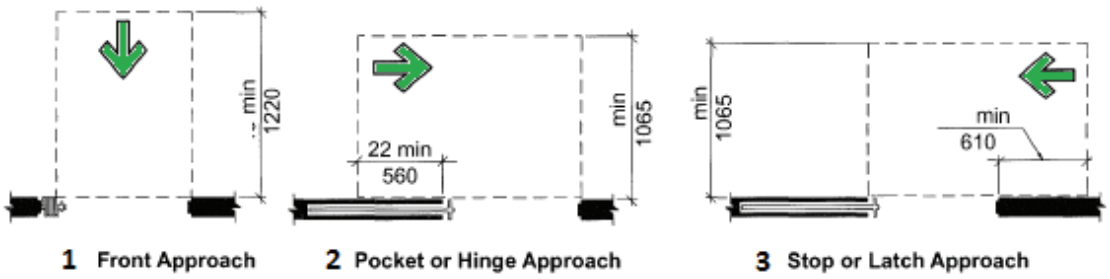


Figure A.04-F3.: Maneuvering Clearance Distances at Sliding and Folding Doors in mm

Table A.04-T1 : Accessible Routes Requirement

ITEMS	REQUIREMENTS
6. DOOR HARDWARE	i. Handles, pulls, latches, locks, and other operable parts on accessible doors shall have a shape that is easy to grasp with one hand and does not require tight grasping, pinching, or twisting of the wrist to operate. Operable parts of such hardware shall be 34 inches (865 mm) minimum and 48 inches (1220 mm) maximum above the floor. Where sliding doors are in the fully open position, operating hardware shall be exposed and usable from both sides.
7. RAMPS	i. Ramps shall have running slope greater than 1:20 and shall not be steeper than 1:12. ii. The clear width of a ramp run shall be 915 mm minimum. Handrails and hand rail supports that are provided on the ramp run shall not project into the required clear width of the ramp run. iii. The rise for any ramp run shall be 760 mm maximum. iv. Ramps shall have landings at the bottom and top of each ramp run. v. Clear width of landings shall be at least as wide as the widest ramp run leading to the landing. vi. Landings shall have a clear length of 1525 mm minimum. vii. Ramps that change direction at ramp landings shall be sized to provide a turning space complying with Table A.04-T1 .2. viii. Ramp runs with a rise greater than 150 mm shall have handrails.
8. ELEVATORS	i. Elevators shall be passenger elevators. ii. Elevator call buttons and keypads shall be minimum 19 mm in the smallest dimension located within reach range as per Table A.04-T1 .3. iii. Call buttons shall have visible signals to indicate when each call is registered and when each call is answered. Call buttons shall provide an audible signal or mechanical motion of the button to indicate when each call is registered. iv. Emergency controls, including the emergency alarm, shall be grouped at the bottom of the panel. v. Elevator doors shall be horizontal sliding type. Car gates shall be prohibited. vi. Elevator hoistway and car doors shall open and close automatically. vii. Elevator car door and hoistway door shall automatically reopen if the door becomes obstructed by an object or person. viii. Elevator doors shall remain fully open in response to a car call for 3 seconds minimum. ix. Elevator car minimum clear inside dimensions shall be as per Figure A.04-F4.

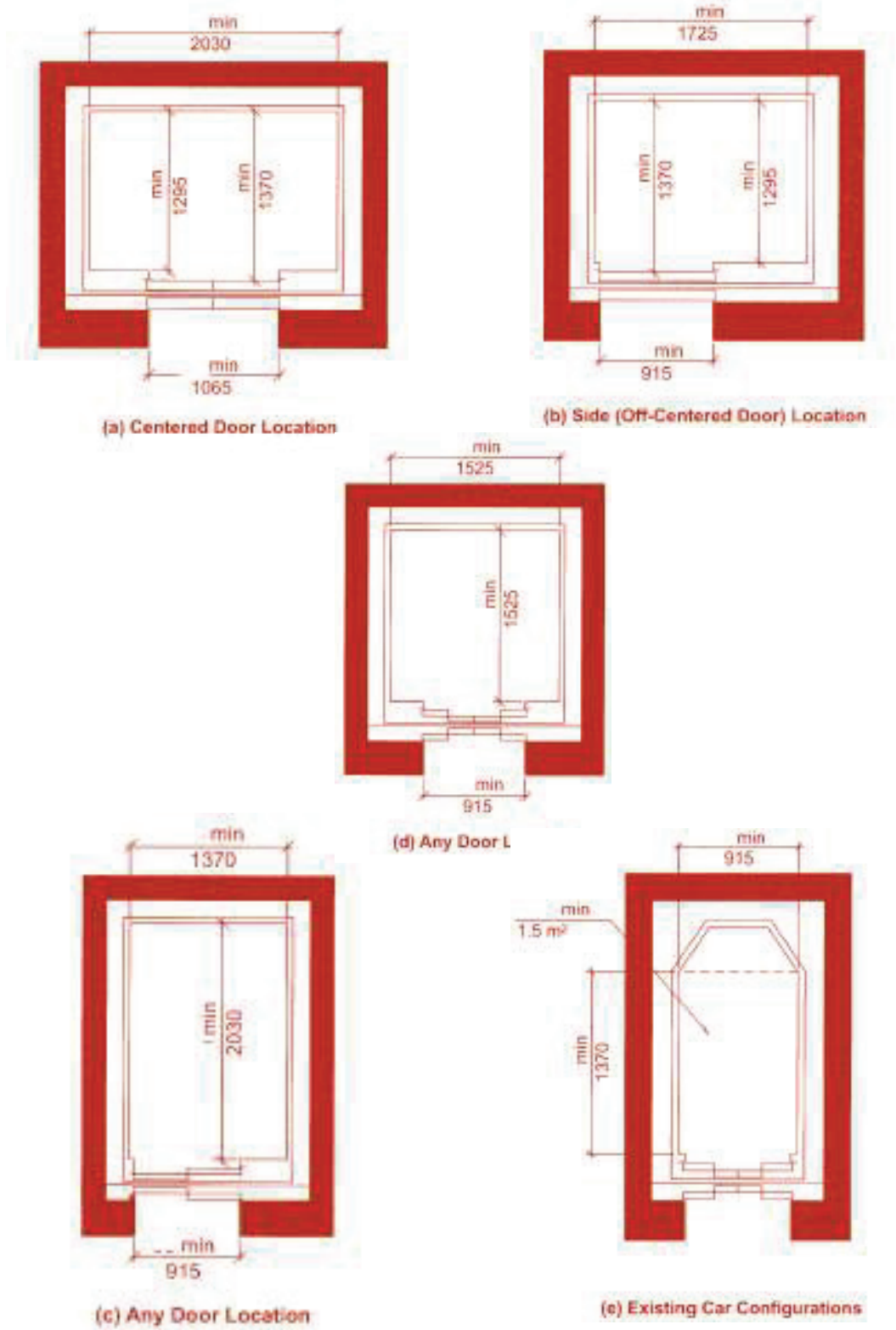


Figure A.04-F4.: Inside Dimensions of Elevator Car, in mm

4.2. Accessible Parking

4.2.1. The requirements for accessible Parking shall be as per **Table A.04-T2.**

Table A.04-T2.: Accessible Parking Requirement

ITEMS	REQUIREMENTS
1. PARKING SPACE WIDTH	i. Parking reserved for people with determination shall be closest to the destination. ii. Car parking spaces shall be 2440 mm minimum in width. Van parking spaces shall be 3350 mm minimum in width. iii. Van parking spaces shall be permitted to be 2440 mm minimum in width where the adjacent access aisle is 2440 mm minimum in width. iv. Car and van parking spaces shall be marked to define the width. Where parking spaces are marked with lines, the width measurements of parking spaces and adjacent access aisles shall be made from the centerline of the markings. v. Where parking spaces or access aisles are not adjacent to another parking space or access aisle, measurements shall be permitted to include the full width of the line defining the parking space or access aisle.
2. ACCESS AISLE	i. Access aisles serving car and van parking spaces shall be 1525 mm minimum in width. ii. A vertical clearance of 2490 mm minimum shall be provided for the parking spaces for vans, access aisles serving such parking spaces and vehicular routes serving parking spaces for vans. iii. Access aisles shall adjoin an accessible route. Two parking spaces shall be permitted to share a common access aisle. Access aisles shall not overlap with the vehicular way. Parking spaces shall be permitted to have access aisles placed on either side of the car or van parking space. Van parking spaces that are angled shall have access aisles located on the passenger side of the parking space. iv. Access aisles shall extend the full length of the parking spaces they serve. v. Access aisles shall be marked so as to discourage parking in them. Where access aisles are marked with lines, the width measurements of access aisles and adjacent parking spaces shall be made from the centerline of the markings. vi. Where access aisles or parking spaces are not adjacent to another access aisle or parking space, measurements shall be permitted to include the full width of the line defining the access aisle or parking space. vii. Accessible parking shall have signs, both in Arabic and English,1525 mm minimum above the floor of the parking space, measured to the bottom of the sign. viii. Parking spaces and access aisles shall be designed so that cars and vans, when parked, cannot obstruct the required clear width of adjacent accessible routes.

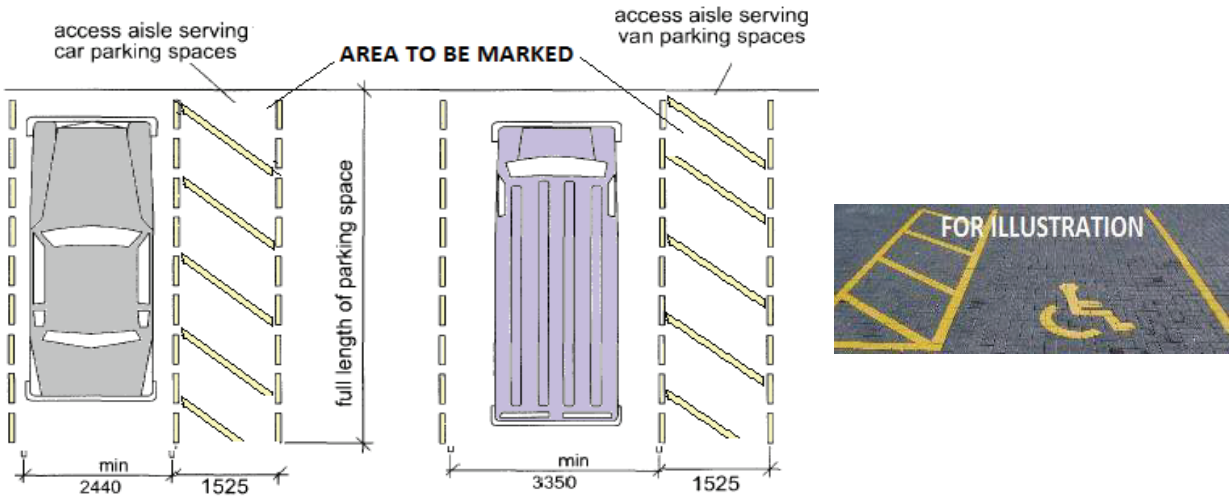


Figure A.04-F5.: Parking Space and Aisle

4.3. Accessible Stair

4.3.1. The requirements for accessible stair shall be as per **Table A.04-T3.**

Table A.04-T3.: Accessible Stair Requirement

ITEMS	REQUIREMENTS
1. STAIR	i. All steps on a flight of stairs shall have uniform riser height and uniform tread depth. ii. Risers shall be100 mm minimum and 180 mm maximum in height. iii. Treads shall be 280 mm minimum in depth. iv. Open risers shall not be permitted. v. Tread Surface shall be as per **Table A.04-T1.1.** vi. Stairs shall have handrails as per **Table A.04-T3.2.** vii. The radius of curvature at the leading edge of the tread shall be 13 mm maximum. viii. The leading 51 mm of the tread shall have visual contrast of dark-on-light or light-on -dark from the remainder of the tread. ix. Lighting facilities shall be capable of providing 10 foot-candles (108 lux) of illuminance measured at the center of tread surfaces and on landing surfaces within 610 mm of step nosing. x. Stair level identification signs in raised characters and braille shall be located at each floor level landing in all enclosed stairways adjacent to the door leading from the stairwell into the corridor to identify the floor level. The exit door discharging to the outside or to the level of exit discharge shall have a sign with raised characters and braille stating "EXIT." See **Section A. Chapter 3. Table A.03-T4.12. and Table A.03-T12.8.**
2. HANDRAIL	i. Handrails shall be provided on both sides of stairs and ramps. ii. In assembly seating areas, handrails shall not be required on both sides along aisle stairs, provided with a handrail either at the side or within the aisle. iii. In assembly seating areas, handrails shall not be required on the sides of ramped aisles serving seats. iv. Handrails shall be continuous within the full length of each stair flight or ramp run. v. Handrails shall not be required to be continuous in aisles serving seating where handrails are discontinuous to provide access to seating and to permit crossovers within the aisles. vi. Top of gripping surfaces of handrails shall be 865 mm minimum and 965 mm maximum vertically above stair nosing, ramp surfaces and walking surfaces. vii. Handrails shall be at a consistent height above stair nosing, ramp surfaces and walking surfaces. viii. Clearance between handrail gripping surface and adjacent surfaces shall be 38 mm minimum. ix. Ramp handrails shall extend horizontally above the landing 305 mm minimum beyond the top and bottom of ramp runs. Extensions shall return to a wall, guard, or floor, or shall be continuous to the handrail of an adjacent ramp run. x. See **Section A. Chapter 3. Table A.03-T4.10. for Details and Figures.**

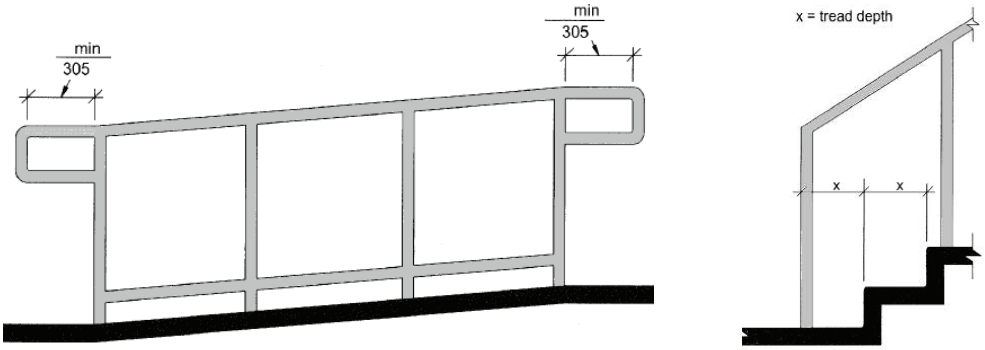


Figure A.04-F6.: Extension of Handrail

4.4. Accessible Audio Visual Alarms and Signs

4.4.1. The requirements for accessible Audio Visual Alarms shall be as per **Table A.04-T4.**

Table A.04-T4 : Requirements for Accessible Audio Visual Alarms and Signs

ITEMS	REQUIREMENTS
1. ALARMS	i. Accessible audible and visible alarms and notifications devices shall be installed as per **Section C Chapter 1. Fire Detection and Alarm Systems.** ii. All visible notification appliances provided within the unit for smoke detection notification shall be activated upon smoke detection. iii. All visible notification appliances provided within the unit for building fire alarm notification shall be activated upon activation of the building fire alarm in the portion of the building containing the unit.
2. SIGNS	i. Tactile signs shall contain both raised characters and braille. Where signs with both visual and raised characters are required, either one sign with both visual and raised characters, or two separate signs, one with visual, and one with raised characters, shall be provided. ii. Directional signs, egress signs, room identification signs and floor identification signs, both in Arabic and English shall have characters in conventional form. Characters shall not be in Italic, oblique, script, decorative or other unusual forms. iii. The uppercase letter "I" shall be used to determine the allowable height of all characters of a font. The uppercase letter "I" of the font shall have a minimum height complying with **Table A.04-T4.a.** iv. The uppercase letter "0" shall be used to determine the allowable width of all characters of a font. The width of the uppercase letter "0" of the font shall be 55 percent minimum and 110 percent maximum of the height of the uppercase "I" of the font. v. Spacing between the baselines of separate lines of characters within a message shall be 135 percent minimum and 170 percent maximum of the character height. vi. Characters and their background shall have a non-glare finish. Characters shall contrast with their background, with either light characters on a dark background, or dark characters on a light background. vii. Braille Signage shall comply with **ANSI 117.1.** viii. Pictograms shall have a field 150 mm minimum in height. Characters or braille shall not be located in the pictogram field.

Table A.04-T4.a : Visual Character and Letters Specifications

HEIGHT ABOVE FLOOR TO BASELINE OF CHARACTER	HORIZONTAL VIEWING DISTANCE	MINIMUM CHARACTER HEIGHT
1. 1015 MM TO LESS THAN OR EQUAL TO1780 MM.	Less than 1830 mm	16 mm
2. 1015 MM TO LESS THAN OR EQUAL TO1780 MM.	1830 mm and greater	16 mm plus 3.2 mm per 305 mm of viewing distance above 1830 mm
3. GREATER THAN 1780 MM TO LESS THAN OR EQUAL TO 3050 MM	Less than 4570 mm	51 mm
4. GREATER THAN 1780 MM TO LESS THAN OR EQUAL TO 3050 MM	4570 mm and greater	51 mm, plus 3.2 mm per 305 mm of viewing distance above 4570 mm
5. GREATER THAN 3050 MM	Less than 6400 mm	75 mm
6. GREATER THAN 3050 MM	6400 mm and greater	75 mm, plus 3.2 mm per 305 mm of viewing distance above 6400 mm



INTERNATIONAL SYMBOL OF ACCESSIBILITY



INTERNATIONAL SYMBOL OF ACCESS FOR HEARING LOSS



INTERNATIONAL SYMBOL OF ACCESS FOR BLIND



INTERNATIONAL SYMBOL FOR AVAILABILITY OF BRAILLE FOR BLIND



INTERNATIONAL SYMBOL FOR AVAILABILITY OF SIGN LANGUAGE FOR DEAF



INTERNATIONAL SYMBOL OF VOLUME CONTROLLED TELEPHONE FOR HARD LISTENING PEOPLE

Figure A.04-F7.: Examples of International Accessible Symbols

Table A.04-T4.: Requirements for Accessible Audio-Visual Alarms and Signs

ITEMS	REQUIREMENTS
3. INACCESSIBLE LOCATION SIGNS	i. Directional signage indicating the route to nearest accessible element shall be provided at INACCESSIBLE BUILDING ENTRANCE, INACCESSIBLE PUBLIC TOILET AND BATHING FACILITIES, ELEVATORS NOT SERVING ACCESSIBLE ROUTE, BATHING ROOM INDICATING NEAREST FAMILY/ASSITED USE REST ROOMS, EXITS AND STAIRS NOT SERVING AS MEANS OF EMERGENCY EGRESS.
4. TELEPHONES	i. For wheelchair accessible telephones, clear floor space shall be as per **Table A.04-T1.** ii. Where a parallel approach is provided, the distance from the edge of the telephone enclosure to the face of the telephone shall be 255 mm maximum. iii. Where a forward approach is provided, the distance from the front edge of a counter within the enclosure to the face of the telephone shall be 510 mm maximum. iv. The telephone handset cord shall be 735 mm minimum in length. v. Telephones shall be hearing aid compatible. vi. Public telephones required to have volume controls shall be equipped with a receiver volume control that provides a gain adjustable up to 20 dB minimum. Incremental volume controls shall provide at least one intermediate step of gain of 12 dB minimum. An automatic reset shall be provided. vii. TIYs required at a public pay telephone shall be permanently affixed within, or adjacent to, the telephone enclosure. Where an acoustic coupler is used, the telephone cord shall be of sufficient length to allow connection of the TIY and the telephone receiver. viii. When in use, the touch surface of TTY keypads shall be 865 mm minimum above the floor.
5. TWO-WAY COMMUNICATION SYSTEMS	i. The system shall provide both visual and audible signals. ii. Handset cords, if provided, shall be 735 mm minimum in length. iii. Telephone entry systems shall comply with ANSI/DASMA 303.

4.5. Accessible Special Rooms and Spaces

4.5.1. The requirements for accessible Audio Visual Alarms shall be as per **Table A.04-T5.**

Table A.04-T5 : Requirements for Accessible Special Rooms and Spaces

ITEMS	REQUIREMENTS
1. ASSEMBLY AREAS	i. A single wheelchair space shall be 915 mm minimum in width. Where two adjacent wheelchair spaces are provided, each wheelchair space shall be 840 mm) minimum in width. ii. Where a wheelchair space can be entered from the front or rear, the wheelchair space shall be 1220 mm minimum in depth. Where a wheelchair space can only be entered from the side, the wheelchair space shall be 1525 mm minimum in depth. iii. The wheelchair space shall adjoin an accessible route. The accessible route shall not overlap the wheelchair space. iv. A wheelchair space shall not overlap the required width of an aisle. v. The companion seat shall be provided beside each wheelchair space and it shall be equivalent in size, quality, comfort and amenities to the seats in the immediate area to the wheelchair space location. Companion seats shall be permitted to be moveable. vi. In row seating, the companion seat shall be located to provide shoulder alignment with the wheelchair space occupant. The shoulder of the wheelchair space occupant shall be measured either 915 mm from the front or 305 mm from the rear of the wheelchair space. The floor surface for the companion seat shall be at the same elevation as the wheelchair space floor surface. vii. Dispersion of seats, line of sight for wheel chair spaces etc. shall be as per **ANSI 117.1.** viii. Minimum required number of wheelchair spaces shall be as per **Table A.04-T5.a.**

Table A.04-T5.a.: Number of Wheelchair spaces required

TOTAL SEATING IN ASSEMBLY AREA	MINIMUM REQUIRED NUMBER OF WHEEL-CHAIR SPACE
1. 4 TO 25	1
2. 26 TO 50	2
3. 51 TO 100	4
4. 101 TO 300	5
5. 301 TO 500	6
7. 501 TO 5000	6, plus 1 additional space for each 150 seats or fraction thereof between 501 through 5000
5. 5001 AND ABOVE	36, plus 1 additional space for each 200 seats or fraction thereof over 5000

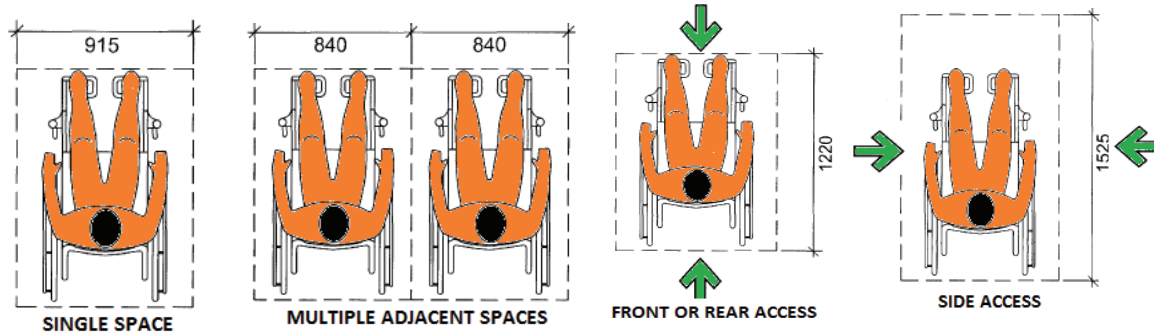


Figure A.04-F8.: Width and Depth of Accessible Wheelchair Spaces in Assembly

Table A.04-T5 : Requirements for Accessible Special Rooms and Spaces

ITEMS	REQUIREMENTS
2. KITCHEN AREAS	i. Pass through Kitchen area accessibility shall be as per **Figure A.04-F10, a and b.** ii. U shaped Kitchen area accessibility shall be as per **Figure A.04-F10, c and d.**

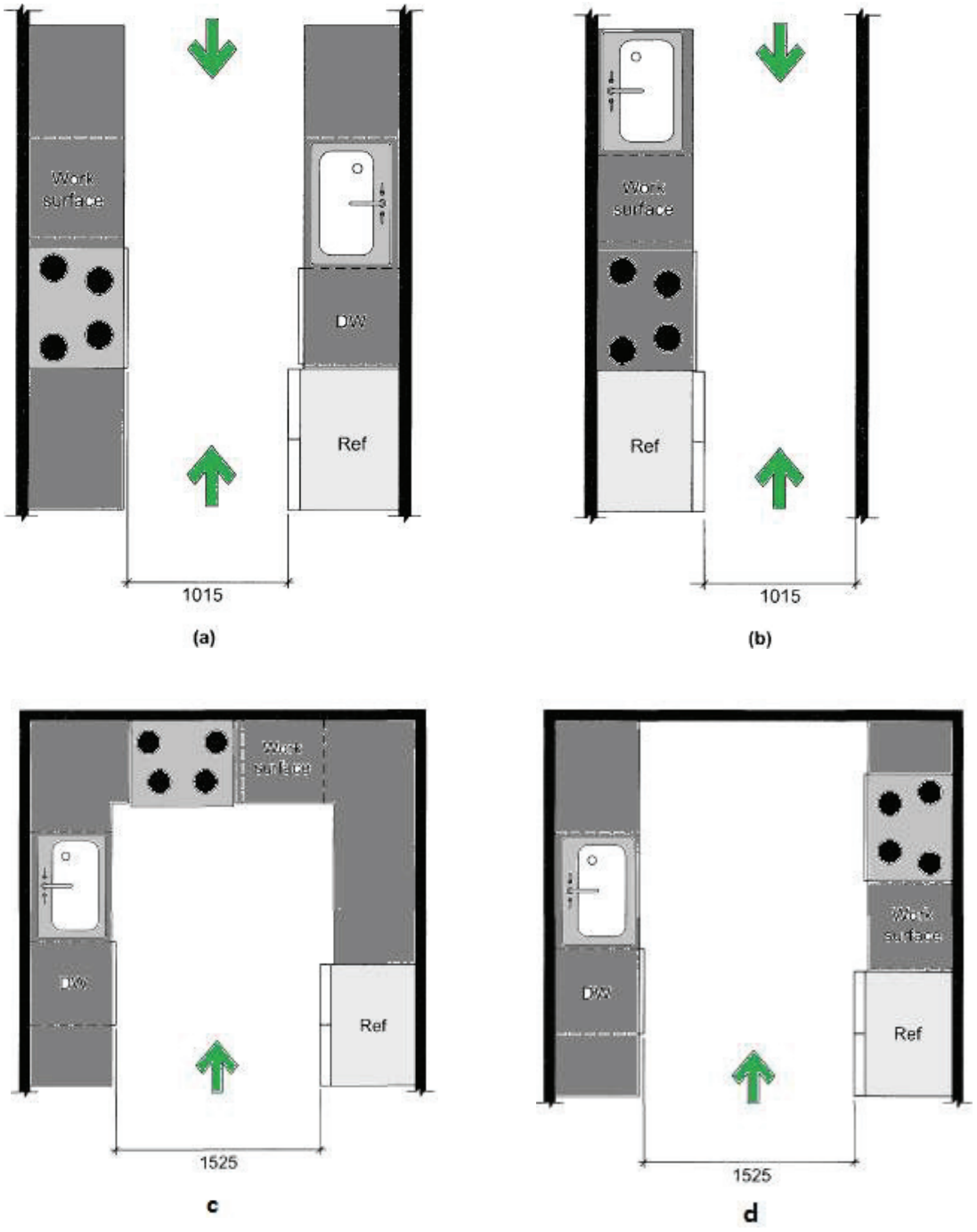
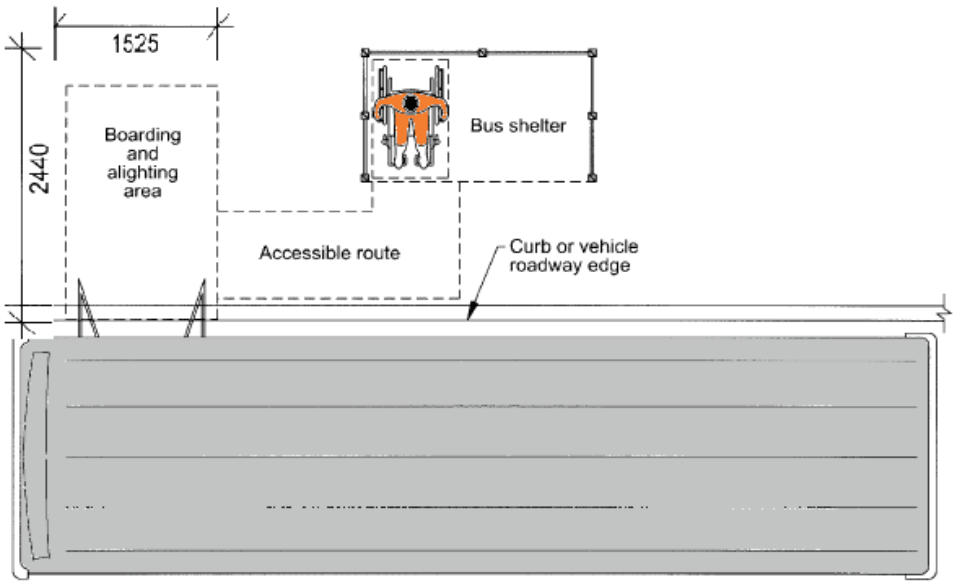


Figure A.04-F9.: Accessible Kitchen Area Clearances in mm

Table A.04-T5 : Requirements for Accessible Special Rooms and Spaces

ITEMS	REQ UIREMENTS
3. BUS STOPS	i. Bus stop boarding and alighting areas shall have a 2440 mm minimum clear length, measured perpendicular to the curb or vehicle roadway edge, and a 1525 mm minimum clear width, measured parallel to the vehicle roadway. ii. The slope of the bus stop boarding and alighting area parallel to the vehicle road-way shall be the same as the roadway, to the maximum extent practicable. The slope of the bus stop boarding and alighting area perpendicular to the vehicle roadway shall be 1:48 maximum. iii. Bus shelters, bus stop boarding and alighting areas shall be connected to streets, sidewalks, or pedestrian paths by an accessible route complying with **Table A.04-T1.** iv. Bus shelters shall provide a minimum clear floor space as per **Table A.04-T1.** v. Bus route identification signs shall comply with **Table A.04-T4.**
4. RAIL AND TRAM PLATFORMS	i. Rail and Tram platforms shall not exceed a slope of 1:48 in all directions. ii. Platform boarding edges not protected by platform screens or guards shall have a detectable warning. iii. Rail station signs shall comply with **Table A.04-T4.** iv. Where signs identify a station or a station entrance, at least one sign with raised characters and braille complying with **Table A.04-T4.** shall be provided at each entrance. v. Station names, Lists of stations, routes and destinations served by the station that are located on boarding areas, platforms, or mezzanines shall have visual characters complying with **Table A.04-T4.** vi. At least one sign with raised characters and braille complying with **Table A.04-T4.** shall be provided on each platform or boarding area to identify specific station**.** vii. Where public address systems convey audible information to the public, the same or equivalent information shall be provided in a visual format. viii. Escalators where provided, shall have a 815 mm minimum clear width, and shall comply with Requirements 6.1.3.S.6-Step Demarcations, and 6.1.3.6.S-Flat Steps of **ASME A 17.1 /CSA B44.** ix. Where a circulation path crosses tracks, it shall comply with **Table A.04-T1.** and shall have a detectable warning 610 mm in depth complying with **Table A.04-T4**., extending the full width of the circulation path.



BUS SHELTERS

Figure A.04-F10.: Accessible Bus Shelter clearances in mm

4.6. Accessible Dwelling and Sleeping Units

4.6.1. The requirements for accessible dwelling and sleeping units shall be as per **Table A.04-T6.**

Table A.04-T6.: Requirements for Accessible Dwelling and Sleeping Units

ITEMS	REQUIREMENTS
1. ACCESSIBLE UNITS	i. The accessible primary entrance shall be on an accessible route from public and common areas. The primary entrance shall not be to a bedroom unless it is the only entrance. ii. At least one accessible route shall connect all spaces and elements that are a part of the unit. Accessible routes shall coincide with or be located in the same area as a general circulation path. iii. All rooms served by an accessible route shall provide a turning space, walking surface, doors and doorways, elevators, ramps as per **Table A.04-T1.** iv. Lighting controls, electrical panel boards, electrical switches and receptacle outlets, environmental controls, appliance controls, operating hardware for operable windows, plumbing fixture controls, and user controls for security or intercom systems shall comply with **ANSI 117.1.** v. Kitchens shall comply with **Table A.04-T5.2.** vi. At least one bed shall be provided with clear floor space, positioned for parallel approach to the side of the bed and an open bed frame.
2. ACCESSIBLE TOILET AND BATHING ROOMS	i. A turning space complying with **Table A.04-T1.** shall be provided within the room . The required turning space shall not be provided within a toilet compartment. ii. Doors shall not swing into the clear floor space or clearance for any fixture. iii. Where mirrors are located above lavatories, a mirror shall be located over the accessible lavatory and shall be mounted with the bottom edge of the reflecting surface 1015 mm maximum above the floor. Where mirrors are located above counters that do not contain lavatories, the mirror shall be mounted with the bottom edge of the reflecting surface 1015 mm maximum above the floor. iv. Coat hooks shall be located within one of the reach ranges specified in **Table A.04-T1.** Shelves shall be 1015 mm minimum and 1220 mm maximum above the floor. v. The accessible toilet and bathing fixtures shall be in a single toilet/bathing area, such that travel between fixtures does not require travel through other parts of the unit.
3. TYPE A DWELLING UNIT	i. Type A Dwelling unit shall be an accessible unit as per **Table A.04-T6.1.** ii. At least one toilet and bathroom shall comply with accessible toilet and bathroom as per **Table A.04-T6.2.** iii. Reinforcement shall be provided for the future installation of grab bars at water closets, bath tubs and for shower seats. iv. The water closet shall be positioned with a wall to the rear and to one side. The centerline of the water closet shall be 405 mm minimum and 455 mm maximum from the sidewall. v. Clear floor space as per **Table A.04-T1.** shall be provided for dishwasher, cooktop, oven and refrigerators. vi. Water closet location, clearances and height shall comply with **Figure A.04-F11.** vii. Bath tub location and clearances shall comply with **Figure A.04-F12.** viii. Type A dwelling unit Kitchen clearances and sink shall comply with **Figure A.04-F13.**

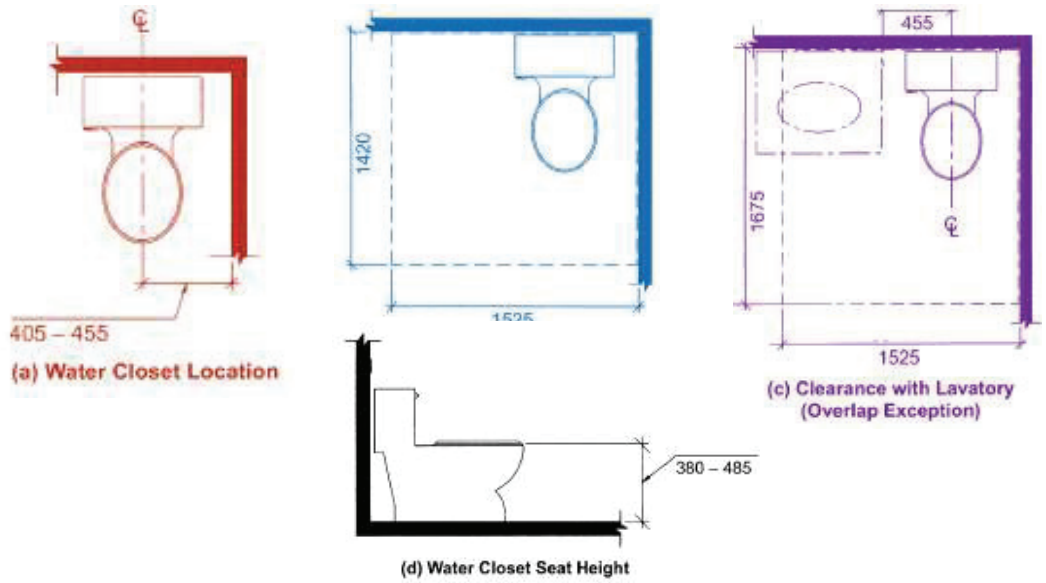


Figure A.04-11.: Unit A Water Closet Clearances in mm

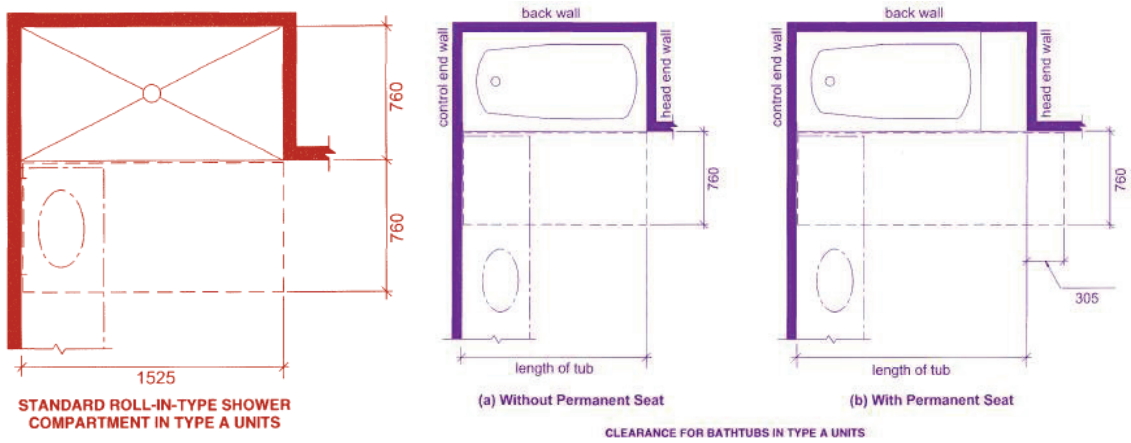


Figure A.04-12.: Unit A Bathtub Clearances in mm

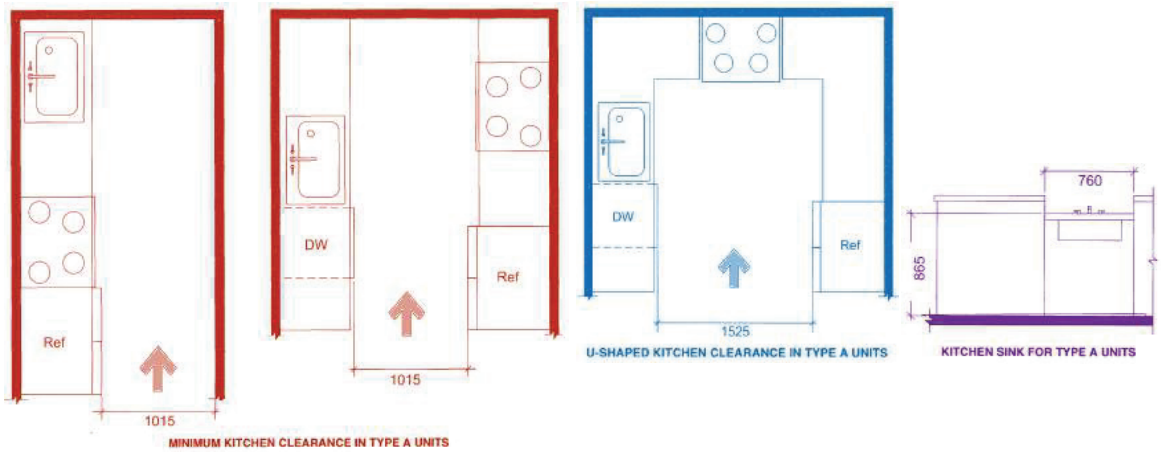


Figure A.04-13.: Unit A Kitchen Clearances in mm

Table A.04-T6.: Requirements for Accessible Dwelling and Sleeping

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ITEMS	REQUIREMENTS
4. TYPE B DWELLING UNIT	i. Type B Dwelling unit shall be an accessible unit as per **Table A.04-T6.1.** ii. At least one toilet and bathroom shall comply with accessible toilet and bathroom as per **Table A.04-T6.2.** iii. Reinforcement shall be provided for the future installation of grab bars at water closets, bath tubs and for shower seats. iv. Clear floor space as per **Table A.04-T1.** shall be provided for dishwasher, cooktop, oven and refrigerators. v. Water closet location, clearances and height shall comply with **Figure A.04-F14.** vi. Bath tub location and clearances shall comply with **Figure A.04-F15.a., Figure A.04-F15.b.** and **Figure A.04-F15.c.** vii. Type B dwelling unit Kitchen clearances and sink shall comply with **Figure A.04-F16.**

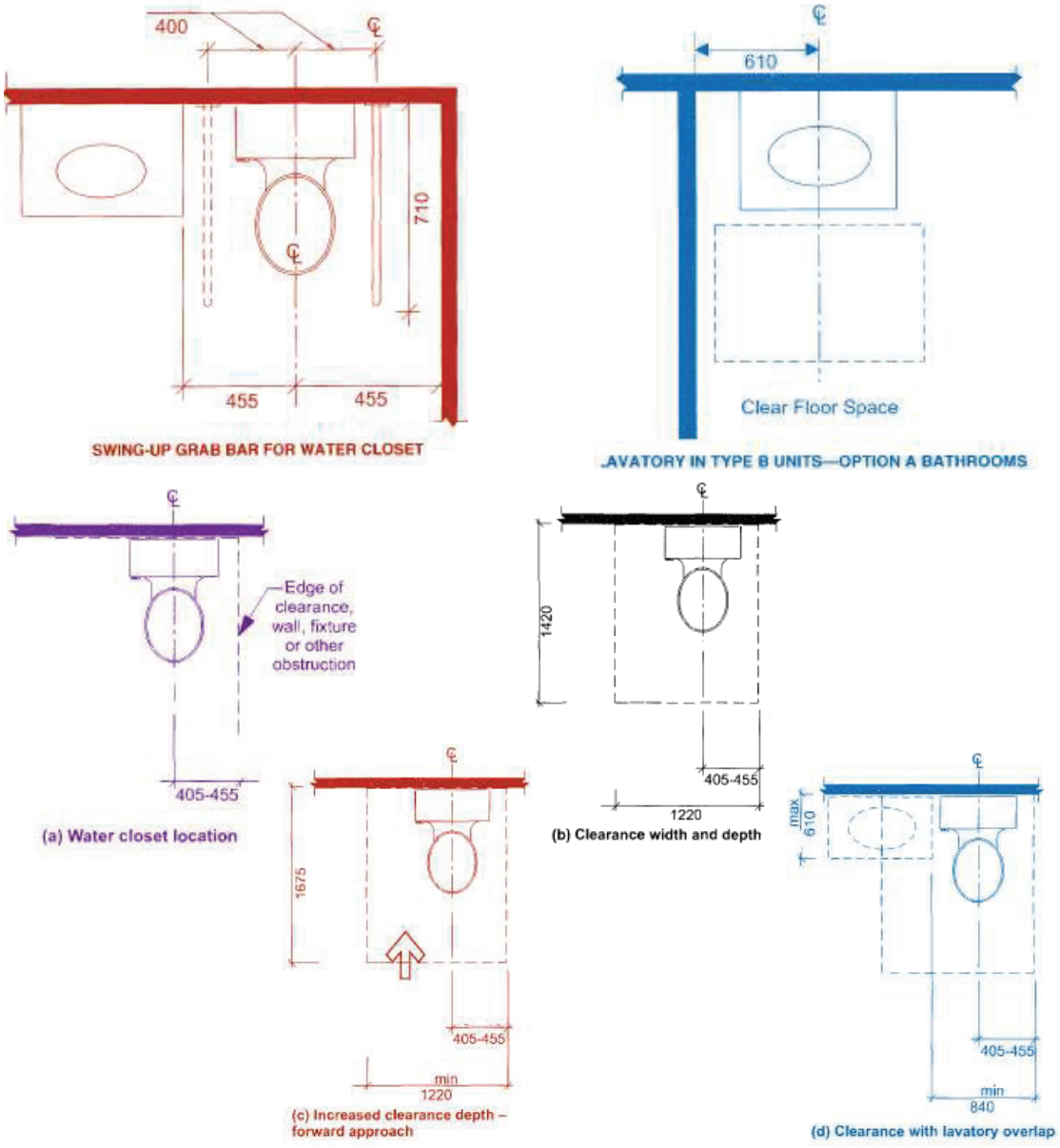


Figure A.04-F14.: Unit B Water Closet Clearances in mm

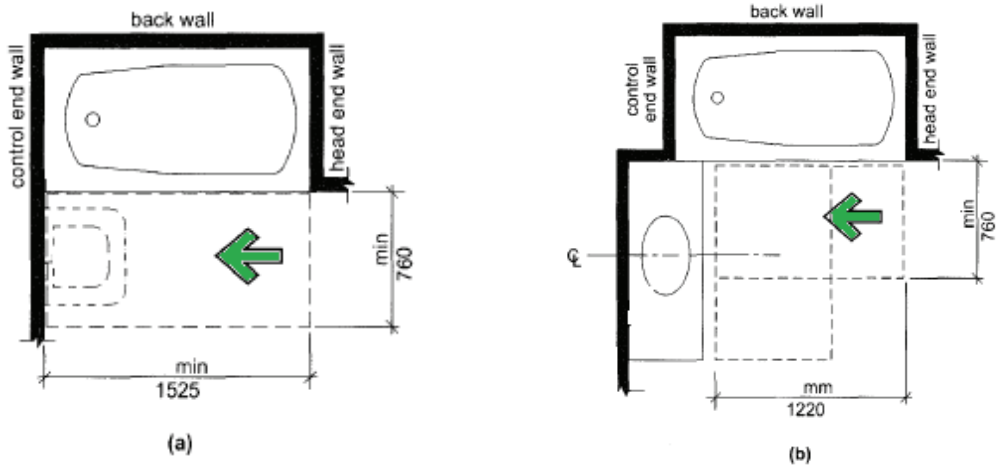


Figure A.04-F15.a.: Unit B Parallel approach Bathtub Clearances in mm

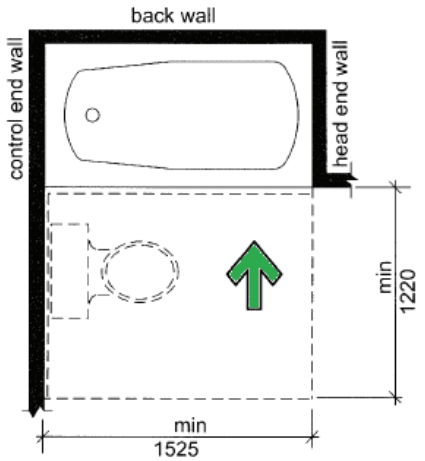


Figure A.04-F15.b.: Unit B Forward approach Bathtub Clearances in mm

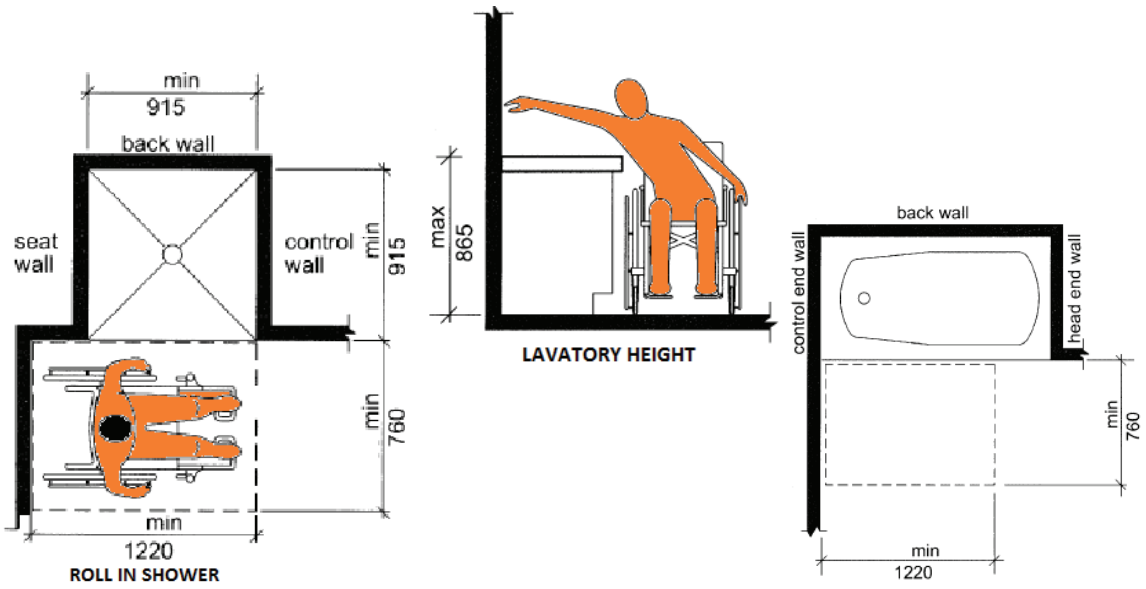


Figure A.04-15.c.: Unit B Bathroom Clearances in mm

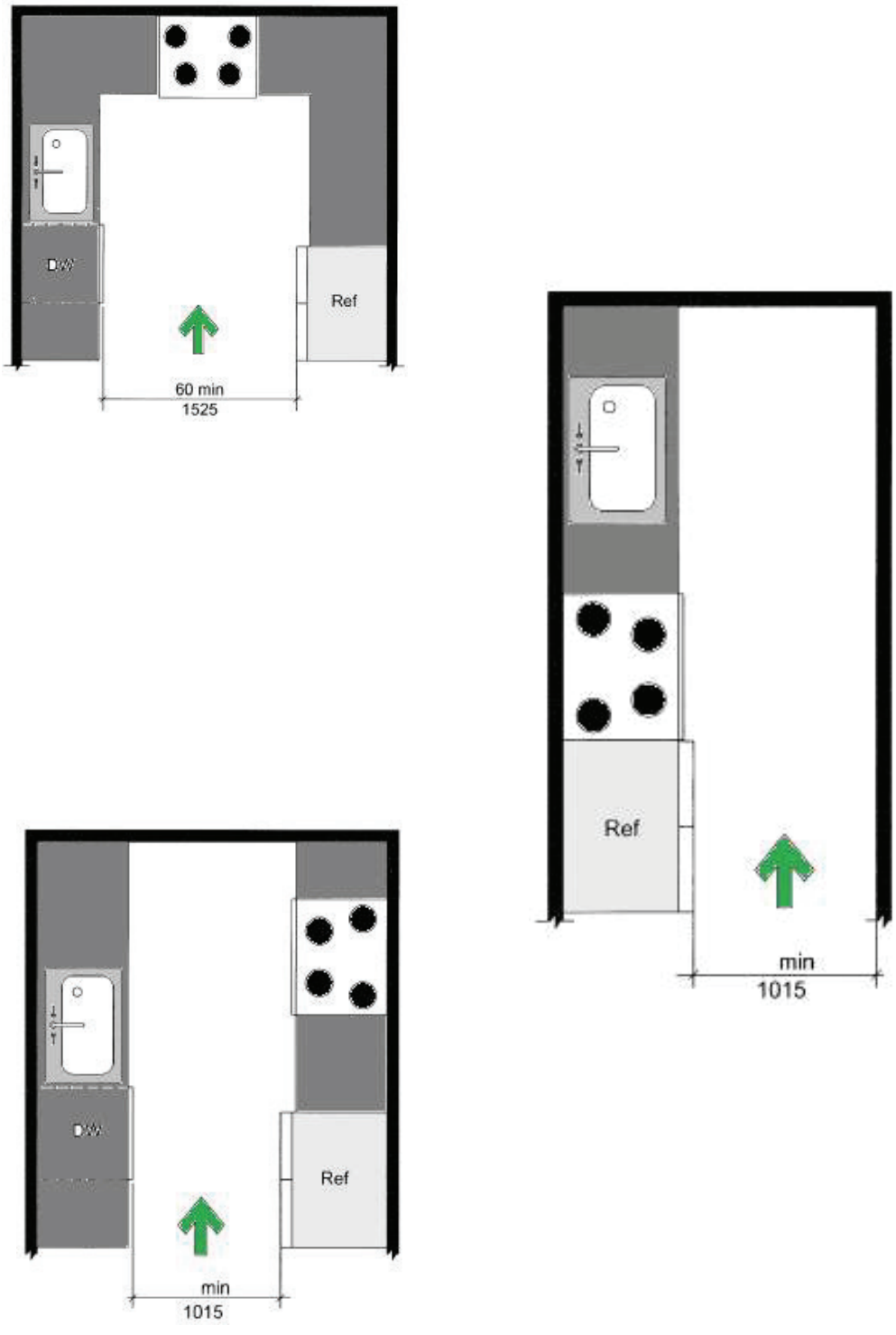


Figure A.04-16.: Unit B Kitchen Clearances in mm

Table A.04-T6.: Requirements for Accessible Dwelling and Sleeping Units

ITEMS	REQUIREMENTS
5. TYPE C (VISITABLE) DWELLING UNIT	i. Circulation path shall consist of walking surface with slope not steeper than 1:20 with doors, doorways, ramps, elevators etc. as per **Table A.04-T1.** ii. Doorways shall have a clear opening of 815 mm minimum. Clear opening of swinging doors shall be measured between the face of the door and stop, with the door open 90 degrees. iii. At least one unit entrance shall be on a circulation path from a public street or sidewalk, a dwelling unit driveway, or a garage. iv. The entrance level shall include a toilet room or bathroom and one habitable space with an area 6.5 m^2 minimum. v. A toilet room or bathroom shall not be required on an entrance level with less than 11.1 m^2 of habitable space. vi. At a minimum, the toilet room or bathroom shall include a lavatory and a water closet. Reinforcement shall be provided for the future installation of grab bars at water closets. Clearances at the water closet shall comply with **Figure A.04-F12.** vii. At a minimum, the food preparation area shall include a sink, a cooking appliance, and a refrigerator. Clearances between all opposing base cabinets, counter tops, appliances or walls within the food preparation area shall be 1015 mm minimum in width. viii. Receptacle outlets and operable parts of lighting controls shall be located 380 mm minimum and 1220 mm maximum above the floor. ix. A means for visually identifying a visitor without opening the unit entry door shall be provided. Peepholes, where used, shall provide a minimum 180-degree range of view.

5. Application of Accessibility Features

5.1. Application of accessible features in a building , site or structure shall be as per **Table A.04-T7.**

Table A.04-T7.: Application of Accessible Features in a Building

ITEMS	REQUIREMENTS	EXCEPTIONS
1. ACCESSIBLE ROUTE **AS PER Table A.04-T1. AND ICC ANSI 117.1**	**1. SITE AND SITE ARRIAVAL POINTS** i. Accessible Routes shall be provided within a site, from public transportation stops, accessible parking, accessible passenger loading zones, public streets and sidewalks to accessible building entrance. ii. At least one accessible route shall connect accessible buildings, accessible facilities, accessible elements and accessible spaces that are on the same site. **2. CONNECTED SPACES** i. When a building or portion of a building is required to be accessible, an accessible route shall be provided to each portion of the building, to accessible building entrances connecting accessible pedestrian walkways and the public way. **3. EMPLOYEE WORK AREA** i. Common circulation areas in employee work space shall have accessible routes. **4. PRESS BOXES** i. Press boxes in assembly areas shall have accessible routes.	i. Other than in buildings or facilities containing or serving Type B units, an accessible route shall not be required between site arrival points and the building or facility entrance if the only means of access between them is a vehicular way not providing for pedestrian access. ii. An accessible route is not required between accessible buildings, accessible facilities, accessible elements and accessible spaces that have, as the only means of access between them, a vehicular way not providing for pedestrian access. i. In ASSEMBLY areas with fixed seating, an accessible route shall not be required to serve levels where wheelchair spaces are not provided. ii. In HEALTHCARE facilities, doors to sleeping units shall be exempted from the requirements for maneuvering clearance at the room side provided the door is a minimum of 1118 mm in width. i. Accessible routes shall not be required in employee work spaces which are less than 27.9 m^2 in area. ii. Accessible routes shall not be required in exterior, open to sky workplaces and at common circulation paths that are integral component of equipment. i. An accessible route shall not be required to press boxes in bleachers that have points of entry at only ii. one level, provided that the aggregate area of all press boxes is 46 m^2 maximum. iii. An accessible route shall not be required to free-standing press boxes that are elevated above grade 3660 mm minimum provided that the aggregate area of all press boxes is 46 m^2 maximum.

Table A.04-T7.: Application of Accessible Features in a Building

ITEMS	REQUIREMENTS	EXCEPTIONS
1. ACCESSIBLE ROUTE **AS PER Table A.04-T1. AND ICC ANSI 117.1**	**5. MULTI-STOREY BUILDINGS** i. At least one accessible route shall connect each storey and mezzanine in multi-storey building. **6. LOCATION OF ACCESSIBLE ROUTE** i. Accessible routes shall coincide with or be located in the same area as a general circulation path. Where the circulation path is interior, the accessible route shall also be interior. Where only one accessible route is provided, the accessible route shall not pass through kitchens, storage rooms, restrooms, closets or similar spaces. **7. SECURITY BARRIERS** i. Accessible routes from parking garages contained within and serving Type B units are not required to be interior. ii. A single accessible route is permitted to pass through a kitchen or storage room in an Accessible unit, Type A unit or Type B unit.	i. Buildings that are less than 3 stories and 279 m^2 in area per storey and are not MERCANTILE, MALL, HEALTHCARE OR TRANSPORTATION FACILITIES, accessible route is not required. ii. Public building with 2 stories having 1 storey with occupant load of 5 or less and does not contain public use shall not be required to have accessible route. iii. In detention and correctional, residential and boarding when they comply to mobility features as per **Table A.04-T1,** floors need not be connected. i. Accessible routes from parking garages contained within and serving Type B units are not required to be interior. ii. A single accessible route is permitted to pass through a kitchen or storage room in an Accessible unit, Type A unit or Type B unit. i. Where security barriers incorporate elements that cannot comply with these requirements, such as certain metal detectors, fluoroscopes or other similar devices, the accessible route shall be permitted to be provided adjacent to security screening devices. The accessible route shall permit persons with disabilities passing around security barriers to maintain visual contact with their personal items to the same extent provided others passing through the security barrier.

Table A.04-T7.: Application of Accessible Features in a Building

ITEMS	REQUIREMENTS	EXCEPTIONS
2. ACCESSIBLE ENTRANCE **AS PER Table A.04-T1. AND ICC ANSI 117.1**	**1. PUBLIC ENTRANCES** i. At least 60% of all public entrances shall be accessible. **2. PARKING GARAGE ENTRANCE** i. Where provided, direct access for pedestrians from parking structures to buildings or facility entrances shall be accessible **3. ENTRANCE FROM TUNNEL/ ELEVATED WALKWAYS** i. Where direct access is provided for pedestrians from a pedestrian tunnel or elevated walkway to a building or facility, at least one entrance to the building or facility from each tunnel or walkway shall be accessible. **4. RESTRICTED ENTRANCES** i. Where restricted entrances are provided to a building or facility, at least one restricted entrance to the building or facility shall be accessible. **5. ENTRANCES FOR INMATES/ DETAINEES** i. Where entrances used only by inmates or detainees and security personnel are provided at judicial facilities, detention facilities or correctional facilities, at least one such entrance shall be accessible. **6. SERVICE ENTRANCE** i. If a service entrance is the only entrance to a building or a tenant space in a facility, that entrance shall be accessible. **7. ACCESSIBE DWELLING UNITS/ TYPE A/ TYPE B** i. At least one accessible entrance shall be provided to each tenant, dwelling unit and sleeping unit in a facility.	i. Loading and service entrances that are not the only entrance to a tenant space need not be accessible.

Table A.04-T7.: Application of Accessible Features in a Building

ITEMS	REQUIREMENTS	EXCEPTIONS
3. PARKING AND PASSENGER LOADING FACILITIES **AS PER Table A.04-T2. AND ICC ANSI 117.1**	**1. GENERAL** i. Where parking is provided, accessible parking spaces shall be provided in compliance with **Table A.04-T2.** and **Table A.04-T7.a.** ii. Where more than one parking facility is provided on a site, the number of parking spaces required to be accessible shall be calculated separately for each parking facility. iii. Accessible parking spaces shall be located on the shortest accessible route of travel from adjacent parking to an accessible building entrance iv. Where passenger loading zones are provided, one passenger loading zone in every continuous 30.4 m maximum of loading zone space shall be accessible. **2. RESIDENTIAL** i. At least 2%, but not less than one, of each type of parking space provided for occupancies in RESIDENTIAL OCCUPANCIES, which are required to have Accessible, Type A or Type B dwelling or sleeping units, shall be accessible. ii. Where parking is provided within or beneath a building, accessible parking spaces shall also be provided within or beneath the building. **3. HOSPITAL, GROUP B AND GROUP C (OUTPATIENT FACILITIES)** i. At least 10%, but not less than one, of patient and visitor parking spaces provided to serve hospital outpatient facilities shall be accessible. **4. REHABILITATION AND OUTPATIENT PHYSICAL THERAPHY FACILITIES** i. At least 20%, but not less than one, of the portion of patient and visitor parking spaces serving rehabilitation facilities specializing in treating conditions that affect mobility and outpatient physical therapy facilities shall be accessible. **5. HEALTHCARE** i. A passenger loading zone shall be provided at an accessible entrance to licensed medical and long-term care facilities where people receive physical or medical treatment or care and where the period of stay exceeds 24 hours	This section does not apply to parking spaces used exclusively for buses, trucks, other delivery vehicles, law enforcement vehicles or vehicular impound and motor pools where lots accessed by the public are provided with an accessible passenger loading zone

Table A.04-T5.a.: Number of Parking spaces required

TOTAL PARKING SPACES PROVIDED	MINIMUM REQUIRED ACCESSIBLE PARKINGS
1. 1 TO 25	1
2. 26 TO 50	2
3. 51 TO 75	3
4. 76 TO 100	4
5. 101 TO 150	5
6. 151 TO 200	6
7. 201 TO 300	7
8. 301 TO 400	8
9. 401 TO 500	9
10 501 TO 1000	2% OF Total
11. 1001 AND ABOVE	20, plus 1 for each 100 or fraction thereof, over 1000

Table A.04-T7.: Application of Accessible Features in a Building

ITEMS	REQUIREMENTS
4. DWELLING AND SLEEPING UNITS **AS PER Table A.04-T6. AND ICC ANSI 117.1**	**1. REHABILITATION/ DAYCARE/ BOARD AND CARE** i. At least 4%, but not less than one, of the dwelling units and sleeping units shall be Accessible units as per **Table A.04-T6.1.** **2. NURSING HOMES** i. At least 50% but not less than one of each type of the dwelling units and sleeping units shall be Accessible units. ii. In structures with four or more dwelling units or sleeping units intended to be occupied as a residence, every dwelling unit and sleeping unit intended to be occupied as a residence shall be a Type B unit. **3. HOSPITALS** i. At least 20%, but not less than one, of the portion of patient and visitor parking spaces serving rehabilitation facilities specializing in treating conditions that affect mobility and outpatient physical therapy facilities shall be accessible. ii. In structures with four or more dwelling units or sleeping units intended to be occupied as a residence, every dwelling unit and sleeping unit intended to be occupied as a residence shall be a Type B unit. **4. DETENTION AND CORRECTION** i. At least 2%, but not less than one, of the dwelling units and sleeping units shall be Accessible units. **5. SPECIAL HOLDING CELLS OR ROOMS** i. In addition to the Accessible units required by **Table A.04-T7.4.4.,** where special holding cells or special housing cells or rooms are provided, at least one serving each purpose shall be mobility features (Accessible unit). Cells or rooms subject to this requirement include, but are not limited to, those used for purposes of orientation, protective custody, administrative or disciplinary detention or segregation, detoxification and medical isolation. **6. RESIDENTIAL, GROUP B (BOARDING, HOSTEL)** i. Accessible units and group B units shall be provided as per **Table A.04-T7.b.** ii. Accessible units shall be dispersed among the various classes of units. Roll-in showers provided in Accessible units shall include a permanently mounted folding shower seat. iii. In structures with four or more dwelling units or sleeping units intended to be occupied as a residence, every dwelling unit and sleeping unit intended to be occupied as a residence shall be a Type B unit. **7. RESIDENTIAL, GROUP A (RESIDENTIAL APARTMENTS, ASSISTED LIVING)** i. Accessible units and group B units shall be provided as per **Table A.04-T7.b.** ii. Where there are four or more dwelling units or sleeping units intended to be occupied as a residence in a single structure, every dwelling unit and sleeping unit intended to be occupied as a residence shall be a Type B unit.

Table A.04-T7.: Application of Accessible Features in a Building

ITEMS	REQUIREMENTS	EXCEPTIONS
4. DWELLING AND SLEEPING UNITS **AS PER Table A.04-T6. AND ICC ANSI 117.1**	**8. HOTEL** i. Accessible units, Type A units and Type B units shall be provided in Hotel occupancies. ii. Hotel occupancies, containing more than 20 dwelling units or sleeping units, at least 2% but not less than one of the units shall be a Type A unit. iii. All units on a site shall be considered to determine the total number of units and the required number of Type A units. Type A units shall be dispersed among the various classes of units. iv. Where there are four or more dwelling units or sleeping units intended to be occupied as a residence in a single structure, every dwelling unit and sleeping unit intended to be occupied as a residence shall be a Type B unit. **9. MULTI-STOREY UNITS** i. Where a multistorey unit is provided with external elevator service to only one floor, the floor provided with elevator service shall be the primary entry to the unit, shall comply with the requirements for a Type B unit and a toilet facility shall be provided on that floor.	i. The required number of Type A units and Type B units in **Table A.04-T7.4.** is permitted to be reduced as below. ii. Where no elevator service is provided in a structure, only the dwelling units and sleeping units that are located on single storey, at least one storey containing dwelling units or sleeping units intended to be occupied as a residence shall be provided with an accessible entrance from the exterior of the structure and all units intended to be occupied as a residence on that storey shall be Type B units. i. A multistorey dwelling or sleeping unit which is not provided with elevator service is not required to be a Type B unit. ii. Where elevator service in the building provides an accessible route only to the lowest storey containing dwelling or sleeping units intended to be occupied as a residence, only the units on that storey which are intended to be occupied as a residence are required to be Type B units.

Table A.04-T5.b.: Number of Required Accessible and Sleeping Units

TOTAL NUMBER OF UNITS PROVIDED	MINIMUM REQUIRED NUMBER OF ACCESSIBLE UNITS WITHOUT ROLL-IN SHOWERS	MINIMUM REQUIRED NUMBER OF ACCESSIBLE UNITS WITH ROLL-IN SHOWERS	TOTAL NUMBER OF REQUIRED ACCESSIBLE UNITS
1. 1 TO 25	1	0	1
2. 26 TO 50	2	0	2
3. 51 TO 75	3	1	4
4. 76 TO 100	4	1	5
5. 101 TO 150	5	2	7
6. 151 TO 200	6	2	8
7. 201 TO 300	7	3	10
8. 301 TO 400	8	4	12
9. 401 TO 500	9	4	13
10 501 TO 1000	2% Of Total	1% Of Total	3% Of Total
11. 1001 AND ABOVE	20, plus 1 for each 100 or fraction thereof, over 1000	10, plus 1 for each 100 or fraction thereof, over 1000	30, plus 2 for each 100 or fraction thereof, over 1000

Table A.04-T7.: Application of Accessible Features in a Building

ITEMS	REQUIREMENTS	EXCEPTIONS
5. ASSEMBLY AREA SEATING **AS PER Table A.04-T5. AND ICC ANSI 117.1**	**<u>1. ASSEMBLY AREA WITH FIXED SEATING</u>** i. Wheelchair spaces and companion seats shall be as per **Table A.04-T5.** ii. In multilevel assembly seating areas, wheelchair spaces shall be provided on the main floor level and on one of each two additional floor or mezzanine levels. iii. Wheelchair spaces shall be provided in each luxury box, club box and suite within assembly facilities. iv. At least 5%, but not less than one, of the total number of aisle seats provided shall be designated aisle seats and shall be the aisle seats located closest to accessible routes. v. Lawn seating areas and exterior overflow seating areas, where fixed seats are not provided, shall connect to an accessible route. vi. Each assembly area where audible communications are integral to the use of the space shall have an assistive listening system. vii. Where stadiums, arenas and grandstands provide audible public announcements, they shall also provide equivalent text or visual information regarding events and facilities. **<u>2. DINING AREA</u>** i. In dining areas, the total floor area allotted for seating and tables shall be accessible. ii. Where dining surfaces for the consumption of food or drink are provided, at least 5%, but not less than one, of the dining surfaces for the seating and standing spaces shall be accessible and be distributed throughout the facility and located on a level accessed by an accessible route.	i. In multilevel assembly spaces utilized for worship services where the second floor or mezzanine level contains 25% or less of the total seating capacity, wheelchair spaces shall be permitted to all be located on the main level. ii. In multilevel assembly seating where the second floor or mezzanine level provides 25% or less of the total seating capacity and 300 or fewer seats, all wheelchair spaces shall be permitted to be located on the main level. iii. Wheelchair spaces in team or player seating serving areas of sport activity are not required to be dispersed. i. In buildings or facilities not required to provide an accessible route between levels, an accessible route to a mezzanine seating area is not required, provided that the mezzanine contains less than 25% of the total area and the same services are provided in the accessible area.
6. TOILETS AND BATHING **AS PER Table A.04-T6. AND ICC ANSI 117.1**	i. Accessible toilets and bathrooms shall be as per **Table A.04-T6.** ii. Family or assisted-use bathing rooms shall include only one shower or bathtub fixture. Family or assisted-use bathing rooms shall also include one water closet and one lavatory. Where storage facilities are provided for separate-gender bathing rooms, accessible storage facilities shall be provided for family or assisted-use bathing rooms. iii. Family or assisted-use toilet and bathing rooms shall be located on an accessible route. iv. The accessible route from any separate-gender toilet room to a family or assisted-use toilet room shall not exceed 152 m. v. In passenger transportation facilities and airports, the *accessible route* from separate-gender toilet rooms to a family or assisted-use toilet room shall not pass through security checkpoints. vi. Where doors swing into a family or assisted-use toilet or bathing room, a clear floor space not less than 762 mm by 1219 mm shall be provided, within the room, beyond the area of the door swing	

Table A.04-T7.: Application of Accessible Features in a Building

ITEMS	REQUIREMENTS
6. TOILETS AND BATHING **AS PER Table A.04-T6. AND ICC ANSI 117.1**	**1. ASSEMBLY, MERCANTILE, MALL** i. An accessible family or assisted-use toilet room shall be provided where an aggregate of six or more male and female water closets is required. In buildings of mixed occupancy, only those water closets required for the assembly or mercantile occupancy shall be used to determine the family or assisted-use toilet room requirement. **2. RECREATIONAL FACILITIES** i. In recreational facilities where separate-gender bathing rooms are provided, an *accessible* family or assisted-use bathing room shall be provided. Fixtures located within family or assisted-use toilet and bathing rooms shall be included in determining the number of fixtures provided in an occupancy.
7. CHECK-OUT AISLES **AS PER Table A.04-T1. AND ICC ANSI 117.1**	i. Where check-out aisles are provided, accessible check-out aisles shall be provided in accordance with **Table A.04-T7.c.** Where check-out aisles serve different functions, at least one accessible check-out aisle shall be provided for each function. ii. Where check-out aisles serve different functions, accessible check-out aisles shall be provided in accordance with **Table A.04-T7.c.** for each function. iii. Where check-out aisles are dispersed throughout the building or facility, accessible check-out aisles shall also be dispersed. iv. Traffic control devices, security devices and turnstiles located in accessible check-out aisles or lanes shall be accessible.
8. DRESSING, FITTING AND LOCKER ROOMS **AS PER Table A.04-T1. AND ICC ANSI 117.1**	i. Where dressing rooms, fitting rooms or locker rooms are provided, at least 5%, but not less than one, of each type of use in each cluster provided shall be accessible.
9. QUEUE AND WAITING LINES **AS PER Table A.04-T1. AND ICC ANSI 117.1**	i. Queue and waiting lines for food, tickets or servicing accessible counters or check-out aisles shall be accessible.

Table A.04-T5.c.: Number of Required Accessible Check-Out Aisles

TOTAL CHECK-OUT AISLES OF EACH FUNCTION	MINIMUM REQUIRED NUMBER OF ACCESSIBLE CHECK-OUT AISLES OF EACH FUNCTION
1. 1 TO 4	1
2. 5 TO 8	2
3. 9 TO 15	3
4. OVER 15	3 Plus 20% of additional Aisles

6. Emergency Evacuation Strategies for People with Determination.

6.1. General

6.1.1. The five general categories of physical disabilities are

a. Mobility Impairment
b. Visual Impairment
c. Hearing Impairment
d. Speech Impairment
e. Cognitive Impairment

6.1.2. The major emergency evacuation components in a building or structure are

a. Emergency Notification (Alarm)
b. Means of Egress

6.1.3. The Challenges faced by physically people with determination can be as obvious as not being able to alert themselves with building emergency notification systems and when alerted, not being able to maneuver through building features for safe evacuation.

6.1.4. To overcome these challenges buildings need to be "Accessible" providing audio and visual alarm notifications and provide accessible routes and features that enable people with determination to maneuver easily to safety during emergencies.

6.1.5. Following guidelines shall be followed to prepare emergency strategies in buildings depending on the presence of people with various disabilities.

6.2. Evacuation of Mobility Impaired People

6.2.1. Mobility impaired people may not have difficulty in hearing or looking. The standard building Fire Alarm and visual notification signals will serve their purpose to alert mobili impaired people and warn them of the emergency and need to vacate the building.

6.2.2. The building shall have accessible routes in compliance with this chapter, providing accessible circulation paths, accessible doors, accessible refuge areas, accessible stairs and accessible elevators.

6.2.3. The building Signage and Notification systems shall comply with this chapter and shall clearly identify the accessible routes to enable the mobility impaired people to find the accessible routes easily and quickly.

6.2.4. Where mobility impaired people cannot use the accessible routes and need assistance, area of refuge such as dedicated area of refuges, corridors of non fire floors or exit stair landings can provide temporary safety from emergency situations in the building.

6.2.5. Where accessible elevators are provided and are part of building evacuation strategy, facility management or General Directorate of Civil Defence personnel can initiate mobility impaired people evacuation using such elevators.

6.2.6. Where mobility impaired people cannot use the accessible routes and elevators not available for evacuation, they need assistance from first responders, General Directorate of Civil Defence personnel, fellow people, neighbors, colleagues, depending on the type of occupancy. Some of the evacuation devices, methods and stair descent devices also need assistance from abled people.

6.2.7. Written or electronic copy of the evacuation procedures and evacuation floor plans will enable them for emergency evacuation.

6.2.8. Foldable wheel chairs shall be provided in every facility. Such wheel chairs shall be stored in easily accessible location. The number of spare wheel chairs shall be in accordance with the number of mobility impaired people in the building. However, minimum of two such wheel chairs shall be available in all occupancies. The facility management shall be trained in usage, maintenance and storing of wheel chairs.

6.3. Evacuation of Visually Impaired People

6.3.1. Visually Impaired people may not have difficulty in hearing or walking. The standard building Fire Alarm, public address system and audio notification signals will serve their purpose to alert visually impaired people and warn them of the emergency and need to vacate the building.

6.3.2. The building shall have accessible routes in compliance with this chapter, providing accessible circulation paths, accessible doors, accessible refuge areas, accessible stairs and accessible elevators.

6.3.3. The building exit and directional signage and Notification systems shall comply with this chapter and shall clearly identify the accessible routes and usable circulation paths to enable the visually impaired people to find the accessible routes. Provision of tactile signs, braille character signage on evacuation plans, in circulation paths, stairs and elevators will enable visually impaired people to find their way to safety easily and comfortably.

6.3.4. New visually impaired people at offices, residential buildings and hospitals should be shown the evacuation plans with tactile and braille signage to familiarize them with options of accessible routes to safety during emergencies.

6.3.5. Handrails shall be provided at all exit stairs as per this chapter so that visually impaired people can maneuver through exits without assistance.

6.3.6. Where visually impaired people cannot navigate through the building, one abled person can lead a single or group of visually impaired people to safety and to exit discharge during fire emergencies.

6.4. Evacuation of Hearing Impaired People

6.4.1. Hearing Impaired people may not have difficulty in seeing or walking. The standard building Fire Alarm with flashing strobe, visual notification signals will serve their purpose to alert hearing impaired people and warn them of the emergency and need to vacate the building.

6.4.2. However, hearing impaired people should be aware in advance which types of visual alarms are triggered in the building in response to what kind of emergencies. Fire emergencies in particular location might trigger visual alarms where as other areas may not trigger alarms but still need to evacuate. Alternative methods of notification need to be put into the emergency evacuation plans for people with hearing impairments so they can get all the information they need to evacuate in a timely manner.

6.4.3. Where hearing impaired people work and live, manual alarms triggered by neighbors and colleagues to warn about non-fire emergencies such as earthquakes, storms, criminal invasion etc.

6.4.4. In assembly areas, malls and roads, visual scrolling reader boards shall be installed to warn the hearing impaired people to notify the emergency situations.

6.4.5. Once the hearing impaired people are warned effectively about the need to evacuate, the usage of standard exits and means of egress is natural for the hearing impaired to find safety of the exterior of building using standard floor plans and visual directional signage.

6.4.6. Written or electronic copy of the evacuation procedures and evacuation floor plans will enable them for emergency evacuation.

6.5. Evacuation of Speech Impaired People

6.5.1. Speech impaired people may not have difficulty in hearing, seeing or walking. These people may not be able to alert other abled people during emergencies. The standard building Fire Alarm, public address system and audio/visual notification signals will serve their purpose to alert speech impaired people and warn them of the emergency and need to vacate the building.

6.5.2. Once the speech impaired people are warned in a standard method about the need to evacuate, the speech impaired people can follow the standard means of egress to safety without any assistance.

6.5.3. Written or electronic copy of the evacuation procedures and evacuation floor plans will enable them for emergency evacuation.

6.6. Evacuation of Cognitive Impaired People

6.6.1. Cognitive impairments prevent a person from using or accessing building features due to an inability to process or understand the information necessary to use the features. Cognitive impairments are caused by a wide range of conditions, but all result in some decreased level of ability to process or understand information, communications or situations.

6.6.2. Standard building features and notification systems are sufficient for cognitive impaired people. however, their ability to understand and process the information to take decisions needs evaluation and verification which needs to be established beforehand and emergency procedures are to be in place for such people.

6.6.3. If the evaluation confirms the ability of cognitive impaired people's capability to evacuate using standard features of building, without assistance, then these people will follow alarm notifications and directional signage to reach safety. If not, then cognitive impaired people should be provided with assistance always to reach them to safety.

7. Standards.

7.1. Acceptable Standards and criteria

7.1.1. There is no year of edition mentioned against any standards. It is the intent of General Directorate of Civil Defence (GDCD) to convey to the customers seeking Standards to follow the "LATEST EDITION OF THE STANDARD, AS AND WHEN THEY ARE UPGRADED/REVISED/AMENDED, TO THE DATE."

7.1.2. Accessible and Usable Buildings and FACILITIES ICC A117.1.

7.1.3. Standards ICC/ANSI A117.1 (Type A and Type B Dwelling Units shall comply with Section 1002 & section 1003

7.1.4. NFPA 5000 which is for Building Construction and safety code.

7.1.5. ANSI/DASMA 303-2017. Performance Criteria For Accessible Communications Entry Systems



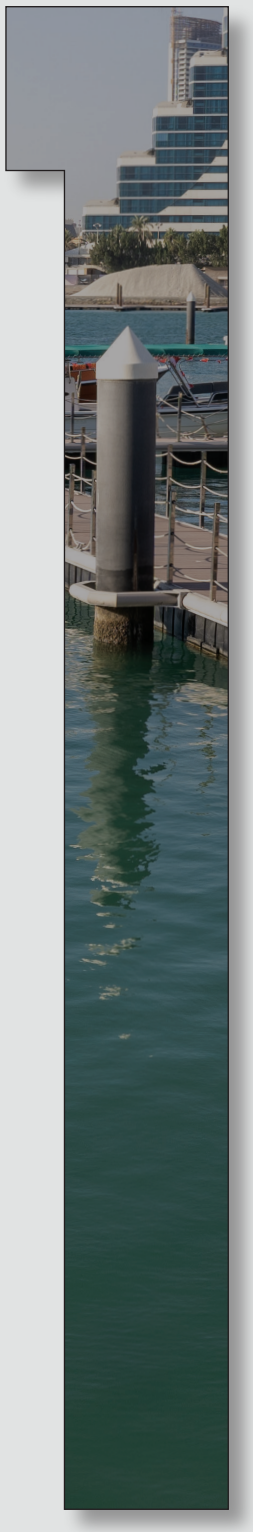
Chapter 1

Marina

Section B

Chapter 1

Marina



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1.0 The scope of this code to ensure acceptable level of fire safety is achieved on marinas, boats, boatyards, yacht clubs, docking facilities, commercial vessels, recreational boats and associated piers, docks and permitted floats.

1.1 Marina management and operator's responsibilities within Civil Defence requirements.

1.2 Access to marina by road and by waterfront

1.3 Construction, Fire and Life safety requirements of Marina.

2.0 Definitions

2.1. General

2.1.1. Shall

It is a mandatory requirement by General Directorate of Civil Defence (GDCD) -Kingdom of Bahrain

2.1.2. Should

It is a suggested requirement recommended by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain but not mandatory.

2.1.3. Listed

Permitted and registered by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain's.

2.1.4. Approved

Permitted and registered by General Directorate of Civil Defence licensing section (GDCD) - Kingdom of Bahrain's.

2.2. Marinas

2.2.1. Marina

A facility, generally on the waterfront, that stores and services boats in berths, on moorings, and in dry storage or dry stack storage.

2.2.2. Pier

A structure extending over the water and supported on a fixed foundation (fixed pier), or on flotation (floating pier), that provides access to the water. A structure, usually of greater length compared to width and projecting from the shore into a body of water with direct access from land, that can be either open deck or provided with a superstructure.

2.2.3. Fixed Pier

Pier constructed on a permanent, fixed foundation, such as on piles, that permanently establishes the elevation of the structure deck with respect to land.

2.2.4. Floating Pier

Pier designed with inherent flotation capability that allows the structure to float on the water surface and rise and fall with water level changes.

2.2.5. Covered Pier

A fixed or floating pier that is provided with a roof system to protect berthed boats from the weather.

2.2.6. Wharf

A structure at the shoreline that has a platform built along and parallel to a body of water with either an open deck or a superstructure.

2.2.7. Boatyard

A facility used for constructing, repairing, servicing, hauling from the water, storing (on land and in water), and launching of boats.

2.2.8. Berth

The water space to be occupied by a boat or other vessel alongside or between bulkheads, piers, piles, fixed and floating docks or any similar access structure.

2.2.9. Slip

A berthing space between or adjacent to piers, wharves, or docks; the water areas associated with boat occupation.

2.2.10. Mooring(s)

Any place where a boat is wet stored or berthed.

2.2.11. Substructure

That portion of the construction below and including the deck immediately above the water.

2.2.12. Superstructure

The portion of the construction of a pier or wharf above the deck.

2.2.13. Marine Terminal

A facility comprised of one or more berths, piers, wharves, loading and unloading areas, warehouses, and storage yards and used for transfer of people and/or cargo between waterborne and land transportation modes.

2.2.14. Terminal Yard

Open areas at a marine terminal site that are provided for the temporary storage of cargo, containers, and cargo-handling equipment. Solid-fill-type wharves that are contiguous to, and form a part of yard areas shall be considered a part of the terminal yard.

2.3. Boats and Motor Craft

2.3.1. Motor Craft

Any boat that is propelled by other than wind or human power.

2.3.2. Machinery Space

Spaces that contain permanently installed engines for mechanical or electrical power or propulsion.

2.3.3. Ignition Source

Any item or substance capable of an energy release of a type and magnitude sufficient to ignite any flammable mixture of gases or vapors that could occur onboard the vessel.

2.3.4. Personal Watercraft

A vessel less than 4 m in length that uses an internal combustion engine powering a water jet pump as its primary source of propulsion and is designed to be operated by a person or persons sitting, standing, or kneeling on rather than within the confines of the hull.

2.3.5. Accessible

Capable of being reached for inspection, maintenance or removal without disturbing the permanent hull structure.

2.3.6. Cargo

A product that is transported for trade and not used for the vessel's operation.

2.3.7. Deck.

A horizontal division in a vessel's structure.

2.3.8. Deck Covering

A material applied to a deck for purposes of increasing the fire or thermal endurance of the deck.

2.3.9. Joiner Construction

Nonstructural partitions used to subdivide compartments, such as bulkhead panels, doors, windows, insulation, ceilings, connectors, and interior finishes.

2.3.10. Lining

Structural components, such as suspended ceilings or curtain bulkheads, which are non–load-bearing or used for aesthetic purposes.

2.3.11. Towboat (Tugboat)

A towing vessel is vessel that is engaged in pulling, pushing, hauling alongside or a combination thereof to tow away the boat in emergency.

2.3.12. Survival Craft

Craft capable of sustaining the lives of persons in distress after abandoning the vessel on which they were originally carried.

2.3.13. Dhow

Generic Arabic term for a sailing vessel.

2.3.14. Vessel

Watercraft of any type.

3.0 Marinas (Marina, Boat yards, Marine Terminals and Terminal Yards)

3.1. Intention

3.1.1. Though the services provided by a marina are those generally associated with active boat use, such as berthing of boats, fueling, sanitary sewage pump out, seasonal boat storage or short-term storage, seasonal boat painting, boat engine maintenance, refueling and voyage repairs. Servicing of a greater nature is generally associated with boatyard facilities. A marina can also incorporate recreational facilities, ship's stores, offices, restaurants or other upland amenities. For the purpose of addressing the fire and life safety issues for marinas in this code, the term “Marina” is used as generic term and also covers boatyards, repair workshops, marine terminals and terminal yards.

3.1.2. However, this chapter does not cover the Tanker moorage, pipeline transfers, storage of flammable liquids, LPG, LNG and similar products in marine tankers, fire and life safety of cruise ships, commercial vessels and deep-sea ship fires.

3.1.3. The marina requirements in this code are to address the following.

3.1.3.1 An efficient fire access way to marinas, boat yards, marine terminals and terminal yards is provided for General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain access during emergencies.

3.1.3.2. Adequate fixed fire protection systems are available at marinas to tackle loading/ unloading area and incidents on shore or vessels and boat fires at marinas.

3.1.3.3. To provide minimum construction, fire and life safety guidelines for marinas, Boat yards, marine terminals and terminal yards to protect life and properties.

3.1.3.4. To provide minimum fire and life safety guidelines for marina operators and yacht owners to be observed on marinas, on board boats, yachts, dhows, and vessels.

3.2. Fundamental approach

3.2.1. Following are the basic approaches that General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain insists marina management, boat owners and marine customers for fire and life safety at marinas.

3.2.1.1. Comply with basic fire safety rules on vessels, boats, yachts and dhows.

3.2.1.2. Provide General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain access road, waterfront access to marinas and provide fixed fire protection systems.

3.2.1.3. Limit the fire to the space and deck of origin using appropriate on-board fire extinguishers and fixed fire hydrants of marina.

3.2.1.4. Marina operators shall have written fire strategy, emergency response plan, rules and regulations for regular inspections, maintenance and housekeeping requirements of vessels, boats, yachts, dhows, marina and storage yards.

3.2.1.5. Marina operators shall have equipment and methods to tow away the vessel on fire from rest of the moored vessels, to mitigate the spread of fire.

3.2.1.6. Limit the fire to the space, area or deck of origin.

3.2.2. The requirements in this chapter are the minimum guidelines. It is the responsibility of vessel designers, consultants, contractors, vessel owners and marina operators to refer to international standards and national regulations such as **Bahrain Yachts Regulations, NFPA 1, NFPA 301, NFPA 302, NFPA 303, NFPA 306, NFPA 307, NFPA 312 and International Code Council - ICC (Chapter 46),** for further clarifications and code compliance.



Devastation of Marina Fires for Illustration

4.0 Construction of Marinas

4.1. Construction of marinas shall comply with **Table: - B.01-T1.**

Table:- B.01-T1: Construction of Marinas

ITEMS	REQUIREMENTS
1. PIERS AND WHARVES	**1. SUBSTRUCTURE CONSTRUCTION** i. All new piers and wharves shall be reinforced concrete or equivalent construction. ii. Where all new piers and wharves constructed of steel and steel piles, shall be provided with fireproofing to provide a minimum of 2-hour fire resistance rating. iii. The existing non- concrete piers and wharves shall be upgraded to comply with **Table:- B.01-T1.1.1.i. or Table:- B.01-T1.1.1. ii.** iv. Design, materials, and workmanship of pier and wharf construction shall conform to standards and construction practices that ensure a durable and safe structure that can withstand the forces of nature to which piers and wharves are likely to be exposed, including the deteriorating influences of the environment and the expected wear and tear of operation and use, so that a safe place is provided for all occupants. v. Concrete or steel portions of pier or wharf structures that are exposed to impact or abrasion by vessels and are subject to damage by floating debris, shall be protected by an open-fender system constructed of non-combustible material as per **Section A, Chapter 02.** vi. When used on the underside of the pier deck, vapor barriers, moisture shields, coatings or finishes shall conform to the definition of noncombustible or limited combustible as defined in **Section A, Chapter 02.** vii. Pier aprons or platforms built along the sides or ends of the pier shall have the substructure and deck constructed using reinforced concrete or equivalent construction. **2. SUPERSTRUCTURE CONSTRUCTION** i. The type of material or combination of materials used in superstructure construction shall meet the general construction provisions of **Section A, Chapter 02.** ii. Exterior walls that are less than 9 m from other buildings or from property lines shall be constructed reinforced concrete or equivalent construction. iii. Exterior walls shall be provided with access to the building interior at intervals not exceeding 60 m for the use of fire fighters, guards and workers.
	 CONCRETE PIER FOR ILLUSTRATION

Table:- B.01-T1: Construction of Marinas

ITEMS	REQUIREMENTS
2. TERMINAL BUILDINGS	i. Where terminal building is a superstructure, it shall comply with **Table:- B.01 T1.1.** ii. Where, terminal buildings are not superstructures, they shall comply with construction requirements as per **Section A, Chapter 02.** iii. All terminal buildings shall be separated from other buildings as necessary to minimize the effects of fire exposure, considering the construction, protection, and separation distances of the respective buildings. iv. Outside storage of cargo shall not be within 6 m of the exterior of the building. Manufacturing, processing, repair, storage operations conducted on the premises of marine terminals shall be confined to separate buildings that are designed, constructed, and protected for that purpose in accordance with **Section A, Chapter 02. and Section D.**
3. TERMINAL YARDS	**1. YARD SURFACE** i. Where yards are situated on piers and wharves, the entire construction shall comply with **Table:- B.01-T1.1.** ii. Yards shall be paved or otherwise surfaced to permit all weather operations of heavy equipment with appropriate marking of roadways, access lanes, parking, and storage areas. iii. Yard shall not allow growth of vegetation. iv. Yards shall be paved or otherwise surfaced to facilitate spill containment and recovery of spills. v. Private vehicle parking in marine terminals shall be permitted only in designated areas. vi. The entire property shall be surrounded by a fence or other means to prevent access by unauthorized persons. vii. Different categories of materials and cargo shall not be mixed and stored on terminal yard.
4. BERTHS	i. Where boats are berthed with the bow or the stern against piers, the piers shall be provided with separation between such berths measuring minimum of 5 m in width, after approximately a distance of 10 boats (approximately 30 m) ii. Each berth shall be arranged such that a boat occupying the berth can be removed in an emergency without the necessity of moving other boats. iii. Where the lay-up berth (vessels declared laid up, requiring restoration, repair or maintenance) is adjacent to a wharf, pier or other land-connected structure, it shall be free from exposure to potential fire and explosion hazards and provide ready access for fire-fighting equipment. vi. Access to all piers, floats, and wharves shall be provided for municipal firefighting equipment.
5. REPAIR WORKSHOPS	i. Construction shall comply with relevant codes of **Section A, Chapter 02.**
6. WAREHOUSES	i. Construction shall comply with relevant codes of **Section A, Chapter 02.**
7. ANCILLIARY BUILDINGS	i. Construction shall comply with relevant codes of **Section A, Chapter 02.**
8. FUEL DISPENSING AREAS	i. Construction shall comply with relevant codes of **Section A, Chapter 02.**

5.0 Fire Service Vehicle, Fireboat and Personnel Accessibility

5.1. Fire service vehicle and personnel accessibility of marinas shall comply with **Table:- B.01-T2.**

Table:- B.01-T2.: Fire service vehicle and personnel accessibility

ITEMS	REQUIREMENTS
1. PIERS AND WHARVES	i. All piers and wharves shall be provided with General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain vehicle access in compliance with **Section A, Chapter 01. Fire service vehicle and personnel accessibility**. ii. No portion of the pier or wharf shall be in excess of 60 m from the fire access road. iii. Fire access for General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain fireboats shall also be provided in accordance with **Section A, Chapter 01, Sub Section 4, Fire Access for General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain Fireboats.** iv. A dedicated berth measuring 15 m long and 5 m in width shall be reserved for the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain fireboats for docking during emergencies. v. The General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain shall have access to fenced, gated, or locked grounds or piers. vi. In coordination with marina operators, appropriate means of access such as keys, cardkeys or combinations shall be provided to the General Directorate of Civil Defence (GDCD) or shall be permitted to be secured in a lock box on the premises accessible to the General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain.
2.TERMINAL BUILDINGS **3. BOATYARDS** **4. REPAIR & MAINTENANCE BUILDINGS**	i. Buildings shall be provided with General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain vehicle access in compliance with **Section A, Chapter 01. Fire service vehicle and personnel accessibility**.
5. TERMINAL YARD	i. The terminal yard shall be provided with General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain vehicle access in compliance with **Section A, Chapter 01. Fire service vehicle and personnel accessibility**. ii. Access for fire-fighting operations shall be provided by means of fire lanes spaced at intervals so that no portion of any storage or parking area is over 15 m. iii. Fire lanes that are U-shaped, do not exceed 90 m in length and are adjacent to cargo piled less than 5 m high shall be permitted to be of 4 m in width. All other fire lanes and access roads shall be a minimum of 6 m in width and in accordance with **Section A, Chapter 01. Fire service vehicle and personnel accessibility**. iv. Multiple number of entry gates, not less than 4.5 m in width shall be provided in the surrounding fence or other barriers to permit access of fire apparatus in case of fire. vi. Fire access for General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain fireboats shall also be provided at the waterfront in accordance with **Section A, Chapter 01, Sub Section. Fire Access for General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain Fireboats.** vi. A dedicated berth measuring 15 m long and 5 m in width shall be reserved for the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain fireboats for docking during emergencies.

6.0 Operational Requirements for Marina Management

6.1. Operational and management requirements for marinas shall comply with **Table:- B.01-T3.**

Table:- B.01-T3.: Operation and Management of Marinas

ITEMS	REQUIREMENTS
1. MARINA MANAGEMENT AND OPERATOR'S RESPONSIBILITY	**1. GENERAL** i. While code compliant design of the marina can reduce certain hazards and risks, the fact remains that proper management of the facility is an important element for reducing the risk of fire at marinas. ii. The marina operators and management shall adopt procedures, prepare emergency action plan, inspection routines and maintenance verification procedures to demonstrate that the facility and equipment are compliant to this code and obtain valid permits and certificates from GDCD regularly. **2. PERMIT TO OWNERS** i. The marina management shall not allow any boats into their marinas to be berthed without issuing a permit to the owner. ii. Such a permit shall be issued only after verifying and receiving a copy of the following. a. Certification of Compliance of the boat Bahrain yacht regulations. b. Valid license for the boat and the owner. c. Valid insurance for the boat and the owner. d. Valid annual safety inspection report for the boat, issued by authorized inspection and maintenance agency. e. Valid annual inspection report of the fire detection, extinguishers and protection systems of the boat, issued by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted inspection and maintenance agency. f. Undertaking letter from the owner to abide by the fire and safety regulations of the marina operator, such as but not limited to 'no live cooking on board', 'no Shisha on board' and 'no barbeque on board'. g. Undertaking letter from the owner to abide by the speed limit of 3 nautical miles at the marinas, boatyards and terminals. iii. The marina operator shall visually inspect the boat to verify good condition of the boat prior to issuing the permit must insure that all boats and floats are registered and permitted by relevant local agencies. **3. FIREBOATS AND TOWING BOATS** i. It is marina management responsibility to be self-sufficient with a minimum of one fireboat fully equipped with the following. a. A fixed fire pump of not less than 1250 gpm, capable of delivering 6.9 bar pressure, necessary hose with nozzles. b. A fixed foam extinguisher, with minimum capacity of 150 Ltr., with necessary hose and nozzles. c. A mobile multipurpose dry powder extinguisher, with a minimum capacity of 50 kg, with necessary hose and nozzle. d. A fixed CO2 fire extinguisher, with a minimum of 20 kg capacity, with necessary hose and nozzle. ii. It is marina management responsibility to be self-sufficient with a towboat having a minimum capacity required to tow away the biggest vessel that the management permits in their marina.

Table:- B.01-T3.: Operation and Management of Marinas

ITEMS	REQUIREMENTS
MARINA MANAGEMENT AND OPERATOR'S RESPONSIBILITY	**4. VESSEL REPAIR, MAINTENANCE AND RE-FUELING WORKS** i. The marina management shall have an inspection made of each boat received for major repair at workshop or at berth or for storage as soon as practicable after arrival of the boat and before commencement of repair or maintenance work aboard. ii. Presence of combustible vapors in any compartment shall be checked. iii. General maintenance and cleanliness, and location of any combustible materials that require removal or protection for the safe accomplishment of the particular work involved shall be done. iv. Quantity, type, and apparent condition of fire-extinguishing equipment onboard shall be inspected. v. Listed and appropriate shore power inlet(s) and ship-to-shore cable(s) shall be ensured. vi. The management shall, as a condition to accepting a boat, require the owner to correct any inadequacies found or to authorize management to do so. vii. Smoking in the working area shall be prohibited. viii. Loose combustibles in the area of any hazardous work shall be removed. ix. Unprotected battery terminals shall be covered to prevent inadvertent shorting from dropped tools or otherwise and the ungrounded battery lead shall be disconnected. x. Personnel employed in the removal or installation of storage batteries shall be qualified. xi. Where electric service is provided to boats in storage, the receptacle providing the power shall be protected with a ground-fault circuit interrupter. xii. The marina operator shall post in a prominent location or provide to boat operators using a marina or boatyard for mooring, repair, servicing, or storage, a list of safe operating procedures stating clearly that use of any form of hibachi grills, charcoal, wood, or gas-type portable cooking equipment, except in specifically authorized areas is prohibited. xiii. Fueling procedures shall be posted and handed over to the customers which should clearly state the following. a. Stop all engines and auxiliaries b. Shut off all electricity, open flames, and heat sources c. Check bilges for fuel vapors d. Extinguish all smoking materials e. Close access fittings and openings that could allow fuel vapors to enter the boat's enclosed spaces f. Remove all personnel from the boat except the person handling the fueling hose xiv. During fueling the following procedures shall be followed. a. Maintain nozzle contact with fill pipe b. Attend fuel-filling nozzle at all times c. Wipe up spills immediately d. Avoid overfilling

Table:- B.01-T3.: Operation and Management of Marinas

ITEMS	REQUIREMENTS
MARINA MANAGEMENT AND OPERATOR'S RESPONSIBILITY	**4. VESSEL REPAIR, MAINTENANCE AND RE-FUELING WORKS** xv. Welding, brazing, soldering, and metal cutting operations shall be performed in a shop specifically provided for the purpose or in an open area. xvi. Such shop, including its flooring, shall be of noncombustible or fire resistive construction. xvii. Combustibles shall be kept at an permitted distance away from the shop or area. xviii. When welding or metal cutting in or on a boat, the following precautions shall be taken a Before operations are started, a fire watch equipped with applicable fire extinguishers shall be established. b Removable combustible materials in proximity to hazardous repair work shall be moved to a safe location aboard or ashore. c Noncombustible material or permitted flameproof tarpaulins shall be used to protect combustible materials that cannot be moved. d Combustible vapor and flammable liquid shall not be in the hot work area. e Means shall be provided to prevent sparks from passing through openings, such as hatches, ports and tank openings. f Noncombustible material, permitted flameproof tarpaulins, or metal shields shall be set around the work in progress to restrict the travel of sparks to other areas. g Before welding or metal cutting is begun on decks or bulkheads, personnel shall inspect conditions on the opposite side thereof and shall determine that the operations will not cause damage by heat or fire. h Fuel tanks shall be safeguarded to prevent vapors from creating a fire hazard. **5. HOUSEKEEPING** i. The marina shall be kept clean all the time, free of vegetation, garbage, discarded plastics, debris, waste materials and combustibles. ii. Debris and waste materials shall be kept in metal containers and removed or emptied at sufficiently frequent intervals to prevent dangerous accumulations. **6. RISK ASSESSMENT AND EVALUATION** i. It is the marina management's responsibility to conduct a comprehensive fire risk assessment of the new, existing and under construction marinas to identify the fire risks, non-compliances and safety violations. ii. The marina management shall upgrade their marinas, firefighting equipment, firefighting systems, operating procedures, training of the staff, emergency action plans and life safety systems to comply with this code by the end of year 2030.

Table:- B.01-T3.: Operation and Management of Marinas

ITEMS	REQUIREMENTS
MARINA MANAGEMENT AND OPERATOR'S RESPONSIBILITY	**7. ELECTRICAL HAZARDS AND SAFETY** i. Electrical systems and electrical equipment in the marina and boatyard require special consideration from marina management because of the existence of wet locations, dampness, rain, atmospheric moisture and severe corrosive conditions. ii. All electrical materials, devices, appliances, fittings, and other equipment shall be listed or labeled by a qualified testing agency, permitted by local power distribution authority and shall be installed and connected in accordance with listing requirements and/or manufacturer's instructions. iii. A bench mark indicating the electrical datum plane of the land area shall be permanently located on shore in the marina or boatyard. iv. Electrical services shall be disconnected from the power source when the water level reaches the bench mark for the electrical datum plane. v. All electrical connections shall be located at least 305 mm above the deck of a floating pier. vi. All electrical connections shall be located at least 305 mm above the deck of a fixed pier but not below the electrical datum plane. vii. Poles or structures used to support electrical service, feeder, or branch circuit shall be used only for that purpose. viii. All cable connections shall be in accordance with **NFPA 70, National Electrical code.** ix. Primary power, when introduced in excess of 230 V phase to phase, shall be transformed to reduce the marina or boatyard electrical system to be not in excess of 230 V phase to phase unless engineered and the system has been permitted by the local power distribution authority. x. The bottom of enclosures for transformers shall not be located below the electrical datum plane. xi. Service equipment, including service disconnecting equipment, meters, and associated equipment, and the main switchboard or panel, shall not be installed in wet locations unless listed for wet locations. xii. Where auxiliary emergency or optional standby power supply equipment is provided, the standby electrical system shall be designed, installed, and maintained as required by the local power distribution authority. xiii. The engine and generator shall be housed in a well-ventilated, fire-resistive enclosure that shall contain only the auxiliary power unit and the necessary controls xiv. The means and methods of grounding the non-current-carrying metal parts of the electrical system and for equipment and portable appliances connected thereto, metal poles, metal supports that carry electrical cables etc. shall comply with the requirements of **Articles 250 and 555 of NFPA 70, National Electrical Code.** xv. Wiring electrical equipment and materials installed on piers, wharves, docks, or similar locations, and wiring methods shall specifically conform to the requirements of **Article 555** and any other applicable requirements of **NFPA 70, National Electrical Code** xvi. Electrical wiring shall be installed in such a way as to avoid possible contact with masts and other parts of boats being moved in the yard. xvii. All the electrical designs, installations, material specifications, approvals, inspections and operations shall be in accordance with local power distribution authority.

Table:- B.01-T3.: Operation and Management of Marinas

ITEMS	REQUIREMENTS
MARINA MANAGEMENT AND OPERATOR'S RESPONSIBILITY	**8. TRAINING** i. It is marina management's responsibility to hire qualified and professional personnel for their operation, administration and maintenance purposes. ii. The marina management employees shall be trained continuously on fire and life safety requirements for marina operations. iii. Such training shall be acquired by authorized and qualified professional training institutions who offer certifications. iv. Each employee shall be instructed in the procedures for responding to a fire, responding to a fire alarm, and reporting a fire to the proper authorities (and to designated facility employees), as well as the employee's designated role(s) in pre fire planning matters. v. Permitted Fire Safety Personnel shall be trained in yard hydrant usage, laying of hose, fire pumps, standpipe systems, wheel-mounted extinguishers and auxiliary water sources in coordination with General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain vi. All employees, including office personnel, shall be given training in the use of portable fire extinguishers. vi. All employees shall know the location and usage of appropriate firefighting equipment. vii. All employees shall be well versed with the "Emergency Action Plan" prepared in accordance with applicable strategies of **Section H, Chapter 02. Emergency Action Plan and Evacuation Procedures"** along with the following considerations. a. Nature of the hazards involved at marinas. b. Types and location of vessels berthed in the marinas. c. Location of communication equipment, hydrants, extinguishers, water sources and other emergency response equipment. d. Designated personnel with their specific roles. **9. LIASON WITH GENERAL DIRECTORATE OF CIVIL DEFENCE (GDCD) - KINGDOM OF BAHRAIN** i. Marina management shall be in a continuous coordination with General Directorate of Civil Defence and other relevant authorities to familiarize with access points, changes in the facility and their emergency action plans. ii. Marina management shall assist the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain in pre fire planning for the following. a. Entries and access routes for equipment within the premises b. Location, construction, use and accessibility of all buildings and all their subdivisions including basements and storage lockers. c. Location and extent of outside working areas. d. Location and means of access to both dry and wet boat storage areas. e. Type and capacity of water lines on piers and walkways, including all points where connection of hydrant or pumper supplies can be affected. f. Types and capacities of facility equipment, including work or tow boats, fire pumps, pier-mounted hose cabinets and all portable fire extinguishers. g. Voltages and capacities of electrical systems and location of electrical disconnecting means. h. Location of gathering (evacuation) points.

Table:- B.01-T3.: Operation and Management of Marinas

ITEMS	REQUIREMENTS
MARINA MANAGEMENT AND OPERATOR'S RESPONSIBILITY	**10. FIRE WATCH** i. Permitted fire safety personnel shall be employed on a 24-hour basis. ii. The route shall be laid out to include every important and potentially hazardous area within the premises. iii. Important and potentially hazardous areas shall be incorporated in a recognized Permitted fire safety personnel recording system, such as a portable watch clock or a computerized reporting system. iv. Permitted fire safety personnel first round shall consist of a complete inspection immediately at the close of the working day. v. Subsequent rounds shall be scheduled so that the interval between visiting each area shall not exceed 1 hour. vi. Document and preserve inspection and maintenance records of fire and hazmat requirements **11. SMOKING AND OTHER RESTRICTIONS** i. Smoking shall be prohibited in the following areas. a. Fuel storage and dispensing areas. b. Covered or enclosed boat storage or berthing areas. c. Battery rooms d. Terminal Yards e. Workshops f. Paint shops g. Other locations identified as dangerous by the management ii. In both language Signs, posters, or posted instructions shall be provided where practicable to remind the owners, guests and public of basic fire safety practices and to warn of unusual or extreme fire hazards. iii. All boat owners at the marina shall be provided with written instructions for reporting fires and other emergencies and actions to be taken in the event of a fire. iv. Open-flame devices used for lighting or decoration shall not be used on a vessel, a float, pier or bulkhead unless permitted by the authority having jurisdiction **12. MAINTAINANCE** i. A maintenance program that requires periodic inspection, testing and operation of fireboats, towboats, fire-fighting equipment and systems and ensures access to all parts of the facility for fire-fighting personnel shall be adopted. ii. All fire-fighting equipment and systems shall be inspected and at regular intervals. iii. Fire extinguishers shall be inspected at least annually and provided with a tag showing the last date of inspection. iv. Fire extinguishers shall be emptied at the end of their service period. v. Hoses shall be unrolled, inspected and tested in accordance with the manufacturer's instructions at least once a year. vi. All electrical equipment, CCTV, Fire detection and alarm system, communication systems, control systems and emergency equipment shall be maintained at regular intervals. vii. Wear and tear of piers and wharves shall be inspected and necessary repair measures shall be taken.

7.0 Storage Requirements

7.1. Outdoor and indoor storage of materials at marinas shall comply with **Table:- B.01-T4.**

Table:- B.01-T4.: Storage Requirements at Marinas

ITEMS	REQUIREMENTS
1. GENERAL	i. The loading, unloading, handling, and storage of hazardous materials is an inherent part of most marine terminal operations. Particular attention should be given to facilities, procedures and operations that minimize dangerous concentrations, avoid the mixing of incompatible materials, ensure safe operations and permit effective fire control in the event of an accident. ii. Tanker moorage, pipeline transfer, storage of flammable liquids, liquefied natural gas, liquefied petroleum gas shall not be handled with general cargo marine terminal operations or general marina. iii. Outside storage of cargo shall not be within 6 m of the exterior of the building. iv. Hazardous material storage, cargo handling, container spacing, cargo area limitations, bulk cargo operations, aisle arrangements at terminal yards etc. shall comply with **NFPA 307. Standard for the Construction and Fire Protection of Marine Terminals, Piers, and Wharves**. v. Flammable and combustible liquids shall be stored, used and handled in accordance with **Section F, Chapter 01. Flammable and Combustible Liquid Usage.** vi. Fuel dispensing shall comply with **Section F, Chapter 01. Flammable and Combustible Liquid Usage.** vii. Liquefied Petroleum Gas shall be stored and installed in accordance with **Section F, Chapter 02. Liquefied Petroleum Gas Code of practice**.
2. BATTERY	i. Where due to size and weight the removal of batteries for storage or charging is impractical, batteries shall be permitted to remain onboard provided the following conditions are met: a. The battery compartment is arranged to provide adequate ventilation. b. A listed battery charger is used to provide a suitable charge. c. The power connection to the charger consists of a three-wire cord of not less than No. 14 AWG conductors connected to a source of 110 V to 125 V single-phase current, with a control switch and approved circuit protection device designed to trip at not more than 125 percent of the rated amperage of the charger. d. There is no connection on the load side of the charger to any other device except the battery, and the boat battery switch is turned off. e. The battery is properly connected to the charger, and the grounding conductor effectively grounds the charger enclosure. f. Unattended battery chargers are checked at intervals not exceeding 8 hours while in operation.

8.0 Fire Protection System Requirements

8.1. Fire protection systems for marinas shall comply with **Table:- B.01-T5.**

Table:- B.01-T5.: Marinas Fire Protection Systems

OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
1. PIERS AND WHARVES	**1. PIERS AND WHARVES** i. Yard hydrant system shall be provided along the wharves and piers as per **Section D, Chapter 04.** ii. No pier, wharf or building portion shall be in excess of 60 m from a yard hydrant. iii. Hydrant network need not be looped. iv. Trolley type foam fire extinguishers shall be provided along the marinas at 60 m intervals. v. The equipment and cabinet shall be permitted for outdoor application. **2. BUILDINGS ON PIERS AND WHARVES HAVING TOAL BUILT UP-AREA MORE THAN 230 m^2 AND/OR BUILT-UP AREA OF INDIVIDUAL BUILIDNG IS MORE THAN 46 m^2 OR BUILDINGS ARE LESS THAN 9 m FROM ADJACENT BUILDING** i. Automatic sprinklers shall be provided in all buildings as per **Section D, Chapter 05.** ii. The sprinkler design density shall be 0.30 gpm with area of sprinkler operation of 2500 ft^2 (232 m^2). iii. Dry riser or Hose reel system shall not be required.	**1. PIERS AND WHARVES** i. The capacity of the fire pump set for hydrant system shall be 1000 gpm at a pressure as required to satisfy 6.9 bar at the most remote hydrant valve. ii. The water tank shall have a capacity of 90 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **2. BUILDINGS ON PIERS AND WHARVES HAVING TOAL BUILT UP AREA MORE THAN 230 m^2 AND/OR BUILT-UP AREA OF INDIVIDUAL BUILIDNG IS MORE THAN 46 m^2 OR BUILDINGS ARE LESS THAN 9 m FROM ADJACENT BUILDING** i. The fire pump and fire water tank feeding hydrant system in accordance with **Table B.01-T3.** shall be sufficient to serve the sprinkler system. ii. Where there is danger of damage to sprinkler, piping or equipment by floating objects, physical barrier shall be provided to exclude such objects.
2. COVERED PIERS AND WHARVES	**1. COVERED PIERS AND WHARVES** i. Yard hydrant system shall be provided along the wharves and piers as per Chapter **Section D, Chapter 04.** ii. No area shall be in excess of 60 m from a yard hydrant. iii. Hydrant network need not be looped. iv. Automatic sprinklers shall be provided in covered piers and wharves as per **Section D, Chapter 05.** v. The sprinkler design density shall be 0.30 gpm with area of sprinkler operation of 2500 ft^2 (232 m^2). vi. Dry riser or Hose reel system shall not be required. vii. Trolley type foam fire extinguishers shall be provided along the fire access road at 120 m intervals. viii. The equipment and cabinet shall be permitted for outdoor application.	**1. COVERED PIERS AND WHARVES** i. The capacity of the fire pump set for hydrant system shall be 1000 gpm at a pressure as required to satisfy 6.9 bar at the most remote hydrant valve. ii. The water tank shall have a capacity of 90 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. iii. Where there is danger of damage to sprinkler, piping or equipment by floating objects, physical barrier shall be provided to exclude such objects. iv. Sprinklers shall be of corrosion-resistant type.

Table:- B.01-T5.: Marinas Fire Protection Systems

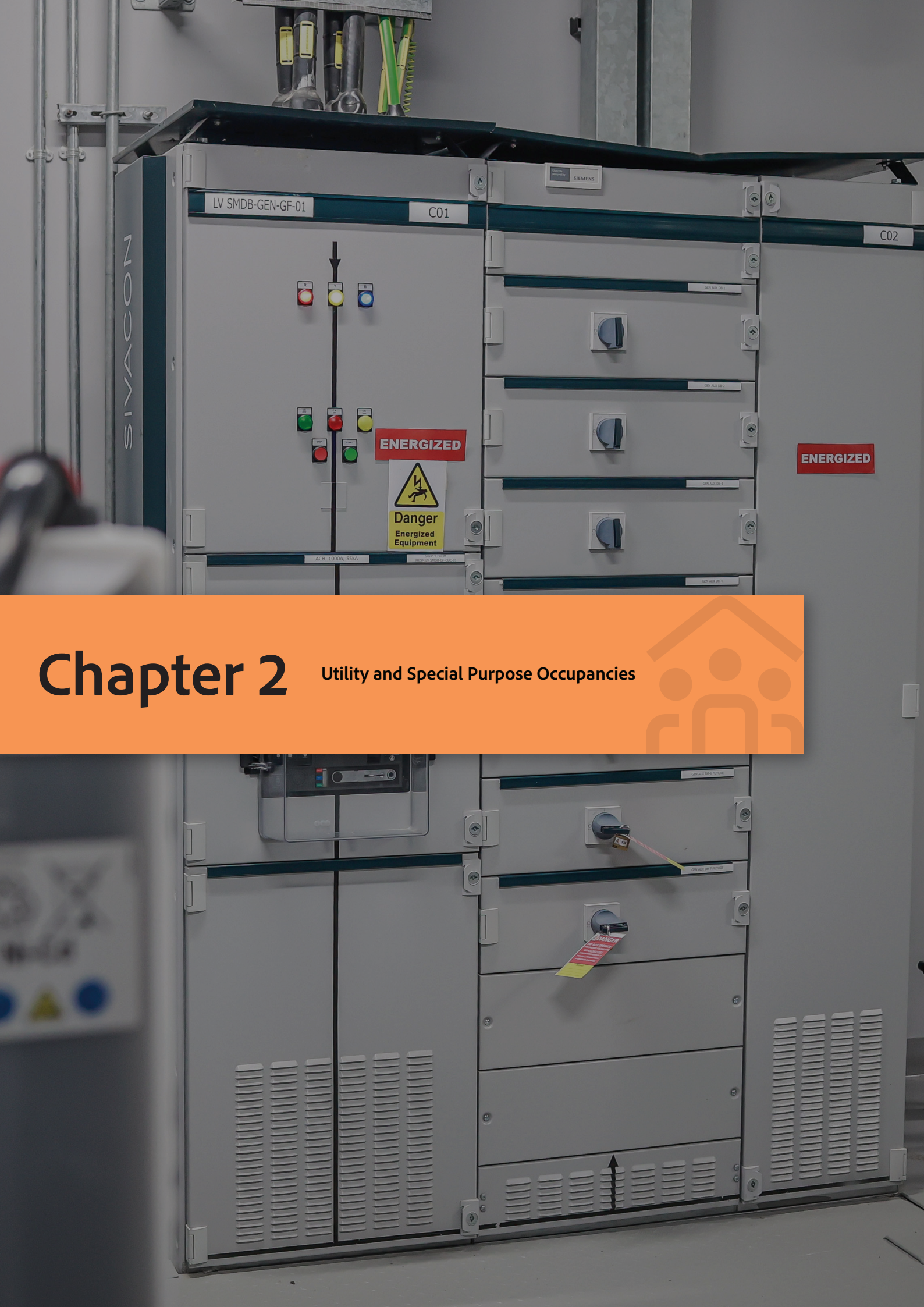
OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
3. TERMINAL YARD	i. Yard hydrant system shall be provided along the wharves and piers as per **Section D, Chapter 04.** ii. No area shall be in excess of 60 m from a yard hydrant. iii. Hydrant network shall be looped in accordance with **Section D, Chapter 04.** iv. There shall be a minimum of 4 breeching inlets distributed along the fire access road, feeding the looped hydrant network. v. Trolley type foam fire extinguishers shall be provided along the piers and wharves at 120 m intervals. vi. The equipment and cabinet shall be permitted for outdoor application.	i. The capacity of the fire pump set for hydrant system shall be 1000 gpm at a pressure as required to satisfy 6.9 bar at the most remote hydrant valve. ii. The water tank shall have a capacity of 120 minutes of operation, with supplementary refilling arrangement for additional 120 minutes, complete with low water level detection and instantaneous refilling arrangement
4. TERMINAL BUILDINGS **&** **5. REPAIR AND MAINTENANCE BUILDINGS**	**1. BUILDINGS STORING BOATS ON RACKS OR BUILDINGS HAVING A BUILT UP-AREA OF MORE THAN 465 m^2** i. Automatic sprinklers shall be provided in all buildings as per **Section D, Chapter 05** ii. The sprinkler design density shall be 0.30 gpm with area of sprinkler operation of 2500 ft^2 (232 m^2). iii. Wet riser + Hose reel system shall be provided throughout the building, as per **Section D, Chapter 03.** where yard hydrant system is not provided. **2. BUILDINGS HAVING A BUILT UP-AREA OF MORE THAN 3600 m^2** i. Automatic sprinklers shall be provided in all buildings as per **Section D, Chapter 05** ii. The sprinkler design density shall be 0.30 gpm with area of sprinkler operation of 2500 ft2 (232 m2). iii. Yard hydrant system shall be provided along the wharves and piers as per **Section D, Chapter 04.** iv. Wet riser system or hose reel system shall not be required.	**1. BUILDINGS STORING BOATS ON RACKS OR BUILDINGS HAVING A BUILT UP- AREA OF MORE THAN 465 m^2** i. The capacity of the fire pump set shall be 1000 gpm at pressure as required to satisfy 4.5 bar at the most remote hose reel outlet valve. ii. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement. **2. BUILDINGS HAVING A BUILT UP-AREA OF MORE THAN 3600 m^2** i. The capacity of the fire pump set shall be 1250 gpm at pressure as required to satisfy 6.9 bar at the most remote hydrant outlet valve. ii. The water tank shall have a capacity of 90 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement.

9.0 Life Safety System Requirements

9.1. Life Safety systems for marinas shall comply with **Table:- B.01-T6.**

Table:- B.01-T6.: Life Safety Systems for Marinas

SYSTEM	LOCATION
1. FIRE DETECTION AND ALARM SYSTEM	i. All enclosed rooms, spaces shall be provided with Automatic fire detection and alarm system in accordance with **Section C, Chapter 01. Fire Detection and Alarm Systems**. ii. All open spaces such as piers, wharves, terminal yards, boat yards shall be provided with manual pull stations or push button type fire alarm system in accordance with **Section C, Chapter 01. Fire Detection and Alarm Systems**. iii. All alarm signals shall be annunciated at the central command center of the marina operator's or management office building at the marina.
2. CCTV	i. All marinas, terminal yards and boatyards shall be provided with CCTV cameras. ii. CCTV footage shall be monitored by at the central command center of the marina operator's or management office building at the marina, by the marina management's designated employees.
3. EMERGENCY LIGHTING	i. All buildings, piers, wharves, terminal yards, boat yards and marina areas shall be provided with outdoor type centrally monitored emergency lighting system in accordance with **Section C, Chapter 04. Emergency Lighting.**
4. ILLUMINATION	i. Electrical lighting shall be provided to ensure adequate illumination of all exterior areas, piers, wharves and floats. ii. Electrical lighting shall not interfere with navigation or aids to navigation. iii. Only listed 120/240 V AC electrical equipment shall be operated unattended.
5. EMERGENCY NOTIFICATION VISUAL ALARM	i. An permitted emergency notification visual alarm shall be provided for the marinas, boatyards and terminals such that the any emergency situations can be visually annunciated and notified to the customers on boats at marinas and at the sea.
6. SIGNAGE	i. Adequate emergency signage, warning signs, caution signs, fire safety instructions, 'NO OPEN FLAME' signs etc. shall be provided throughout the ii. Emergency exit signage shall comply with **Section C, Chapter 05. Exit Signs.**



Chapter 2

Utility and Special Purpose Occupancies

Section B

Chapter 2

Utility and Special Purpose Occupancies



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1.0 SCOPE

1.1 This code provides minimum requirements of fire and life safety to utility occupancies such as Substation, Pumping Station, Sewage Treatment Facilities, Cooling Towers, and Telephone Switching Stations

1.2 To provide Fire Safety requirement for solar power generation facilities.

1.3 Fire Safety requirement for Waste Water Treatment Stations.

1.4 Fire Safety requirement for District Cooling Stations/Cooling Towers.

1.5 Fire Safety requirement for GSM Switching Station.

2. Definitions

2.1. General

2.1.1. Shall

It is a mandatory requirement by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain.

2.1.2. Should

It is a suggested requirement recommended by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain but not mandatory.

2.1.3. Listed

Permitted and registered by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain.

2.1.4. Watts

V X I = W.

Where V is voltage—Voltage—The electromotive force or potential difference, measured in volts. Voltage is the "pressure" that pushes an electrical charge through a conductor.

I is Amperage or Current—The amount of electrical charge flowing past a given point per unit of time, measured in amperes or amps. Amperage is the measure of electrical current flow.

W is Wattage— The rate at which an appliance uses electrical energy. Wattage is considered the amount of work done when one ampere at one volt flows through conductor having one ohm of resistance.

2.2. Utilities

2.2.1. Substation

2.2.1.1. High Voltage Direct Current (HVDC) Converter Station

A facility that functions as an electrical rectifier (ac-dc) or an inverter (dc-ac) to control and transmit power in a high voltage network. There are two types of HVDC valves — the mercury arc valve and the present-day technology solid-state thyristor valve. Both types of valves present a fire risk due to high voltage equipment that consists of oil-filled converter transformers, wall bushings, and capacitors in addition to various polymeric components.

2.2.1.2. Substation

A substation is used to change AC voltages from one level to another (step-up or step-down), and/or change alternating current to direct current or direct current to alternating current. It is used to switch generators, equipment, and circuits or lines in and out of a system. Some substations are small with little more than a transformer and associated switches. Others are very large with several transformers and dozens of switches and other equipment.

2.2.1.3. Transformer (Power Transformer)

A transformer is used to raise (Step-up) or lower (Step-down) the voltage as required to serve through distribution or transmission lines/circuits.

2.2.1.4. Capacitor Bank

Capacitance of conductors and dielectrics that permits the storage of electricity when potential difference exists between the conductors. Its value is expressed as the ratio of quantity of electricity to a potential difference. A capacitance value is always positive. An array of capacitors connected into a circuit. Capacitors are used to control voltages supplied to the customer by eliminating the voltage drop in the system caused by inductive reactive loads.

2.2.1.5. Current Transformer

Can be used to supply information for measuring power flows and the electrical inputs for the operation of protective relays associated with the transmission and distribution circuits or for power transformers. These current transformers have the primary winding connected in series with the conductor carrying the current to be measured or controlled. The secondary winding is thus insulated from the high voltage and can then be connected to low-voltage metering circuits.

2.2.1.6. High Voltage Underground Cables

High Voltage Underground Cables are constructed in many different ways, but are usually shielded cables. They are made with a conductor, conductor-strand shielding, insulation, semi-conducting insulation shielding, metallic insulation shielding, and a sheath. The sheath can be metallic and may then serve as the metallic insulation shielding and be covered with a nonmetallic jacket to protect the sheath. This sheath helps to reduce or eliminate inductive reactance. Such cables are commonly used in circuits operating at 2400 volts or higher.

2.2.1.7. Control Room

The substation room contains switchboard panels, supervisory control/SCADA equipment, power-line carrier, meters, and relays. The control room provides all weather protection and security for the control equipment.

2.2.1.8. Battery Room

Batteries are used in the substation control house as a backup to power the control systems in case of a power blackout. These batteries are stored in dedicated and ventilated Battery room.

2.2.1.9. Battery Charger Room

Battery charger rooms house the battery charging equipment and controls.

2.2.1.10. Shunt Reactor

Shunt Reactors are used in an extra high-voltage substation to neutralize Inductive reactance in long EHV transmission lines.

2.2.1.11. Switchgear

Switchgear can be either for outdoor use or for indoor use. An outdoor metalclad Switchgear is a weatherproof housing for circuit breakers, protective relays, meters, current transformers, potential transformers, bus conductors, and other equipment. An indoor switchgear must be protected from the environment and contains the same types of equipment as the outdoor type.

2.2.1.12. Cable Spread Area

Area populated with High voltage cables penetrating walls and floors, connecting the equipment, transformers, switchgear, control equipment and distribution network.

2.2.1.13. Transmission Bus

Transmission bus are steel structure arrays of switches used to route power into a substation.

2.2.1.14. Distribution Bus

Distribution bus are steel structure arrays of switches used to route power out of a substation.

2.2.1.15. Circuit Breakers

A circuit breaker is an automatically operated electrical switch designed to protect high voltage electrical circuit from damage caused by overload or short circuit. Its basic function is to detect a fault condition and, by interrupting continuity, to immediately discontinue electrical flow. Unlike a fuse, which operates once and then has to be replaced, a circuit breaker can be reset (either manually or automatically) to resume normal operation.

2.2.1.16. Ring Main Unit Room (RMU)

A room housing Ring Main Units. RMU is a totally sealed, gas-insulated compact switchgear unit. The primary switching devices can be either switch disconnectors or fused switch disconnectors or circuit breakers. Different combinations of these primary switching devices within the unit are commonly used.

2.2.2. Solar Power Generation

2.2.2.1. Solar Energy

Energy emitted by the sun in the form of electromagnetic energy. Solar energy is generally understood to mean any energy made available by capturing and converting of solar radiation.

2.2.2.2. Solar Cell or Photovoltaic (PV) Cell

The basic photovoltaic device that generates electricity when exposed to light.

2.2.2.3. Absorber

Component of a solar collector for absorbing radiant energy and transferring this energy as heat into a fluid.

2.2.2.4. Aperture

Solar collector opening through which unconcentrated solar radiation is admitted.

2.2.2.5. Photovoltaic Module

Complete and environmentally protected assembly of interconnected photovoltaic cells.

2.2.2.6. Solar Energy System

Assembly of components that produce and supply electricity by the conversion of solar energy.

2.2.2.7. Array

Assembly of mechanically integrated and electrically interconnected PV modules, PV panels or PV sub-arrays and its support structure. A PV array does not include its foundation, tracking apparatus, thermal control, and other such components.

2.2.2.8. Panel

A collection of modules mechanically fastened together, wired, and designed to provide a field-installable unit.

2.2.2.9. Inverter

Equipment that is used to change voltage level or waveform, or both, of electrical energy. Commonly, an inverter *also known as a power conditioning unit [PCU] or power conversion system [PCS] + is a device that changes dc input to an ac output. Inverters may also function as battery chargers that use alternating current from another source and convert it into direct current for charging batteries.

2.2.2.10. Interactive System

A solar photovoltaic system that operates in parallel with and may deliver power to an electrical production and distribution network. For the purpose of this definition, an energy storage subsystem of a solar photovoltaic system, such as a battery, is not another electrical production source.

2.2.2.11. Building Integrated Photovoltaics

Photovoltaic cells, devices, modules, or modular materials that are integrated into the outer surface or structure of a building and serve as the outer protective surface of that building.

2.2.3. Waste Water Treatment and Collection (Sewage Treatment) Facilities.

2.2.3.1. Industrial Waste

Generally liquid, solid, or gaseous wastes originating from the manufacture of specific products.

2.2.3.2. Domestic Wastewater

Wastewater derived principally from sources such as dwellings, commercial establishments, and institutions, that might or might not contain small amounts of groundwater, surface water, or storm water. Wastewater is primarily composed of the used water supply from the community. It is used to flush and transport human wastes and the liquid wastes of commerce, industry, and institutions. Groundwater, surface water, and storm water might also be present. The primary purposes of wastewater treatment are to protect the health and well-being of the community and the quality of the receiving waterway.

2.2.3.3. Residential Wastewater

Wastewater derived from areas consisting of single- and multiple-family residences.

2.2.3.4. Wastewater Treatment

The first major treatment in a wastewater treatment plant, generally consisting of screening, comminution or grinding, grit removal, sedimentation, skimming, or any combination of such unit processes. The second step in treatment is biological oxidation using activated sludge or trickling filtration followed by clarification.

2.2.3.5. Sludge

A semiliquid mass of accumulated settled solids deposited from raw or treated wastewater in tanks or basins; also referred to as bio-solids.

2.2.3.6. Industrial Sewer

A sewer intended to receive only industrial wastewater or other liquid or water carried wastes that is located on a private property, owned and operated to carry industry specific contaminants, and properly treated to federal and state requirements before direct discharge or receives proper pre-treatment in accordance with federal or state requirements before discharge to a municipal sewer system.

2.2.3.7. Building Sewer

In plumbing, a sewer that consists of the extension from the building drain to the public sewer or other place of disposal; also called house connection or lateral.

2.2.3.8. Sanitary Sewer

A sewer that carries liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions together with minor quantities of storm water, surface water, and groundwater that are not admitted intentionally.

2.2.3.9. Incineration

Combustion or controlled burning of volatile organic matter in sludge and solid waste that reduces the volume of the material while producing heat, dry inorganic ash, and gaseous emissions.

2.2.3.10. Sedimentation

The unit process of subsidence of suspended matter carried by water, wastewater, or other liquids by gravity.

2.2.3.11. Oxygen enriched atmosphere

Air atmospheres containing more than 23.5 percent oxygen by volume at one standard atmosphere pressure.

2.2.3.12. Hydrogen Sulfide (H_2S)

A toxic and lethal gas produced in sewers and digesters by anaerobic decomposition of wastewater solids or other anaerobic wastewater or sludge treatment processes.

2.2.3.13. Methane (CH_4)

A colorless, odorless, flammable gaseous hydrocarbon present in natural gas and formed by the anaerobic decomposition of organic matter.

2.2.3.14. Anaerobic Digestion

A unit process designed to biologically convert organic matter (sludge) through the action of microorganisms in the absence of elemental oxygen.

2.2.4. District Cooling Facilities and Cooling Towers

2.2.4.1. Cooling Tower

A cooling tower is a heat rejection device, which extracts waste heat to the atmosphere though the cooling of a water stream to a lower temperature. The type of heat rejection in a cooling tower is termed "evaporative" in that it allows a small portion of the water being cooled to evaporate into a moving air stream to provide significant cooling to the rest of that water stream

2.2.4.2. District Cooling

District cooling is the centralized production and distribution of cooling energy. Chilled water is delivered via an underground-insulated pipeline to office, industrial and residential buildings to cool the indoor air of the buildings within a district.

2.2.4.3. Counter Flow Cooling Tower

A cooling tower classification in which the water flows countercurrent to the airflow.

2.2.4.4. Cross Flow Cooling Tower

A cooling tower classification in which the airflow is essentially perpendicular to the flow of water.

2.2.4.5. Mechanical Draft Cooling Tower

A cooling tower classification in which air movement depends on fans or blowers.

2.2.4.6. Natural Draft Cooling Tower

A cooling tower containing no fans or blowers, in which air movement depends on the difference in densities of the heated air inside the tower and the cooler air outside.

2.2.4.7. Cell

The smallest tower subdivision that can function as an independent unit with regard to air and water flow.

2.2.4.8. Fire Resistant Partition

A tight, continuous partition suitable for use in a cooling tower environment that has a fire resistance rating of 20 minutes or more.

3.0 Fire and Life Safety of Utility Occupancies

3.1. Substations

3.1. 1. General

3.1.1.1. The provisions of this chapter specify the Fire and Life Safety requirements for Substations.

3.1.1.2. All kinds of substations perform one or combinations of the following functions.
a. Change voltage from one level to the other, up or down.
b. Regulate voltage to compensate for system voltage changes.
c. Switch transmission and distribution lines into and out of the grid system.
d. Measure electric power qualities flowing into the circuits.
e. Connect communication signals to the circuits
f. Eliminate lightning and other electrical surges from the system
g. Connect electric power generating plants to the system.
h. Make interconnections between the electric systems of more than one utility.
i. Control reactive kilovolt-amperes supplied to and the flow of reactive Kilovolt-ampere in the circuits.

3.1.1.3. The fire incidents and risk of fires in substations locally in the kingdom of Bahrain and Internationally have been very low.

3.1.1.4. However, facility has potential fire hazards and the impact of fire can be catastrophic, severely affecting the power supply to citizens, damage to personal and neighboring property and assets.

3.1.1.5. Though most of the substations are unmanned, fire can cost lives of utility personnel, General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain personnel, contracting personnel and even general public, when fire grows.

3.1.1.6. Fire and Life Safety requirements in this chapter are minimum guidelines. It is consultant's responsibility to follow utility provider's material specifications, risk assessments of individual facilities and further requirements of referenced documents of **3.1.1.7.**

3.1.1.7. This chapter is based on the guidelines of **NFPA 850, NFPA 820, NFPA 214, OSHA, IEEE (Institute of Electrical and Electronics Engineers), Electricity and water authority requirements.**

3.1.2. Substations - Fire and Life Safety Requirements

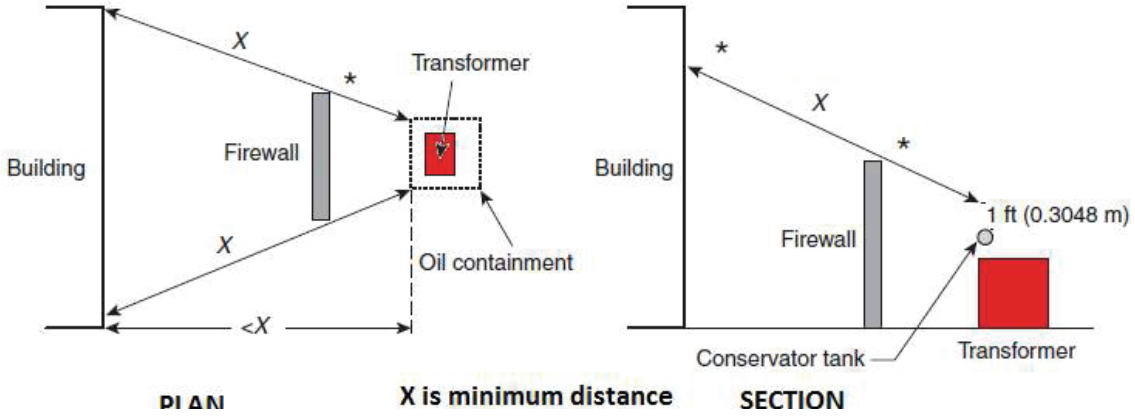
3.1.2.1. The Fire Detection and Life Safety requirements for substation shall be as per **Table:-B.02-T1.**

Table:-B.02-T1: Fire Detection and Life Safety Requirements for Substations

ITEMS	REQUIREMENTS
1. CONSTRUCTION	**1. TYPE OF CONSTRUCTION** i. The Substation building shall be of Fire-Resistant construction equivalent to Type I (443) as per **Section A, Chapter 02.** **2. COMPARTMENTATION** i. Every room of the substation building shall be a 2-hour fire resistance rated separate compartment. ii. Battery rooms, relay rooms, switchgear room, control room, cable spreading room, GIS room shall be separate compartments from each other, of 2-hour fire resistance rating. iii. Battery rooms shall be separate from battery charger rooms with 2-hour fire resistance rated compartments. iv. Fire pump room shall be separated from all other areas by 2-hour fire resistance rated compartment. v. Offices shall be separated from the rest of the areas by 2-hour fire resistance rated compartment. vi. Transformers, capacitors located adjacent to substation building shall be separated from the main building by 2-hour fire resistance rated walls. **3. OUTDOOR OIL INSULATED TRANSFORMERS** i. Power capacitor units located outdoor, which contain a combustible dielectric fluid, should be a minimum of 3m from any structure or building without fire resistive rating. ii. Outdoor oil insulated transformers containing 1893liters or more of oil, shall be separated from adjacent structures and from each other by 2-hour fire resistance rated walls. iii. Such a fire wall separating oil insulated transformers shall be designed to with-stand the effects of exploding transformer bushings or lightening arrestors. iv. Where outdoor transformers are not separated by fire walls, they shall be separated from any structure by a distance as per **Table:-B.02-T1.a.** v. As a minimum, the firewall should extend at least 0.3 m above the top of the transformer casing and oil conservator tank and at least 0.61 m beyond the width of the transformer and cooling radiators.

Table:-B.02-T1.a.: Separation distance of Oil insulated transformers from structures

TRANSFORMER OIL CAPACITY (GAL)	MINIMUM DISTANCE WITHOUT FIRE WALL (X) (m)
1. LESS THAN 500	Oil spill containment basin shall be 1.5 m away from any structure.
2. 500 — 5000	7.6
3. MORE THAN 5000	15.2



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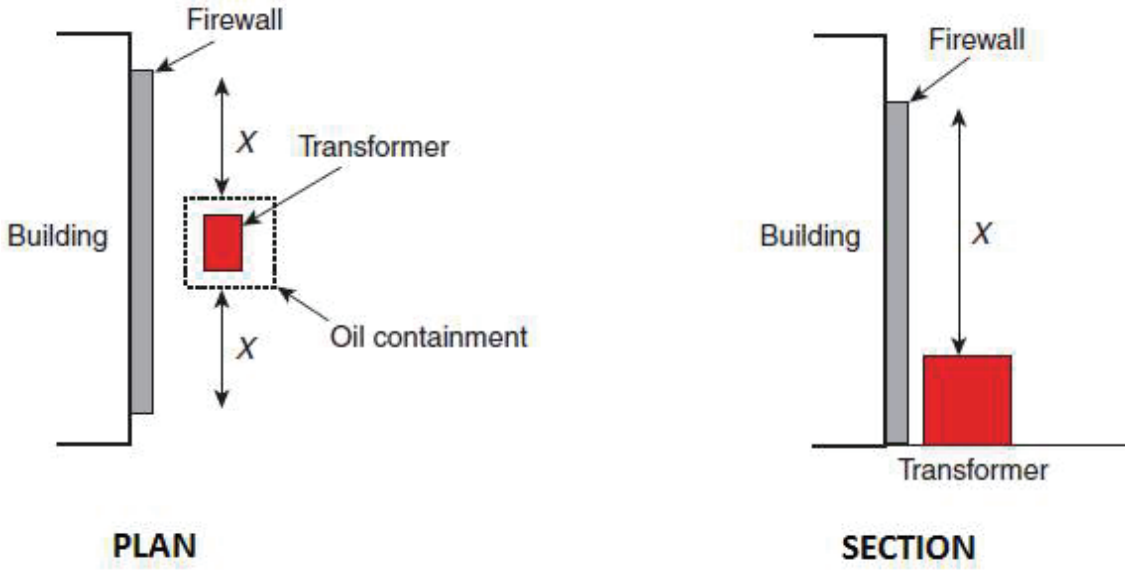


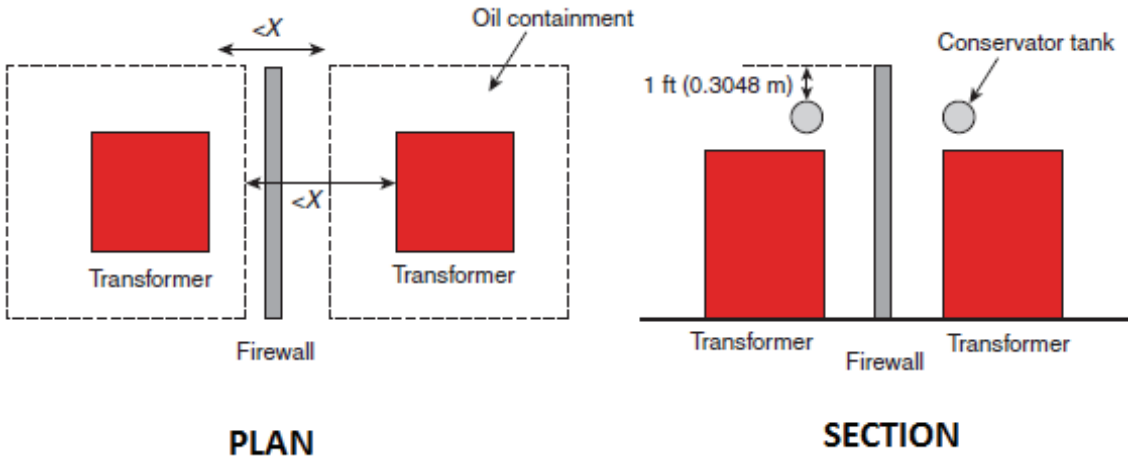


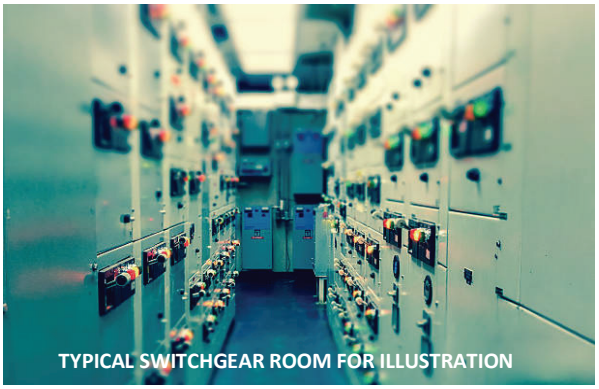
Figure:-B.02-F1.: Outdoor Transformer Separation Distances and Fire Wall Line of Sight



TYPICAL SUBSTATION FOR ILLUSTRATION



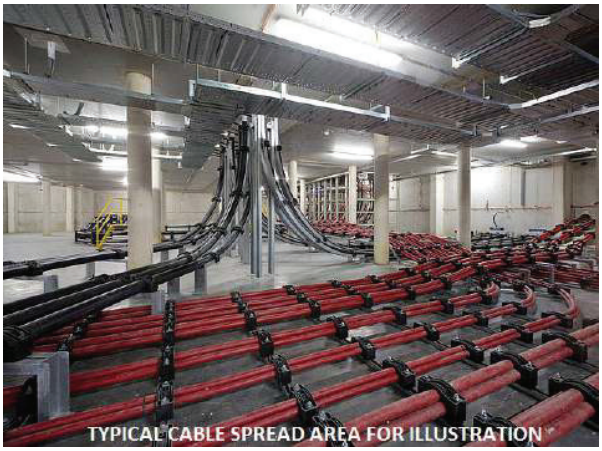
OUTDOOR TRANSFORMERS FOR ILLUSTRATION



TYPICAL SWITCHGEAR ROOM FOR ILLUSTRATION



TYPICAL CONTROL ROOM FOR ILLUSTRATION



TYPICAL CABLE SPREAD AREA FOR ILLUSTRATION

Table:- B.02-T1: Fire Detection and Life Safety Requirements for Substations

ITEMS	REQUIREMENTS
1. CONSTRUCTION	**4. INDOOR OIL INSULATED TRANSFORMERS** i. Capacitor units located indoors, which contain flammable dielectric fluid, should be separated from adjacent areas by a 3-hour fire resistance rated barrier. ii. If transformer is to be indoors, dry type (Air-cooled) transformers are recommended to be installed indoors. iii. When an oil filled equipment or transformer is installed indoors, it should be installed in transformer /Capacitor vault or room. iv. Oil insulated transformers having more than 100-gal oil capacity shall be separated from adjacent areas by 3-hour fire resistance rated fire barriers without fire suppression system and 1-hour fire resistance rated fire barriers if protected with automatic fire suppression as per **Table:-B.02-T1.b.** v. Oil insulated transformers having a rating more than 35 kV shall be separated from adjacent areas by 3-hour fire resistance rated fire barriers without automatic fire suppression system and 1-hour fire resistance rated fire barriers if protected with automatic fire suppression as per **Table:-B.02-T1.b.** vi. Where multiple oil insulated transformers having more than 100-gal oil capacity are installed adjacent to each other in group, the group shall be separated from adjacent areas by 3-hour fire resistance rated fire barrier and automatic fire suppression shall be provided as per **Table:-B.02-T1.b.** **5. OIL CIRCUIT BREAKERS** i. Oil circuit breakers are recommended to be installed outdoors. ii. If circuit breakers are to be indoors, it is recommended to be dry type or gas cooled circuit breakers. **6. SPILL AND DRAINAGE** i. Transformer vaults or rooms, Cable spreading rooms, basements and cable tunnels should be provided with adequate fixed drainage arrangement, preferably with fixed sump and piping. ii. Special precautions should be taken to collect and contain the oil for oil filled equipment and oil filled transformers by providing Yard stone, Bern, holding tanks or curb around equipment, or pits. iii. The substation grading must be contoured to permit the oil to flow to an area that will not affect or endanger other equipment or areas. iv. The discharge from any oil pressure relief device should be directed away from any nearby equipment to prevent from the splashing of flaming oil. v. Equipment protected with water suppression systems shall also be provided with drainage systems to prevent flooding.
2. FIRE STOPPING	i. Every penetration in the substation building shall be sealed and fire stopped with permitted and listed material as per **Section A, Chapter 02, Sub Section 4.** ii. Cable penetrations, equipment penetrations, piping and duct penetrations and all openings in fire barriers shall be provided with permitted and listed fire stopping systems as per **Section A, Chapter 02, Sub Section 4.** iii. Fire barriers shall also be provided with Fire dampers where ducts penetrate to maintain the fire rating and integrity of the fire barrier.

Table:-B.02-T1: Fire Detection and Life Safety Requirements for Substations

ITEMS	REQUIREMENTS
3. FIRE DOORS	i. All doors located in fire barriers, all doors opening into exit corridor, doors in the stairwells shall be fire-rated and shall comply with requirements of **Section A, Chapter 02, Table:- A.02-T10.** ii. All doors located in exterior walls or 3-hour fire barrier vaults, doors shall have a 3-hour fire-resistance rated as per **Section A, Chapter 02, Table:- A.02-T10.** iii. All doors between compartments shall be self-closing and Panic hardware shall be provided on all exit doors.
4. FIRE ACCESS	i. Fire access shall be provided for the substation as per **Section A, Chapter 01, Fire Access.** ii. Minimum of 6 m of road access having capacity to carry fire apparatus weight as per **Section A, Chapter 01**, shall be ensured in remote, rural and desert areas.
5. MEANS OF EGRESS	i. Minimum of 2 exits shall be available from each compartment except storage, offices and roof. ii. Basements and Cable spreading areas' stairs and exits shall discharge directly outside the building at ground floor. iii. 50% of building exits shall discharge directly outside. iv. Basements and Cable spread areas, battery rooms, indoor transformer rooms shall have a maximum travel distance of 23 m, to the exit. v. Control rooms, offices, switchgear rooms, battery charger rooms, HV and LV rooms shall have maximum travel distance of 60 m, to the exit. vi. The Common path of travel anywhere in the building shall not exceed 15 m. vii. There shall be no dead end anywhere in the building. Exits shall be arranged remotely at opposite directions. viii. Batteries, relay and control panels, equipment in the substation shall be arranged such that minimum of 1200 mm exit access width is available between such arrangements or between equipment and the wall. ix. Any Means of egress requirements, dimensions, specifications not mentioned in this section shall comply with **Section A, Chapter 3. Means of Egress.**
6. FIRE EXTINGUISHERS	**1. OFFICES, CORRIDORS** i. Fire extinguishers shall be provided as per **Section D, Chapter 01. Table:-D.01-T3.** **2. LV ROOMS, TELEPHONE ROOMS, CONTROL ROOMS, SWTCHGEAR ROOMS, RMU ROOMS** i. Fire extinguishers shall be provided as per **Section D, Chapter 01. Table:-D.01-T3.** **3. HV ROOM** i. Fire extinguishers shall be provided as per **Section D, Chapter 01. Table:-D.01-T3.** **4. TRANSFORMER (DRY TYPE) ROOM** i. Fire extinguishers shall be provided as per **Section D, Chapter 01. Table:-D.01-T3.**

Table:- B.02-T1: Fire Detection and Life Safety Requirements for Substations

ITEMS	REQUIREMENTS
7. EXIT SIGNS	i. Exit and Directional signs shall be provided at all exit doors and corridors in accordance with **Section C, Chapter 05. Section 4.** ii. Photo luminescent Exit and Directional signs shall be provided at all exit doors and exit access at basements and cable spread areas in accordance with **Section C, Chapter 05. Table C.05-T1.4.** iii. Evacuation plans shall be provided at control room, basements and cable spread areas in accordance with **Section C, Chapter 05. Table C.05-T1.8.** iv. Adequate WARNING signs regarding electric shocks, thermal shock impacts, use of inappropriate Fire Extinguishing media, and precise identification of breeching inlets for particular water system etc. shall be provided throughout the facility.
8. EMERGENCY LIGHTING	i. Monitored type emergency lighting shall be provided throughout the substation in accordance with **Section C, Chapter 04. Section 4.3.** ii. Outdoor Type-High intensity monitored emergency lighting shall be provided near the outdoor transformers, capacitors and fire pump room, in accordance with **Section C, Chapter 04. Section 4.3.** iii. Battery room Emergency Exit Lights shall be explosion proof.
9. VOICE	NOT REQUIRED
10. FIRE ALARM SYSTEM	**1. BATTERY CHARGER ROOM, CONTROL ROOM, CEILING VOIDS, FLOOR VOID, COMMUNICATION ROOM, RMU ROOM, SWITCHGEAR ROOM, RELAY ROOM, LV/MV/HV ROOM** i. Aspiration Type Air Sampling Smoke Detection System shall be provided as per **Section C, Chapter 01. Sub Section 5.5. or** point type optical smoke detection shall be provided in accordance with **Section C, Chapter 01. Sub Section 5.3.** **2. BATTERY ROOM** i. Heat Detection and Alarm System shall be provided as per **Section C, Chapter Sub Section 5.7.** ii. Flame Detection and Alarm System shall be provided as per **Section C, Chapter 01. Sub Section 5.9.** (In addition, listed Hydrogen detectors shall be provided to monitor the Hydrogen levels and to be interfaced with battery room exhaust fan) **3. CABLE SPREADING ROOM, CABLE BASEMENT, CABLE TUNNEL, CABLE TRENCHES** i. Aspiration Type Air Sampling Smoke Detection System shall be provided for the ceiling as per Section **C, Chapter 01. Sub Section 5.5.** ii. Linear Type Heat Detection System shall be provided on the cable trays as per **Section C, Chapter 01 Sub Section 5.8.** **4. INDOOR OIL FILLED TRANSFORMER ROOM** i. Multisensors specifically listed for purpose shall be provided as per **Section C Chapter 01, Table C.01.T12**

Table:- B.02-T1: Fire Detection and Life Safety Requirements for Substations

ITEMS	REQUIREMENTS
10. FIRE ALARM SYSTEM	**5. OUTDOOR OIL FILLED TRANSFORMER VAULTS** i. Flame (Radiant Energy) Detection and Alarm System shall be provided as per **Section C, Chapter 01. Sub Section 5.9.** ii. Probe type Heat detectors shall be provided as per **Section C, Chapter 01. Sub Section 5.7.** **6. AHU ROOM** i. Multi-sensor detector shall be provided as per **Section C, Chapter 01. Table 8.12.1.** **7. FIRE PUMP ROOM** i. Heat Detection and Alarm System shall be provided as per **Section C, Chapter 01. Sub Section 4.7.** **8. OFFICES, CORRIDORS, STORAGE** i. Smoke Detection and Alarm System shall be provided as per **Section C, Chapter 01. Sub Section 4.3.**
11. SMOKE VENTILATION SYSTEM	**1. BATTERY ROOM** i. Ventilation fan shall be provided for the room calculated as per **Chapter 6.Table 6.2.3.** to keep the Hydrogen concentration below 1%. Ventilation fans shall be interfaced with Hydrogen detection. **2. CONTROL ROOM, BATTERY CHARGER ROOM, SWITCHGEAR ROOM** i. Smoke ventilation shall be provided as per **Section E, Chapter 01.** Utilizing building HVAC system to achieve the required smoke ventilation shall be Permitted and shall be designed with motorized dampers and fire rated ducts as per **Section E, Chapter 01.** ii. Room normal air-conditioning shall be such that it creates positive differential pressure compared to outside areas to prevent sensitive equipment damage from smoke infiltration from neighboring areas. **3. CABLE SPREADING ROOM, CABLE BASEMENT** i. Smoke extraction with fire rated ducts and dedicated extract fans shall be provided as per **Section E, Chapter 01.**

3.1.2.2. The Fire Protection for 33/11 kV or higher Primary Substation shall comply with **Chapter 9** and Table**: - B.02-T1.b.**

Table:- B.02-T1.b: Fire Protection Requirements for 33/11 kV or higher Primary Substations

OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP AND WATER TANK CAPACITY
1. OFFICE **2. CORRIDOR** **3. STORAGE** **4. FIRE PUMP ROOM** **5. CIRCULATION AREAS** **6. HVAC ROOM**	i. Sprinklers shall be provided as per Section **D, Chapter 05.** ii. Sprinkler design densities shall be as per **Section D, Chapter 05.** iii. Dry riser + Hose Reel/Rack System shall be provided throughout the substation building as per **Section D, Chapter 03.** iv. Separate breeching inlets shall be provided for sprinkler system, landing valves, water spray systems and labeled clearly.	i. Capacity of the combined fire pump set for Deluge Water Spray, automatic sprinkler system, wet riser system and yard hydrant system shall be 750 gpm at pressure as required to satisfy 6.9 bar at the most remote Landing valve. ii. Fire pump selection, design, installation and maintenance shall be as per **Section D, Chapter 02**. iii. Water tank shall have capacity of 60 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. iv. Water tank shall comply with requirements of **Section D, Chapter 02 and Section A, Chapter 02.** v. Where water mist is opted to be installed to protect Cable tunnels, capacity of the fire pump set for Water Mist shall be as per manufacturer's specification and permitted design and installation guideline.
7. OIL FILLED TRANSFORMERS WITH MORE THAN 500-GAL (1890 L) OIL CAPACITY (INDOOR OR OUTDOOR) **8. CABLE SPREAD AREAS**	Automatic Deluge Water Spray as per **Section D, Chapter 06.** shall be provided.	
9. CABLE TUNNELS	Automatic Deluge Water Spray as per **Section D, Chapter 06. Sub Section 3.8.** Shall be provided. **OR** Automatic Water Mist System, as per **Section D, Chapter 06. Sub Section 3.10.** Shall be provided.	
10. SUBSTATION YARD	Yard Fire Hydrants shall be provided as per **Section D, Chapter 04,. Sub Section 3.11.**, in a loop to cover the entire area.	
11. CONTROL ROOM **12. BATTERY CHARGER ROOM** **13. RMU ROOM** **14. LV/MV ROOM** **15. COMMUNICATION ROOM** **16. CABLE TRENCHES** **17. INDOOR CAPACITOR BANK**	Clean Agent system shall be provided as per **Section D, Chapter 9. Sub Section 3.14.**	
18. SWITCHGEAR ROOM **19. DRY TRANSFORMERS** **20. OIL FILLED TRANSFORMERS WITH LESS THAN 500 GAL OIL CAPACITY**	No Requirement	

3.1.2.3. The Fire Protection for 22/0.4 kV or 11/0.4 kV or lower distribution Substation shall Comply with **Section D and Table: - B.02-T1.c.**

Table:- B.02-T1.c: Fire Protection Requirements for 22/0.4 kV or 11/0.4 kV or lower distribution Substations

OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP AND WATER TANK CAPACITY
1. OFFICE **2. CORRIDOR** **3. STORAGE** **4. FIRE PUMP ROOM** **5. CIRCULATION AREAS** **6.HVAC ROOM**	No Requirements	i. Capacity of the combined fire pump set for Deluge Water Spray and wet riser system shall be 500 gpm at pressure as required to satisfy 6.9 bar at the most remote Landing valve. ii. Fire pump selection, design, installation and maintenance shall be as per **Section D, Chapter 02.** iii. Water tank shall have capacity of 60 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. iv. Water tank shall comply with requirements of **Section D, Chapter 02 and Section A, Chapter 02.**
7. OIL FILLED TRANSFORMERS WITH MORE THAN 500 GAL (1890 L) OIL CAPACITY (INDOOR OR OUTDOOR)	Automatic Deluge Water Spray as per **Section D, Chapter 06. Sub Section 3.8.** shall be provided.	
8. DRY TRANSFORMERS	No Requirements	
9. CABLE TUNNELS	No Requirements	
10. SUBSTATION YARD	No Requirements.	
11. CONTROL ROOM **12. BATTERY CHARGER ROOM** **13. RMU ROOM** **14. LV/MV/HV ROOM** **15. COMMUNICATION ROOM** **16. CABLE TRENCHES**	No Requirements	
17. SWITCHGEAR ROOM **18. DRY TRANSFORMERS** **19. OIL FILLED TRANSFORMERS WITH LESS THAN 500 GAL OIL CAPACITY**	No Requirement	

3.2. Solar Power Generation Systems

3.2.1. General

3.2.1.1. The major concerns of Solar System Fire safety arise from the solar cells itself. Poor installation and connections to inverter might cause a fire.

3.2.1.2. Where fires are triggered in the vicinity of solar product installation, concern in the industry is the reaction of solar products to fire and its impact on flame spread and toxic smoke emission.

3.2.1.3. When solar products are under fire, the toxic product of combustion is a concern to fire fighters, combating the fire.

3.2.1.4. Hence, solar cells or permitted product to international standards is of prime requirement, which along with the weather and energy performance, also assess flame spread characters and toxicity of product of combustion of the product.

3.2.1.5. All solar products shall be General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain listed and permitted. See **Sub Section 3.2.4.** for material permitted.

3.2.1.6. Solar or PV façade systems installation, thermal barrier requirements, fire breaks etc. shall be in accordance with **Section A, Chapter 02, Section 5.** And appropriate additional large-scale façade tests and engineering analysis may also be required.

3.2.2. Hazards to Fire Fighters

3.2.2.1. Solar energy systems on fire consist of following hazards for the fire fighters
a. Trip and Slipping, if installed on roofs/sloped roofs
b. Structural collapse due to Extra weight
c. Flame Spread on panels, spreading to interior and façade
d. Inhalation of toxic products of combustion
e. Electrical Shock
f. Battery emissions and explosions
g. Hot Fluids if the system is thermal

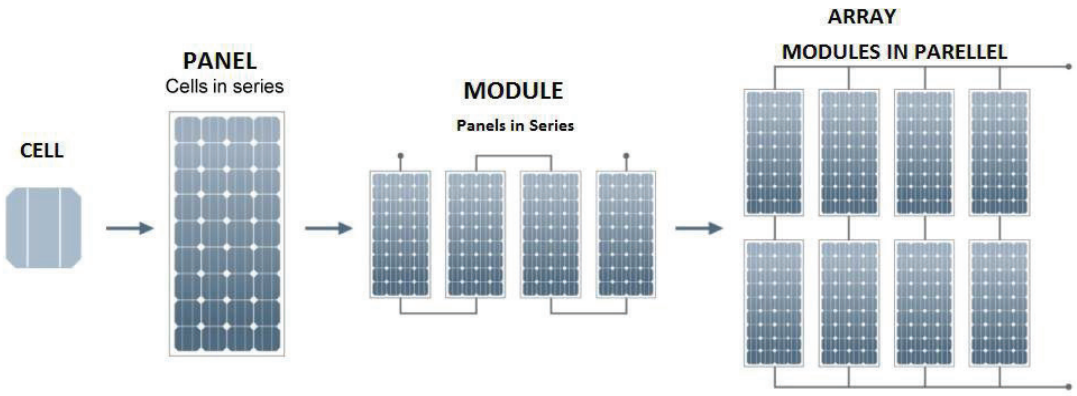


Figure:- B.02-F2.: Solar Energy System Components

3.2.3. Solar Power Generation Systems– Fire and Life Safety

3.2.3.1. The Fire and Life Safety requirements for Solar Power Generation Systems shall be as per **Table:-B.02-T2.**

Table:-B.02-T2.: Fire and Life Safety Requirements for Solar Power Generation Systems

ITEMS	REQUIREMENTS
1. FLAME SPREAD CHARACTERS	**1. FLAME SPREAD CHARACTERISTICS OF PV CELLS ON ROOF** i. The minimum requirement for Solar PV cells to be installed on roof of Low-rise buildings and Private Villas is Class B or equivalent class when tested to test standards as required by **Sub Section 3.2.4.** of this chapter. ii. For Midrise, High-rise and Super High-rise buildings, the minimum requirement for Solar PV cells to be installed on roof is Class A, when tested to test standards as per **Sub Section 3.2.4.** of this chapter. iii. Where solar panels are installed on combustible roofs, such combustible roofs shall be separated from the solar panels, cabling and installations by non- combustible material in accordance with **Section A, Chapter 02. Sub Section 8.1.44.** **2. FLAME SPREAD CHARACTERISTICS OF PV CELLS ON FACADE** i. The minimum requirement for Solar PV cells to be installed on building facade of any building of any occupancy shall be Class A, when tested to test criteria as per **Sub Section 3.2.4.** of this chapter. ii. When solar panels, PV cells are installed on the facade systems, they shall not reduce the structural integrity or the fire resistance rating of the exterior walls. iii. The solar panels and PV cells installed on building envelope, shall demonstrate through large scale system tests that the building envelope is not altered in its fire resistance rating. See **Sub Section 3.2.4.** of this chapter for fire test requirements.
2. CONSTRUCTION	**1. ACCESS** i. Solar panel installations on roof or on commercial scale as generation plant shall provide access to fire fighters around the installations. ii. Minimum of 1.2 m wide access path shall be available around the installations. iii. Solar installations on roof shall be such that access and emergency operations from first responders and fire fighters' operations and maneuvering is not jeopardized. iv. Commercial installations on ground such as Solar power plants shall have 6 m clear fire access around the installations and in between arrays in full compliance with **Section A, Chapter 01. Fire Access**, considering the dead ends, maximum distance, turning radius etc. **2. SECURITY** i. Commercial Solar Panel installations shall be secured with fence and CCTV monitoring to prevent accidental entry of people and animals. Accidental trespassing of people and animals into such installations could result in loss of life and damage to installations.

Table:- B.02-T2.: Fire and Life Safety Requirements for Solar Power Generation Systems	
ITEMS	**REQUIREMENTS**
2. CONSTRUCTION	ii. In domestic installations such as on roofs, facility management should take precautions to isolate and restrict access to such areas to prevent accidental trespassing by children and individuals, posing a risk to their safety. **3. LOCATION** i. The solar panel installations on roof shall not obstruct the Smoke Control System (Pressurization system, Smoke Extract System etc.) equipment and components such as air intake openings and fans. Obstructions to smoke control system components can severely affect the efficiency and intent of the smoke control strategy of the buildings. ii. Solar panel installations shall not obstruct any building means of egress. iii. Solar panel installations shall not obstruct access to LPG Tanks, if any. iv. Solar panel installations shall not obstruct building HVAC components. **4. MEANS OF EGRESS** i. Other than Private Villas and Commercial Villas, solar installations shall have access to two permanent building exit stairs, designed as per **Section A, Chapter 03. Means of Egress.** ii. Solar installations having access with temporary ladders, spiral stairs and open steel stairs are not acceptable.
3. SUBSTATIONS	i. Substations, if any, shall comply with **Sub Section 3.1.** of this chapter.
4. EQUIPMENT	i. Transformers, if any, shall comply with **Sub Section 3.1.** of this chapter. ii. Inverts shall be listed and permitted as per **Sub Section 3.2.3.7.**
5. SYSTEM IDENTIFICA-TION	i. Equipment and the system shall have clear identification label near the control system or Command Center or reception, stating if the type of solar system is “Thermal” or “Photovoltaic” and the associated warning and safety precautions to be taken during fire accidents. ii. Solar components release hazardous and toxic elements when they decompose in fire. These warning details shall be identified and made visible with warning signs. iii. Color coding and standard identification of energized parts of solar system shall be in place to identify “ON” parts such as electrical wire conduits, panel segments etc.
6. EMERGENCY SHUTDOWN	i. In large solar power generation installations, adequate module and array level isolation (disconnect facilities) shall be provided segment wise strategically. Remote shutdown features of modules and arrays shall be considered to enable emergency responders and fire fighters, to safely isolate energized segments and successfully execute firefighting operations. ii. In domestic applications, module and array disconnect switches shall be provided on roof. iii. Disconnect switches for solar system shall be clearly labeled and distinct from any other devices such as “Manual Call Points”, “Emergency LPG Shut-off” and activation buttons of “Fire suppression systems”. iv. Location of disconnect switches, inverters and arrangement of solar arrays shall be depicted in a “Site Layout” plan and shall be posted at key locations such as control rooms, emergency command centers, building receptions etc.

Table:- B.02-T2.: Fire and Life Safety Requirements for Solar Power Generation Systems

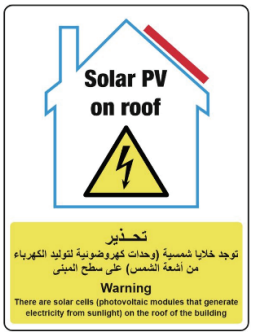
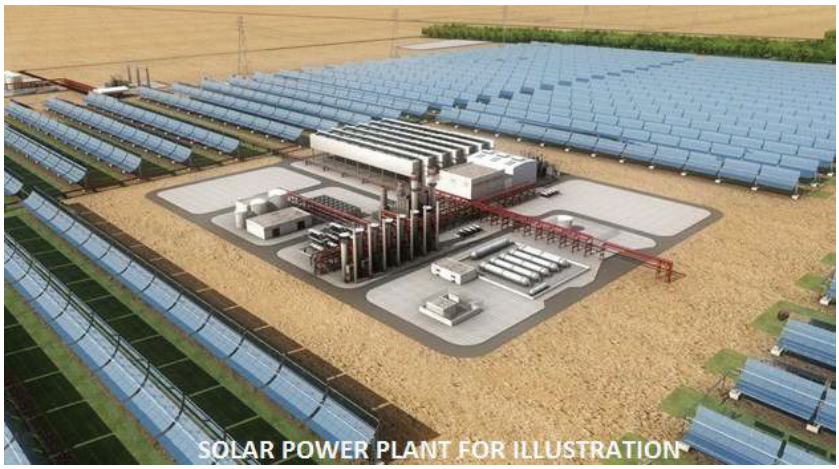
ITEMS	REQUIREMENTS
7. FIRE DETECTION AND ALARM SYSTEM	i. Fire Detection and Alarm system shall be provided to all the ancillary buildings such as control room, equipment room, storage room and inverter rooms of the solar energy generation plants and commercial installations, in accordance with **Section C, Chapter 01. Fire Detection and Alarm System.** ii. Main FACP shall be located in control room with annunciator panel at security guard room or main panel shall be located at security guard room.
8. FIRE EXTINGUISHERS	i. In solar energy generating plants, Fire extinguishers shall be provided through out ancillary buildings in accordance with **Section D, Chapter 01. Fire Extinguishers.** ii. Trolley type, wheeled CO2 extinguishers, in accordance with **Section D, Chapter 01, Table 4.3.5.**, shall be provided at visible and accessible locations throughout large outdoor solar panel installations, in an enclosed protected outdoor cabinet. iii. One Trolley type, wheeled CO2 extinguisher, in accordance with **Section D, Chapter 01, Table 4.3.5.**, shall be provided on roof, where solar panels are installed on roof. iv. Foam Type and Water Type extinguishers shall not be used on solar installation fires.
9. FIRE PROTECTION SYSTEM	NOT REQUIRED. However, substations and transformers, if any, shall comply with **Section 3.1.** of this chapter.
10. WARNING SIGNS	i. Warning signs shall be provided near all solar system installations, as shown. 
	

Table:-B.02-T2.: Fire and Life Safety Requirements for Solar Power Generation Systems

ITEMS	REQUIREMENTS
11. FIRE STRATEGY	**1. GENERAL** i. Preplanned Fire strategy is of utmost important requirement in tackling solar power system fires, since it poses additional dangers and hazards to fire fighters than the normal fires. ii. The Utility service provider, stakeholders, owners, system operators, manufacturers and installers shall jointly develop the fire strategy along with General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain. iii. A clear written fire strategy addressing the electrical shock hazard, isolation of panels and arrays, isolation of modules, type of firefighting agent to be used and the method of firefighting etc. based on the following. **A. KEY ELEMENTS TO BE CONSIDERED IN THE FIRE STRATEGY** i. Management shall assign responsible and knowledgeable person to coordinate with Emergency responders and General Directorate of Civil Defence, who knows hazards and disconnection switch locations and methods and who can assist General Directorate of Civil Defence (GDCD) during fire emergencies. ii. Photovoltaic panels exposed to the sun are always “ON” and hence energized. iii. De-energizing solar panels is almost impossible. So, first responders and fire fighters should always consider the solar system and its components as “energized”. iv. Care should be taken never to cut or damage conduits and equipment and should always be treated as energized. v. Facility management and Utility provider should always be familiar with locations of disconnection switches scattered throughout the installation areas. vi. If all connections to inverter are not disconnected, the grid will still be live with voltages. vii. Battery storage arrangement poses additional threat. Batteries maintain electrical current during night time. Batteries on fire can be explosive and emit hazardous materials, corrosive gases and toxic fumes. viii. Appropriate PPE (Personal Protective Equipment) shall be available at all times along with respiratory protective equipment (Self-contained Breathing Apparatus), during and post fire cleanup activities. ix. Minimum of 5 m distance should be maintained from these equipment while fighting fire. **B. KEY ELEMENTS TO BE CONSIDERED IN THE POST FIRE STRATEGY** i. During normal operation, solar power components are safe but during fire solar cells components are very dangerous in terms on hazardous and toxic materials emitted. ii. Care should be taken to avoid exposure to these hazardous materials during fire and during cleanup activities. iii. New solar technologies in domestic usage are integral part of the building components and materials and during fire, the hazardous nature of these materials may not be obvious to occupants, first responders and firefighters.

Table:- B.02-T2.: Fire and Life Safety Requirements for Solar Power Generation Systems

ITEMS	REQUIREMENTS
12. TRAINING	i. The solar power generation organization, service providers along with manufacturers shall regularly conduct training programs and workshops for the maintenance contractors, emergency responders and General Directorate of Civil Defence (GDCD) personnel. ii. Training shall concentrate on equipping emergency responders and General Directorate of Civil Defence (GDCD) personnel with in-depth knowledge of Solar cells such as a. Their behavior under fire scenarios b. Burning characteristics c. Flame spread, smoke generation, hazardous, corrosive and toxic gases generated etc. d. Identification of energized components of the system e. Identification of disconnecting switches and methods f. International best practices for firefighting in solar system

3.2.4. Solar System (Photovoltaic Cell, PV) Material Test Standards and Permits.

3.2.4.1. Acceptable Test Standards and criteria

3.2.4.1.1. All the Materials, Systems, Assemblies, Pipes and fittings, equipment, Products and Accessories, referred to in this chapter shall be listed, permitted and registered by the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain.

3.2.4.1.2. There is no year of edition mentioned against any test standards. It is the intent of General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain to convey to the customers seeking laboratory tests and the test laboratories to follow the "LATEST EDITION OF THE TEST STANDARD, AS AND WHEN THEY ARE UPGRADED/REVISED/ AMENDED, TO THE DATE."

3.2.4.2. PV Cells (BAPV) to be Installed on Roof of Lowrise Buildings

i. Class B, with ANSI/UL 1703, Standard for Safety for Flat-Plate Photovoltaic Modules and Panels. **OR**
ii. CLASS B, with IEC 61730-2, Requirements for PV modules tested under Fire conditions.

3.2.4.3. PV Cells (BAPV) to be Installed on Roof of Midrise and Highrise Buildings

i. Class B, with ANSI/UL 1703, Standard for Safety for Flat-Plate Photovoltaic Modules and Panels. **OR**
ii. CLASS A, with IEC 61730-2, Requirements for PV modules tested under Fire conditions.

3.2.4.4. PV Cells Integrated into Building (BIPV) Material to be Installed on Roof of Midrise and Highrise Buildings shall Comply with any of the following

i. Class A, with ANSI/UL 790, Standard for Standard Test Method for Roof Coverings
ii. Class A, with ASTM E 108, Standard Test Method of Roof Coverings
iii. Class A, with NFPA 256, Standard Methods of fire tests of roof coverings
iv. Class A, with EN 13501-5, Classification using data from external fire exposure to roofs.
v. Class A, with ISO 13501-5, Classification using data from external fire exposure to roofs.

3.2.4.5. PV Cells (BAPV) to be Installed on facade of any Buildings

i. Class B, d0, S1, with EN 13501-1, Classification using data from reaction to fire tests

3.2.4.6. PV Systems (BAPV) or (BIPV), as Facade System to be Installed on Facade of any buildings

i. Shall be tested as per **Section A, Chapter 02. Table:- A.02-T14.a.**

3.2.4.7. Inverters

i. IEC 62109 –1, Safety of power converters for use in photovoltaic power systems, and IEC 62109 –2, Particular requirements for inverters **OR**
ii. UL 1741, Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources

3.3. Waste Water Treatment and Collection Facilities (Sewage Treatment)

3.3.1. General

3.3.1.1. The requirements of this chapter provide minimum fire and life safety guidelines for Sewage or wastewater treatment facilities and associated collection systems.

3.3.1.2. The principal elements of wastewater treatment are as follows:
a. Preliminary treatment
b. Primary treatment
c. Secondary treatment
d. Tertiary treatment
e. Disinfection
f. Sludge treatment.

3.3.1.3. Preliminary treatment is the conditioning of wastewater as it enters the wastewater treatment plant. Preliminary treatment removes materials that might be harmful to or might adversely affect the operation of the treatment plant. Such material might include lumber, cardboard, rags, stones, sand, plastic, grease, and scum. The methods and equipment used to remove these materials include bar racks, bar screens, and gravity or aerated grit chambers.

3.3.1.4. Secondary treatment is intended to reduce the concentrations of the remaining suspended solids and the dissolved and colloidal organic matter in the Wastewater. Such material is not removed to any significant degree in primary treatment. A wastewater treatment plant having secondary treatment following primary treatment commonly can achieve removal of a total of 90 percent of the influent suspended solids and biochemical oxygen demand of the raw wastewater. Secondary treatment processes can be either biological or physical chemical.

3.3.1.5. Most municipal secondary treatment processes are biological. These processes can be classified as fixed film or suspended growth. In each process, a mixed population of microorganisms is established in the presence of oxygen. These microorganisms metabolize the dissolved organic matter in the wastewater and form a biological mass. The effluent from fixed film or suspended growth processes contains suspended biological solids. These solids are removed from the treated wastewater in a secondary sedimentation tank.

3.3.1.6. Physical–chemical treatment includes one or more physical–chemical unit processes to treat primary effluent. Such processes might include chemical coagulation, precipitation, and filtration to remove suspended matter and activated carbon adsorption to remove soluble organics.

3.3.1.7. Disinfection is necessary to destroy pathogenic bacteria, viruses, and amoebic cysts commonly found in wastewater. Disinfection processes can be chemical, such as ozonation or chlorination, or physical, such as ultraviolet irradiation. Chemical disinfection using chlorine and, infrequently, ozone is the most widely used means of wastewater disinfection.

3.3.2. Wastewater Treatment (Sewage Treatment) Facilities - Fire and Life Safety

3.3.2.1. The Fire and Life Safety requirements for Wastewater treatment facilities shall be as per **Table:- B.02-T3.**

3.3.2.2. The requirements of **Table:- B.02-T3.** Are limited to Fire detection, Fire Protection and ventilation only. Explosion and electrical classification of the hazard shall be evaluated by consultants based on **NFPA 820** and relevant standards and regulations of utility service company.

Table:- B.02-T3.: Fire and Life Safety Requirements for Wastewater treatment facilities

HAZARD/ LOCATION	REQUIREMENTS
1. STORM WATER PUMPING STATION (WET WELLS)	**1. RISK** i. Possible ignition of flammable gases and floating flammable liquids. **2. VENTILATION FOR PROCESS AREAS** i. Normally Not Ventilated. **3. FIRE DETECTION** i. Not required except for ancillary buildings, as per **Section C, Chapter 01.** **4. FIRE PROTECTION** i. Not required.
2. STORM WATER PUMPING STATION (DRY WELLS)	**1. RISK** i. Possible ignition of flammable gases and floating flammable liquids. **2. VENTILATION FOR PROCESS AREAS, IF ENCLOSED** i. Continuously ventilated providing 6 Air Changes per Hour, in compliance with **Section E, Chapter 01.** **3. FIRE DETECTION** i. Not required except for ancillary buildings, as per **Section C, Chapter 01.** **4. FIRE PROTECTION** i. Fire extinguisher shall be provided as per **Section D, Chapter 01.**

Table:- B.02-T3.: Fire and Life Safety Requirements for Wastewater treatment facilities

HAZARD/ LOCATION	REQUIREMENTS
3. RESIDENTIAL WASTEWATER PUMPING STATION (WET WELLS)	**1. RISK** i. Possible ignition of flammable gases and floating flammable liquids. **2. VENTILATION FOR PROCESS AREAS, IF ENCLOSED** i. Continuously ventilated, providing 12 Air Changes per Hour, in compliance With **Section E, Chapter 01.** **3. FIRE DETECTION** i. Combustible Gas Detection shall be provided and Fire Detection and Alarm System shall be provided for ancillary buildings, as per **Section C, Chapter 01.** **4. FIRE PROTECTION** i. Fire extinguisher shall be provided as per **Section D, Chapter 01.**
4. RESIDENTIAL WASTEWATER PUMPING STATION (DRY WELLS)	**1. RISK** i. Buildup of flammable liquid vapors. **2. VENTILATION FOR PROCESS AREAS, IF ENCLOSED** i. Continuously ventilated providing 6 Air Changes per Hour, in compliance with **Section E, Chapter 01** **3. FIRE DETECTION** i. Not required except for ancillary buildings, as per **Section C, Chapter 01.** **4. FIRE PROTECTION** i. Fire extinguisher shall be provided as per **Section D, Chapter 01.**
5. ODOR CONTROL AND VENTILATION SYSTEMS SERVING CLASSIFIED AREAS	**1. RISK** i. Buildup of flammable liquid vapors. **2. VENTILATION FOR PROCESS AREAS, IF ENCLOSED** i. Continuously ventilated providing 6 Air Changes per Hour, in compliance with **Section E, Chapter 01.** **3. FIRE DETECTION** i. Combustible Gas Detection shall be provided and Fire Detection and Alarm system shall be provided for ancillary buildings, as per **Section C, Chapter 01.** **4. FIRE PROTECTION** i. Fire extinguisher shall be provided as per **Section D, Chapter 01.**

Table:- B.02-T3.: Fire and Life Safety Requirements for Wastewater treatment facilities

HAZARD/ LOCATION	REQUIREMENTS
6. DIVERSION AND CONTROL STRUCTURES **7. COARSE AND FINE SCREEN FACILITIES** **8. FLOW EQUALIZATION TANKS** **9. GRIT REMOVAL TANKS** **10. PRE-AERATION TANKS** **11. PRIMARY / SECONDARY / INTERMEDIATE SEDIMENTATION TANKS** **12. ANAEROBIC TOWERS, ANAEROBIC FIXED FILM SYSTEM** **13. GAS HANDLING SYSTEMS FOR LIQUID TREATMENT PROCESS** **14. FLASH MIXER TANKS** **15. NITRIFICATION AND DENITRIFI-CATION TANKS** **16. BREAKPOINT CHLORINATION TANKS**	**1. RISK** i. Possible ignition of flammable gases and floating flammable liquids. **2. VENTILATION FOR PROCESS AREAS, IF ENCLOSED** i. Continuously ventilated, providing 12 Air Changes per Hour, in compliance with **Section E, Chapter 01.** **3. FIRE DETECTION, IF ENCLOSED** i. Combustible Gas Detection shall be provided and Fire Detection and Alarm system shall be provided for ancillary buildings, as per **Section C, Chapter 01.** **4. FIRE PROTECTION** i. Yard Fire Hydrant shall be provided as per **Section D, Chapter 04.** ii. Fire extinguisher shall be provided as per **Section D, Chapter 01.**

Table:- B.02-T3.: Fire and Life Safety Requirements for Wastewater treatment facilities

HAZARD/ LOCATION	REQUIREMENTS
17. AMMONIA STRIPPING TOWERS **18. GRAVITY AND PRESSURE FILTERS** **19. CARBON COLUMN OR TANKS** **20. BACK WASH WATER AND WASTE BACKWASH WATER HOLDING TANKS** **21. ULTRAVIOET DISINFECTION UNIT** **22. EFFLUENT STRUCTURES** **23. SCUM AND GRIT HANDLING BUILDINGS** **24. SCUM PUMPING AREAS** **25. SLUDGE PUMPING AND STORAGE AREAS** **26. DEWATERING BUILDINGS WITH CENTRIFUGES, GRAVITY BELT, VACCUM FILTERS AND FIL-TER PRESSES**	**1. RISK** i. Possible ignition of flammable gases and floating flammable liquids. **2. VENTILATION FOR PROCESS AREAS, IF ENCLOSED** i. Continuously ventilated, providing 12 Air Changes per Hour, in compliance with **Section E, Chapter 01.** **3. FIRE DETECTION, IF ENCLOSED** i. Combustible Gas Detection shall be provided and Fire Detection and Alarm system shall be provided for ancillary buildings, as per **Section C, Chapter 01.** **4. FIRE PROTECTION** i. Yard Fire Hydrant shall be provided as per **Section D, Chapter 04.** ii. Fire extinguisher shall be provided as per **Section D, Chapter 01.**

Table:- B.02-T3.: Fire and Life Safety Requirements for Wastewater treatment facilities

HAZARD/ LOCATION	REQUIREMENTS
27. INCINERATORS AND INCINERATOR BUILDINGS AND OPERATIONS	**1. RISK** i. Firebox Explosion. **2. VENTILATION FOR PROCESS AREAS, IF ENCLOSED** i. Not Applicable **3. FIRE DETECTION, IF ENCLOSED** i. Combustible Gas Detection shall be provided and Fire Detection and Alarm system shall be provided for ancillary buildings, as per **Section C, Chapter 01.** **4. FIRE PROTECTION, IF ENCLOSED** i. Automatic Water Sprinkler/Water Spray/Water Mist shall be provided as per **Section D.** ii. Yard Fire Hydrant shall be provided as per **Section D, Chapter 04.** iii. iii. Fire extinguisher shall be provided as per **Section D, Chapter 01.**
28. WASTE GAS BURNERS	**1. RISK** i. Gas Piping and appurtenances. **2. VENTILATION** i. Not Applicable **3. FIRE DETECTION** i. Not Required. **4. FIRE PROTECTION** i. Not Required.
29. UNDERGROUND TUNNELS WITH PIPING CON-TAINING SLUDGE GAS AND NATURAL GAS	**1. RISK** i. Ignition or natural gas or sludge gas. **2. VENTILATION** i. Not Required. **3. FIRE DETECTION** i. Combustible Gas Detection shall be provided and Fire Detection and Alarm system shall be provided for ancillary buildings, as per **Section C, Chapter 01.** **4. FIRE PROTECTION, IF ENCLOSED** i. Fire extinguisher shall be provided as per **Section D, Chapter 01.**

Table:- B.02-T3.: Fire and Life Safety Requirements for Wastewater treatment facilities

HAZARD/ LOCATION	REQUIREMENTS
30. SLUDGE DRYING,	**1. RISK** i. Dust explosion and dust ignition. **2. VENTILATION FOR PROCESS AREAS, IF ENCLOSED** ii. Not Required. **3. FIRE DETECTION, IF ENCLOSED** i. Fire Detection and Alarm System shall be provided, as per **Section Chapter 01.** **4. FIRE PROTECTION, IF ENCLOSED** i. Automatic Water Sprinkler/Automatic Foam System/ Water Spray/Water Mist s, as applicable on fire risk assessment shall be provided as per **Section D** ii. Yard Fire Hydrant shall be provided as per **Section D, Chapter 04.** iii. Fire extinguisher shall be provided as per **Section D, Chapter 01.** **5. DUST EXPLSOION** i. Explosion protection for the area and boilers shall be provided upon fire risk assessment, in accordance with **NFPA 61, NFPA 69, NFPA 499 and NFPA 654.**



3.4. District Cooling Plants and Cooling Towers– Fire and Life Safety

3.4.1. General

3.4.1.1. The requirements of this chapter provide minimum fire and life safety guidelines for District Cooling facilities and cooling towers.

3.4.1.2. The Fire and Life Safety requirements for district cooling plants and cooling towers shall comply with **Table: - B.02-T4.**

Table:- B.02-T4.: Fire and Life Safety Requirements for District Cooling facilities and Cooling Towers

HAZARD/ LOCATION	REQUIREMENTS
1. PUMP ROOMS (CHILLED WATER PUMPS, MAKE UP WATER PUMPS) **2. R.O. PLANT (REVERSE OSMOSIS)** **3. CHILLER ROOMS**	**1. CONSTRUCTION** i. Plant shall be compartmented into separate fire areas, such as pump rooms, control rooms, electrical equipment rooms, battery rooms etc. with 2 hour fire resistance rated walls **Section A, Chapter 02. Construction.** **2. LIFE SAFETY** i. Minimum of 2 exits shall be provided for the pump rooms, in compliance with **Section A, Chapter 03. Means of Egress.** ii. Exit Signs shall be provided as per **Section C, Chapter 05. Exit Signs.** iii. Emergency Lighting shall be provided as per **Section C, Chapter 03. Emergency Lighting** **3. VENTILATION** i. Ventilation shall be provided in compliance with **Section E, Chapter 01. Smoke Control Systems**. **4. FIRE DETECTION** i. Heat Detection and Alarm System shall be provided, as per **Section C, Chapter 01. Fire Detection and Alarm System.** **5. FIRE PROTECTION** i. Automatic Water Sprinkler shall be provided as per **Section D, Chapter 05. Sprinkler Systems.** ii. Wet Risers shall be provided throughout in accordance with **Section D, Chapter 03. Fire Hose Systems.** iii. Fire extinguisher shall be provided as per **Section D, Chapter 01.**
4. TRANSFORMERS **5. CAPACITIR BANKS** **6. SWITCHGEAR ROOMS** **7. CABLE SPREADING ROOMS** **8. CONTROL ROOMS** **9. BATTERY ROOMS** **10. BATTERY CHARGER ROOMS**	i. Fire and Life safety, Fire Detection and Fire Protection requirements for these hazards and locations, if any, shall be in accordance with **Sub Section 3.1. Substations**, of this chapter.

Table:- B.02-T4.: Fire and Life Safety Requirements for District Cooling facilities and Cooling Towers

HAZARD/ LOCATION	REQUIREMENTS
11. COOLING TOWERS	**1. CONSTRUCTION** i. Water cooling towers with combustible exterior surfaces, including deck, distribution basins, louvers fills etc., shall be located at least 30 m from a) Structures or processes that emit sparks or flying brands under ordinary circumstances, such as chimneys, incinerators, flare stacks or coal burners. b) Materials or processes of severe fire hazard, such as petroleum processing and storage tanks, explosives manufacturing or storage, and petroleum product pipelines and pumping stations. ii. Cooling towers with combustible exterior surfaces which are protected for exposure protection such as water spray system as per **Section D, Chapter 06. Fire Water Spray System**, the separation distance of 12 m from structures and processes as mentioned in **Table:- B.02-T4.11.1.i.,** above shall be acceptable. iii. Cooling towers with "noncombustible" surfaces, distribution system, louvers, fill and drift eliminator shall be permitted to be located at 12 m or more from hazards listed in **Table:- B.02-T4.11.1.i.** iv. A fire resistant partition, tested in accordance with **NFPA 251.** shall be provided to underside of the fan deck (counter flow towers) or distribution basin (crossflow towers) and shall extend below the operating water level of cold-water basin. **2. LIFE SAFETY** i. Minimum of 2 enclosed exits shall be provided for the cooling tower location, in compliance with **Section A, Chapter 03. Means of Egress.** ii. Exit Signs shall be provided as per **Section C, Chapter 05. Exit Signs.** iii. Emergency Lighting shall be provided as per **Section C, Chapter 04. Emergency Lighting** **3. FIRE DETECTION** i. Heat Detection and Alarm System shall be provided, as per **Section C, Chapter 01. Fire Detection and Alarm System.** ii. Where cooling tower deluge water spray system is provided, Pilot Line detectors, installed in accordance with **NFPA 214**, shall be permitted to actuate the deluge water spray system. **4. FIRE PROTECTION** i. Where cooling tower's structure, fan, distribution system, louvers, fill and drift eliminator materials are all of noncombustible materials, fire protection system is not required. ii. Where any of the material of cooling tower is combustible and not classified as "noncombustible", cooling tower shall be provided with deluge water spray system as per **NFPA 214**. and **Section D, Chapter 06, Water Spray Systems.** iii. Where deluge water spray system is provided, minimum rate of application shall be a. Under the fan decks of counter flow towers, shall be 0.5 gpm/ft^2, including fan opening. b. Under the fan decks of crossflow towers, shall be 0.33 gpm/ft^2, including fan opening. c. Over the fill areas of crossflow towers, shall be 0.5 gpm/ft^2 . iv. Wet Risers shall be provided throughout in accordance with **Section D, Chapter 03, Wet Riser Systems.** v. Fire extinguisher shall be provided as per **Section D, Chapter 01.**

3.5. GSM Towers (Switching Stations)- Fire and Life Safety

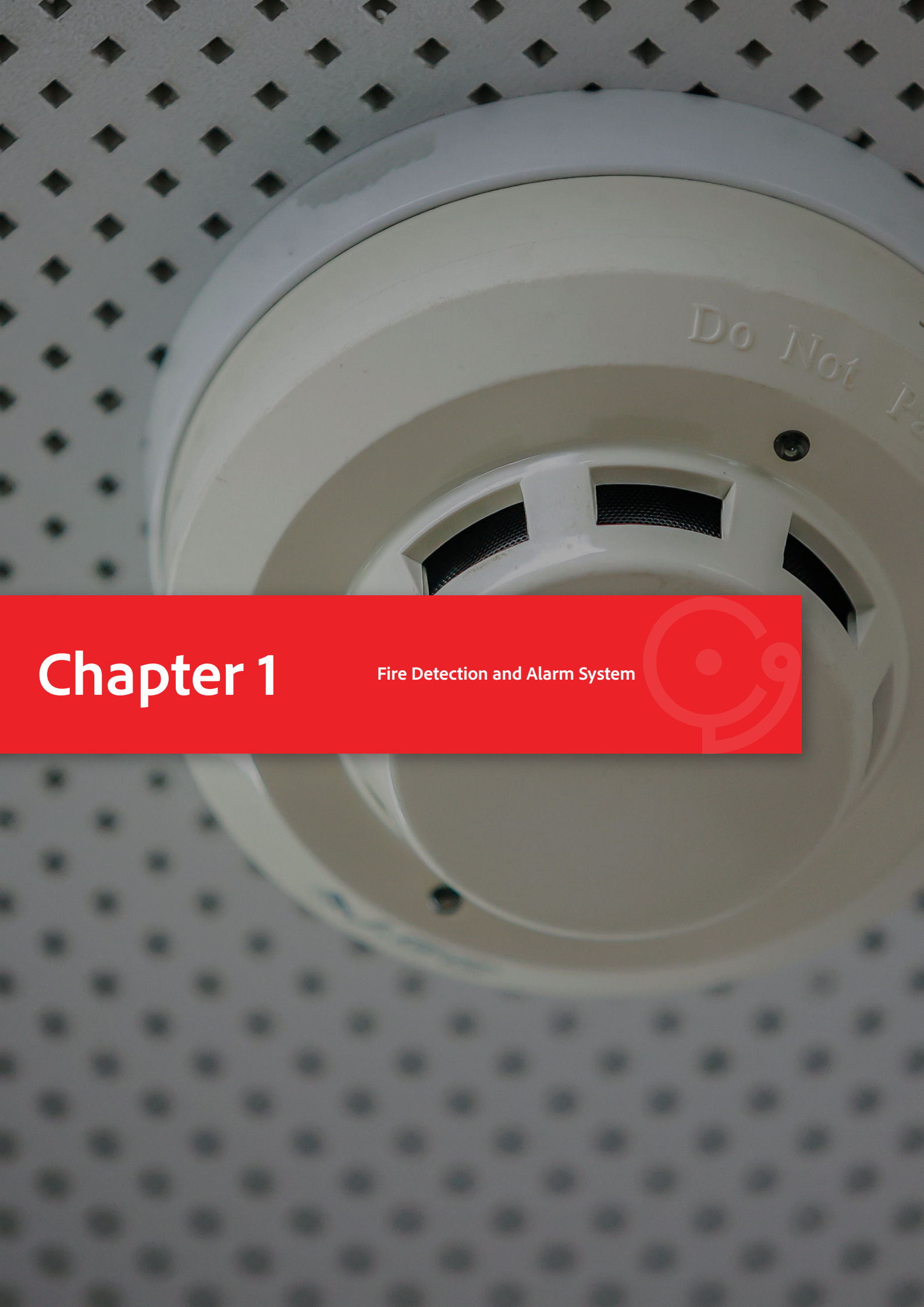
3.5.1. General

2.5.1.1. The requirements of this chapter provide minimum fire and life safety guidelines for GSM Towers or Switching Stations.

2.5.1.2. The Fire and Life Safety requirements for GSM Towers or Switching Stations shall comply with **Table:- B.02-T5.**

Table:- B.02-T5.: Fire and Life Safety Requirements for GSM Towers

HAZARD/ LOCATION	REQUIREMENTS
1. EQUIPMENT CABIN	**1. CONSTRUCTION** i. Cabins and Pole and decorative pole shall be constructed of "Noncombustible" material in accordance with **Section A, Chapter 02. Construction. Table 1.7.45.** **2. LIFE SAFETY** i. Emergency Lighting shall be provided as per **Section C, Chapter 04, Emergency Lighting** **3. FIRE DETECTION** i. Smoke Detection and Alarm System shall be provided, as per **Section C, Chapter 01, Fire Detection and Alarm System.** ii. Smoke Detection and Alarm System shall be annunciated at Telecom service provider main control room. **4. FIRE PROTECTION** i. Fire extinguisher shall be provided as per **Section D, Chapter 01.** ii. Clean agent system, where provided, shall comply with **Section D, Chapter 09. Clean agent Systems.**



Chapter 1

Fire Detection and Alarm System

Section C

Chapter 1

Fire Detection and Alarm System

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8.1 Acceptable Test Standards and criteria.....

1.0 SCOPE

1.1. To provide methods of detecting smoke, heat, flame, fire and providing means of notifying the occupant at the earliest possible.

1.2. This code outline the minimum design, installation, commissioning, and maintenance requirements for fire detection and alarm systems.

1.3. To establish and maintain equipment and material quality.

2.0 DEFINITIONS

2.1 General

2.1.1 Shall

It is mandatory requirement from General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain.

2.1.2 Should

It is a suggested requirement recommended by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain, but not mandatory

2.1.3 Listed

Permitted and registered by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain.

2.2 Types of Smoke and Fire Detectors

2.2.1 Addressable Device

A fire alarm system component with discrete identification that can have its status individually identified or that is used to individually control other functions.

2.2.2 Air-Sampling Type Smoke Detector or Aspirating Smoke Detector (ASD)

A smoke detection system in which an air sample is drawn from the protected area by a ventilator or pump to the central sensor, which analyzes the air sample for the presence of smoke particles.

2.2.3 Analogue Detector

A device that produces a quantitative signal as per status change in the protected zone, and it is unlike the traditional detectors that indicate the on/off statuses only.

2.2.4 Combination Detector

A combination that either responds to more than one of the fire phenomena or employs more than one operating principle to sense one of these phenomena. Typical examples are the combination of a heat detector with a smoke detector or a combination rate of rise and fixed temperature heat detector.

2.2.5 Flame Detector

A device used for detecting infrared and ultraviolet rays emitting from flames.

2.2.6 Fixed Temperature Detector

A device that responds when its sensitive element heated up and reaches the predetermined temperature.

2.2.7 Heat Detector

A fire detector that detects either an abnormally high temperature or rate of rise, or both.

2.2.8 Line-Type Heat Detector

A device used for detecting heat in which the sensing element is continuous line along a certain path, for example heat sensitive cable.

2.2.9 Multi-State Detector

A device that produces output signals (more than two), to include "Normal", "Fire Alarm" and other abnormal conditions.

2.2.10 Optical Beam-Type Smoke Detector

A smoke detector comprising a light source and a receiver to detect the obscuration of light as a result of smoke alone a line. The transmitter and receiver may be at opposite ends or they may be incorporated into a single housing with a reflector at the opposite end.

2.2.11 Rate-of-Rise Detector

A device that responds when the temperature rate of rises is more than a predetermined level.

2.2.12 Smoke Detector

A device used for detecting visible and invisible particles of smoke, resulting from combustion. Several operating principles are used for detection such as photoelectrical, Ionization spot, Air-sampling and optical beam type smoke detectors.

2.2.13 Spot-Type Smoke Detector

A spot-type smoke detector **is a device that detects the presence of smoke at a specific, localized point or area using photoelectric/ light-scattering technique.**

2.2.14 Gas Detector

A device that detects the presence of a specified gas concentration. Gas detectors can be either spot- type or line type detectors.

2.2.15 Multi-sensor Detector

A device that contains multiple sensors that separately respond to physical stimulus such as heat, smoke, or fire gases, or employs more than one sensor to sense the same stimulus. A device capable of generating multiple alarm signals from any one of the sensors employed in the design, independently or in combination. The sensor output signals are mathematically evaluated to determine when an alarm signal is warranted. The evaluation can be performed either at the detector or at the control unit. This device has listings for each sensing method employed.

2.2.16 Radiant Energy sensing Fire Detector

A device that detects radiant energy, such as ultraviolet, visible, or infrared, that is emitted as a product of combustion reaction and obeys the laws of optics.

2.3 Fire Detection System

2.3.1 Addressable System

A system, in which input and output devices have a unique address that can be read, recognized and controlled by the control panel.

2.3.2 Alarm Signal

A signal activated by the alarm system to warn of emergency conditions that require immediate action by all occupants of the affected area.

2.3.3 Alarm Warning

System to warn of emergency conditions that require action by particular people who may (or may not be) occupants of the affected area.

2.3.4 Alarm Zone

Geographical sub-division of the protected premises, in which the fire alarm warning or signal can be given separately, and independently, of a fire alarm warning or signal in any other alarm zone.

2.3.5 Analogue Addressable System

Addressable system that reports quantitative status signals rather than two state signals.

2.3.6 Annunciator

A unit containing one or more indicator lamps, alphanumeric displays or other equivalent means of indication that provides status information about circuit, condition or location information from the main control panel.

2.3.7 Area of voice coverage

Area in which speech signal from voice alarm are sufficiently intelligible and warning signals from the system are sufficiently audible.

2.3.8 Automatic Alarm

Automatic alarm systems that activate auxiliary systems, such as firefighting system, elevators and fire safety system.

2.3.9 Bell

An electromechanical device used to produce audible signals.

2.3.10 Buzzer

A device used to produce low audible warning without causing panic.

2.3.11 Combined System

An alarm system consists of conventional, addressable and analogue systems.

2.3.12 Control Panel

A component of the fire alarm system, provided with primary and secondary power source, which receive signals from initiating devices or other fire alarm control units, and processes these signals to determine part or all of the required fire alarm system output functions.

2.3.13 Decibel

Decibel (dB) is a measurement unit of sound pressure level, it equals one tenth of a Bell, which is the decimal logarithm of ratios between two quantities.

2.3.14 Emergency Communications System (ECS)

A system that is interlinked with the fire alarm to give evacuation or emergency messages throughout the premises for all occupants.

2.3.15 Evacuation system

A system intended to evacuate the building occupants to a safe refuge by broad casting alert and evacuation messages.

2.3.16 Final Voltage of a Battery

The voltage at which the battery is considered depleted. This voltage may be at the point where the powered device no longer functions as intended by the manufacturer where further discharge may cause erratic operation or may cause irreversible damage to the battery or both.

2.3.17 Horn

A funnel-like device used for emitting audible signals different from bell sounds.

2.3.18 Manual Call Point

Manual operation device used to activate the fire alarm.

2.3.19 Manual System

A system that does not contain automatic detectors and whereby the fire alarm may be activated only manually.

2.3.20 Mimic Diagram

A topographic diagram of the protected buildings and its affiliate departments. It consists of electric circuits that activate visual alarm signals connected fire system to indicate alarm location.

2.3.21 Phased evacuation

A system of evacuation in which different parts of the premises are evacuated in a controlled sequence of phases, those parts of the premises expected to be at greatest risk being evacuated first.

2.3.22 Staged Alarm

A fire alarm system in which two or more stages of alarm warning can be given within a given alarm zone before an alarm signal for that zone is triggered.

2.3.23 Standby Supply

An electrical automatic power supply connected to the fire alarm system and operated in case of main supply failure.

2.3.24 Voice Alarm system

Dedicated manual or automatic system for originating and distributing of voice instructions, alert and evacuation signals for the safe evacuation of occupants. This system to be used for emergency situation like fire.

2.3.25 Zone

A part of the protected building which contains one or more fire detectors, the zone defined by a unique alphanumeric which is indicated at the control panel.

2.3.26 Alarm Repeater System

A device or system for the purpose of automatically retransmitting alarm information received by the alarm processing equipment.

2.3.27 Alarm Verification Feature

A feature of automatic fire detection and alarm systems to reduce unwanted alarms wherein smoke detectors report alarm conditions for a minimum period of time, or confirm alarm conditions within a given time period after being reset, in order to be accepted as a valid alarm initiation signal.

2.3.28 Annunciator

A unit containing one or more indicator lamps, alphanumeric displays, or other equivalent means in which each indication provides status information about a circuit, condition, or location.

2.3.29 Fire Safety Plan

Documentation that provides information on the use of alarms, transmission of alarms, response to alarms, evacuation of immediate area, evacuation of smoke compartment, preparation of floors and building for evacuation and extinguishment of fire.

2.3.30 Abnormal Condition

An abnormal condition that poses an immediate threat to life, property, or mission.

2.3.31 Pre-Alarm Condition

An abnormal condition that poses a potential threat to life, property, or mission, and time is available for investigation.

2.3.32 Supervisory Condition

An abnormal condition in connection with the supervision of other systems, processes, or equipment.

2.3.33 Trouble Condition

An abnormal condition in a system due to a fault

2.3.34 Normal Condition.

Circuits, systems, and components are functioning as designed and no abnormal condition exists

2.3.35 Wireless Control Unit

A component that transmits/ receives and processes wireless signals

2.3.36 Two-Way Emergency Communications System

Two-way emergency communications systems are divided into two categories, those systems that are anticipated to be used by building occupants and those systems that are to be used by fire fighters, police, and other emergency services personnel. Two-way emergency communications systems are used to both exchange information and to communicate information such as, but not limited to, instructions, acknowledgement of receipt of messages, condition of local environment, and condition of persons, and to give assurance that help is on the way.

2.3.37 Emergency Command Center

The room(s) or area(s) staffed during any emergency event by assigned emergency management staff. The room or area contains system communications and control equipment serving one or more buildings where responsible authorities receive information from premises sources or systems or from (higher level) regional or national sources or systems and then disseminate appropriate information to individuals, a building, multiple buildings, outside campus areas, or a combination of these in accordance with the emergency response plan established for the premises. The room or area contains the controls and indicators from which the ECS systems located in the room or area can be manually controlled as required by the emergency response plan and the emergency management coordinator or the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain personnel.

2.3.38 Emergency Response Plan

A documented set of actions to address the planning for, management of, and response to natural, technological, and man-made disasters and other emergencies.

2.3.39 Fire Alarm Control Interface

The Fire Alarm control interface coordinates signals to and from the fire alarm system and other systems.

2.3.40 Public Address System

An electronic amplification system with a mixer, amplifier, and loudspeakers, used to reinforce a given sound and distributing the “sound” to the general public around a building.

2.3.41 Intrinsically Safe

Intrinsically Safe Design is a design technique applied to electrical equipment and wiring for Explosive and hazardous locations where flammable vapors and atmosphere exists. The technique is based on limiting energy, electrical and thermal, to a level below that required to ignite a specific hazardous atmospheric mixture. It also combines techniques to not release electrically emitted sparks. (Refer Section F Chapter 1)

2.4 Types of Ceiling Surfaces

2.4.1 Smooth Ceiling

A ceiling surface un interrupted by continuous projections, such as solid joists, beams or ducts extending more than 4 in. (100 mm) below the ceiling surface.

2.4.2 Solid Joist Ceiling

Ceilings that have solid structural or solid nonstructural members projecting down from the ceiling surface for a distance of more than 4 in. (100 mm) and spaced at intervals of 36 in. (910 mm) or less, center to center.

2.4.3 Beam Ceiling

Ceilings that have solid structural or solid nonstructural members projecting down from the ceiling surface more than 4 in. (100 mm) and spaced more than 36 in. (910 mm), center to center.

3.0 FIRE DETECTION AND ALARM SYSTEMS

3.1 Intention

Fire Detection and Alarm Systems requirements in this chapter are to accomplish the following:

3.1.1. To enable designers and owners to make appropriate selection of Fire detection systems to complement the overall Fire Strategy of the building to enhance the safety level.

3.1.2. Provide early warning to occupants about the fire emergencies to enable them to evacuate to safety.

3.1.3. Ensure permitted and listed material and equipment are selected by the consultants and contractors to maintain the quality of Fire Detection and alarm systems

3.1.4. Ensure owners and facility management maintain the Fire Detection and Alarm Systems to continue fulfilling the design intent.

3.2 Fire Detection Concept

3.2.1. The purpose of fire alarm and signaling systems shall be primarily to provide notification of alarm, supervisory, and trouble conditions, to alert the occupants effectively, to evacuate, to summon aid and to control emergency control functions.

3.2.2. The Fire produces variety of reactions and characteristic signatures such as Smoke, Heat, Radiant Energy. However, different fires based on the fuel it is consuming, have different characteristic signatures such as some fires produce intense heat without smoke, some produce low heat with intense smoke and some burn without flame but produce smoldering smoke. The fire detectors are designed to identify and sense these various inputs and process the data to evaluate, compare and differentiate the environmental conditions or preset conditions to generate the output through control systems called “Fire Alarm”.

3.2.3. The Fire Detection and Alarm System essentially consists of Fire Detectors, communicating with Central Control Unit called Fire Alarm Control Panel through wiring or wireless signals to generate Alarm through sounders, bells and audio-visual alarm devices. The entire components are powered by primary power supply and secondary power supply through Batteries.Requirements of this chapter are minimum guidelines. It is consultant’s responsibility to further refer to NFPA 70, NFPA 72, NFPA 75, NFPA 76, NFPA 110, NFPA 111 and Manufacturer’s design specifications and guidelines for more details.

4.0 TYPES OF FIRE DETECTION SYSTEMS

The various types of Fire Detectors that can be incorporated into Fire Detection and Alarm systems are as follows.

4.1 Types of Detectors

4.1.1 Smoke Detectors

A. Ionization Smoke Detectors

B. Photoelectric Smoke Detectors

C. Optical Smoke Detectors

D. Aspiration Type Air Sampling Smoke Detectors

E. Beam Type Smoke Detectors

F. Video Type smoke Detectors

4.1.2 Heat Detectors

A. Spot Type Heat Detectors

B. Line Type Heat Detectors

C. Fusible Link Heat Detectors

4.1.3 Radiant Energy Detectors

A. Ultraviolet Flame Detectors

B. Infrared Flame Detectors

C. Video Type Flame Detection

D. Spark and Ember Flame Detection

4.1.4 Multi-sensing Detectors

A. Heat-Smoke Multi-sensing Detectors

B. Combination of Gases Detectors

4.1.5 Manual Detectors

A. Manual Break Glass Call Point

B. Manual push button Call Point

C. Manual Pull Station

4.1.6 Supervisory Detectors

A. Water Flow Switch Detectors (Sprinkler System, Deluge System etc.)

B. Pressure Switch Detectors (Pre-action Systems,

C. Supervisory Signal Detectors (Pump, Water low level, automatic Door Close/ Open, elevator status etc.)

4.1.7 Gas Detectors

A. Carbon Monoxide (CO) Detectors

B. LP Gas Detectors

C. Flammable Gas and Vapor Detector

4.2 Types of Control Mechanisms

The various types of Control Mechanisms to monitor the Detectors and Sensors are as follows.

A. Addressable Fire Control Systems

B. Conventional Fire Control Systems

C. Wired Fire Control System

5.0 DETAILS OF FIRE DETECTION AND ALARM SYSTEMS

5.1 General Requirements

The general requirements of Fire Detection and Alarm System shall be as per **Table: - C.01-T1**.

Table: - C.01-T1 General Requirements of Fire Detection and Fire Alarm System

ITEMS	REQUIREMENTS
1. EQUIPMENT AND MATERIALS	i. Only listed and Permitted addressable Fire Detection and Alarm System shall be provided in all new constructions. Conventional type Fire detection Systems are not acceptable, unless it is an existing installation. ii. All Fire Detection and Alarm System equipment, Material, Accessories, Wiring shall be General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted and listed as per **Section 8**. iii. System components shall be installed, tested, inspected, and maintained in accordance with the manufacturer's published instructions and this Code. iv. Along with recommendations of this chapter, permitted Manufacturer's specifications should also be followed regarding spacing and installation details. v. All devices and appliances that receive their power from the initiating device circuit or signaling line circuit of a control unit shall be listed for use with the control unit. vi. Equipment shall be designed so that it is capable of performing its intended functions under the following conditions: a. At 85 percent and at 110 percent of the nameplate primary (main) and secondary (standby) input voltage(s). b. At ambient temperatures of 0°C (32°F) and 49°C (120°F) c. At a relative humidity of 85 percent and an ambient temperature of 30°C (86°F)
2. DESIGN BASIS	Fire Detection shall be based on thorough evaluation of the area to be protected with following minimum considerations. i. Structural features, size, and shape of the rooms and bays. ii. Occupancy and uses of areas Ceiling heights iii. Ceiling shape, surface, and obstructions. iv. Ventilation v. Ambient environment vi. Gas characteristics of the gases present vii. Configuration of the contents in the area to be protected viii. Response time(s)
3. DETECTORS (INITIATING	i. All kinds of Detectors shall be permitted and listed by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain Initiating

DEVICES)	devices of the manual or automatic type shall be selected and installed to minimize unwanted alarms. ii. Where subject to mechanical damage, an initiating device shall be protected. A mechanical guard used to protect a smoke, heat, or radiant energy sensing detector shall be listed for use with the detector. iii. Initiating devices shall be supported independently of their attachment to the circuit conductors. iv. Unless tested and listed for recessed mounting, detectors shall not be recessed into the mounting surface. v. Initiating devices shall be installed in a manner that provides accessibility for periodic inspection, testing, and maintenance.
4. MANUAL CALL POINTS	i. The manual call points shall be used only for fire alarm initiation. In addition, all manual call points within an occupancy shall be of similar design. ii. Time from the operation of call point to the actuation of alarm signal shall not exceed (10) seconds. iii. Where call points are installed in combustible, explosive environments these devices shall be listed for the application (**Refer section F Chapter 1).** iv. Where manual call points are installed in food preparation environment, where breakable parts resulting from operation may cause risks, the designer shall consult with and conform to related permitted standards. v. The manual call points shall be installed on all escape routes and in particular beside stairwell entrances and all exits to open air. vi. The manual call points shall be installed so that they are clearly visible, unobstructed and accessible. vii. Distribution of the manual call points should be such that travel distance should not be more than 61 m to reach the nearest manual call point. viii. These figures to be reduced to 25m and 16m in limited mobility areas like in which area's having greatest risk of fire. ix. Manual Call Point shall be installed within 1.5 m from exit door opening. x. The manual call points shall be installed generally at the height of 1.2 m, above floor level and in plain, accessible, well-lit and free-hindrances places.

5. COVERAGE	i. Every building shall be provided with Addressable Fire Detection and Alarm System as per General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain Regulation. Every building, enclosed structure, enclosed occupiable spaces and building under construction shall be provided with Automatic Addressable Fire Detection and Alarm System. ii. Detectors shall not be installed until after the cleanup of all construction works is completed and finalized. Any detectors installed for the purposes of protection during construction, shall be checked to confirm that their sensitivity is within the listed and marked sensitivity range and shall be repaired or replaced as necessary. iii. Detector coverage shall include all rooms, halls, storage areas, basements (unless protected by automatic sprinklers), attics, lofts and other enclosed usable spaces. iv. Detectors shall not be required to cover above false ceiling compartmented spaces on the rooms having less than 5m2 area. v. Detectors shall not be required below open grids/cloud ceilings if opening of the grid are 6.4 mm or large and such openings constitute at least 70% of the ceiling or grid material. vi. Detectors shall not be required at non-combustible spaces such as below raised floor or accessible trench areas which do not consist service pipes, electrical wiring and communication cables.
6. STAIRS	i. At least one smoke detector shall be installed at the top of stairways in non- high-rise building. Additional smoke detectors may be required based on building size and layout. ii. In Highrise and Super Highrise buildings, along with one smoke detec-tor at the top of the stair, multiple smoke detectors at intermediate landings, every 23 m, shall be provided. iii. Stairs shall be provided with Voice speakers with clear speech audibility. iv. Sounders shall not be required in stairs.
7. ELEVATOR SHAFT	i. At least one smoke detector shall be installed at the top of the elevator shaft of a non-high rise building to initiate elevator recall. ii. In Highrise and Super Highrise buildings, along with one smoke detec-tor at the top of the shaft, multiple smoke detectors at intermediate levels, every 23 m, shall be provided to initiate elevator recall.
8. PARTITIONS	i. Where partitions within the spaces extend to within 15% of the ceiling height, the spaces separated by the partitions shall be considered as separate rooms. ii. And such separate rooms shall be provided with individual detector coverage.
9. HVAC	i. In spaces served by air-handling systems, detectors shall not be located lesser than 1m from supply or return diffusers, where airflow prevents operation of the detectors.

	ii. Where concealed accessible spaces above suspended ceilings are used as a return air plenum, detection shall be provided at each connection from the return air plenum to the central air-handling system. iii. Detectors installed in such plenums shall be listed for such application. iv. In under-floor spaces and above-ceiling spaces that are used as HVAC plenums, detectors shall be listed for the anticipated environment as required by ambient conditions like temperature, humidity and airflow. v. Detector used in plenums shall have spacing and locations selected on the basis of anticipated airflow patterns and fire type. vi. Detectors placed in environmental air ducts or plenums shall not be used as a substitute for open area detectors.
10. EXPLOSIVE ATMOSPHERE	i. Where Fire Detection and Alarm System is installed in explosive, hazardous atmosphere with flammable vapors in its atmosphere, all devices, enclosures, wiring, junction boxes, connectors and circuitry shall be listed and permitted "Explosion Proof" and "Intrinsically Safe" equipment.
11. DETECTION ZONES (Typically For existing Conventional Systems)	i. Buildings shall be divided into a number of detection zones for easy recognition and short search time. Fire alarm systems shall be designed to suite the fire plan procedures followed by occupants during emergency. Single open, short circuit or ground in one detection zone shall not affect the operation of other zones. ii. The area of any single open detection zone to which the building has been divided shall not exceed 2, 000 m^2; except for a single, open plan area, which should not exceed 10, 000 m^2. iii. If any floor area is greater than 2, 000m^2, it shall be divided into separate detection zones of 2, 000m^2 or less, this subdivision may or may not be achieved by a physical barrier. iv. Search distance shall not exceed 60 m for conventional system; Search distance for addressable system is 100 m if building is protected by sprinklers. v. A zone shall not include multiple floors. vi. Automatic fire detectors within any enclosed stairwell or lift shaft or other enclosed flu-like structure should be considered as a separate detection zone. vii. Indication of detection zone status on the control panel is by LED and/or graphical text indicator. viii. Voids below raised floor and voids above false ceiling shall be configured as separate zones from the room space. ix. Any remote indicator should be clearly labelled to indicate detectors located in voids. They should be sited and/or labelled in such a way as to assist in determining the location of the detectors that they serve.
12. ALARM ZONES	i. Alarm zones shall be clearly defined in complex buildings where

	phased evacuation is required or in buildings where a stage alarm is to be provided. ii. Alarm zone may include of several detection zones and not visa-versa. iii. Alarm zone boundaries shall match those of fire compartments and/or detection zones. iv. The extent of any overlap of signals between alarm zones shall not be sufficient to result in confusion of occupants in any area of the building. v. At no time shall conflicting alarm warning or alarm signals be broadcast within one alarm zone.
13. WIRING	i. All Fire Detection and Alarm wiring shall be 2-hour fire rated and General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain listed. ii. Metal conduits are not necessary where wiring is 2-hour fire rated and listed by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain. iii. Metal conduits are required where fire alarm wiring is in corrosive environment; irrespective of wiring fire rating. iv. Fire alarm system wiring and equipment, including all circuits controlled and powered by the fire alarm system, shall be installed in accordance with the requirements of this code and of NFPA 70 Article 760. v. All fire detection alarm wiring shall be Class A type where circuit redundancy is ensured and operational capability continues even when single open condition, single ground fault and single fault in the circuitry exists. And such faults are annunciated in the control panel. vi. Loop isolators shall be installed to monitor and maintain wiring integrity and safeguard from short circuits. Loop isolators shall be installed as per manufacturer's guidelines.

14. FIRE ALARM CONTROL PANEL (FACP)	**1. GENERAL** i. Fire Alarm Control Panel shall be permitted and listed by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain. ii. Fire Alarm Main Control Panel installed in all Highrise building shall have high performance and stability with Analog Addressable digital protocol capabilities including but not be limited to, system cabinet, power supply, voice command module, microphone, built in Signaling Line Circuit (SLC), LCD annunciator, minimum of eight programmable & addressable terminal for Notification circuits, associated peripheral devices, batteries, wiring, conduit and other relevant components and accessories required to furnish a complete and operational life safety system. iii. FACP shall follow distributed intelligence architecture for flexible loop expansion such that circuit modules can easily be added/upgrade the capacity of the Control panel to monitor the additional detectors or additional loops of detectors and desired output functions. iv. FACP shall be multi-functional, having feature to monitor and supervise Fire Detection, Gas Detection and Fire Suppression activation simultaneously. v. Generally, FACP should have spare capacity to add 20% more detectors with additional wiring and interface modules without adding additional circuit boards (modules) to upgrade, to enable alterations and up gradation to the facility. vi. FACP shall be installed in a location which is attended by facility management designated personnel easily, such as ground floor reception areas, security guard houses, emergency command centers, facility monitoring rooms, nurse stations at hospitals etc. vii. FACP shall be located in a visible and accessible location. viii. FACP shall not be installed in an unattended room, service rooms, mechanical rooms. **2. POSITIVE ALARM SEQUENCE (DELAYED ALARM SEQUENCE)** Systems that have positive alarm features complying with following points shall be permitted, if approved by the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain i. The signal from an automatic fire detection device selected for positive alarm sequence operation shall be acknowledged at the fire alarm control unit by trained personnel within 15 seconds of annunciation in order to initiate the alarm investigation phase. ii. If the signal is not acknowledged within 15 seconds, notification signals in accordance with the building evacuation or relocation plan and remote signals shall be automatically and immediately activated. iii. Trained personnel shall have up to 180 seconds during the alarm investigation phase to evaluate the fire condition and reset the system. If the system is not reset during the investigation phase, notification signals in accordance with the building evacuation plan and remote signals shall be automatically and immediately activated. iv. If a second automatic fire detector selected for positive alarm sequence is actuated during the alarm investigation phase,

14.FIRE ALARM CONTROL PANEL (FACP)	notification signals in accordance with the building evacuation or relocation plan and remote signals shall be automatically and immediately activated. v. If any other initiating device is actuated, notification signals in accordance with the building evacuation or relocation plan and remote signals shall be automatically and immediately activated. vi. The system shall provide means for bypassing the positive alarm sequence. **3. ACTUATION TIME** i. Actuation of alarm notification devices or emergency voice communications, fire safety functions, and annunciation at the protected premises shall occur within 10 seconds after the activation of an initiating device. ii. An open or ground condition of any fire alarm circuits shall result in the annunciation of a trouble signal at the protected premise within 200 seconds. iii. System bandwidth is monitored to confirm that all communications between equipment that is critical to the operation of the fire alarm system or fire safety functions take place within 10 seconds; failure shall be indicated within 200 seconds. iv. Failure of any equipment that is critical to the operation of the fire alarm system or fire safety functions is indicated at the master fire alarm control unit within 200 seconds. v. A listed barrier gateway, integral with or attached to each control unit or group of control units, as appropriate, shall be provided to prevent the other systems from interfering with or controlling the fire alarm system. vi. Each interconnected fire alarm control unit shall be separately monitored for alarm, supervisory, and trouble conditions. vii. Interconnected fire alarm control unit alarm signals shall be permitted to be monitored by zone or by combined common signals. viii. Protected premises fire alarm control units shall be capable of being reset or silenced only from the fire alarm control unit at the protected premises or a computer-based front-end unit listed for use by the manufacturer of the fire alarm control unit. ix. All non–fire alarm components shall be listed for fire alarm use or for fire conditions. **4. DETECTION DEVICES-ALARM SIGNAL INITIATION** i. A smoke detector that is continuously subjected to a smoke concentration above alarm threshold does not delay the system functions by more than 1 minute. **5. SPRINKLER SYSTEM (WATER FLOW SWITCH) -ALARM INITIATION** i. Waterflow alarm-initiating devices from sprinkler system shall be connected to a dedicated function fire alarm control unit designated as “sprinkler waterflow and supervisory system,” and permanently identified on the control unit and record drawings. ii. Where waterflow alarm-initiating devices are connected to a building

14. FIRE ALARM CONTROL PANEL (FACP)	fire alarm system, recommended a dedicated function fire alarm control unit shall not be required in car parking. iii. The number of waterflow alarm–initiating devices permitted to be connected to a single alarm initiating device circuit shall not exceed five. iv. Activation of the initiating device (Water Flow Switch) shall occur within 90 seconds of waterflow at the alarm-initiating device when flow occurs that is equal to or greater than that from a single sprinkler of the smallest orifice size installed in the system. v. Movement of water due to waste, surges, or variable pressure shall not initiate an alarm signal. **6. SPRINKLER SYSTEM (WATER FLOW SWITCH) -SUPERVISORY SIGNAL INITIATION** i. Supervisory signal-initiating devices shall be connected to a dedicated function fire alarm control unit designated as "sprinkler waterflow and supervisory system," and permanently identified on the control unit and record drawings. ii. Where supervisory signal-initiating devices are connected to a building fire alarm system, recommended a dedicated function fire alarm control unit shall not be required in car parking. iii. The number of supervisory signal-initiating devices permitted to be connected a single initiating device circuit shall not exceed 20. **7. FIRE PUMP - ALARM INITIATION** i. A pump running signal shall be permitted to be a supervisory or alarm signal. **8. OTHER FIRE SUPPRESSION SYSTEMS -ALARM INITIATION** i. The actuation of a fire suppression system shall annunciate an alarm or supervisory condition at the building fire alarm control unit. **9. OTHER FIRE SUPPRESSION SYSTEMS –SUPERVISORY SIGNAL INITIATION** i. An off-normal condition of a fire suppression system shall annunciate a supervisory condition at the building fire alarm control unit. ii. Supervisory signals that latch in the off-normal state and require manual reset of the system to restore them to normal shall be permitted. **10.SUPPRESSION SYSTEM ACTUATION-RELEASING SERVICE CONTROL UNITS** i. Releasing service control units shall be connected to the protected premises fire alarm system. ii. Fire alarm and supervisory signals generated at the releasing control unit shall be annunciated at a protected premises fire alarm unit. iii. Actuation of any suppression system connected to a releasing service control unit shall be annunciated at the protected premises fire alarm control unit even where the system actuation is by manual means or otherwise accomplished without actuation of the releasing service control unit.

14. FIRE ALARM CONTROL PANEL (FACP)	iv. If a valve is installed in the connection between a suppression system and an initiating device, the valve shall be supervised. **11. TROUBLE SIGNAL INITIATION** i. Automatic fire suppression system alarm-initiating devices and supervisory signal initiating devices and their circuits shall be designed and installed so that they cannot be subject to tampering, opening, or removal without initiating a Trouble signal. This provision shall include junction boxes installed outside of buildings to facilitate access to the initiating device circuit. **12. NOTIFICATION/FIRE ALARM SIGNAL** i. Fire alarm and mass notification systems provided for evacuation or relocation of occupants shall have one or more notification on each floor of the building.
15. POWER SUPPLIES	i. At least two power supply sources shall be provided for any fire Detection and alarm system, one primary and one secondary, fully supervised by FACP for failure, loss of power, trouble, short circuit conditions. ii. Each power supply shall be of adequate capacity for the full functionality of the System. iii. Primary Supply shall be directly from the Electric Utility Supply. iv. The supply from Electric Utility branch shall be direct to Fire Alarm System only and shall not serve any other loads. v. The system circuit disconnecting means shall be permanently identified as to its purpose, shall be secured and shall be accessible only to authorized personnel. vi. Such disconnecting switch shall be clearly marked “FIRE ALARM/DO NOT DISCONNECT” vii. All wiring from Electric Utility branch to Fire Alarm Control Panel shall be 2-hour fire rated and protected from mechanical damages. viii. An overcurrent protective device shall be provided in accordance with NFPA 70. ix. The secondary means of Power Supply shall be permitted to be either permitted UPS in accordance with NFPA 111 or Batteries dedicated to the FACP. x. Operation on secondary power shall not affect the required

POWER SUPPLIES	performance of a system or supervising station facility, including alarm, supervisory, and trouble signals and indications. xi. The secondary power supply capacity for supervising station facilities and equipment shall be capable of supporting operations for a minimum of 24 hours and then shall be capable of operating the system during a fire or other emergency condition for a period of 30 minutes at maximum connected load. xii. Battery calculations shall include a minimum 25 percent safety margin above the calculated amp-hour capacity required. xiii. Batteries shall be marked with the month and year of manufacture using the month/year format. xiv. Storage batteries shall comply with the requirements of Article 480 of NFPA 70. xv. Battery charging equipment shall be provided to recharge batteries within 48 hours after fully charged batteries have been subject to a single discharge cycle.  **Audio Visual Notification Devices for Illustration**  **Audio/Sounder Notification Devices for Illustration**
16. NOTIFICATION DEVICES (BELLS, SOUNDERS)	i. The notification appliances are used to initiate or direct evacuation or relocation of the occupants, or for providing information to occupants or staff, as the building fire strategy. ii. All notification devices shall be permitted and listed by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain. iii. Notification devices shall have nameplate indicating the electrical connection parameters, audible decibels or visible performance and installation methods. iv. Notification devices shall be installed such that they are not mechanically damaged and shall be protected against mechanical damage where subjected to. v. Notification devices shall be mounted such that they are supported independently of their attachments to circuit conductors.

	vi. An average ambient sound level greater than 105 dBA shall require the use of a visible notification device. vii. The total sound pressure level produced by combining the ambient sound pressure level with all audible notification appliances operating shall not exceed 110 dBA at the minimum hearing distance. viii. Where audible appliances are installed to provide signals for sleeping areas, they shall have a sound level of 75 dBA ix. If ceiling heights allow, wall-mounted notification devices shall have their tops above the finished floors at heights of not less than 2.29 m and below the finished ceilings at distances of not less than 150 mm. x. Audible notification appliances for wide area signaling shall be installed in accordance with the permitted design documents, and the manufacturer's installation instruction to achieve the required performance. xi. Audible Appliance in Private mode provided for the sleeping areas to awaken occupants shall produce a low frequency alarm signal that complies with a fundamental frequency of 520Hz & listed for producing low frequency waveforms. xii. Audible alarm notification appliances in public mode provide and maintain a sound pressure level of 15 decibels (dBA) above ambient sound levels or 5 dBA above the maximum sound level having duration of at least 60 seconds. Contractor or listed company must provide the necessary calculation to ensure an effective audible alarm throughout the premise.
17. VISUAL NOTIFICATION DEVICES	i. Visible notification devices shall be permitted and listed by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain. ii. The flash rate shall not exceed two flashes per second (2 Hz) nor be less than one flash every second (1 Hz) throughout the listed voltage range of the appliance. iii. A maximum pulse duration shall be 0.2 second with a maximum duty cycle of 40%. iv. The pulse duration shall be defined as the time interval between initial and final points of 10% of maximum signal. v. Lights used for fire alarm signaling only or to signal the intent for complete evacuation shall be clear or nominal white and shall not exceed 1,000 cd (effective intensity). vi. Lights used to signal occupants to seek information or instructions shall be clear, nominal white or other color as required by the emergency plan. vii. Visible notification devices shall be located not more than 4.57 m from the end of the corridor with a separation not greater than 30.5 m between visible notification devices. viii. Wall-mounted devices shall be mounted such that the entire lens is not less than 2 m and not greater than 2.44 m above the finished floor. ix. Where low ceiling heights do not permit wall mounting at a

minimum of 2 m, wall mounted visible appliances shall be mounted within 150 mm of the ceiling.

x. Visual alarm signals (flashers) shall be used in areas where audio alarm signal is not effective, not feasible to type of occupancy (i.e. Noisy parking spaces, extremely noisy environment like engine room and plant rooms) or in areas where audio alarm requires the aid of visual alarm.

18. VISUAL NOTIFICATION DEVICES SPACING IN ROOMS

i. The spacing of Visual Notification devices in room shall be as per Manufacturer's specifications. However, number of devices shall be as per **Table: - C.01-T1. a**

ii. Room spacing in accordance with **Table: -C.01-T1. a** and **Figure: - C.01-F3** for wall- mounted appliances shall be based on locating the visible notification device

Table: - C.01-T1. a Spacing of Visual Notification Devices in Rooms

MAXIMUM ROOM SIZE	MAXIMUM CEILING HEIGHT	MINIMUM REQUIRED LIGHT OUTPUT (ONE LIGHT, cd)
1. 6.1 m x 6.1 m	3 m	15
2. 9.1 m x 9.1 m	3 m	30
3. 12.2 m x 12.2 m	3 m	60
4. 13.4 m x 13.4 m	3 m	75
5. 15.2 m x 15.2 m	3 m	95
6. 16.2 m x 16.2 m	3 m	110
7. 16.8 m x 16.8 m	3 m	115
8. 18 m x 18 m	3 m	135
9. 19.2 m x 19.2 m	3 m	150
10. 20.7 m x 20.7 m	3 m	177
11. 21.3 m x 21.3 m	3 m	185
12. 6.1 m x 6.1 m	6.1 m	30
13. 9.1 m x 9.1 m	6.1 m	45
14. 13.4 m x 13.4 m	6.1 m	75
15. 14 m x 14 m	6.1 m	80
16. 15.2 m x 15.2 m	6.1 m	95
17. 16.2 m x 16.2 m	6.1 m	110
18. 16.8 m x 16.8 m	6.1 m	115
19. 18 m x 18 m	6.1 m	135
20. 19.2 m x 6.1 m	6.1 m	150
21. 20.7 m x 20.7 m	6.1 m	177
22. 21.3 m x 21.3 m	6.1 m	185
23. 6.1 m x 6.1 m	9.1 m	55
24. 9.1 m x 9.1 m	9.1 m	75
25. 15.2 m x 15.2 m	9.1 m	95
26. 16.2 m x 16.2 m	9.1 m	110

27. 16.8 m x 16.8 m	9.1 m	115
28. 18 m x 18 m	9.1 m	135
29. 19.2 m x 19.2 m	9.1 m	150
30. 20.7 m x 20.7 m	9.1 m	177
31. 21.3 m x 21.3 m	9.1 m	185

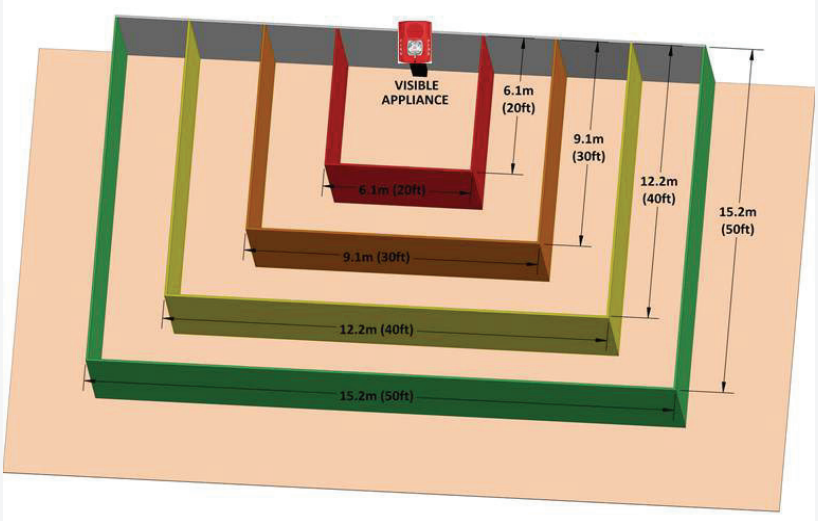


Figure: -C.01-F1: Visual Notification Devices space arrangement

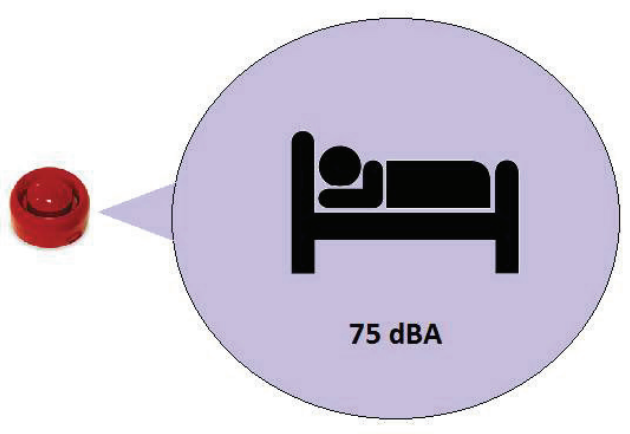


Figure: -C.01-F2: Decibel Requirement for Sleeping Areas

19. NOTIFICATION ZONES

i. Fire alarm and mass notification systems provided for evacuation or relocation of occupants shall have one or more notification zones on each floor of the building.

ii. Notification zones shall be consistent with the emergency response or recovery plan.

iii. Evacuation plan for the protected premises.

iv. The boundaries of notification zones shall be coincident with building outer walls, building fire or smoke compartment boundaries, floor separations, or other fire safety subdivisions.

	v. In protected premises with more than one notification zone, a single open, short-circuit, or ground on the system installation conductors shall not affect operation of more than one notification zone.
20. NOTIFICATION COMBINED WITH PUBLIC ADDRESS SYSTEM (PA SYSTEM)	i. Speakers used as alarm notification appliances on fire alarm systems shall also be permitted to be used for non-emergency purposes, provided that one of the following conditions is met: a. The emergency command center is constantly attended by trained personnel. b. The speakers and associated audio equipment are installed or located with safeguards to resist tampering or mal adjustments of those components essential for intended emergency notification. ii. Speakers used as alarm notification appliances on fire alarm systems shall also be permitted to be used for mass notification systems. iii. Fire alarm signals from combination system shall be distinctive, clearly recognizable and with the exception of mass notification inputs, take precedence over any other signal even when a non–fire alarm signal is initiated first and shall be indicated as follows in descending order of priority unless otherwise permitted by this Code: a. Signals associated with life safety b. Signals associated with property protection c. Trouble signals associated with life and/or property protection d. All other signals. iv. Live voice instructions originating from the protected premises fire or mass notification systems shall override all previously initiated signals and shall have priority over both of the following: a. Any subsequent automatically initiated signals on that channel b. Remotely generated mass notification messages.
21. SUPPRESSION SYSTEM ACTUATION THROUGH FACP	i. Fire alarm control units used for automatic or manual activation of a fire suppression system shall be listed for releasing service and permitted by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain. ii. Releasing devices for suppression systems shall be listed for use with releasing service control units. iii. Fire alarm systems used for fire suppression–releasing service shall be provided with a disconnect switch to allow the system to be tested without actuating the fire suppression systems. iv. Operation of a disconnect switch or a disable function shall cause a supervisory signal at the fire alarm control unit. v. The disconnect shall be a physical switch and not be accomplished by using software. vi. Suppression systems or groups of systems shall be controlled by a single control unit that monitors the associated initiating device(s), actuates the associated releasing device(s), and controls the associated agent release notification appliances. vii. If the releasing control unit is located in a protected premise having a

	separate fire alarm system, it shall be monitored for alarm, supervisory, and trouble signals, but shall not be dependent on or affected by the operation or failure of the protected premises fire alarm system. viii. If there is a separate control panel for suppression sys, it must be connected with the main Fire alarm control panel of the building. ix. Fire alarm systems performing suppression system releasing functions shall be installed in such a manner that they are effectively protected from damage caused by activation of the suppression system(s) they control.
22. ELEVATOR RECALL FOR FIREFIGHTERS' SERVICES **ELEVATOR RECALL FOR FIREFIGHTERS' SERVICES**	i. System-type smoke detectors, or other automatic fire detection located in elevator lobbies, elevator hoist ways, and elevator machine rooms including machine space, control room, and control space used to initiate fire fighters' service recall, shall be connected to the building fire alarm system. ii. Each elevator lobby, elevator hoist way, and elevator machine room smoke detector, or other automatic fire detection, shall be capable of initiating elevator recall when all other devices on the same initiating device circuit have been manually or automatically placed in the alarm condition. iii. A lobby smoke detector shall be located on the ceiling within 6.4 m of the centerline of each elevator door within the elevator bank under control of the detector. iv. Smoke detectors shall not be installed in non-sprinklered elevator hoist ways unless they are installed to activate the elevator hoist way smoke relief equipment. v. If ambient conditions prohibit installation of automatic smoke detection, other automatic fire detection shall be permitted. vi. When actuated, any detector that has initiated firefighters' recall shall also be annunciated at the building fire alarm control unit and required remote annunciators.  **Firefighters' Elevator Switch for Illustration**
23. VISUAL WARNING FOR ELEVATORS	i. Actuation from elevator hoist way and elevator machine room smoke detectors or other automatic fire detection shall cause separate and distinct visible annunciation at the building fire alarm control unit or the fire alarm control unit and required annunciators to alert fire fighters and other emergency personnel that the elevators are no longer safe to use.

	ii. Where lobby detectors are used for other than initiating elevator recall, the signal initiated by the detector shall also initiate an alarm signal. iii. For each elevator or group of elevators, an output(s) shall be provided for the elevator visual warning signal in response to the following: c. Activation of the elevator machine room initiating devices d. Activation of the elevator hoist way initiating devices
24. ELEVATOR SHUTDOWN **ELEVATOR SHUTDOWN**	i. Elevator system shall have over riding switch for Fire Fighter's control to override all the elevator shutdown functions. ii. Where elevators are used for evacuation in the building fire strategy, the elevators and fire fighter's control mechanisms shall include all the features as per **Chapter 3, Section A Table: -A.03-T3.9** iii. Where heat detectors are used to shut down elevator power prior to sprinkler operation, the detector shall have both a lower temperature rating and a higher sensitivity as compared to the sprinkler. iv. If heat detectors are used to shut down elevator power prior to sprinkler operation, they shall be placed within 610 mm of each sprinkler head. v. If pressure or water flow switches are used to shut down elevator power immediately upon or prior to the discharge of water from sprinklers, the use of devices with time-delay switches or time-delay capability shall not be permitted. vi. Control circuits to shut down elevator power shall be monitored for presence of operating voltage. Loss of voltage to the control circuit for the disconnecting means shall cause a supervisory signal to be indicated at the control unit and required remote annunciators. vii. The initiating devices shall be monitored for integrity by the fire alarm control unit.
25. HVAC SHUTDOWN	i. If connected to the fire alarm system serving the protected premises, all detection devices used to cause the operation of HVAC systems' smoke dampers, fire dampers, fan control, smoke doors, and fire doors shall be monitored for integrity. ii. Smoke detectors mounted in the air ducts of HVAC systems shall initiate either an alarm signal at the protected premises or a supervisory signal at a constantly attended location or supervising station. iii. If the fire alarm control unit actuates the HVAC system for the purpose of smoke control, the automatic alarm-initiating zones shall be coordinated with the smoke-control zones they actuate. iv. Where interconnected as a combination system, a Firefighter's Smoke Control Panel (SCP) as per **Chapter 01 Section E Table: - E.01-T1** shall be provided to perform manual control over the automatic operation of the system's smoke control strategy. v. Where interconnected as a combination system, the smoke control system programming shall be designed such that normal HVAC operation or changes do not prevent the intended performance of

	the smoke control strategy.
26. DOOR RELEASE SERVICE	**1. GENERAL** i. All detection devices used for door hold-open release service shall be monitored for integrity. ii. All door hold-open release and integral door release and closure devices used for release service shall be monitored for integrity. iii. Magnetic door holders that allow doors to close upon loss of operating power shall not be required to have a secondary power source. iv. Any device or system intended to actuate the locking or unlocking of exits shall be connected to the fire alarm system serving the protected premises. v. All exits shall unlock upon receipt of any fire alarm signal by means of the fire alarm system serving the protected premises. vi. If exit doors are unlocked by the fire alarm system, the unlocking function shall occur prior to or concurrent with activation of any public-mode notification appliances in the area(s) served by the normally locked exits. vii. All doors that are required to be unlocked by the fire alarm system shall remain unlocked until the fire alarm condition is manually reset. **2. SMOKE DETECTORS FOR DOOR RELEASE SERVICE** i. Smoke detectors that are part of an open area protection system covering the room, corridor, or enclosed space on each side of the smoke door and that are located and spaced as required by spot-type detectors requirement shall be permitted to accomplish smoke door release service. ii. Smoke detectors shall be of the photoelectric or other permitted type. iii. If the depth of wall section above the door is 610 mm or less, one ceiling mounted smoke detector shall be required on one side of the doorway only, or two wall-mounted detectors shall be required, one on each side of the doorway. In **Figure: - C.01-F3 part A OR B** shall apply. iv. If the depth of wall section above the door is greater than 610 mm on one side only, one ceiling-mounted smoke detector shall be required on the higher side of the doorway only, or one wall-mounted detector shall be required on both sides of the doorway. In **Figure: - C.01-F3 part D**, shall apply. v. If the depth of wall section above the door is greater than 610 mm on both sides, two ceiling-mounted or wall-mounted detectors shall be required, one on each side of the doorway. **Figure: - C.01-F3 part F**, shall apply. vi. If a detector is specifically listed for door frame mounting or if a listed combination or integral detector door closer assembly is used, only one detector shall be required if installed in the manner recommended by the manufacturer's published instructions. **Figure: - C.01-F3 parts A, C, and E,** shall apply. vii. If the depth of wall section is more than 1524 mm, additional

detectors might be required.

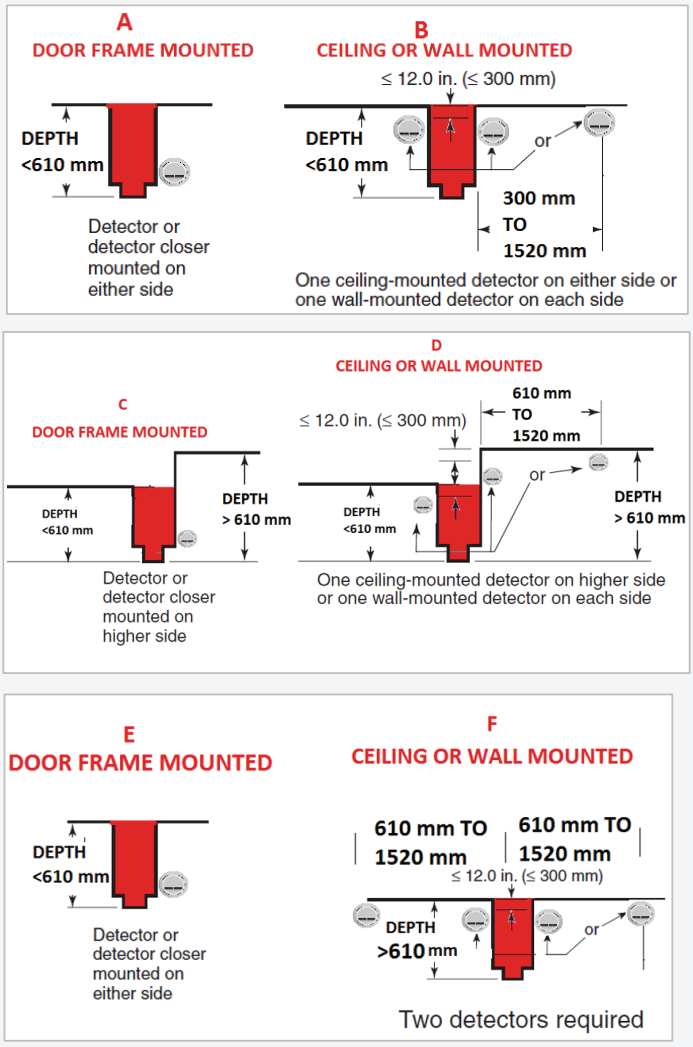


Figure: - C.01-F3 Smoke Detector Location Requirements for Door Release Service

3. SMOKE DETECTORS FOR VARIOUS DOOR ARRANGEMENT

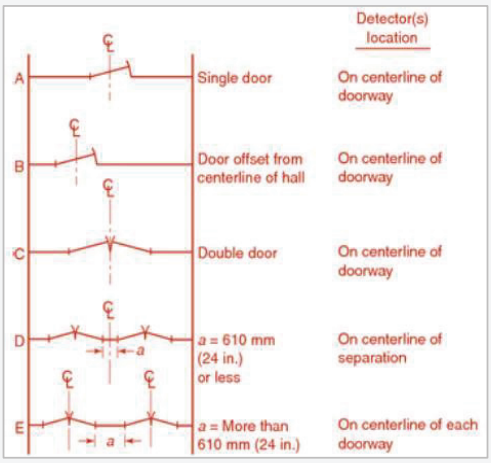
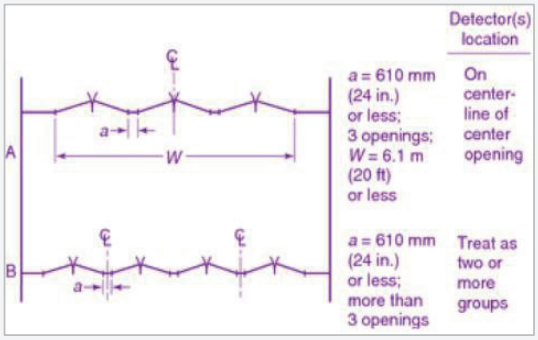
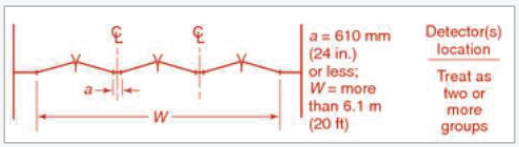
i. If the separation between doorways exceeds 610 mm, each doorway shall be treated separately. **Figure: - C.01-F4 part E,** shall apply.

ii. Each group of three or more doorway openings shall be treated separately. **Figure: - C.01-F5** shall apply.

iii. Each group of doorway openings that exceeds 6.1 m in width measured at its overall extremes shall be treated separately. **Figure: - C.01-F6** shall apply

iv. If there are multiple doorways and listed door frame-mounted detectors or if listed combination or integral detector–door closer assemblies are used, there shall be one detector for each single or double doorway.

v. If ceiling-mounted smoke detectors are to be installed on a smooth ceiling for a single or double doorway, they shall be located as follows (**Figure: - C.01-F4** shall apply):

	a. On the centerline of the doorway b. No more than 1.5 m measured along the ceiling and perpendicular to the doorway (**Figure: - C.01-F3** shall apply.) c. No closer than shown in **Figure: - C.01-F3 parts B, D, and F**  **Figure: - C.01-F4 Detector Location for Single and Double Doors**  **Figure: - C.01-F5 Detector Location for Group of Doorways**  **Figure: - C.01-F5 Detector Location for Group of Doorways over 6.1m in width**
27. WATER LEVEL SUPERVISORY	i. Two separate and distinct signals shall be initiated: one indicating that the required water level has been lowered or raised (off-normal) and the other indicating restoration. ii. A pressure tank signal-initiating device shall indicate both high and low water level conditions. The off-normal signal shall be initiated when the water level falls 76 mm or rises 76 mm. iii. A supervisory signal-initiating device for other than pressure tanks shall initiate a low-water level signal when the water level falls 300 mm.
28. PRESSURE SUPERVISORY	i. Two separate and distinct signals shall be initiated: one indicating that the required pressure has increased or decreased (off-normal)

	and the other indicating restoration of the pressure to its normal value. ii. A pressure tank supervisory signal-initiating device for a pressurized limited water supply, such as a pressure tank, shall indicate both high- and low- pressure conditions. iii. The off-normal signal shall be initiated when the required pressure increases or decreases by 70 kPa (10 psi). iv. A pressure supervisory signal-initiating device for a dry-pipe sprinkler system shall indicate both high and low-pressure conditions. The off-normal signal shall be initiated when the pressure increases or decreases by 70 kPa (10 psi). v. A steam pressure supervisory signal-initiating device shall indicate a low- pressure condition. The off-normal signal shall be initiated prior to the pressure falling below 110% of the minimum operating pressure of the steam operated equipment supplied.
29. CONTROL VALVE SUPERVISORY	i. Two separate and distinct signals shall be initiated: one indicating movement of the valve from its normal position (off-normal) and the other indicating restoration of the valve to its normal position. ii. The off-normal signal shall be initiated during the first two revolutions of the hand wheel or during one-fifth of the travel distance of the valve control apparatus from its normal position. iii. The off-normal signal shall not be restored at any valve position except normal. iv. An initiating device for supervising the position of a control valve shall not interfere with the operation of the valve, obstruct the view of its indicator, or prevent access for valve maintenance.
30. SMOKE CONTROL SYSTEMS	i. Smoke detectors installed and used to prevent smoke spread by initiating control of fans, dampers, doors, and other equipment shall be classified in the following manner: a. Area detectors that are installed in the related smoke compartments b. Detectors that are installed in the air duct systems. c. Video image smoke detection that is installed in related smoke compartments. ii. To prevent the recirculation of dangerous quantities of smoke, a detector permitted for air duct use shall be installed on the supply side of air-handling systems. iii. Area smoke detectors within smoke compartments shall be permitted to be used to control the spread of smoke by initiating operation of doors, dampers, and other equipment.
31. DETECTORS IN AIR DUCTS	i. Detectors shall be listed for installation in air ducts. ii. Air duct detectors shall be installed in such a way as to obtain a representative sample of the airstream. This installation shall be permitted to be achieved by any of the following methods:

iii. Rigid mounting within the duct

iv. Rigid mounting to the wall of the duct with the sensing element protruding into the duct

v. Installation outside the duct with rigidly mounted sampling tubes protruding into the duct

vi. Installation through the duct with projected light beam

vii. Detectors shall be mounted in accordance with the manufacturer's published instructions and shall be accessible for cleaning by providing access doors or control units.

viii. The location of all detectors in air duct systems shall be permanently and clearly identified and recorded.

ix. Detectors mounted outside of a duct that employs sampling tubes for transporting smoke from inside the duct to the detector shall be designed and installed to allow verification of airflow from the duct to the detector.

x. Detectors shall be listed for operation over the complete range of air velocities, temperature, and humidity expected at the detector when the air-handling system is operating.

xi. All penetrations of a return air duct in the vicinity of detectors installed on or in an air duct shall be sealed to prevent entrance of outside air and possible dilution or redirection of smoke within the duct.

xii. Where in-duct smoke detectors are installed in concealed locations more than 3 m above the finished floor or in arrangements where the detector's alarm or supervisory indicator is not visible to responding personnel, the detectors shall be provided with remote alarm or supervisory indication in a location within the room.

xiii. Remote alarm or supervisory indicators shall be installed in an accessible location and shall be clearly labeled to indicate both their function and the air- handling unit(s) associated with each detector.

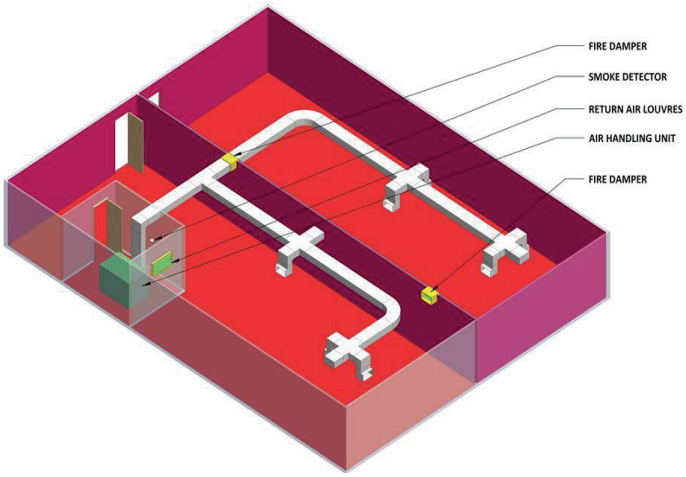


Figure: - C.01-F7 Smoke detectors at Return Air Louvers

5.2 Smoke Detection System

The Smoke Detection and Alarm System shall comply with **Table: -C.01-T2**. and the General Requirements of Fire Detection and Alarm System as per **Table: -C.01-T1**

Table: - C.01-T2 Smoke Detection and Alarm Systems

ITEMS	REQUIREMENTS
1. IONIZATION TYPE SMOKE DETECTORS	i. An ionization smoke detector has a very small amount of radioactive material (an alpha emitter) that ionizes the air in the sensing chamber, rendering the air conductive and permitting a minute current flow through the air between two charged electrodes. This gives the sensing chamber an effective electrical conductance. When smoke particles enter the ionization area, they decrease the conductance of the air by attaching themselves to the ions, causing a reduction in ion mobility. The current flow is monitored and when conductance is below a predetermined level, the detector is in alarm. ii. With analog addressable detectors the alarm threshold can be varied to compensate for ambient conditions.
2. PHOTOELECTRIC TYPE SMOKE DETECTORS	i. The presence of suspended smoke particles generated during the combustion process affects the propagation of a light beam passing through the air. The effect can be utilized to detect the presence of a fire in two ways: a. obscuration of light intensity over the beam path OR b. scattering of the light beam. ii. Smoke detectors that operate on the principle of light obscuration consist of a light source, a light beam collimating system, and a photosensitive device. When dense smoke obscures part of the light beam, or less dense smoke obscures more of the beam, the light reaching the photosensitive device is reduced and this initiates the alarm. iii. In Smoke detectors using Scattering of light principle, when smoke particles enter a light path, scattering results. Smoke detectors utilizing the photo e- electric light-scattering principle are usually of the spot type. They contain a light source and a photosensitive device arranged so the light rays normally do not fall onto the device. When smoke particles enter the light path, light strikes the particles and is scattered onto the photosensitive device, causing the detector to respond.
3. SELECTION OF SMOKE DETECTORS	i. The selection and placement of smoke detectors shall take into account both the performance characteristics of the detector and the areas into which the detectors are to be installed to prevent nuisance and unintentional alarms or improper operation after installation.
4. AMBIENT CONDITION	i. Smoke detectors shall not be installed where following conditions exist. a. Temperature is below 0°C. b. Temperature is above 38°C.

<table>
<tr><td></td><td>c. Relative Humidity is above 93%.
d. Air velocity is greater than 1.5 m/sec (300 ft./min).
e. Ceiling height exceeds 9 m.</td></tr>
<tr><td>5. LOCATION</td><td>i. The location of smoke detectors shall be based on an evaluation of potential ambient sources of smoke, moisture, dust, or fumes, and electrical or mechanical influences, to minimize nuisance alarms.
ii. In addition to temperature, humidity, and velocity variations, smoke detectors are also affected by common environmental conditions as mechanical vibration, electrical interference, presence of aerosols and other environmental influences. Tests for these conditions are also conducted by the testing laboratories in their listing program. Manufacturers' installation guidelines shall be followed for location details.</td></tr>
<tr><td>6. SENSITIVITY</td><td>i. Smoke detectors shall be marked with their nominal production sensitivity and tolerance in percent per foot (percent per meter) obscuration, as required by the listing.
ii. Smoke detectors that have provision for field adjustment of sensitivity shall have an adjustment range of not less than 0.6 percent per foot (1.95 percent per meter) obscuration.
iii. If the means of adjustment of sensitivity is on the detector, a method shall be provided to restore the detector to its factory calibration.
iv. Detectors that have provision for program-controlled adjustment of sensitivity shall be permitted to be marked with their programmable sensitivity range only.</td></tr>
<tr><td>7. HIGH AIR MOVEMENT AREAS</td><td>i. Smoke detectors shall not be located directly in the airstream of supply registers.
ii. Smoke detector spacing in high air movement areas shall be in accordance with Table: -C.01-T2. a.
<table>
<tr><th colspan="3">Table: - C.01-T2a Smoke Detector Spacing Based On-Air Movement</th></tr>
<tr><th>MINUTES PER AIR CHANGE</th><th>AIR CHANGES PER HOUR</th><th>SPACING PER DETECTOR</th></tr>
<tr><td>1 Minute</td><td>60</td><td>11.61</td></tr>
<tr><td>2 Minutes</td><td>30</td><td>23.23</td></tr>
<tr><td>3 Minutes</td><td>20</td><td>34.84</td></tr>
<tr><td>4 Minutes</td><td>15</td><td>46.45</td></tr>
<tr><td>5 Minutes</td><td>12</td><td>58.06</td></tr>
<tr><td>6 Minutes</td><td>10</td><td>69.68</td></tr>
<tr><td>7 Minutes</td><td>8.6</td><td>81.29</td></tr>
<tr><td>8 Minutes</td><td>7.5</td><td>83.61</td></tr>
<tr><td>9 Minutes</td><td>6.7</td><td>83.61</td></tr>
<tr><td>10 Minutes</td><td>6</td><td>83.61</td></tr>
</table></td></tr>
</table>

5.3 Installation and Spacing of Spot Type Smoke Detection System

The Installation and Spacing of Spot Type Smoke Detection and Alarm System shall comply with **Table: - C.01-T3** Spot Type Smoke Detection System as per **Table: - C.01-T2.** and the General Requirements Fire Detection and Alarm System as per **Table: - C.01-T1**

Table: - C.01- T3 Installation and Spacing of Spot Type Smoke Detection

ITEMS	REQUIREMENTS
1. INSTALLATION AND SPACING OF SPOT TYPE SMOKE DETECTORS	**1. GENERAL** i. The location and spacing of smoke detectors shall be based upon the anticipated smoke flows due to the plume and ceiling jet produced by the anticipated fire, as well as any pre-existing ambient airflows that could exist in the protected compartment. ii. Detector location and spacing shall take into consideration the following features. a. Ceiling shape and surface. b. Ceiling height. c. Configuration of material content in the area. d. Combustion characteristics of the fuel load in the area. e. Compartment ventilation. f. Ambient temperature, pressure, altitude, humidity and atmosphere. iii. If the intent is to protect against specific hazard, detectors shall be placed closer to the hazard, than required by the spacing guidelines **2. SMOOTH CEILINGS** i. Spot type detectors shall be placed on the ceiling. ii. Spot-type smoke detectors shall be located on the ceiling not less than 100 mm from a sidewall to the near edge. iii. Detectors shall not be installed on sidewall as regular practice. Where whole areas are covered by ceiling mounted detectors and corner areas are desired to be protected, detectors shall be mounted on sidewalls at 300 mm down from the ceiling to the top of the detector. iv. The distance between smoke detectors shall not exceed a nominal spacing (S) of 9 m. v. There shall be detectors within a distance of one-half the nominal spacing, measured at right angles from all walls or partitions extending upward in sloped ceilings or towards center to within the top 15 percent of the ceiling height. vi. All points on the ceiling shall have a detector within a distance equal to or less than 0.7 times the nominal 9 m spacing, S. (0.7S). vii. Detector Spacing preferably to be 5.6m apart from wall. Refer **NFPA section 2022 A.17.6.3.1.1** **Figure: - C.01- F8 Spacing of Spot Type Smoke Detector on Smooth Ceilings**

Table: - C.01- T3 Installation and Spacing of Spot Type Smoke Detection

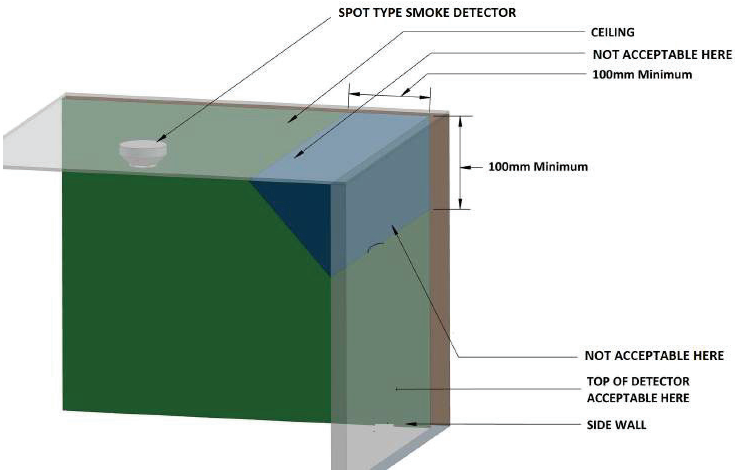
ITEMS	REQUIREMENTS
INSTALLATION AND SPACING OF SPOT TYPE SMOKE DETECTORS	 **Figure: - C.01- F9Spacing of Spot Type Smoke Detector on corner of Smooth Ceilings** **3. UNDER RAISED FLOORS** i. Under raised floors having void height of 300 mm or more, or with cable runs and service piping and cuts shall be provided with smoke detection system. ii. To minimize dust contamination, smoke detectors, where installed under raised floors, shall be mounted only in an orientation for which they have been listed. iii. Spaces under raised floors and above suspended ceilings must be treated as separate rooms for smoke detector placement. Detectors in these areas cannot replace detectors in the main room. Detector spacing follows smooth ceiling requirements. **4. CEILINGS WITH SOLID JOISTS AND BEAM CONSTRUCTION** i. Solid joists shall be considered equivalent to beams for smoke detector spacing guidelines. ii. For ceilings with beam pockets formed by intersecting beams including waffle or pan type ceilings, of depths of less than 10% of ceiling or ceilings with beam depths of less than 10% of the ceiling height (0.1 H), smooth ceiling spacing shall be permitted. Spot-type smoke detectors shall be permitted to be located on ceilings or on the bottom of beams. iii. For ceilings with beam pockets formed by intersecting beams including waffle or pan type ceilings, of depths of equal to/more than 10% of ceiling height or ceilings with beam depths equal to or greater than 10% of the ceiling height (0.1 H), the following shall apply: a. Where beam spacing is equal to or greater than 40 percent of the ceiling height (0.4 H), spot-type detectors shall be located on the ceiling in each beam pocket.

Table: - C.01- T3 Installation and Spacing of Spot Type Smoke Detection

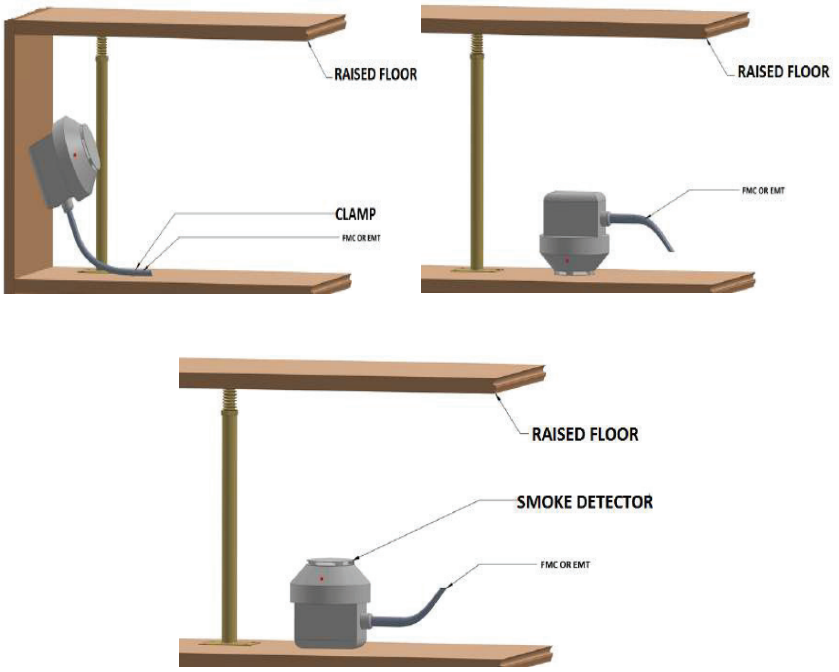
ITEMS	REQUIREMENTS
INSTALLATION AND SPACING OF SPOT TYPE SMOKE DETECTORS	b. Where beam spacing is less than 40 percent of the ceiling height (0.4 H), the following shall be permitted for spot detectors: 1. Smooth ceiling spacing in the direction parallel to the beams and at one-half smooth ceiling spacing in the direction perpendicular to the beams. 2. Location of detectors either on the ceiling or on the bottom of the beams. iv. For corridors 4.6 m in width or less having ceiling beams or solid joists perpendicular to the corridor length, the following shall apply: a. Smooth ceiling spacing shall be permitted. b. Location of spot-type smoke detectors on ceilings, sidewalls, or the bottom of beams or solid joists. v. For rooms of 84 m2 or less, the following shall be permitted: a. Use of smooth ceiling spacing b. Location of spot-type smoke detectors on ceilings or on the bottom of beams.  **Figure: -C.01-F10 Not Acceptable Detector orientation under raised floor**

Table: - C.01- T3 Installation and Spacing of Spot Type Smoke Detection

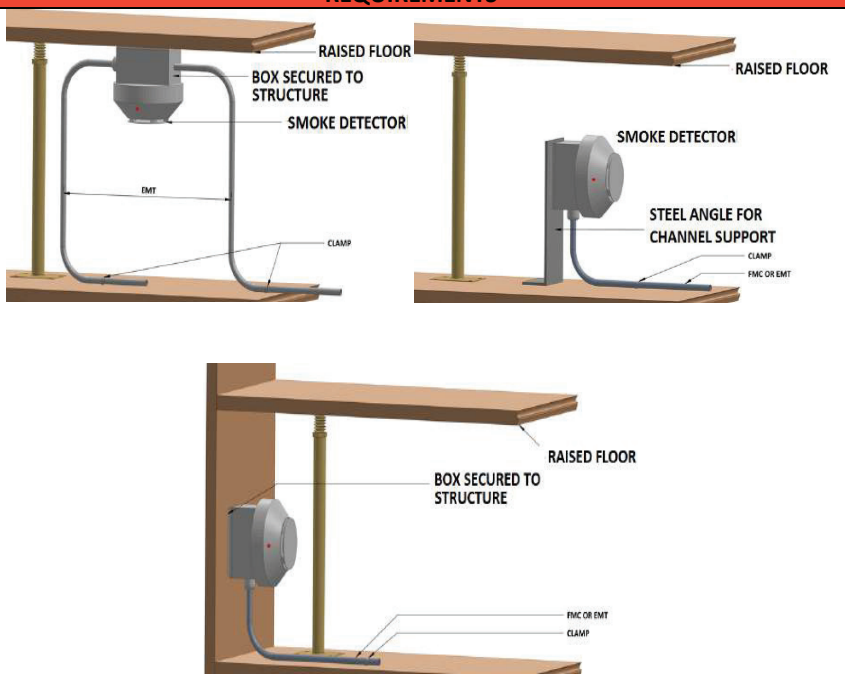
ITEMS	REQUIREMENTS
INSTALLATION AND SPACING OF SPOT TYPE SMOKE DETECTORS	 **Figure: - C.01-F11 Acceptable Detector orientation under raised floor**   

Table: - C.01- T3 Installation and Spacing of Spot Type Smoke Detection

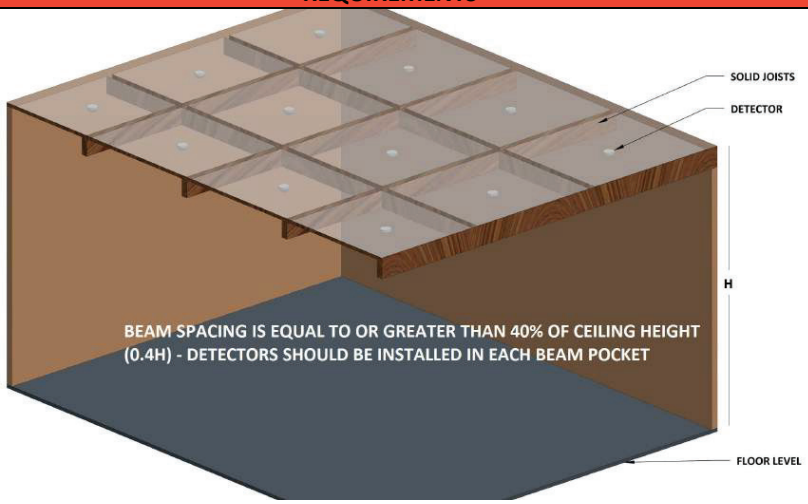
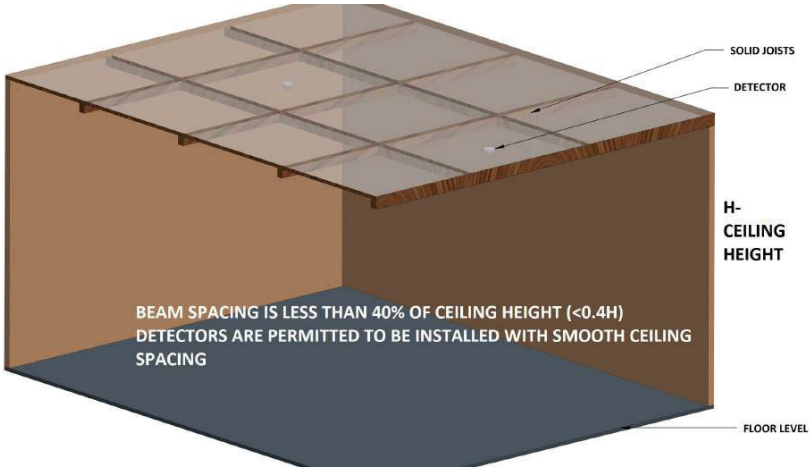
ITEMS	REQUIREMENTS
INSTALLATION AND SPACING OF SPOT TYPE SMOKE DETECTORS	 Figure: -C.01-F12 Smoke Detector Spacing and Location in Joists and beams with spacing greater than 40% of ceiling height   Figure: -C.01-F13 Smoke Detector Spacing at Joists and Beams spacing less than 40% of ceiling height

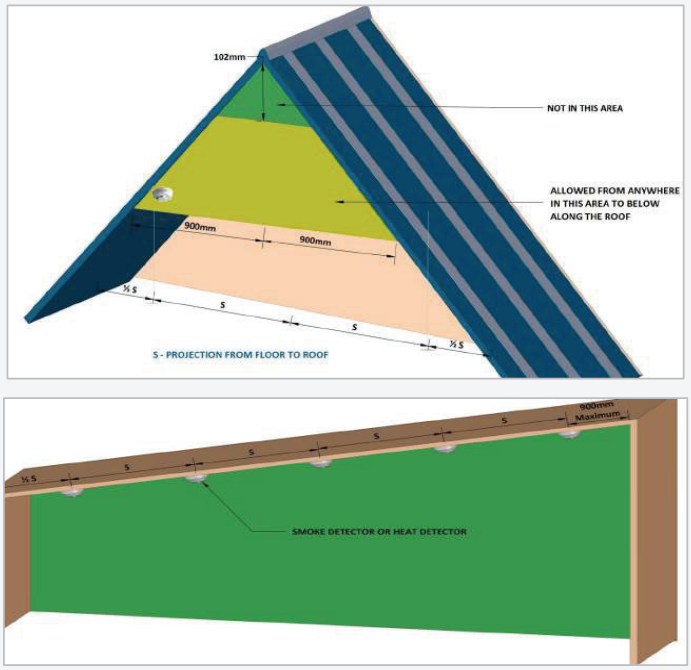
Table: - C.01- T3 Installation and Spacing of Spot Type Smoke Detection

ITEMS	REQUIREMENTS
INSTALLATION AND SPACING OF SPOT TYPE SMOKE DETECTORS	**5. SLOPED CEILING, BEAMS RUNNING PARALLEL** i. For sloped ceiling with beams running parallel up slope, the following shall apply. a. Spot-type detector(s) shall be located on the ceiling within beam pocket(s). b. The ceiling height shall be taken as the average height over slope. c. Spacing shall be measured along a horizontal projection of the ceiling. d. Smooth ceiling spacing shall be permitted within beam pocket(s) parallel to the beams. e. For beam depths less than or equal to 10% of the ceiling height (0.1 H), spot type detectors shall be located with smooth ceiling spacing perpendicular to the beams. f. For beam depths greater than 10% of the ceiling height (0.1 H), the following shall apply for spacing perpendicular to the beams: 1. For beam spacing greater than or equal to 40% of the ceiling height (0.4 H), spot-type detectors shall be located in each beam pocket. 2.For beam spacing less than 40% of the ceiling height (0.4 H), spot-type detectors shall not be required in every beam pocket but shall be spaced not greater than 50 percent of smooth ceiling spacing. **6. SLOPED CEILING, BEAMS RUNNING PERPENDICULAR** i. For sloping ceilings with beams running perpendicular across slope, the following shall apply: a. Spot-type detector(s) shall be located at the bottom of the beams. b. The ceiling height shall be taken as the average height over slope. c. Spacing shall be measured along a horizontal projection of the ceiling. d. Smooth ceiling spacing shall be permitted within beam pocket(s). e. For beam depths less than or equal to 10% of the ceiling height (0.1 H), spot type detectors shall be located with smooth ceiling spacing. f. For beam depths greater than 10% of the ceiling height (0.1 H), spot-type detectors shall not be required to be located closer than (0.4 H) and shall not exceed 50 % of smooth ceiling spacing. **7. SLOPED CEILING, BEAM POCKETS FORMED BY INTERSECTING BEAMS** i. For sloped ceilings with beam pockets formed by intersecting beams, the following shall apply: a. Spot-type detector(s) shall be located at the bottom of the beams. b. The ceiling height shall be taken as the average height over slope. c. Spacing shall be measured along a horizontal projection of the

Table: - C.01- T3 Installation and Spacing of Spot Type Smoke Detection

ITEMS	REQUIREMENTS
INSTALLATION AND SPACING OF SPOT TYPE SMOKE DETECTORS	ceiling. d. For beam depths less than or equal to 10% of the ceiling height (0.1 H), spot type detectors shall be spaced with not more than three beams between detectors and shall not exceed smooth ceiling spacing. e. For beam depths greater than 10% of the ceiling height (0.1 H), spot-type detectors shall be spaced with not more than two beams between detectors, but shall not be required to be spaced closer than (0.4 H), and shall not exceed 50% of smooth ceiling spacing. **8. PEAKED CEILINGS** i. Detectors shall first be spaced and located within 910 mm of the peak, measured horizontally. The number and spacing of additional detectors, if any, shall be based on the horizontal projection of the ceiling. ii. For a roof slope of less than 30 degrees, all detectors shall be spaced using the height at the peak. For a roof slope of greater than 30 degrees, the average slope height shall be used for all detectors other than those located in the peak. **9. SHEDS** i. Detectors shall first be spaced and located within 910 mm of the peak, measured horizontally. The number and spacing of additional detectors, if any, shall be based on the horizontal projection of the ceiling.

Table: - C.01- T3 Installation and Spacing of Spot Type Smoke Detection

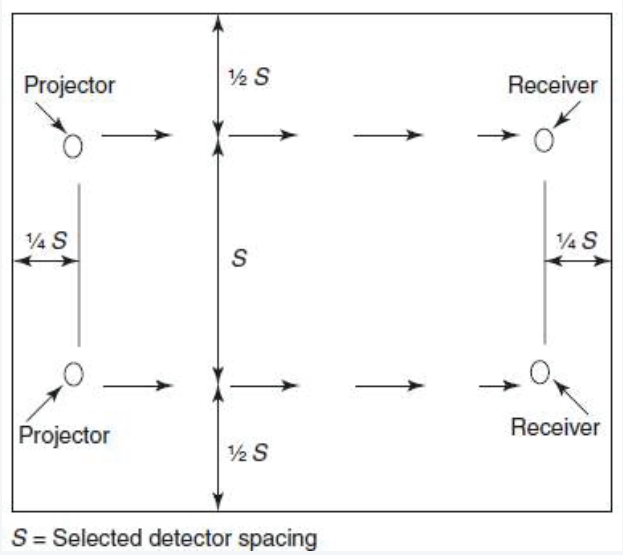
ITEMS	REQUIREMENTS
2. PROHIBITED LOCATIONS	i. Smoke detectors shall not be installed within 3 m radial distance along horizontal path from cooking appliances. ii. Smoke detectors shall not be located within 1 m of the bathroom having shower or bathtub. iii. Smoke detectors shall not be installed within a 910 mm horizontal path from the tip of the blade of a ceiling-suspended (paddle) fan.  **Figure: - C.01-F14 Spot Type Smoke Detector Spacing and Location at Sheds and Peaked ceiling**

5.4 Installation and Spacing of Beam Type (Projected Beam) Smoke Detection System

The Installation and Spacing of Beam Type Smoke Detection and Alarm System shall comply with **Table: -C.01-T4** Smoke Detection Systems as per **Table: -C.01-T2** and the General Requirements of Fire Detection and Alarm System as per **Table: - C.01-T1**

Table: - C.01- T4 Installation and Spacing of Beam Type Detection Systems

ITEMS	REQUIREMENTS
1.INSTALLATION AND SPACING OF BEAM TYPE SMOKE DETECTORS	i. Projected beam–type smoke detectors shall be located in accordance with the manufacturer's published instructions. ii. The effects of stratification shall be evaluated when locating the detectors. iii. The beam length shall not exceed the maximum permitted by the equipment listing. iv. On smooth ceilings, a spacing of not more than 18.3 m between projected beams and not more than one-half that spacing between a projected beam and a sidewall (wall parallel to the beam travel)

	should be used as a guide. v. Other spacing should be determined based on ceiling height, airflow characteristics, and response requirements. In some cases, the light beam projector is mounted on one end wall, with the light beam receiver mounted on the opposite wall. However, it is also permitted to suspend the projector and receiver from the ceiling at a distance from the end walls not exceeding one-quarter the selected spacing (S). vi. If mirrors are used with projected beams, the mirrors shall be installed in accordance with the manufacturer's published instructions. vii. A projected beam–type smoke detector shall be considered equivalent to a row of spot-type smoke detectors for level and sloping ceiling applications. viii. Projected beam–type detectors and mirrors shall be mounted on stable surfaces to prevent false or erratic operation due to movement. ix. The beam shall be designed so that small angular movements of the light source or receiver do not prevent operation due to smoke and do not cause nuisance or unintentional alarms. x. The light path of projected beam–type detectors shall be kept clear of opaque obstacles at all times.
2. VERIFICATION OF ALARM	i. Where the light path of a projected beam–type detector is abruptly interrupted or obscured, it should give a trouble signal after verification of interruption then process the signal and activates alarm.  S = Selected detector spacing

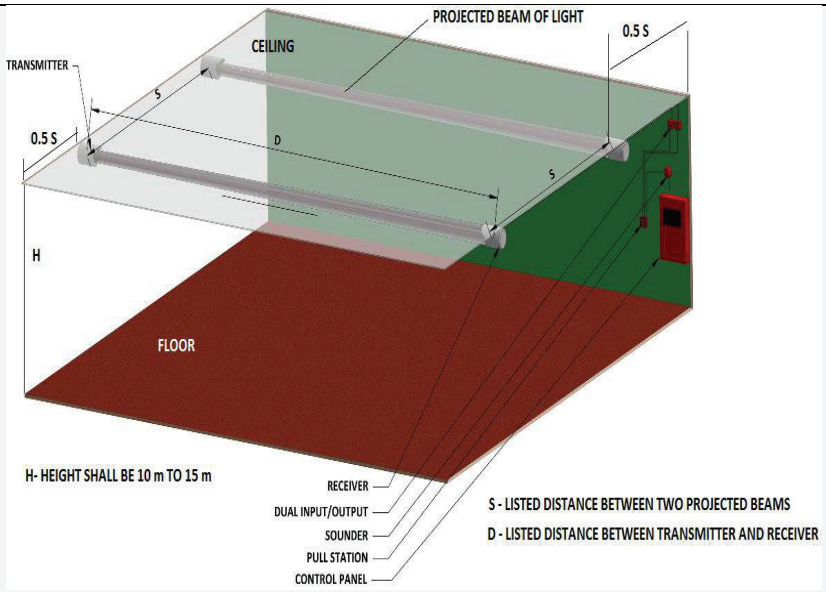


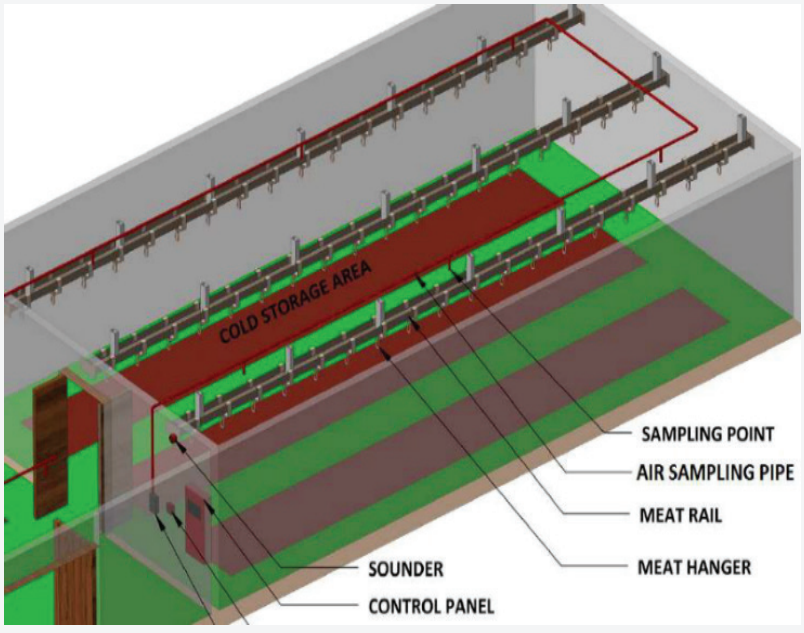
Figure: -C.01-F15 Beam Projection Type Smoke Detection Spacing

5.5 Installation and Spacing of Aspiration Type Air Sampling Smoke Detection System

The Installation and Spacing of Aspiration Type Air Sampling Smoke Detection and Alarm System shall comply with **Table: - C.01-T5**., Smoke Detection Systems as per **Table: - C.01-T2** and the General Requirements Fire Detection and Alarm System as per **Table: - C.01-T1**

Table: - C.01- T5: Installation of Aspiration Type Air Sampling Smoke Detection Systems

ITEMS	REQUIREMENTS
1. INSTALLATION AND SPACING OF ASPIRATION TYPE AIR SAMPLING SMOKE DETECTION SYSTEM	i. Each sampling port of an air sampling–type smoke detector shall be treated as a spot-type detector for the purpose of location and spacing. ii. Sampling pipe networks shall be designed on the basis of, and shall be supported by, sound fluid dynamic principles to ensure required performance. iii. Manufacturer's listed design guideline and calculation software shall be followed. iv. Sampling pipe network design details shall include calculations showing the flow characteristics of the pipe network and each sample port. v. Air-sampling detectors shall give a trouble signal if the airflow is outside the manufacturer's specified range. vi. The sampling ports and in-line filter, if used, shall be kept clear in

	accordance with the manufacturer's published instructions. vii. Air-sampling network piping and fittings shall be airtight and permanently fixed. viii. Where practicable, pipe run lengths in a multiple-pipe system should be nearly equal, or the system should be otherwise pneumatically balanced. The air sampling–type detector system should be able to withstand dusty environments by air filtering, electronic discrimination of particle size, or other listed methods or combinations thereof. ix. The detector should be capable of providing optimal time delays of alarm outputs to eliminate nuisance alarms due to transient smoke conditions. x. The detector should also provide facilities for the connection of monitoring equipment for the recording of background smoke level information necessary in setting alert and alarm levels and delays. xi. In cold room applications the detector unit shall be installed outside the subzero temperature areas. Installation of piping shall be such that condensation does not occur inside the piping. xii. Detector shall be able to connect in a Class A wiring method. xiii. In-line filter used on the pipe network shall be included in the listing for the air-sampling type smoke detector. xiv. Sampling system piping shall be conspicuously identified as "SMOKE DETECTOR SAMPLING TUBE — DO NOT DISTURB," as follows: a. At changes in direction or branches of piping b. At each side of penetrations of walls, floors, or other barriers c. At intervals on piping that provide visibility within the space, but no greater than 6.1 m.
2. AIR SAMPLE TRANSPORT TIME	i. Maximum air sample transport time from the farthest sampling port to the detector shall not exceed 120 seconds.  **Figure: - C.01-F16 Air Sampling Type Smoke Detection for Meat Storage Freezers**

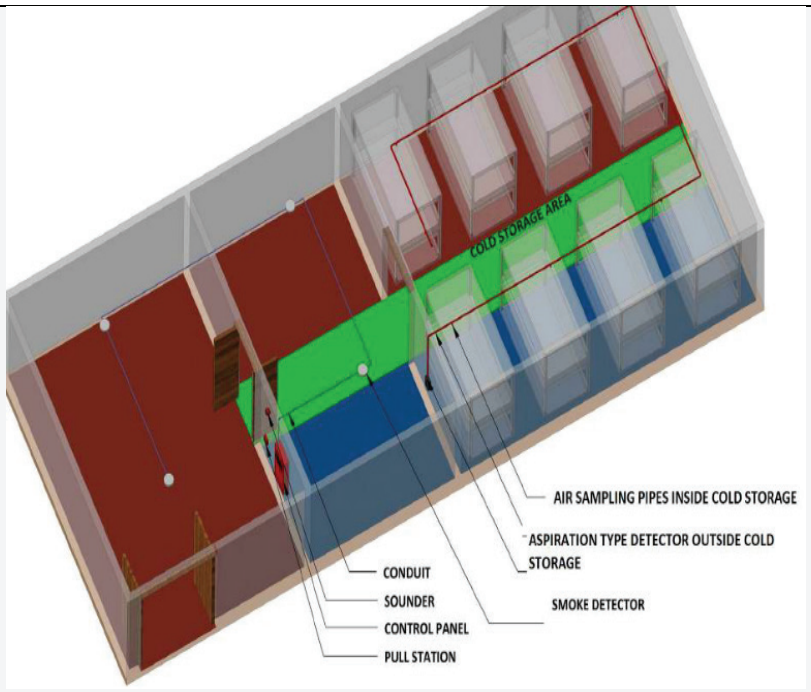


Figure: -C.01-F17 Air Sampling Type Smoke Detection for Freezer Rooms

5.6 Heat Detection and Alarm System

The Heat Detection and Alarm System shall comply with **Table: - C.01-T6** and the General Requirements for Fire Detection and Alarm System as per **Table: - C.01-T1**.

Table: - C.01- T6: Heat Detection System

ITEMS	REQUIREMENTS
1. HEAT DETECTION SYSTEM	i. Heat detectors shall include in their installation instructions, technical data, and listing documentation the operating temperature and Response Time Index (RTI) as determined by the organization listing the device. ii. All heat sensing detectors shall be permitted and listed by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain. The CoC shall clearly state the end use application of the Heat detectors.
2. OPERATING TEMPERATURE	i. Heat-sensing fire detectors shall be marked with their listed operating temperature. ii. Heat-sensing fire detectors where the alarm threshold is field adjustable shall be marked with the temperature range. iii. Spot Type heat detectors shall be marked with their RTI.
3. FIXED TEMPERATURE HEAT DETECTORS	i. Fixed-temperature heat detectors are designed to alarm when the temperature of the operating element reaches a specified point. The air temperature at the time of alarm can be considerably higher than the rated temperature (depending on the fire growth rate), because it takes time for the air to raise the temperature of the operating element to its set point. This condition is called thermal lag.

	ii. Fusible Link Type heat detectors made up of eutectic metals are used as a solder to secure a spring under tension. When the element fuses, the spring action closes contacts and initiates an alarm. Eutectic metals cannot be restored; either the device or its operating element must be replaced upon actuation. iii. Continuous Line Type detection uses a pair of steel wires in a normally open circuit. The conductors are held apart by a heat-sensitive insulation. The wires, under tension, are enclosed in a braided sheath to form a single cable assembly. When the design temperature is reached, the insulation melts, the two wires contact, and an alarm is initiated. Following an alarm, the fused section of the cable must be replaced to restore the system.
4. RATE COMPENSATION DETECTORS	i. A rate compensation detector is a device that responds when the temperature of the surrounding air reaches a predetermined level, with the rate of temperature rise having minimal effect on response (low thermal lag). Typical rate compensation type is spot type heat detectors.
5. RATE-OF-RISE HEAT DETECTORS	i. The rate-of-rise detector, however, will function when the rate of temperature increase exceeds a predetermined value, typically around 12 to 15°F (7 to 8°C) per minute. Rate-of-rise detectors are designed to compensate for ii. the normal changes in ambient temperature (less than 12°F *6.7°C+ per minute) that are expected under non-fire conditions.
6. ELECTRONIC SPOT TYPE HEAT DETECTORS	i. A thermoelectric effect detector is a device that utilizes a sensing element consisting of one or more thermistors, which produce a change in electrical resistance in response to an increase in temperature. This change in resistance is monitored by associated electronic circuitry, and the detector responds when the resistance changes at an abnormal rate (rate-of-rise type) or when the resistance reaches a specific value (fixed-temperature type).
7. COLOR CODING OF HEAT DETECTORS	i. Heat-sensing fire detectors of the fixed temperature or rate-compensated, spot type shall be marked with a color code in accordance with **Table: - C.01-T6. a**. ii. If the overall color of a heat-sensing fire detector is the same as the color code marking required for that detector, one of the following arrangements, applied in a contrasting color and visible after installation, shall be employed: a. Ring on the surface of the detector b. Temperature rating in numerals at least 9.5mm high. iii. Detectors having fixed-temperature or rate-compensated elements shall be selected in accordance with **Table: -C.01-T6. a**, for the maximum expected ambient ceiling temperature. The temperature rating of the detector shall be at least 11°C above the maximum expected temperature at the ceiling.

Table: - C.01-T6. a Color Coding of Heat Detectors

TEMPERATURE CLASSIFICATION	HEAT DETECTOR TEMPERATURE RATING RANGE	MAXIMUM CEILING TEMPERATURE	COLOR CODE
1.Low	39 °C—57 °C	28 °C	Uncolored
2.Ordinary	58 °C—79 °C	47 °C	Uncolored
3.Intermediate	80 °C—121 °C	69 °C	White
4. High	122 °C—162 °C	111 °C	Blue
5. Extra High	163 °C—204 °C	152 °C	Red
6.Very Extra High	205 °C—259 °C	194 °C	Green
7. Ultra-High	260 °C—302 °C	249 °C	Orange

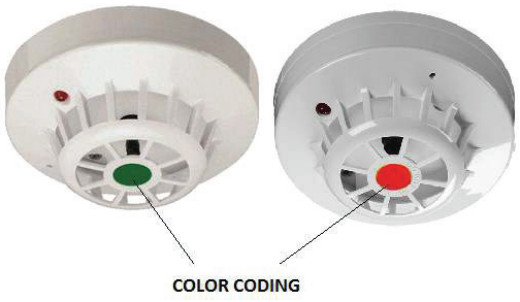


Figure: - C.01-F18 Spot Type Heat Detector Color Coding and Marking

5.7 Installation and Spacing of Spot Type Heat Detection System

The Installation and Spacing of Spot Type Smoke Detection and Alarm System shall comply with **Table: - C.01-T7** Heat Detection System as per **Table: - C.01-T7** and the General Requirements for Fire Detection and Alarm System as per **Table: - C.01-T1**

Table: - C.01- T7 Installation and Spacing of Spot Type Heat Detection Systems

ITEMS	REQUIREMENTS
1. INSTALLATION AND SPACING OF SPOT TYPE HEAT DETECTORS	**1. GENERAL** i. The location and spacing of heat detectors shall be based upon preexisting ambient temperature that could exist in the protected compartment. ii. Detector location and spacing shall take into consideration the following features. a. Ceiling shape and surface. b. Ceiling height. c. Configuration of material content in the area. d. Combustion characteristics of the fuel load in the area. e. Compartment ventilation. f. Ambient temperature, pressure, altitude, humidity and atmosphere. iii. If the intent is to protect against specific hazard, detectors shall be

Table: - C.01- T7 Installation and Spacing of Spot Type Heat Detection Systems

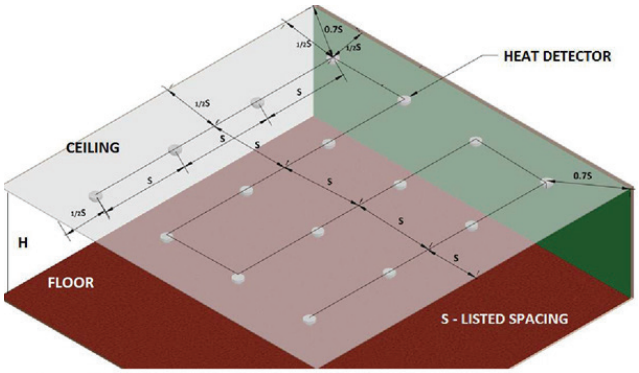
ITEMS	REQUIREMENTS
	placed closer to the hazard, than required by the spacing guidelines iv. In general, shall be located on the ceiling not less than 100 mm from the sidewall. Where ceiling coverage is adequate and detectors are required on side- walls, they shall be installed on the sidewalls between 100 mm and 300 mm from the ceiling. **2. SMOOTH CEILINGS** i. The distance between detectors shall not exceed their listed spacing, and there shall be detectors within a distance of one-half the listed spacing, measured at right angles from all walls or partitions extending upward to within the top 15 percent of the ceiling height. ii. All points on the ceiling shall have a detector within a distance equal to or less than that of their listing specifications. **3. IRREGULAR CEILINGS** i. For irregularly shaped areas, the spacing between detectors shall be permitted to be greater than the listed spacing, provided that the maximum spacing from a detector to the farthest point of a sidewall or corner within its zone of protection is not greater than 0.7 times the listed spacing. **4. CEILINGS WITH SOLID JOIST CONSTRUCTION** i. The design spacing of heat detectors, where measured at right angles to the solid joists, shall not exceed 50 percent of the listed spacing. ii. In the case of solid joist construction, detectors shall be mounted at the bottom of the joists.  H - SEE SPACING (S) REDUCTION AS PER HEIGHT SEE TABLE C.01.T7.a **Figure: - C.01-F19 Spacing of Heat Detectors on Smooth Ceiling**

Table: - C.01- T7 Installation and Spacing of Spot Type Heat Detection Systems

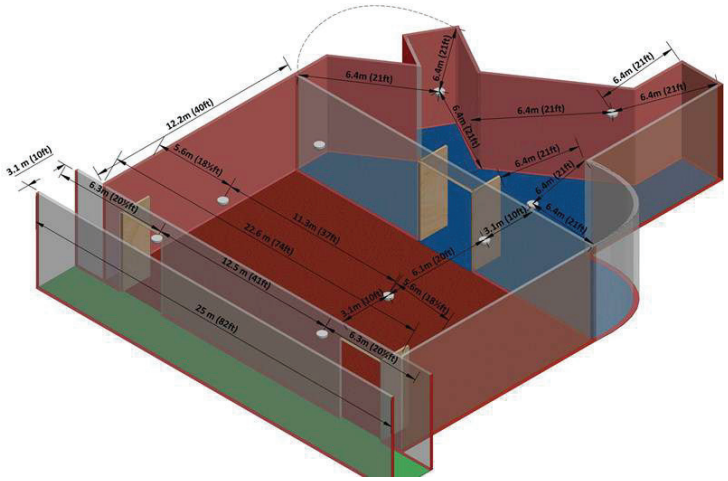
ITEMS	REQUIREMENTS
	 **Figure: - C.01-F20 Spacing of Heat Detectors on Irregular Ceiling** **5. CEILINGS WITH BEAM CONSTRUCTION** i. A ceiling shall be treated as a smooth ceiling if the beams project no more than 100 mm below the ceiling. ii. Where the beams project more than 100 mm below the ceiling, the spacing of spot-type heat detectors at right angles to the direction of beam travel shall be not more than two-thirds of the listed spacing (S). iii. Where the beams project more than 460 mm below the ceiling and are more than 2.4 m on center, each bay formed by the beams shall be treated as a separate pocket area. iv. Where beams are less than 300 mm in depth and less than 2.4 m on center, detectors shall be permitted to be installed on the bottom of beams. **6. SLOPED CEILINGS WITH PEAKS OR SHEDS** i. For a ceiling slope of less than 30 degrees, all detectors shall be spaced using the height at the peak. ii. All detectors, other than those located in the peak, shall be spaced using the average slope height or the height of the peak. iii. Spacing shall be measured along a horizontal projection of the ceiling in accordance with the type of ceiling construction. iv. A row of detectors shall first be located at or within 910 mm of the peak of the ceiling. v. Additional detectors shall be spaced ceiling slope degree. **7. HIGH CEILINGS** i. On ceilings 3 m to 9.1 m high, heat detector spacing shall be reduced in accordance with **Table: -C.01-T7.** a prior to any additional reductions for beams, joists, or slope, where applicable.

Table: - C.01- T7 Installation and Spacing of Spot Type Heat Detection Systems

ITEMS	REQUIREMENTS

CEILING HEIGHT	MULTIPLY LISTED SPACING BY THIS FACTOR
1. 0 m—3 m	1.00
2. >3 m—3.7 m	0.91
3. >3.7 m—4.3 m	0.84
4. >4.3 m—4.9 m	0.77
5. >4.9 m—5.5 m	0.71
6. >5.5 m—6.1 m	0.64
7. >6.1 m—6.7 m	0.58
8. >6.7 m—7.3 m	0.52
9. >7.3 m—7.9 m	0.46
10. >7.9 m—8.5 m	0.40
11. >8.5 m—9.1 m	0.34

5.8 Installation and Spacing of Line Type Heat Detection System

The Installation and Spacing of Line Type Smoke Detection and Alarm System shall comply with **Table: -C.01-T8** Heat Detection System as per **Table: -C.01-T6** and the General Requirements for Fire Detection and Alarm System as per **Table: -C.01-T1**

Table: - C.01- T7 Installation and Spacing of Spot Type Heat Detection Systems

ITEMS	REQUIREMENTS
1. INSTALLATION AND SPACING OF LINE TYPE HEAT DETECTORS	**1. GENERAL** i. The line type detector shall be listed and permitted by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain, including its mounting accessories and hardware as assembly. ii. The location and spacing of heat detectors shall be based upon pre-existing ambient temperature that could exist in the protected compartment. iii. Detector location and spacing shall take into consideration the following features. a. Ceiling shape and surface. b. Ceiling height. c. configuration of material content in the area. d. combustion characteristics of the fuel load in the area. e. compartment ventilation. f. Ambient temperature, pressure, altitude, humidity and atmosphere. iv. The detector shall produce trouble signal during short circuits and open ends, not alarm signal. v. If the intent is to protect against specific hazard, detectors shall be

Table: - C.01- T7 Installation and Spacing of Spot Type Heat Detection Systems

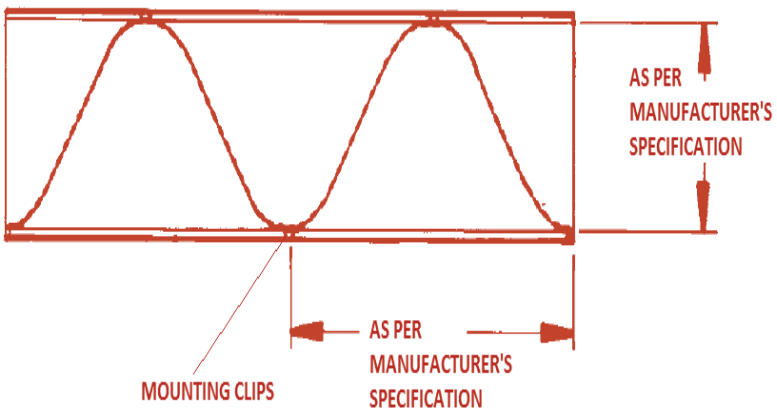
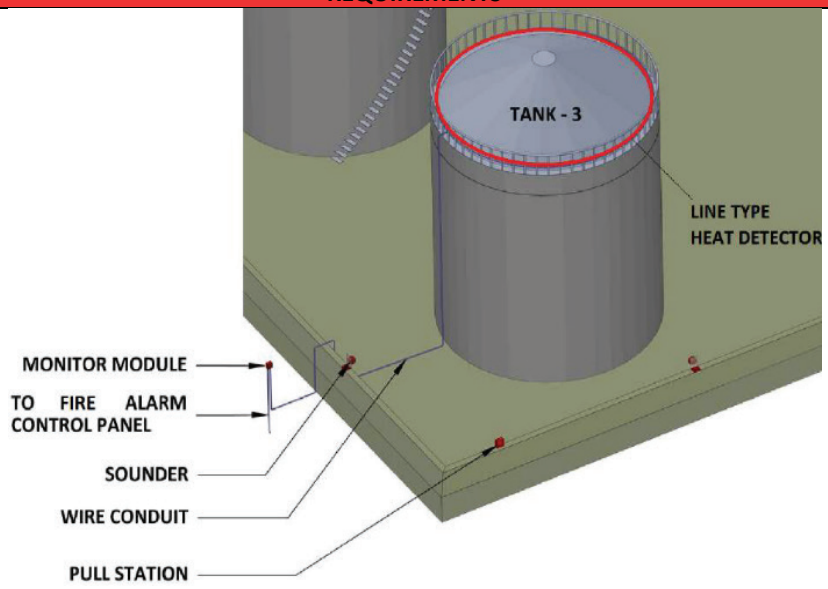
ITEMS	REQUIREMENTS
	placed closer to the hazard, than required by the spacing guidelines vi. In general, line-type heat detectors shall be located on the ceiling or on the sidewalls not more than 510 mm from the ceiling. vii. Maximum spacing of line type detector shall not exceed 15.2 m. up to 3 m of the ceiling height or the hazard protected. viii. Spacing shall be reduced to 9.1 m when installed above 3m from ceiling or the hazard protected. **2. EXTERIOR INSTALLATONS** i. Where line type detectors are installed outdoors and exterior areas, the ambient temperature on detector or its mounting surfaces will increase. Shielding of the detector shall be required to comply with detector temperature ratings and its application. ii. Outdoor installations of line type detectors, to safeguard from wind and storms, shall be secured with additional fasteners/hangers/hooks than recommended by the manufacturer in general areas. **3. OTHER APPLICATIONS** i. Manufacturer's listed design guide and manual shall be followed for spacing, location and installation methods for other applications such as Conveyers, Rack storage, Cable trenches, Fuel oil Tanks etc.  **Figure: -C.01-F21 Spacing of Line Type Heat Detectors on Cable Treys**

Table: - C.01- T7 Installation and Spacing of Spot Type Heat Detection Systems

ITEMS	REQUIREMENTS
	 Figure C.01.F22 Line Type Heat Detectors on Fuel Tanks

5.9 Flame Detection System (Radiant Energy-Sensing Fire Detection)

The Design, Installation and Spacing of Flame Detection and Alarm System (Radiant Energy-Sensing Detection) shall comply with **Table: - C.01-T9** and the relevant General Requirements for Fire Detection and Alarm System as per **Table: - C.01-T1**

Table: - C.01- T9 Design, Installation and Spacing of Flame Detection Systems

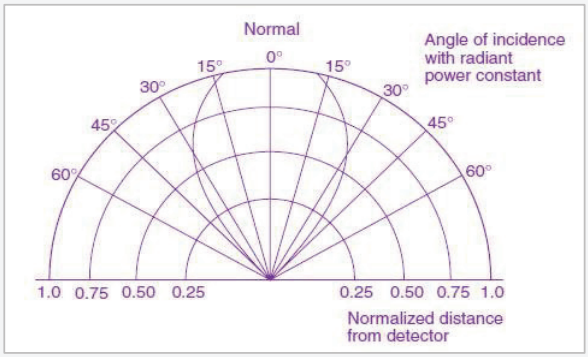
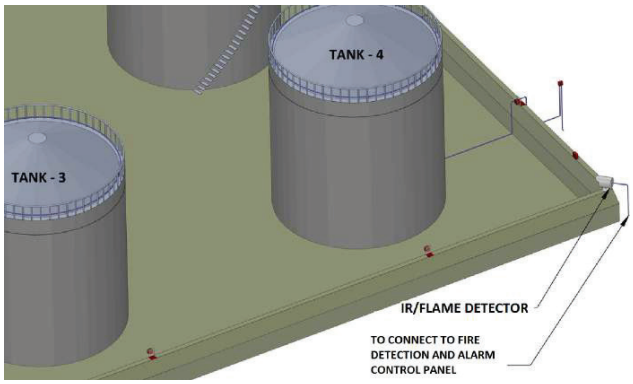
ITEMS	REQUIREMENTS
1. DESIGN, INSTALLATION AND SPACING OF FLAME/ RADIANT ENERGY SENSING DETECTORS	i. The type and quantity of radiant energy–sensing fire detectors shall be determined on the basis of the performance characteristics of the detector and an analysis of the hazard, including the burning characteristics of the fuel, the fire growth rate, the environment, the ambient conditions, and the capabilities of the extinguishing media and equipment. ii. The selection of the radiant energy–sensing detectors shall be based on the following: a. Matching of the spectral response of the detector to the spectral emissions of the fire or fires to be detected. b. Minimizing the possibility of spurious nuisance alarms from non-fire sources inherent to the hazard area.
2. WORKING PRINCIPLES	i. Ultraviolet flame detectors typically use a vacuum photodiode Geiger Muller tube to detect the ultraviolet radiation that is produced by a flame. The photodiode allows a burst of current to flow for each ultraviolet photon that hits the active area of the tube. When the number of current bursts per unit time reaches a predetermined level, the detector initiates an alarm. ii. A spark/ember-sensing detector usually uses a solid-state photodiode or phototransistor to sense the radiant energy emitted by embers, typically between 0.5 microns and 2.0 microns in normally dark environments. These detectors can be made extremely sensitive (microwatts), and their response times can be made very short (microseconds). iii. The greater the angular displacement of the fire from the optical axis of the detector, the larger the fire must become before it is detected. This phenomenon establishes the field of view of the detector. **Figure: -C.01-F16.** shows example of the effective sensitivity versus angular displacement of a flame detector.  **Figure C.01.F23 Normalized Sensitivity vs. Angular Displacement**

Table: - C.01- T9 Design, Installation and Spacing of Flame Detection Systems

ITEMS	REQUIREMENTS
3. SPACING	i. Radiant energy–sensing fire detectors shall be employed consistent with the listing or Permit and the inverse square law, which defines the fire size versus distance curve for the detector. ii. Detector quantity shall be based on the detectors being positioned so that no point requiring detection in the hazard area is obstructed or outside the field of view of at least one detector. iii. The location and spacing of detectors shall be the result of an engineering evaluation that includes the following: a. Size of the fire that is to be detected b. Fuel involved c. Sensitivity of the detector d. Field of view of the detector e. Distance between the fire and the detector f. Radiant energy absorption of the atmosphere g. Presence of extraneous sources of radiant emissions h. Purpose of the detection system i. Response time required. iv. In applications where the fire to be detected could occur in an area not on the optical axis of the detector, the distance shall be reduced or detectors shall be added to compensate for the angular displacement of the fire in accordance with the manufacturer's published instructions. v. Because flame detectors are line-of-sight devices, their ability to respond to the required area of fire in the zone that is to be protected shall not be compromised by the presence of intervening structural members or other opaque objects or materials. vi. Provisions shall be made to sustain detector window clarity in applications where airborne particulates and aerosols coat the detector window between maintenance intervals and affect sensitivity.

Table: - C.01- T9 Design, Installation and Spacing of Flame Detection Systems

ITEMS	REQUIREMENTS
	vii. Radiant energy–sensing detectors shall not be placed in protective housings (e.g., behind glass) to keep them clean, unless such housings are listed for the purpose.  **Figure C.01.F24 Radiant Energy Detectors installed at Fuel Tank Yard**

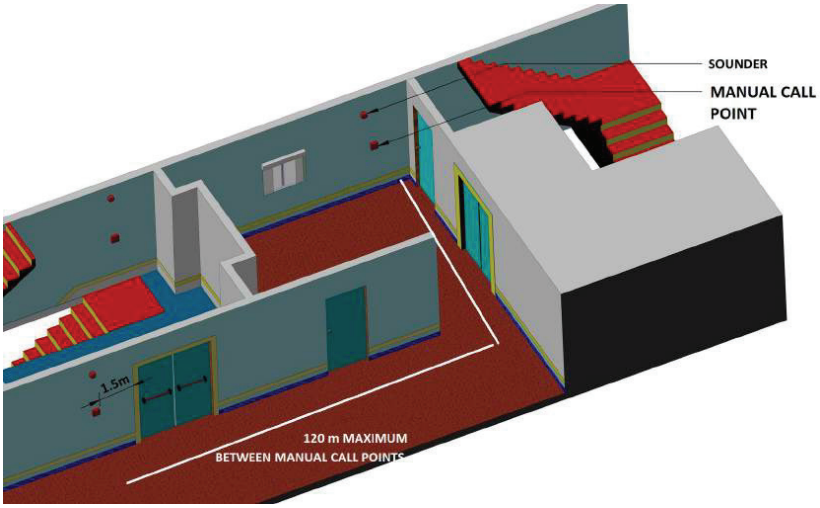
5.10 Manual Fire Alarm Initiating System (Manual Call Points)

The Design, Installation and Spacing of Manual Fire Alarm Initiating Devices shall comply with **Table: - C.01-T10** and the relevant General Requirements for Fire Detection and Alarm System as per **Table: - C.01-T1**

Table: - C.01- T10 Design, Installation and Spacing of Manual Fire Alarm Initiating Devices

ITEMS	REQUIREMENTS
1. DESIGN, INSTALLATION AND SPACING OF MANUAL FIRE ALARM INITIATING SYSTEMS	i. Manually actuated alarm-initiating devices shall be securely mounted. ii. Manually actuated alarm-initiating devices shall be mounted on a background of contrasting color. iii. The operable part of a manually actuated alarm initiating device shall be at 1200 m from the finished floor. iv. Manually actuated alarm-initiating devices shall be permitted to be single action or double action. v. Listed protective covers shall be permitted to be installed over single- or double-action manually actuated alarm initiating devices. vi. Manual fire alarm boxes shall be used only for fire alarm initiating purposes. vii. Manual fire alarm boxes shall be installed so that they are conspicuous, unobstructed, and accessible. viii. Unless installed in an environment that precludes the use of red paint or red plastic, manual fire alarm boxes shall be red in color. ix. Manual fire alarm boxes shall be located within 1.5 m of each exit doorway on each floor. x. Additional Fire Alarm boxes shall be installed such that maximum travel distance to nearest Fire Alarm box shall not exceed 61 m,

Table: - C.01- T10 Design, Installation and Spacing of Manual Fire Alarm Initiating Devices

ITEMS	REQUIREMENTS
	measured horizontally on the same floor. xi. Manual fire alarm boxes shall be mounted on both sides of grouped openings over 12.2 m in width, and within 1.5 m of each side of the grouped opening.  **Figure C.01.F24 Installation of Manual Call Points**

5.11 Wireless or Radio Frequency based Fire Alarm Systems

The Design, Installation and Spacing of Wireless or Radio frequency-based Fire Alarm System shall comply with **Table: - C.01-T11** and the relevant General Requirements Fire Detection and Alarm System as per **Table: - C.01-T1**

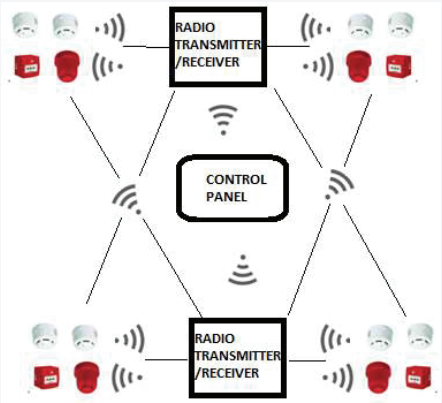
Table: - C.01- T11 Design, Installation and Spacing of Wireless Systems

ITEMS	REQUIREMENTS
1. DESIGN, INSTALLATION AND SPACING OF WIRELESS FIRE ALARM SYSTEMS	i. Wireless Fire Alarm Systems shall be listed and permitted by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain as a full system assembly including low power radio equipment, transmitters, receivers, Detectors, Control Units and accessories. ii. Wireless Fire Alarm Systems shall be addressable, pin-pointing exact device initiating alarm or in trouble condition or has battery failure. iii. The system shall follow Mesh Communication Topology with no signal booster, expanders for communication within devices. iv. iii. The Control Unit shall be capable of interfacing with wired Analogue addressable Fire Alarm Systems.
2. POWER SUPPLIES	i. A primary battery(s) (dry cell) shall be permitted to be used as the sole power source for devices incorporating a low-power radio transmitter/transceiver where all of the following conditions are met: a. Each transmitter/transceiver shall serve only one device and shall be individually identified at the system control unit.

Table: - C.01- T11 Design, Installation and Spacing of Wireless Systems

ITEMS	REQUIREMENTS
	b. The battery(s) shall be capable of operating the low power radio transmitter/ transceiver and its associated device for not less than 1 year before the battery depletion threshold is reached. c. A low battery signal shall be transmitted before the device is no longer capable of providing 15 days of trouble signal operation followed by the signaling of a single nontroubled response. The low battery signal shall be distinctive from alarm, supervisory, tamper, and trouble signals, shall visibly identify the affected low-power radio transmitter/transceiver, and, when silenced, shall automatically re-sound at least once every 4 hours. d. Catastrophic (open or short) battery failure shall cause a trouble signal identifying the affected low-power radio transmitter/transceiver at the system control unit. When silenced, the trouble signal shall automatically re-sound at least once every 4 hours. e. Any mode of failure of a primary battery in a low-power radio transmitter/ transceiver shall not affect any other low-power radio transmitter/transceiver.
3. ALARM SIGNAL	i. When a wireless initiating device is actuated, its low power radio transmitter/ transceiver shall automatically transmit an alarm signal. ii. Response time shall occur within 10 seconds after the activation of an initiating device. iii. Each low-power radio transmitter/transceiver shall automatically repeat alarm transmissions at intervals not exceeding 60 seconds until the initiating device is returned to its non-alarm condition. iv. Fire alarm signals shall be distinctive, clearly recognizable, and shall be indicated as follows in descending order of priority a. Signals associated with life safety. b. Signals associated with property protection. c. Trouble signals associated with life and/or property protection. d. All other signals v. A fire alarm signal from a low-power radio transmitter/transceiver shall latch at its system control unit until it is manually reset.
4. MONITORING FOR INTEGRITY	i. Single loss of transmission network shall not affect the communication and alarm signal transmission. The transmission network shall be backed up by series of loops and redundant alternate transmission paths. ii. The low-power radio transmitter/transceiver shall be specifically listed as using a communication method that is highly resistant to misinterpretation of simultaneous transmissions and to interference (e.g., impulse noise and adjacent channel interference). iii. The occurrence of any single fault that disables communication between any low-power radio transmitter/transceiver and the receiver/transceiver system control unit shall cause a latching trouble signal within 200 seconds at the system control unit that

Table: - C.01- T11 Design, Installation and Spacing of Wireless Systems

ITEMS	REQUIREMENTS
	individually identifies the affected device. iv. A single fault on the signaling channel shall not cause an alarm signal. v. Removal of a low-power radio transmitter/ transceiver from its installed location shall cause immediate transmission of a distinctive trouble signal that indicates its removal and individually identifies the affected device. vi. Reception of any unwanted (interfering) transmission by a retransmission device or by the receiver system control unit for a continuous period of 20 seconds or more shall cause an audible and visible trouble indication at the system control unit, identifying it as specific interfering trouble condition.  **Figure: - C.01-F25 Typical Radio Communicated Fire Alarm System Network**

5.12 Other Fire Detectors

The Design, Installation and Spacing of Other Fire Detectors shall comply with **Table: - C.01-T12** and the relevant General Requirements Fire Detection and Alarm System as per **Table: - C.01-T1**

Table: - C.01- T12 Design, Installation and Spacing of Other Fire Detectors

ITEMS	REQUIREMENTS
1. MULTI SENSORS	i. Because of the device-specific, software-driven solution of multi-criteria detectors to reduce unwanted alarms and improve detector response to a non-specific fire source, location and spacing criteria included with manufacturer's guidelines and listed design manual shall be followed.
2. GAS DETECTORS	i. Gas detection (Other than LP Gas detection) shall be designed and installed as per manufacturer's listed design guidelines. ii. LP Gas detection and Alarm system shall be as per **Chapter 02 Section F**. Fire safety Guidelines for Liquefied Petroleum Gas Installations iii. Gas detection equipment shall be listed for the specific gas or vapor it is intended to detect. iv. Any gas detection systems installed on a fire alarm system shall comply with all the applicable requirements of this Code. v. The requirements of this Code shall not apply to gas detection

Table: - C.01- T12 Design, Installation and Spacing of Other Fire Detectors

ITEMS	REQUIREMENTS
	systems used solely for process control. vi. The selection and placement of the gas detectors shall be based on an engineering evaluation.
3. VIDEO IMAGE FIRE DETECTORS	i. Video image Fire detection systems and all of the components thereof, including hardware and software, shall be listed for the purpose of Fire detection. ii. Systems shall be designed in accordance with a performance-based design approach.

6.0 APPLICATION OF FIRE DETECTION AND ALARM SYSTEMS

6.1 Application of Fire Detection and Alarm System based on the building type

The application of Fire Detection and Alarm System based on the building type and occupancy shall be as per **Table: - C.01-T13**.

Table: - C.01- T13 Design, Installation and Spacing of Other Fire Detectors

BUILDING / OCCUPANCY	APPLICABLE FIRE DETECTION AND ALARM SYSTEMS
1. SUPER HIGHRISE BUILDING/ HIGHRISE BUILDING	i. Smoke Detection and Alarm System shall be provided throughout the building as per **Section 5.3**. ii. Fire Pump, all building fire suppression systems, Fire Water Level, LP Gas detection, CO Monitoring and other interconnected systems like door release, Elevator recall, Smoke Control etc. shall be interfaced with Fire Detection and Alarm System, based on building fire strategy, as per **Section 5.1**. iii. Main FACP shall be located at the continuously attended location such as Emergency Command Centre or Reception or Security guard house, as per the building fire strategy. iv. Additional Sub FACP's or Annunciators complete with all functional features shall be provided at the elevator lobby of the floor or the mechanical floor at every 45 m height of the building and connected to main FACP in a network. v. Activation of the Fire Detection and Alarm System shall only trigger 5 floors of evacuation alarm, at fire floor, 3 floors above and at 1 floor below. General Fire Alarm shall not be required to trigger entire building evacuation alarm or general Fire Alarm. Security or facility management personnel or authorized person shall intimate the occupants on Voice Alarm System/Public Address System about the situation.

Table: - C.01- T13 Design, Installation and Spacing of Other Fire Detectors

BUILDING / OCCUPANCY	APPLICABLE FIRE DETECTION AND ALARM SYSTEMS
	vi. Positive Alarm Sequence (Positive Alarm Delay) as per **Table: - C.01-T1.14.2**, shall be followed. If the alarm is not silenced by authorized personnel or FACP is not reset within 15 seconds, or multiple alarms are triggered from other initiating devices within 180 seconds, then the entire fire floor, entire floors above fire floor and 1 floor below fire floor shall have evacuation alarm. Security or facility management personnel or authorized person shall intimate the occupants on Voice Alarm System/Public Address System about the situation. vii. If the alarm is not silenced by authorized personnel or FACP is not reset or multiple alarms are triggered from other initiating devices within 240 seconds, then the entire building shall have evacuation alarm. Security or facility management personnel or authorized person shall intimate the occupants on Voice Alarm System/Public Address System about the situation.
2. MIDRISE BUILDINGS/ LOWRISE BUILDINGS	i. Smoke Detection and Alarm System shall be provided throughout the building as per **Section 5.3**. ii. Fire Pump, all building fire suppression systems, Fire Water Level, LP Gas detection, CO Monitoring and other interconnected systems like door release, Elevator recall, Smoke Control etc. shall be interfaced with Fire Detection and Alarm System, based on building fire strategy, as per **Section 5.1** iii. Main FACP shall be located at the continuously attended location such as Emergency Command Centre or Reception or Security guard house, as per the building fire strategy. iv. Positive Alarm Sequence (Positive Alarm Delay) as per **Table: - C.01-T1.14.2** shall be followed. If the Fire Detection Alarm is not silenced by authorized personnel or FACP is not reset or multiple alarms are triggered from other initiating devices within 180 seconds, then the entire building shall have evacuation alarm.
3.ASSEMBLY BUILDINGS / BUSINESS BUILDINGS / RESIDENTIAL BUILDINGS / DAY CARE BUILDINGS/ MERCANTILE	i. Smoke Detection and Alarm System shall be provided throughout the building as per **Section 5.3** ii. Fire Pump, all building fire suppression systems, Fire Water Level, LP Gas detection, CO Monitoring and other interconnected systems like door release, Elevator recall, Smoke Control etc. shall be interfaced with Fire Detection and Alarm System, based on building fire strategy, as per **Section 5.1** iii. Auxiliary Rooms and Spaces Fire Detection and Alarm System as per **Table: - C.01-T14** and Equipment s Fire Detection and Alarm System as per **Table: - C.01-T15** shall be provided. iv. Positive Alarm Sequence (Positive Alarm Delay) as per **Table: - C.01-T1.14.2** shall be followed. If the general Fire alarm is not silenced by authorized personnel or FACP is not reset or multiple alarms are triggered from other initiating devices within 180 seconds, evacuation fire alarm shall be triggered throughout.
4. EXISTING PRIVATE VILLAS (G+1) CONVERTED TO:	i. Smoke Detection and Alarm System shall be provided throughout the building as per **Section 5.3**.

Table: - C.01- T13 Design, Installation and Spacing of Other Fire Detectors

BUILDING / OCCUPANCY	APPLICABLE FIRE DETECTION AND ALARM SYSTEMS
NURSERIES, DAY CARE CENTERS, RESTAURANTS, SHOW ROOMS, BOUTIQUES	or i. Wireless /Low powered radio frequency-based Fire Detection and Alarm System shall be provided in each villa as per **Section 5.11**. ii. Auxiliary Rooms and Spaces Fire Detection and Alarm System as per **Table: - C.01-T14** and Equipment s Fire Detection and Alarm System as per **Table: - C.01-T15** shall be provided. iii. Main FACP OR the cluster radio HUB shall be located at the continuously attended location such as reception or Security guard house. iv. Each villa shall be provided with audio visual notification devices outside such that notification devices are visible from the common approach road.
5. EDUCATION BUILDINGS	i. Smoke Detection and Alarm System shall be provided throughout the building as per **Section 5.3** ii. Auditoriums, Gymnasiums, Cafeteria, Laboratories and indoor swimming pools shall be provided with Heat Detection System as per **Section 5.6** iii. Fire Pump, all building fire suppression systems, Fire Water Level, LP Gas detection, CO Monitoring and other interconnected systems like door release, Elevator recall, Smoke Control etc. shall be interfaced with Fire Detection and Alarm System, based on building fire strategy, as per **Section 5.1.** iv. Auxiliary Rooms and Spaces Fire Detection and Alarm System as per **Table: - C.01-T14** and Equipment s Fire Detection and Alarm System as per **Table: - C.01-T15** shall be provided. v. Main FACP shall be located at the continuously attended location such as Emergency Command Centre or Reception or Security guard house, as per the building fire strategy. vi. An annunciator panel shall be located inside the Principal's office. vii. A total evacuation alarm initiating switch shall be provided at the Principal's office, in addition to the emergency evacuation public address system. Positive Alarm Sequence (Positive Alarm Delay) as per **Table: - C.01-T1.14.2**, shall be followed. viii. Student recall signal shall be distinct from fire alarm or any other signal. ix. Manual Call points shall be permitted to be enclosed with listed cover box.
6. HEALTHCARE BUILDINGS	i. Smoke Detection and Alarm System shall be provided throughout the building as per **Section 5.3.** ii. Fire Pump, all building fire suppression systems, Fire Water Level, LP Gas detection, CO Monitoring and other interconnected systems like door release, Elevator recall, Smoke Control etc. shall be interfaced with Fire Detection and Alarm System, based on building fire strategy, as per **Section 5.1.** iii. Auxiliary Rooms and Spaces Fire Detection and Alarm System as per **Table: - C.01-T14** and Equipment s Fire Detection and Alarm System

Table: - C.01- T13 Design, Installation and Spacing of Other Fire Detectors

BUILDING / OCCUPANCY	APPLICABLE FIRE DETECTION AND ALARM SYSTEMS
	as per **Table: - C.01-T15** shall be provided. iv. Main FACP shall be located at the continuously attended location such as Emergency Command Centre or Reception or Security guard house, as per the building fire strategy. v. Additional annunciators shall be located at nurse stations strategically throughout the facility. vi. General Fire Alarm shall not trigger evacuation alarm and interconnected systems such as elevator recall, HVAC Shutdown, door release operations etc. in the facility. vii. Nurse stations /Staff areas shall be provided with evacuation alarm initiating bush button or switch within 61 m from the nurse station. viii. Positive Alarm Sequence (Positive Alarm Delay) as per **Table: - C.01-T1.14.2** shall be followed. ix. Activation of the nurse evacuation push button shall trigger evacuation alarm and interconnected systems such as elevator recall, HVAC Shutdown, door release operations etc. as per building fire strategy. x. In critical care areas, such as operation theatres, ICU's, in lieu of audible notification devices, visual notification devices shall be permitted. xi. The Fire Alarm zoning shall coincide with building smoke compartments or zones.
7. DETENTION AND CORRECTIONAL BUILDINGS	i. Aspiration Type Air Sampling Smoke Detection System shall be provided throughout inmates' cells, prison sleeping areas as per **Section 5.5** ii. Smoke Detection and Alarm System shall be provided throughout, Office, maintenance, Day rooms, and Activity rooms monitored by continuously by staff and areas other than prison cells and inmates' areas of the building as per **Section 5.3** iii. Smoke detectors shall be permitted to be installed in exhaust ducts from cells and behind grills of cells. iv. Manual fire alarm boxes shall be permitted to be locked, provided that staff is present within the area when it is occupied and staff has keys readily available to unlock the boxes. v. Auditoriums, Gymnasiums, Cafeteria and indoor swimming pools shall be provided with Heat Detection System as per **Section 5.6** vi. Fire Pump, Fire Water Level, LP Gas detection, CO Monitoring and other interconnected systems like door release, Elevator recall, Smoke Control etc. shall be interfaced with Fire Detection and Alarm System, based on building fire strategy, as per **Section 5.1** vii. Auxiliary Rooms and Spaces Fire Detection and Alarm System as per **Table: - C.01-T14** and Equipment s Fire Detection and Alarm System as per **Table C.01.T15** shall be provided. viii. Main FACP shall be located at the continuously attended location such as Emergency Command Centre or Supervisor or Security guard

Table: - C.01- T13 Design, Installation and Spacing of Other Fire Detectors

BUILDING / OCCUPANCY	APPLICABLE FIRE DETECTION AND ALARM SYSTEMS
	house, as per the building fire strategy. ix. General Fire Alarm shall not trigger evacuation alarm and interconnected systems such as elevator recall, HVAC Shutdown, door release operations etc. in the facility. x. Supervisor/Staff areas shall be provided with evacuation alarm initiating push button or switch for evacuation alarm and General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain notification. xi. Positive Alarm Sequence (Positive Alarm Delay) as per **Table: - C.01-T1.14.2** shall be followed. xii. Activation of evacuation push button shall trigger evacuation alarm and interconnected systems such as elevator recall, HVAC Shutdown, door release operations etc. as per building fire strategy.
8. HOTEL BUILDINGS	i. Smoke Detection and Alarm System shall be provided throughout the building as per **Section 5.3** ii. Fire Pump, all building fire suppression systems, Fire Water Level, LP Gas detection, CO Monitoring and other interconnected systems like door release, Elevator recall, Smoke Control etc. shall be interfaced with Fire Detection and Alarm System, based on building fire strategy, as per **Section 5.1** iii. Auxiliary Rooms and Spaces Fire Detection and Alarm System as per **Table: - C.01-T14** and Equipment s Fire Detection and Alarm System as per **Table C.01.T15** shall be provided. iv. Main FACP shall be located at the continuously attended location such as Emergency Command Centre or Reception Desk or Security guard house, as per the building fire strategy. v. An annunciator panel shall be located at the Reception Desk. vi. A total evacuation alarm initiating switch shall be provided at the Reception Desk. vii. General Fire Alarm shall not trigger evacuation alarm. viii. Positive Alarm Sequence (Positive Alarm Delay) as per **Table: - C.01-T1.14.2** shall be followed. ix. If the alarm is not silenced by authorized personnel or FACP is not reset or multiple alarms are triggered from other initiating devices within 120 seconds, evacuation alarm shall be triggered throughout.
9. STORAGE AND WAREHOUSE/ INDUSTRIAL BUILDINGS	i. Smoke Detection and Alarm System shall be provided throughout as per **Section 5.3**. ii. Fire Pump, all building fire suppression systems, Fire Water Level, LP Gas detection, CO Monitoring and other interconnected systems like door release, Elevator recall, Smoke Control etc. shall be interfaced with Fire Detection and Alarm System, based on building fire strategy, as per **Section 5.1.** iii. Auxiliary Rooms and Spaces Fire Detection and Alarm System as per **Table: - C.01-T14** and Equipment s Fire Detection and Alarm System as per **Table: - C.01-T15** shall be provided.

Table: - C.01- T13 Design, Installation and Spacing of Other Fire Detectors

BUILDING / OCCUPANCY	APPLICABLE FIRE DETECTION AND ALARM SYSTEMS
	iv. In a single tenant warehouse, main FACP shall be located at the continuously attended location such as Emergency Command Centre or Supervisor or Security guard house, as per the building fire strategy. v. In multi-tenant warehouse, a single main FACP shall be permitted to monitor all the warehouses in the group and FACP's for individual warehouses shall not be required. Such main FACP shall be located at the security guard house or the facility management office. vi. Each warehouse shall be provided with audio visual notification devices outside such that notification devices are visible from the common entrance. vii. General Fire Alarm shall be the evacuation alarm.
10. COLD STORAGE	i. Aspiration Type Air Sampling Smoke Detection System shall be provided inside freezer and cold room areas as per **Section 5.5** ii. Smoke Detection and Alarm System shall be provided throughout, Office, maintenance, store room areas of the building as per **Section 5.3**
11. ENCLOSED PARKING	i. No Fire Detectors are required if the enclosed parking is provided fully with automatic sprinkler System. ii. Where enclosed parking is provided with automatic sprinkler system, Manual Fire Detection and Alarm System shall be provided as per **Section 5.10.** iii. Where enclosed parking is not provided with automatic sprinkler system, Heat detection and alarm system shall be provided as per **Section 5.7** iv. Audio Visual notification devices shall be provided throughout the parking areas. v. Fire Pump, all building fire suppression systems, Fire Water Level, LP Gas detection, CO Monitoring and other interconnected systems like door release, Elevator recall, Smoke Control etc. shall be interfaced with Fire Detection and Alarm System, based on building fire strategy, as per **Section 5.1**. vi. Auxiliary Rooms and Spaces Fire Detection and Alarm System as per **Table: - C.01-T14** and Equipment s Fire Detection and Alarm System as per **Table: - C.01-T15** shall be provided. vii. General Fire Alarm shall not trigger be the evacuation alarm. viii. If the general fire alarm is not silenced by authorized personnel or FACP is not reset or multiple alarms are triggered from other initiating devices within 120 seconds, evacuation alarm shall be triggered throughout.

Table: - C.01- T13 Design, Installation and Spacing of Other Fire Detectors

BUILDING / OCCUPANCY	APPLICABLE FIRE DETECTION AND ALARM SYSTEMS
12. ROBOTIC OR MECHANICAL PARKING OR ROBOTIC LOGISTICS	i. Aspiration Type Air Sampling Smoke Detection System shall be provided throughout vehicle stacking and storing areas as per **Section 5.5.** ii. Smoke Detection and Alarm System shall be provided throughout, Office, maintenance, reception, store rooms areas of the building as per **Section 5.3.**
13. COVERED MALL	i. Smoke Detection and Alarm System shall be provided throughout the building as per **Section 5.3**. ii. Fire Pump, all building fire suppression systems, Fire Water Level, LP Gas detection, CO Monitoring and other interconnected systems like door release, Elevator recall, Smoke Control etc. shall be interfaced with Fire Detection and Alarm System, based on building fire strategy, as per **Section 5.1.** iii. Auxiliary Rooms and Spaces Fire Detection and Alarm System as per **Table: - C.01-T14** and Equipment s Fire Detection and Alarm System as per **Table: - C.01-T15** shall be provided. iv. Main FACP shall cover the entire mall through sub FACP's distributed strategically throughout in a network to coincide with Fire Evacuation Zoning of the mall as per mall fire strategy. v. Main FACP shall be located at the continuously attended location such as Emergency Command Centre or Mall management office or Security guard house, as per the building fire strategy. vi. In the case of Retails shops, the control panel must be separate or connected to the main control panel of the building at the main entrance to the commercial shop. vii. Individual tenant spaces shall not be required to have individual FACP's. Sub FACP's provided by the mall in strategic locations shall monitor the tenant spaces' detectors. viii. An annunciator panel shall be located at all the Mall Information Desks. ix. Positive Alarm Sequence (Positive Alarm Delay) as per **Table: - C.01-T1.14.2** shall be followed. x. General fire alarm from a single tenant space shall trigger evacuation alarm only in that particular tenant space and not the mall evacuation alarm nor the fire zone evacuation alarm. xi. If the single tenant evacuation alarm is not silenced by authorized personnel or FACP is not reset or multiple alarms are triggered from other initiating devices within 180 seconds, then the particular fire zone evacuation alarm shall be triggered. Security or mall management personnel or authorized person shall inti- mate the occupants on Voice Alarm System/Public Address System about the situation. xii. Visual Display Notification with messages shall be permitted along with Voice Speakers and Public address Systems.

Table: - C.01- T13 Design, Installation and Spacing of Other Fire Detectors

BUILDING / OCCUPANCY	APPLICABLE FIRE DETECTION AND ALARM SYSTEMS
14. COMMERCIAL VILLA	i. Recommended Smoke Detection and Alarm System in each villa as per **Section 5.3 but** not mandatory or i. Recommended Wireless /Low powered radio frequency-based Fire Detection and Alarm System in each villa as per **Section 5.11** but not mandatory ii. Auxiliary Rooms and Spaces Fire Detection and Alarm System as per **Table: - C.01-T14** and Equipment's Fire Detection and Alarm System as per **Table: - C.01-T15** shall be provided. iii. Main FACP or the cluster radio HUB shall be located at the continuously attended location such as Emergency Command Centre or facility management office or Security guard house (or even at developer's office in case of wireless/ radio system), as per the building fire strategy. iv. Each villa shall be provided with audio visual notification devices outside such that notification devices are visible from the common approach road.
15. PETROL AND GAS STATIONS (HAZARDOUS MATERIALS)	i. Smoke Detection and Alarm System shall be provided throughout the Mini Mart, Retails, Restaurants, Dining Areas, Service Stations as per **Section 5.3.** ii. Fire Pump, all building fire suppression systems, Fire Water Level, LP Gas detection, CO Monitoring and other interconnected systems, if any, shall be interfaced with Fire Detection and Alarm System, based on building fire strategy, as per **Section 5.1.** iii. Auxiliary Rooms and Spaces, if any, Fire Detection and Alarm System as per **Table: - C.01-T1.14** and Equipment s Fire Detection and Alarm System as per **Table: - C.01-T1.15** shall be provided. iv. Main FACP shall cover the entire Petrol/Gas Station complex. FACP's for individual tenants shall not be required. v. Main FACP shall be located at the continuously attended location such as management office or Security guard house or at Mini Mart cash counter, as per the building fire strategy. vi. General fire alarm from a single tenant space shall trigger evacuation alarm only in that particular tenant space. vii. If the alarm is not silenced by authorized personnel or FACP is not reset or multiple alarms are triggered from other initiating devices within 180 seconds, then the complex evacuation alarm shall be triggered. viii. Audio/Visual Notification devices shall be provided outside each tenant outlets.
16. NURSERY (PLANTS AND VEGETATION)	i. Fire Detection and Alarm System shall not be required.

6.2 Application of Fire Detection and Alarm System for auxiliary rooms and spaces

The application of Fire Detection and Alarm System for auxiliary rooms and spaces shall be as per **Table: - C.01-T14**

Table: - C.01- T14 Auxiliary Rooms and Spaces Fire Detection and Alarm System

BUILDING / OCCUPANCY	APPLICABLE FIRE DETECTION AND ALARM SYSTEMS
1. ATRIUM	i. Projected Beam Smoke Detection and Alarm System shall be provided to cover atrium as per **Section 5.4.** or i. Aspiration Type Air Sampling Smoke Detection System shall be provided as per **Section 5.5.**
2. ANESTHETIZING ROOM	i. Smoke Detection and Alarm System shall be provided to as per **Section 5.4**. or Aspiration Type Air Sampling Smoke Detection System shall be provided as per **Section 5.5.**
3. OPERATION ROOM	i. Aspiration Type Air Sampling Smoke Detection System shall be provided as per **Section 5.5.**
4. BATTERY CHARGER ROOM	i. Heat Detection and Alarm System shall be provided as per **Section 5.7**
5. BATTERY ROOM	i. Heat Detection and Alarm System shall be provided as per **Section 5.7.** and i. Flame Detection and Alarm System shall be provided as per **Section 5.9**. ii. In addition, listed Hydrogen detectors shall be provided
6. BMS ROOM	i. Smoke Detection and Alarm System shall be provided as per **Section 5.4**.
7. COMPUTER ROOM	i. Smoke Detection and Alarm System shall be provided as per **Section 5.4**. or i. Aspiration Type Air Sampling Smoke Detection System shall be provided as per **Section 5.5.**
8. DIESEL GENERATOR ROOM	i. Heat Detection and Alarm System shall be provided as per **Section 5.7**.
9. ELECTRICAL ROOM	i. Smoke Detection and Alarm System shall be provided as per **Section 5.4**.
10. AHU ROOM	i. Multi-sensors shall be provided as per **Table: - C.01-T12.1**
11. LV ROOM	i. Smoke Detection and Alarm System shall be provided as per **Section 5.4.**

Table: - C.01- T14 Auxiliary Rooms and Spaces Fire Detection and Alarm System

BUILDING / OCCUPANCY	APPLICABLE FIRE DETECTION AND ALARM SYSTEMS
	or i. Aspiration Type Air Sampling Smoke Detection System shall be provided as per **Section 5.5.**
12. LIFT MACHINE ROOM	i. Multi-sensors shall be provided as per **Table: - C.01-T12.1**
13. SERVER ROOMS	i. Smoke Detection and Alarm System shall be provided to as per **Section 5.4.** or i. Aspiration Type Air Sampling Smoke Detection System shall be provided as per **Section 5.5**.
14. STAIR	i. At least one smoke detector shall be installed at the top of the stair of a non-high-rise building as per **Section 5.3**. ii. In Highrise and Super Highrise buildings, along with one smoke detector at the top of the shaft, multiple smoke detectors at intermediate landings, every 23 m, shall be provided as per **Section 5.3**.
15. ELEVATOR SHAFT	i. At least one smoke detector shall be installed at the top of the elevator shaft of a non-high-rise building as per **Section 5.3**. ii. In Highrise and Super Highrise buildings, along with one smoke detector at the top of the shaft, multiple smoke detectors at intermediate levels, every 23 m vertically in the shaft, shall be provided as per **Section 5.3**.
16. ABOVE FALSE CEILING SPACES HAVING VOID HEIGHT OF MORE THAN 85 CM	i. Smoke Detectors shall be provided in the void as per **Section 5.3.** ii. Remote response indicators shall be provided throughout to identify alarm status of concealed detectors. iii. However, above false ceiling detectors shall not be required where such voids are inaccessible voids.
17. BELOW RAISED FLOOR HAVING VOID HEIGHT OF MORE THAN 30 CM OR WHERE CABLE RUNS AND DUCTING ARE INSTALLED	i. Smoke Detectors shall be provided in the void as per **Section 5.3.** ii. Remote response indicators shall be provided throughout to identify alarm status of concealed detectors.
18. ENCLOSED SPACES HAVING HEIGHT MORE THAN 10 M TO LESS THAN 20 M FROM FINISHED FLOOR LEVEL	i. Projected Beam Detection System shall be provided as per **Section 5.4.**
19. ENCLOSED SPACES HAVING HEIGHT MORE THAN 20 M	i. Aspiration Type Air Sampling Detection System shall be provided as per **Section 5.5.**

Table: - C.01- T14 Auxiliary Rooms and Spaces Fire Detection and Alarm System

BUILDING / OCCUPANCY	APPLICABLE FIRE DETECTION AND ALARM SYSTEMS
FROM FINISHED FLOOR LEVEL	
20. PUBLIC BATHROOMS HAVING AREA MORE THAN 5 M^2	i. Heat Detection and Alarm System shall be provided as per **Section 5.7.**
21. LAUNDRY	i. Smoke Detectors shall be provided in the void as per **Section 5.3.**
22. STORAGE ROOM	i. Smoke Detectors shall be provided in the void as per **Section 5.3.**
23. PANTRY	i. Heat Detection and Alarm System shall be provided as per **Section 5.7.**
24. PUMP ROOM	i. Heat Detector shall be provided as per **Section 5.7.**
25. GARBAGE ROOM	i. Heat Detector shall be provided as per **Section 5.7.**
26. BEDROOM	i. Sounder based Smoke Detector shall be provided as per **Section 5.3.**
27. LIVING ROOM	i. Smoke Detector shall be provided as per **Section 5.3.**
28. OPEN KITCHEN	i. Detectors specifically listed for Kitchen shall be provided as per their listing specifications. or i. Heat Detector in the kitchen shall be provided as per **Section 5.7**. along with Smoke Detector, 3 m away from the Kitchen counter, in the living room shall be provided as per **Section 4.3**. or i. Multi-sensors specifically listed for Kitchen shall be provided as per **Table: - C.01-T12.1**
29. CLOSED KITCHEN	i. Detectors specifically listed for Kitchen shall be provided as per their listing specifications. or i. Heat Detector in the kitchen shall be provided as per **Section 5.7.**
30. CORRIDOR	i. Smoke Detector shall be provided as per **Section 5.3**.
31. TEMPORARY KIOSKS	i. Battery Operated Smoke Detectors, listed and permitted by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain shall be provided.
32. TEMPORARY TENTS	i. Battery Operated Smoke Detectors, listed and permitted by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain shall be provided.
33. TEMPORARY MODULAR HOUSES/ OFFICES	i. Smoke Detector shall be provided as per **Section 5.3.**

Table: - C.01- T14 Auxiliary Rooms and Spaces Fire Detection and Alarm System

BUILDING / OCCUPANCY	APPLICABLE FIRE DETECTION AND ALARM SYSTEMS
34. FOOD TRUCKS	i. Heat Detector shall be provided as per **Section 5.7.**
35. MERCANTILE TRUCKS	i. Heat Detector shall be provided as per **Section 5.7.**
36. BUILDING ROOFS	i. Building roofs used for restaurant seating, assembly and as Sheesha bars or smoking area shall be provided with Manual Fire Detection and Alarm System, as per **Section 5.10.**
37. OPEN STORAGE SHEDS	i. Manual Fire Detection and Alarm System, as per **Section 5.10.**

6.3 Application of Fire Detection and Alarm System for Equipment

The application of Fire Detection and Alarm System for equipment shall be as per **Table: -C.01-T15.**

Table: - C.01- T15 Equipment Fire Detection and Alarm System

BUILDING / OCCUPANCY	APPLICABLE FIRE DETECTION AND ALARM SYSTEMS
1. KITCHEN HOOD	i. Fusible Link Heat Detection and Alarm System shall be provided as per **Section 5.6**. (Pre-engineered Systems shall be acceptable)
2. LPG TANKS	i. LP Gas Detection and Alarm System shall be provided as per **Chapter 02 Section E** ii. LP Gas detection control panel shall be interfaced with Fire Detection and Alarm Control Panel. iii. The triggering of deluge water spray for the LP Gas tank shall be through following means. a. LP Gas detection from the LP Gas tank area. b. Fire Detection from roof and one floor below. c. Cross zoned fire detection from rest of the building. d. Manual actuation of deluge water spray from LP Gas detection control panel.
3. FLAMMABLE LIQUID TANKS	i. Intrinsically Safe Flame (Radiant Energy) Detection and Alarm System shall be provided as per **Section 5.9.** and as per Risk assessment proposed and stamped by the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted House of Expertise. and i. Intrinsically Safe Linear Type Heat Detection System shall be provided on the tank roof as per **Section 5.8**. and as per Risk assessment proposed and stamped by the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted House of Expertise.
4. CABLE SPREAD AREAS	i. Aspirated Type Air Sampling Smoke Detection System shall be provided for the room ceiling as per **Section 5.5.** and i. Linear Type Heat Detection System shall be provided on the cable

	trays as per **Section 5.8.**
5. DIESEL GENERATORS AREA	i. Heat Detection and Alarm System shall be provided as per **Section 5.7**
6. BOILERS AREA	i. Heat Detection and Alarm System shall be provided as per **Section 5.7**
7. COOLING TOWERS	i. Linear Type Heat Detection System shall be provided on the cable trays as per **Section 5.8**.
8. TRANSFORMERS	i. Linear Type Heat Detection System shall be provided on the cable trays as per **Section 5.8**.
9. BULK OIL STORAGE	i. Intrinsically Safe Flame (Radiant Energy) Detection and Alarm System shall be provided as per **Section 5.9**. and as per Risk assessment proposed and stamped by the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted House of Expertise. and i. Intrinsically Safe Linear Type Heat Detection System shall be provided on the tank roof as per **Section 5.8**. and as per Risk assessment proposed and stamped by the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted House of Expertise.
10. BULK FLAMMABLE LIQUID STORAGE	i. Intrinsically Safe Flame (Radiant Energy) Detection and Alarm System shall be provided as per **Section 5.9**. and as per Risk assessment proposed and stamped by the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted House of Expertise. and i. Intrinsically Safe Linear Type Heat Detection System shall be provided on the tank roof as per **Section 5.8**. and as per Risk assessment proposed and stamped by the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted House of Expertise.
11. BULK FLAMMABLE GAS STORAGE	i. Intrinsically Safe Flame (Radiant Energy) Detection and Alarm System shall be provided as per **Section 5.9.** and i. Gas Detection (Particular Type) and Alarm System shall be provided as per Risk assessment proposed and stamped by the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted House of Expertise
12. BULK FLAMMABLE SOLID STORAGE	i. Fire Detection and Alarm Systems shall be based on comprehensive Risk assessment and shall be proposed and stamped by the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted House of Expertise.
13. HIGH HAZARD LOGISTICS	i. Fire Detection and Alarm Systems shall be based on comprehensive Risk assessment and shall be proposed and stamped by the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted House of Expertise.
14. CHEMICAL WAREHOUSES	i. Fire Detection and Alarm Systems shall be based on comprehensive Risk assessment and shall be proposed and stamped by the General

	Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted House of Expertise.
15. ARMS, AMMUNITION, EXPLOSIVES	i. Fire Detection and Alarm Systems shall be based on comprehensive Risk assessment and shall be proposed and stamped by the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted House of Expertise.
16. PROCESSING, GENERATING PLANTS	i. Fire Detection and Alarm Systems shall be based on comprehensive Risk assessment and shall be proposed and stamped by the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted House of Expertise.
17. PROCESSING, GENERATING PLANTS	i. Fire Detection and Alarm Systems shall be based on comprehensive Risk assessment and shall be proposed and stamped by the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted House of Expertise.

7.0 DESIGN, INSTALLATION, INSPECTION AND MAINTENANCE OF FIRE DETECTION AND ALARM SYSTEMS

7.1 Design/Specification and Submittals

7.1.1. Design, Specifications and Submittals to General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain for permit shall be main consultants' responsibility. Consultant shall have competent and knowledgeable personnel to understand the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain requirements and codes and standards.

7.1.2. Design submittals shall be complete with Fire Detection Design Objective, Manufacturer's design Specifications, Battery calculations, Detector Spacing criteria, appropriate selection of types of systems and their components, in compliance with this code.

7.2 Installation

7.2.1. Installation of Fire Detection and Alarm Systems shall be carried out only by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted and licensed contractors. General contractors, MEP Contractors, Electrical contractors, BMS Contractors, Home automation Contractors shall not be allowed to install Fire Detection and Alarm Systems.

7.2.2 Installation contractor qualification and Permit from General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain is based on their training from respective system manufacturers, experience, understanding of codes and standards and workmanship.

7.2.3 Installation contractors shall apply to General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain and secure passing marks in General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain examination to gain license and be qualified as "permitted Fire Detection and Alarm Systems contractors".

7.2.4 Installation contractor shall not commence work on site without receiving General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain stamped and permitted drawings from the Consultant.

7.2.5 It is contractor's responsibility to adhere to consultant's General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted drawings and Manufacturer's installation guidelines and specifications.

7.3 Inspection and Acceptance

7.3.1 Inspection and acceptance shall be main consultant's responsibility.

7.3.2 Main consultant shall inspect contractor work during installations and ensure that all systems are installed, tested, commissioned and performing as per the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted drawings, manufacturer's design and installation guidelines, acceptance criteria and their intended purpose.

7.3.3 Consultant shall handover system inspection report, maintenance manuals to the owner.

7.4 Inspection and Maintenance

7.4.1 The building owner, his appointed representative and the facility management shall be responsible to ensure that all the Fire Detection and Alarm Systems in the facility are inspected regularly, maintained and repaired to serve their intended purpose during emergencies.

7.5 Fire Detection and Alarm System Acceptance Test

7.5.1 The Fire Detection and Alarm System acceptance tests and criteria shall be as per **Table: - C.01-T16**

7.5.2 The acceptance tests required by **Table C.01.T16**. are minimum guideline. The complete tests shall be as per Manufacturer's guidelines, NFPA 70, and NFPA 72

Table: - C.01- T16 Acceptance Tests for Fire Detection and Alarm System

ITEM	REQUIREMENTS
1.DOCUMENTATION	i. Lead Consultant shall prepare pre-handover test reports, update drawings as per site conditions (prepare shop drawings), battery calculations, document all the manufacturer's design, installation and maintenance guidelines. ii. Prepare documentation for any performance-based design approach was adopted. iii. Emergency plans and sequence of operation, sequence of alarm signals, sequence matrix shall be documented to be handed over to the owner.

Table: - C.01- T16 Acceptance Tests for Fire Detection and Alarm System

ITEM	REQUIREMENTS
2. ACCEPTANCE TESTS	**1. RESPONSIBILITY** i. Lead consultant shall carry out the following acceptance tests with Fire Detection and Alarm System contractors and other relevant contractors. **2. POWER SUPPLY** i. Primary Power and Secondary Power is available and satisfactory. ii. Batteries /UPS are of right rating and installed properly. iii. Primary Mains disconnect switch location and switch number is mentioned on drawing and inside FACP.
	3. FACP i. FACP location is as per approved drawings. ii. FACP controls are working, displays are satisfactory. iii. LAMP test of the FACP is satisfactory. iv. Remote annunciators are working and displays are satisfactory **4. VISUAL INSPECTION OF INITIATING DEVICES** i. Detectors are installed as per approved locations and spacing. ii. Detectors are free of obstructions. iii. Detectors are at satisfactory distance from air diffusers, air movement areas. iv. Manual call points are installed near exits satisfactorily. v. Manual call points are installed at acceptable height. **5. VISUAL INSPECTION OF NOTIFICATION DEVICES** i. Notification devices are installed at proper heights and location. ii. Ii. Visible notifications are free of obstruction iii. Alarm audibility and visibility is clear and understandable. iv. Alarm notification is both in English and Arabic. **6. OPERATIONAL/ FUNCTIONAL TESTS** i. Notify 24 X 7 and Civil Defence of the Functional tests. ii. Disconnect any suppression systems monitored and triggered by the Fire Detection and Alarm System to be tested. iii. The following operational and functional tests shall be conducted. **7. SECONDARY POWER** i. Load voltage verification ii. Discharge test iii. Charger tests

Table: - C.01- T16 Acceptance Tests for Fire Detection and Alarm System

ITEM	REQUIREMENTS
	8. FACP i. Functional tests of FACP Lamps, LEDS and LCD. ii. Fuses: Removal and normalization. iii. Disconnect switches operation. iv. Trouble signals initiation (open wire, loop, unlock detector etc.) v. Trouble signal normalization. vi. Ground fault monitoring. vii. Annunciation to remote panels. **9. INITIATING DEVICES** i. Trigger alarm through smoke detectors using listed aerosol. ii. Trigger alarm through operating manual call points. iii. Trigger alarm through heat detectors by heat blower. iv. Verify alarm signal generation. v. Verify annunciator alarms and displays. vi. Verify the location displays and confirm addresses of initiating device. vii. Verify following interconnected systems upon alarm signal. **10. INTERCONNECTED SYSTEMS** i. Interconnected systems such as HVAC shut down, dampers, doors, elevators are functioning satisfactorily. ii. The interconnected systems are monitored and supervised. iii. Disconnect, initiate trouble signal and normalize **11. NOTIFICATION DEVICES** i. Audibility is clear. And within the acceptable strength. ii. Voice messages are clear and comprehendible. iii. Visual notifications are satisfactory and convey the alarm. iv. Verify supervision of notification devices. Initiate trouble and restore
3. HANDING OVER	**1. DOCUMENTS TO BE HANDED OVER TO OWNER BY CONSULTANT** i. Consultant shall handover as built drawings, copy of civil defence approved and stamped drawings. ii. System manufacturer's design, installation, inspection and maintenance manual. iii. Inspection report signed by Consultant, Contractors and Owner's representatives. iv. Civil Defence NOC, completion certificates. **2. SYSTEM SOFTWARE**

Table: - C.01- T16 Acceptance Tests for Fire Detection and Alarm System

ITEM	REQUIREMENTS
	i. For software-based systems, a copy of the site-specific software shall be provided to the system owner or owner's designated representative. ii. The site-specific software documentation shall include both the user passcode and either the system programming password or specific instruc- tions on how to obtain the programming password from the system manu- facturer. iii. The passwords provided shall enable currently certified qualified programming personnel to access, edit, modify, and add to the existing system site specific software.

7.6 Inspection and Maintenance of Fire Detection and Alarm System

7.6.1 The inspection and Maintenance of Fire Detection and Alarm system shall be as per **Table C.01.T17**

7.6.2 The inspection and Maintenance of Fire Detection and Alarm system required by **Table C.01.T17**. are minimum guidelines. The complete tests and maintenance shall be as per manufacturer guidelines NFPA 70, NFPA 72

Table: - C.01- T17 Inspection and Maintenance for Fire Detection and Alarm System

ITEM	REQUIREMENTS
1. DAILY	i. Verify that FACP is free of troubles, faults and is working with normal power in satisfactory condition. ii. Verify signal receiving to annunciators. iii. Take investigation and rectification action if there are fault signals or any abnormal conditions and displays present on FACP.
2. WEEKLY	i. Check fuses. ii. Check primary power supply for normality. iii. Check interfaced systems and equipment iv. Perform Lamp test, LED, LCD Test. v. Check for trouble signals. vi. Check for initiating devices LED blinking randomly. vii. Take investigation and rectification action if there are fault signals or any abnormal conditions and displays present on FACP.
3. MONTHLY	i. Inspect Lead-Acid batteries for electrolyte level. ii. Perform walk-through tests from FACP to verify all devices are communicating with FACP satisfactorily.

Table: - C.01- T17 Inspection and Maintenance for Fire Detection and Alarm System

ITEM	REQUIREMENTS
4. QUARTERLY	i. Verify that initiating devices are free from obstructions, dust, paint etc. verify orientation is intact. ii. Verify water flow switches, water level indicators, LPG signals and Fire pump signals are satisfactorily monitored.
5. SEMI-ANNUALLY (TWICE A YEAR)	i. Verify FACP and annunciator's functionality. ii. Operate and verify releasing mechanisms without discharging suppression agents. iii. Verify fire suppression agent systems supervisory signals, switches. iv. Verify working condition of Notification devices. v. Verify Visible notification devices functionality. vi. Perform all other tests required Daily, Monthly and Quarterly. vii. Take investigation and rectification action if there are fault signals or any abnormal conditions, loss of signals and displays are present on FACP.
6. ANNUALLY	i. Primary power supply shall be tested under maximum load with all devices in load, operating simultaneously. ii. Disconnect all primary power supply and verify power backup and trouble signals from secondary power supplies. iii. Complete test of FACP and annunciators as per acceptance tests. iv. Initiate and trigger fire alarms on all initiating devices and verify alarm signals, supervisory signals and trouble signals as per acceptance tests. v. Verify all notification devices functionality as per acceptance test. vi. Verify interconnected system supervision, releasing mechanisms as per acceptance test. vii. Take investigation and rectification action if there are fault signals or any abnormal conditions and displays present on FACP.

8.0 MATERIAL TEST STANDARDS, PERMITS AND REGISTRATION

8.1 Acceptable Test Standards and criteria

8.1.1. All the Devices, Controls, Wiring, Modules, Materials, Systems, Assemblies, equipment, Products, Components and Accessories, referred to in this chapter with respect to Life Safety, Fire Safety and Emergency Services shall be Listed, Permitted and Registered by the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain.

8.1.2. There is no year of edition mentioned against any test standards. It is the intent of General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain to convey to the customers seeking laboratory tests and the test laboratories to follow the "LATEST EDITION OF THE TEST STANDARD, AS AND WHEN THEY ARE UPGRADED/REVISED/AMENDED, TO THE DATE"

8.1.3 Smoke Detectors

i. FM3230, Permitted standard for Smoke Actuated Detectors for automatic alarm signaling.

ii. UL 268 7th edition, Standard for Smoke Detectors for Fire Alarm Systems.

iii. EN 54-7, Fire detection and fire alarm systems. Smoke detectors. Point detectors using scattered light, transmitted light or ionization.

iv. EN 14604, Smoke alarm devices (Household)

v. ISO7240-7, Fire detection and alarm systems - Part 7: Point-type smoke detectors using scattered light, transmitted light or ionization.

vi. EN 54-12, Smoke detectors - Line detectors using a transmitted optical beam

vii. ISO 7240-12, Smoke detectors - Line detectors using a transmitted optical beam

8.1.4 Heat Detectors

i. UL 521, Standard for Heat Detectors for Fire Protective Signaling Systems.

ii. FM 3210, Heat Detectors for Automatic Fire Alarm Signaling.

iii. EN 54-5, Fire detection and fire alarm systems. Heat detectors. Point detectors

iv. ISO 7240-5, Fire detection and alarm systems. Point type heat detectors

v. BS 5446-2, Fire detection and fire alarm devices for dwellings (Household)

8.1.5 Air Sampling Type Detectors

i. EN 54-20, Fire detection and fire alarm systems. Aspirating smoke detectors

ii. FM3230, Permitted standard for Smoke Actuated Detectors for automatic alarm signaling

8.1.6 Flame Detectors

i. FM 3260, Radiant Energy-Sensing Fire Detectors for Automatic Fire Alarm Signaling.

ii. EN 54-10, Flame detectors - Point detectors

iii. ISO 7240-10 - Flame detectors - Point detectors

iv. BS ISO 19292, Ships and marine technology. Lifesaving and fire protection. Point-type resettable flame detectors for ships

8.1.7 Multi-Sensor Fire Detectors

i. ISO 7240-15, Point type fire detectors using scattered light, transmitted light or ionization sensors in combination with a heat sensor

ii. EN 54-29, Multi-sensor fire detectors - Point detectors using a combination of smoke and heat sensors

iii. EN 54-30, Multi-sensor fire detectors - Point detectors using a combination of carbon monoxide and heat sensors

iv. EN 54-31, Multi-sensor fire detectors - Point detectors using a combination of smoke, carbon monoxide and optionally heat sensors

8.1.8 Line Type Detectors

i. BS EN 54-22:2015 - Fire detection and fire alarm systems. Resettable line-type heat detectors.

8.1.9 Carbon Monoxide Detectors

i. LPS 1265, Requirements and Testing Procedures for the LPCB Permit and Listing of Carbon Monoxide Fire Detectors Using Electrochemical Cells

ii. ISO 7240-6, Carbon monoxide fire detectors using electrochemical cells

iii. LPS 1274, Testing procedures for the LPCB Permit and listing of carbon monoxide / heat multi-sensor detectors using electrochemical cells

iv. LPS 1279, Testing procedures for the LPCB Permit and listing of point multi-sensor fire detectors using optical or ionization smoke sensors and electrochemical cell CO sensors and optically heat sensors

v. EN 54-26 - Carbon monoxide detectors - Point detectors

vi. EN 50291-1: 2018 Carbon Monoxide Alarms

8.1.10 Combustible Gases Detection

i. BS EN 50194 Electrical apparatus for the detection of combustible gases in domestic premises. Test methods and performance requirements

8.1.11 Manual Call Points

i. UL 38, Standard for Manual Signaling Boxes for Fire Alarm Systems.

ii. EN 54-11, Manual call points

iii. ISO 7240-11, Manual call points

iv. FM-3010, Permitted Standard for Fire Alarm Signaling Systems

8.1.12 Duct Detectors

i. UL 268A, Standard for Smoke Detectors for Duct Application

ii. LPS 1280 Testing procedures for the LPCB Permit and listing of duct smoke detectors using point smoke detectors.

iii. EN 54-27, Fire detection and alarm systems. Duct smoke detectors

iv. FM3230, Permitted standard for Smoke Actuated Detectors for automatic alarm signaling.

8.1.13 Video Image Smoke Detector

i. UL 268 B, Outline of Investigation for Video Image Smoke Detectors.

ii. FM 3232, Video Image Fire Smoke Detectors for Automatic Fire Alarm Signaling.

8.1.14 Audible Notification Devices

i. UL 464, Audible Signaling Devices for Fire Alarm and Signaling devices, including accessories.

ii. UL 1480, Speakers for Fire Alarm and Signaling Systems, including Accessories.

iii. FM 3150, Audible Notification Appliances for Automatic Fire Alarm Signaling.

iv. EN 54-3, Sounders

8.1.15 Visible Notification Devices

i. UL 1638, Visible Signaling Devices for Fire Alarm and Signaling Systems, including accessories.

ii. EN 54-23, Fire alarm devices. Visual alarm devices

iii. UL 1971, Standard for Signaling Devices for the Hearing Impaired

8.1.16 FACP (Fire Alarm Control Panel) Control Units

i. UL 864, 10th edition Standard for Control Units and Accessories for Fire Alarm Systems.

ii. FM 3010, Fire Alarm Signaling Systems

iii. FM 3011, Central Station Service for Fire Alarms and Protective Equipment Supervision.

iv. EN 54-2, Control and indicating equipment

v. ISO 7240-2, Control and indicating equipment

8.1.17 Door Closers-Holders

i. UL 228, Standard for Door Closers-Holders, with or without integral smoked detectors.

ii. FM 4121, Fire and Smoke Door Holder and/or Release Devices.

8.1.18 Wireless, Radio linked Fire Detection and Alarm System

i. EN 54-25, Components using radio links

ii. LPS 1257, Requirements and Testing Procedures for Radio Linked Fire Detection and Fire Alarm Equipment.

iii. UL 985, Standard for Household Fire Warning System Units (Villas).

8.1.19 Line Isolators

i. EN 54-17, Short circuit isolators

ii. EN 54-18, Input/output devices

8.1.20 Input/ Output Devices

i. EN 54-18, Input/output devices

8.1.21 Compatibility Testing of Components

i. EN 54-13, Compatibility assessment of system components

ii. LPS 1054, Requirements and testing procedures for the LPCB Permit and

iii. listing of component compatibility for fire detection and alarm systems

8.1.22 Power Supply Equipment

i. EN 54-4, Power supply equipment

ii. ISO 7240-4, Power supply equipment

8.1.23 Fire rated Cable, Certified for 120 minutes

i. EN 50200, Method of test for resistance to fire of unprotected small cables for use in emergency circuits

ii. UL 2196, Standard for Fire Test for Circuit Integrity of Fire Resistive Power, Instrumentation, Control, and Data Cables

iii. BS 8434-2, Methods of test for assessment of the fire integrity of electric cables. Test for unprotected small cables for use in emergency circuits. BS EN 50200 with a 930° flame and with water spray.

iv. BS 7629-1, Electric cables. Specification for 300/500 V fire resistant screened cables having low emission of smoke and corrosive gases when affected by fire.

Multicore and multipair cables.

Test for Resistance to Fire.

- Category STANDARD 60
- Category ENHANCED 120

v. BS 6387, Test method for resistance to fire of cables required to maintain circuit integrity under fire conditions.

vi. IEC 60331-1, Tests for electric cables under fire conditions.

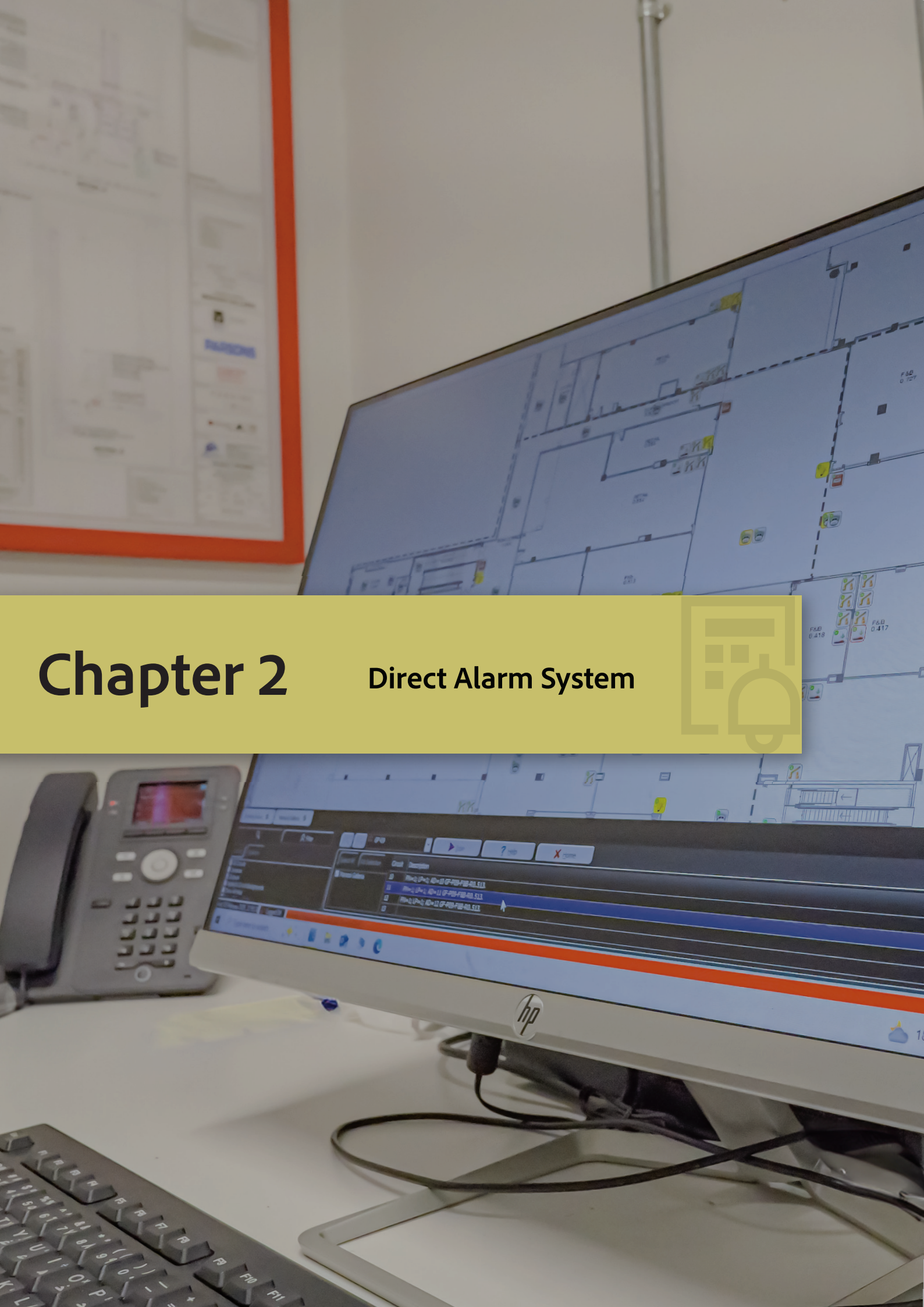
vii. IEC 60331-2, Tests for electric cables under fire conditions.

viii. IEC 60332-2-2, Tests on electric and optical fiber cables under fire conditions.

ix. IEC 60332-3-10, Tests on electric and optical fiber cables under fire conditions.

x. IEC 60331-2, Tests for electric cables under fire conditions.

xi. UL 1724, Outline of Investigation for Fire Tests for Electrical Circuit Protective Systems.



Chapter 2

Direct Alarm System

Section C

Chapter 2

Direct Alarm System



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1.0 Scope

The system is designed for smart remote monitoring of Fire and Life Safety Systems, Fire Water tanks, Elevators and LP Gas detection systems in public buildings, with an emphasis on larger structures that incorporate critical plant items through a Building Management System (BMS).

The system should be scalable, maintain redundancy for reliability and shall be integrated with emergency services or a command center.

2.0 Definitions

2.1 General

2.1.1 Shall

It is mandatory requirement for General Directorate of Civil Defense (GDCD) -Kingdom of Bahrain

2.1.2 Should

It is a suggested requirement recommended by General Directorate of Civil Defense (GDCD) - Kingdom of Bahrain but not Mandatory

2.1.3 Listed

Permitted and registered by General Directorate of Civil Defense (GDCD)
- Kingdom of Bahrain.

2.1.4 Smart Monitoring System

Connection or annunciation of building fire and life safety systems signals directly to General Directorate of Civil Defense (GDCD) - Kingdom of Bahrain monitoring systems

3.0 Smart Monitoring System

3.1 General

3.1.1 General Directorate of Civil Defense (GDCD) - Kingdom of Bahrain has made a commitment to enhance Life safety and national Security by implementing the smart monitoring system.

3.1.2 Smart monitoring system will detect and report alarms in real time from fire and Life Safety Systems, Fire Water tanks, Elevators and LP Gas detection Systems of the buildings, directly to General Directorate of Civil Defense (GDCD) - Kingdom of Bahrain control and monitoring systems.

3.1.3 The system provides General Directorate of Civil Defense (GDCD) - Kingdom of Bahrain with the following:

3.1.3.1 Unified monitoring and operating base to deal with fire emergencies effectively and timely

3.1.3.2 Monitor Fire and Life Safety systems of city buildings round the clock.

3.1.3.3 Supervise Fire and Life Safety systems faults and intimate building owners immediately for corrective measures.

3.1.3.4 Access to a master database of building details, fire and life safety system information, nature of occupancy, nature of hazard, details of adjacent buildings etc. to ensure instant and appropriate dispatch of fire trucks, rescue vehicles and equipment to the reported accident scene

3.2 Applicability

3.2.1 Every building in Bahrain including private villas, warehouses and factories shall be connected to General Directorate of Civil Defense (GDCD) - Kingdom of Bahrain through Smart and Direct Alarm Systems.

3.2.2 Such a Direct Alarm system shall be a smart system, utilizing state of the art technology and shall be able to annunciate and communicate with building fire and life safety systems, remotely from General Directorate of Civil Defense (GDCD) - Kingdom of Bahrain control rooms.

3.2.3 Smart monitoring Systems shall be specified by General Directorate of Civil Defense (GDCD) - Kingdom of Bahrain.

3.2.4 It is building owner and project consultant's responsibility to identify and acquire these requirements through General Directorate of Civil Defense (GDCD) - Kingdom of Bahrain

3.2.5 The requirements in this chapter are general guidelines for the smart monitoring system. Systems having smart, audio, visual features utilizing cloud technologies, wireless technologies, exceeding the requirements of this chapter shall be permitted and acceptable.

3.2.6 It is building owner and project consultant's responsibility to provide infrastructure, system features, and necessary provisions for interfacing in accordance with the smart monitoring system specifications as required by General Directorate of Civil Defense (GDCD) - Kingdom of Bahrain

3.3. Specifications

3.3.1. The minimum specifications of the smart monitoring System shall be in accordance with **Table:-C.02-T1**

Table:- C.02-T1 : Smart Monitoring System Specifications

ITEMS	REQUIREMENTS
1. SIGNALS FROM BUILDING	**1. ALARM** i. As a minimum, the following "Alarm" signals from a building shall be annunciated to General Directorate of Civil Defense (GDCD) - Kingdom of Bahrain through Smart monitoring System. **a. 'Fire Alarm' from Fire Detection and Alarm Control Panel (FACP)** **b. 'Low Water level' alarm from building Fire Water Tank** **c. 'LP Gas or Natural Gas leakage' alarm from building gas detection system** **d. 'Fire Pump in operation' annunciation from building fire pump controller** **e. 'Diesel Fuel Low' signal from Diesel Fire Pump controller** **f. 'Pressure Low' signal from fire water line** **g. 'Passenger Alarm' signal from Lift control panel** **2. FAULTS** i. As a minimum, the following "Fault" signals from a building shall be annunciated to General Directorate of Civil Defense (GDCD) - Kingdom of Bahrain through Smart monitoring System. **a. 'Fault' from Fire Detection and Alarm Control Panel (FACP)** **b. 'Fault' from Fire Pump Controller** **c. 'Fault' from LP Gas or natural gas control panel** **d. 'Fault' from Smoke Control Panel (SCP)** **e. 'Fault' from elevator control panel** **f. 'Fault' from Emergency Lighting control panel**
2.PROVISIOS REQUIRED IN THE BUILDING	**1. GENERAL** i. It is owner and consultant's responsibility to provide the required features, interfacing accessibility, protocols and necessary wiring as per smart monitoring system specifications from General Directorate of Civil Defense (GDCD) - Kingdom of Bahrain. However, following minimum features shall be available in the building for smart monitoring system interfacing. ii. Smart monitoring system Interfacing panel shall be located in an permitted location, preferably next to main FACP, security rooms, reception or Emergency Command Center. Interfacing panel shall not be located at the basement or outside the building. iii. A minimum space of 800mm x 800mm x 500mm shall be available at 1.5 m above the finished floor level. iv. There shall be excellent cellular signal coverage at the interfacing panel location. v. Proper terminals for electrical connectivity shall be available in the interfacing panel. vi. 230V AC power supply terminals within the interface panel shall be available. vii. Interfacing panel shall have earthing.

Table:- C.02-T1 : Smart Monitoring System Specifications

ITEMS	REQUIREMENTS
PROVISIONS REQUIRED IN THE BUILDING	**2. LOWRISE AND MIDRISE BUILDINGS** i. Dedicated volt free contacts (VFC) in the FACP shall be available. The state of the VFC should ideally be normally closed (NC) during normal condition and open (NO) during alarm condition, for a. Common fire alarm from FACP b. Common fire alarm system fault from FACP ii. Dedicated volt free contacts (VFC) in the Fire Pump Controller shall be available. The state of the VFC should ideally be normally closed (NC) during normal condition and open (NO) during alarm condition, for a. Fire Pump in operation b. Common system fault from controller c. System Pressure Low d. Diesel fuel low e. Water tank level low iii. Dedicated volt free contacts (VFC) in the Gas control panel shall be available. The state of the VFC should ideally be normally closed (NC) during normal condition and open (NO) during alarm condition, for a. Gas leak detection b. Common system fault from control panel iv. Dedicated volt free contacts (VFC) in the Elevator control panel shall be available. The state of the VFC should ideally be normally closed (NC) during normal condition and open (NO) during fault condition, for a. Common elevator fault from control panel b. Passenger Alarm from elevator control panel.



Figure:-C.02-F1 : Typical Smart Monitoring System Concept

3. HIGHRISE AND SUPERHIGH RISE BUILDINGS

3. a. SMART BUILDINGS WITH OPEN PROTOCOLS

i. Where buildings are provided with FACP's, Smoke control panel, Gas detection panel, Fire pump controllers and elevator control panels with state of the art Internet or things (IoT) features OR building has 'Smart' features OR building has BMS (Building Management Systems), open protocols shall be made available to achieve the required signal annunciation and communication as per **Table:- C.02-T1.1.**

ii. The acceptable open protocols shall be such as following
   a. BACnet IP
   b. BACnet MSTP
   c. Modbus TCP
   d. Modbust RTU with RS485 ports
   e. Lonworks

3.b. BUILDINGS WITHOUT OPEN PROTOCOLS

i. Dedicated volt free contacts (VFC) in the FACP shall be available. The state of the VFC should ideally be normally closed (NC) during normal condition and open (NO) during alarm condition, for
   a. Common fire alarm from FACP
   b. Common fire alarm system fault from FACP

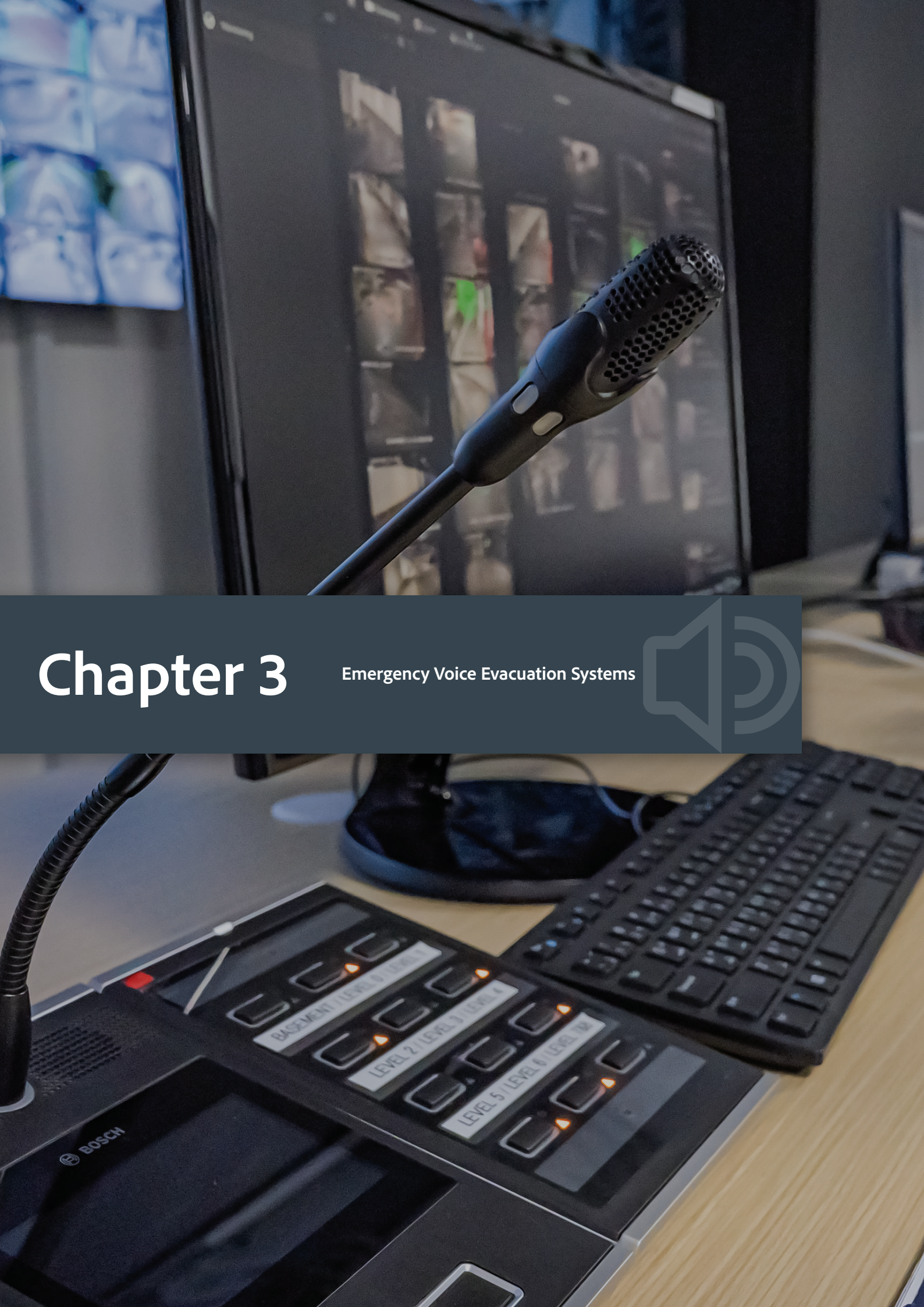
ii. Dedicated volt free contacts (VFC) in the Fire Pump Controller shall be available. The state of the VFC should ideally be normally closed (NC) during normal condition and open (NO) during alarm condition, for
   a. Fire Pump in operation
   b. Common fire pump system fault from controller
   c. System Pressure Low
   d. Diesel fuel low
   e. Water tank level low

iii. Dedicated volt free contacts (VFC) in the Gas control panel shall be available. The state of the VFC should ideally be normally closed (NC) during normal condition and open (NO) during alarm condition, for
   a. Gas leak detection
   b. Common gas detection system fault from control panel

iv. Dedicated volt free contacts (VFC) in the Smoke control panel shall be available. The state of the VFC should ideally be normally closed (NC) during normal condition and open (NO) during fault condition, for
   a. Common system fault from control panel

v. Dedicated volt free contacts (VFC) in the Elevator control panel shall be available. The state of the VFC should ideally be normally closed (NC) during normal condition and open (NO) during fault condition, for
   a. Common elevator fault from control panel
   b. Passenger Alarm from elevator control panel

vi. Dedicated volt free contacts (VFC) in the Emergency lighting control panel shall be available. The state of the VFC should ideally be normally closed (NC) during normal condition and open (NO) during fault condition, for
   a. Common system fault from control panel

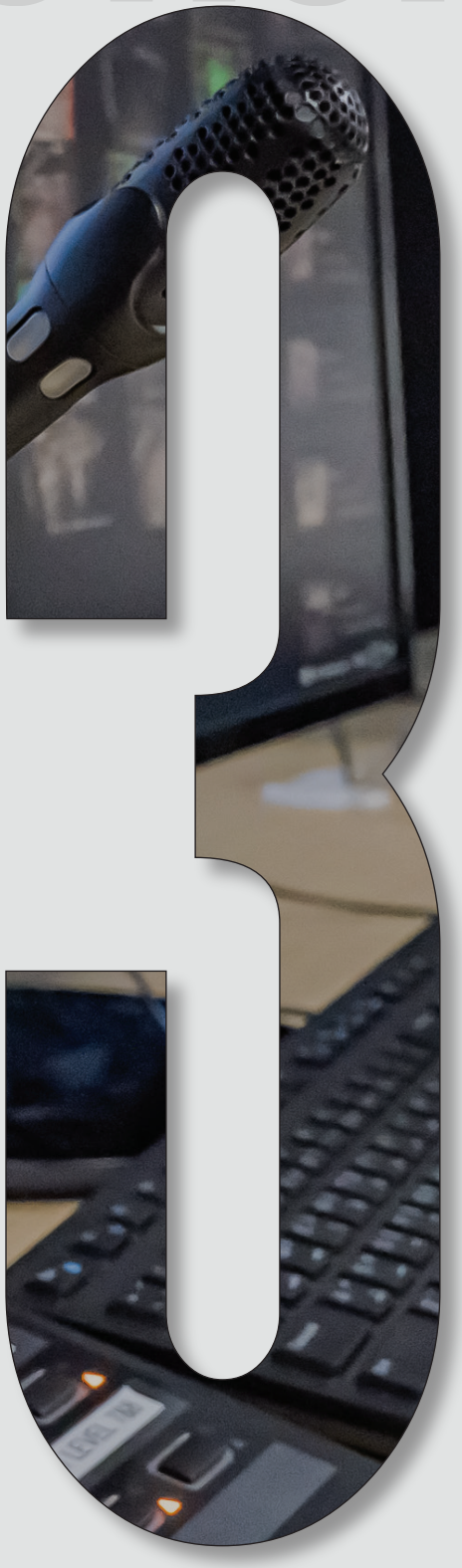


Chapter 3

Emergency Voice Evacuation Systems

Chapter 3

Emergency Voice Evacuation Systems



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1. SCOPE

1.1 To provide clear and audible messages through voice speakers such that occupants can react and take action swiftly during emergency situations to get out of the facility to the point of safety.

2.1 To provide design basis for the emergency voice evacuation and communication system

2. DEFINITIONS

General

2.1.1 Shall

It is a mandatory requirement from General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain.

2.1.2. Should

It is a suggested requirement recommended by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain but not mandatory.

2.1.3. Listed

Permitted and registered by Bahrain General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain.

2.1.4. Decibels

Decibel (dB) is a measurement unit of sound pressure level, it equals one tenth of a Bell, which is the decimal logarithm of ratios between two quantities.

2.2 Voice Alarm

2.2.1. Voice Evacuation System/ Voice Alarm Communication System (EVC)

Dedicated manual or automatic equipment for originating and distributing voice instructions, as well as alert and evacuation signals pertaining to a fire emergency, to the occupants of building.

2.2.2. Public Address System

An electronic amplification system with a mixer, amplifier, and loudspeakers, used to reinforce a given sound and distributing the “sound” to the general public around a building.

2.2.3. Emergency Communication System

A system for the protection of life by indicating the existence of an emergency situation and communicating information necessary to facilitate an appropriate response and action, such as evacuation.

2.2.4. One-way Emergency Communication System

One-way emergency communications systems are intended to broadcast information, in an emergency, to people in one or more specified indoor or outdoor areas. It is intended that emergency messages be conveyed either by audible, visible, or textual means, or any combination thereof.

2.2.5. Two-way Emergency Communication System

Two-way emergency communications systems are divided into two categories, those systems that are anticipated to be used by building occupants and those systems that are to be used by firefighters, police, and other emergency services personnel. Two-way emergency communications systems are used to both exchange information and to communicate information such as, but not limited to, instructions, acknowledgement of receipt of messages, condition of local environment, and condition of persons, and to give assurance that help is on the way.

2.2.6. Mass Notification System

A system used to provide information and instructions to people in a building(s) or other space using intelligible voice communications and including visible signals, text, graphics, tactile, or other communication methods.

2.2.7. Auxiliary Alarm Box

An alarm box that can only be operated from one or more remote initiating devices or an auxiliary alarm system used to send an alarm to the communications center

2.2.8. Manual Fire Alarm Box

A manually operated device used to initiate a fire alarm signal

2.2.9. Alert Tone

An attention-getting signal to alert occupants of the pending transmission of a voice message

2.2.10. Average Ambient Sound Level

The root mean square, A-weighted, sound pressure level measured over the period of time that any person is present, or a 24-hour period, whichever time period is the lesser.

2.2.11. Communication Center

A building or portion of a building that is specifically configured for the primary purpose of providing emergency communications services or public safety answering point (PSAP) services to one or more public safety agencies under the authority or authorities having jurisdiction.

2.2.12. Communication Circuit

Any signaling path of an emergency communications system that carries voice, audio, data, or other signals.

2.2.13. Alarm Condition

An abnormal condition that poses an immediate threat to life, property, or mission.

2.2.14. Pre-alarm Condition

An abnormal condition that poses a potential threat to life, property, or mission, and time is available for investigation.

2.2.15. Emergency Command Center

The room(s) or area(s) staffed during any emergency event by assigned emergency management staff. The room or area contains system communications and control equipment serving one or more buildings where responsible authorities receive information from premises sources or systems or from (higher level) regional or national sources or systems and then disseminate appropriate information to individuals, a building, multiple buildings, outside campus areas, or a combination of these in accordance with the emergency response plan established for the premises. The room or area contains the controls and indicators from which the ECS (Emergency Communication Systems) systems located in the room or area can be manually controlled as required by the emergency response plan and the emergency management coordinator.

2.2.16. Mass Notification Priority Mode

The mode of operation whereby all fire alarm occupant notification is superseded by emergency mass notification action.

2.2.17. Notification Zone

A discrete area of a building, bounded by building outer walls, fire or smoke compartment boundaries, floor separations, or other fire safety subdivisions, in which occupants are intended to receive common notification.

3.0 Emergency Voice Evacuation or Communication System (EVC)

3.1. Purpose

3.1.1. The provisions of this chapter are to convey building fire alarm signals to people through pre-recorded voice messages or through live public address messages on building voice speaker system.

3.1.2. Voice Evacuation or communication systems are a very essential communication tools in high rise, Super highrise, crowded assembly buildings, schools and malls, to efficiently manage people during fire and other emergencies. This chapter addresses the requirements for proper design and installation of the Emergency Voice Evacuation or Communication System.

3.2. General

3.2.1 Pre-recorded Emergency Voice messages shall be prepared by people who are familiar with fire emergency procedures and evacuation strategies

3.2.2 The pre-recorded voice messages shall be both in Arabic and English, in an accent which is familiar and intelligible to the people of Bahrain

3.2.3 Pre-recorded messages shall be simple, audible, clear and to the point

3.2.4 Voice messages shall not be generalized to all buildings. Voice messages shall be customized to specific buildings with specific directions or actions to be taken by the occupants

3.2.5 Voice messages shall be automatic. The Emergency Voice Evacuation or Communication System response shall be an automatic response, upon the receipt of confirmed Fire Alarm Signal, be it automatic or manually triggered.

3.2.6. It is consultant's responsibility to design and execute intelligible voice messages, based on acoustic features of the area, ceiling height, sound absorption of materials in the area etc., where audible voice messages are delivered as intended to people clearly, intelligibly and meaningfully.

3.2.7. It is consultant's responsibility to refer to **NFPA 1, NFPA 70, NFPA 72, NFPA 101** and **Manufacturer's design guidelines** for further clarifications and code complaint Emergency Voice Evacuation Systems

3.3 Sound Basics

3.3.1. Sound is created by mechanical vibrations that displace air molecules to create repetitive changes in air pressure. The ear detects these changes in air pressure and perceives the magnitude as loudness and the frequency as pitch.

3.3.2. Human normal ear can hear sound ranges from 20 Hz to 20,2000 Hz.

3.3.3. Human speech frequencies range from 500 Hz to 4000 Hz.

3.3.4. Pre-recorded messages shall be simple and to the point.

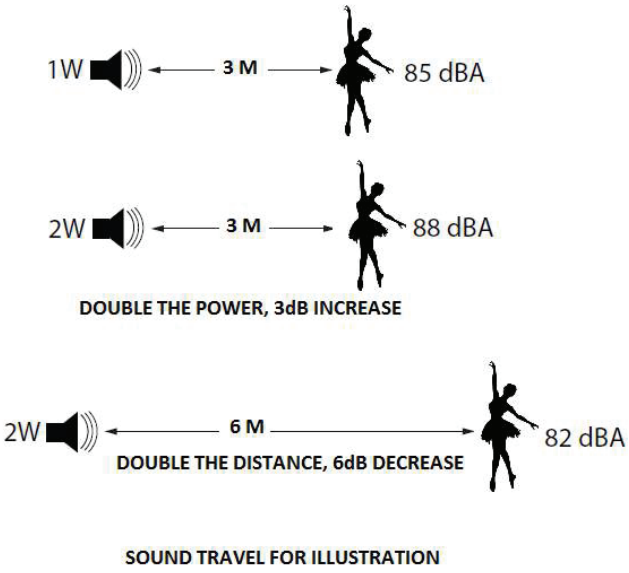
3.3.5. The sound travels through air. The air molecules themselves do not move very far they simply transfer sound pressure changes into sound waves. Sound waves always move away from the sound source such as speakers.

3.3.6. More power the sound source emits, the wider the sound waves travel and further the sound waves spread, less intense they become.

3.2.7. Generally sound pressure drops approximately 6 dB for every distance doubled. And sound pressure increases by 3 dB for every doubling of power (Watt).

AVERAGE AMBIENT SOUND LEVELS FOR INFORMATION

OCCUPANCY	AVERAGE AMBIENT SOUND LEVEL
1. ASSEMBLY	55 dBA
2. BUSINESS	55 dBA
3. EDUCATIONAL	45 dBA
4. RESIDENTIAL	35 dBA
5. MERCANTILE	40 dBA
6. MECHANICAL ROOMS	85 dBA
7. STORAGE (WAREHOUSE)	30 dBA
8. INDUSTRIAL	80 dBA



SOUND TRAVEL FOR ILLUSTRATION

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Refer Table A.18.4.4 Average Ambient Sound Level According to location in NFPA 72 2022 Edition

3.4. Emergency Voice Evacuation or Communication System (EVC) Specifications

3.4.1 The Emergency Voice Evacuation or Communication system requirements shall comply with **Table: - C.03-T1**

Table: - C.03-T1 Specifications of Emergency Voice Evacuation or Communication Systems

ITEMS	REQUIREMENTS
1. LOCATION	i. EVC control unit shall be next to FACP, at continuously monitored location, which is attended by facility management or designated personnel at all times, such as reception areas, security guard houses, Central command centers, Facility monitoring rooms, nurse stations at hospitals etc. See FACP location, **Section C, Chapter 01, Table: - C.01.T1.14.1**
2. VOICE MESSAGES	**1. GENERAL** i. Emergency communications systems shall be capable of the reproduction of prerecorded, synthesized, or live (e.g., microphone, telephone handset, and radio) messages with voice intelligibility. ii. Intelligibility is a complex function of the source audio, the acoustic response of the architectural features and materials of the immediate vicinity, and the dynamics created by the room's occupants. iii. Voice alarm speakers shall be listed and permitted by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain and they shall be tested as part of the voice evacuation system. iv. Voice Messages shall be developed for each scenario developed in the emergency response plan. Based on the emergency response plan, emergency messages shall have content that provides information and instructions to people in the building, area, site, or installation. v. Evacuation voice messages shall be preceded and followed by a minimum of two cycles of the emergency evacuation signal. vi. Where the system is used to transmit relocation instructions or other non-evacuation messages, a continuous alert tone of 3-second to 10-second duration followed by a message (or messages where multi-channel capability is provided) shall be automatic, and the sequence shall be repeated at least three times to direct occupants in the evacuation signaling zone where the alarm initiation originated and other evacuation signaling zones in accordance with the building's fire evacuation plan. **2. MICROPHONE** i. Where microphones are provided for the live emergency voice messages to be delivered, "usage instructions" with schematics shall be posted next to the microphone with user instructions such as distance that the microphone to be held from mouth.
3. POSITIVE ALARM SEQUENCE	i. Emergency Voice Evacuation or Communication System in Positive Alarm Sequence (Delayed Alarm sequence), as per **Chapter 01, Section C Table: - C.01.T1.14.2 shall** be permitted.

Table: - C.03-T1 Specifications of Emergency Voice Evacuation or Communication Systems

ITEMS	REQUIREMENTS
4. TONES AND DECIBEL REQUIREMENTS	**1. TONE** i. Tone preceding any voice message shall be permitted to be part of the voice message in occupancies where sleeping risk in involved. **2. PRIVATE MODE AUDIBILITY** i. Voice messages in private mode/areas shall be 10 dB above the ambient sound level having duration of 60 seconds, measured 1.5 m above the floor area required to be served using A-weighted scale (dBA). **3. PUBLIC MODE AUDIBILITY** i. Voice messages in public mode/areas shall be 15 dB above the ambient sound level having duration of 60 seconds, measured 1.5 m above the floor area required to be served using "A-weighted scale" (dBA). **4. SLEEPING AREA AUDIBILITY** i. Voice messages in sleeping areas shall be 75 dB measured at the pillow level in the area required to be served using A-weighted scale (dBA).
5. SPEAKERS	i. Speakers for the voice evacuation system shall be dedicated, listed, permitted and tested for the emergency voice evacuation systems. ii. Speakers used as Fire Alarm notification in accordance with **Chapter 01, Section C Table: - C.01-T1.14.2** shall be permitted to be used as voice evacuation speakers, provided they comply with this **Chapter, Sub Section 3.4.** iii. Where speakers are not dedicated, building ancillary function speakers shall be permitted to be part of the Voice evacuation system provided they comply with voice message intelligibility, circuit integrity, wiring requirements, addressable etc, as per this **Chapter, Sub Section 3.4.** iv. Speakers shall be with flashers or strobe light where installed at basements, plant rooms and noisy industrial areas. v. Where provided, speakers in each enclosed stairway shall be connected to a separate notification zone for manual paging only.

6. ZONES	i. If acceptable to the authority having jurisdiction, the system shall permit the application of an automatic evacuation signal to one or more signaling zones and at the same time, shall permit manual voice paging to the other signaling zones selectively or in any combination. ii. Undivided, non-compartmentalized fire or smoke zones of the building shall not be divided into multiple voice evacuation signaling zones. iii. If multiple notification appliance circuits are provided within a single zone, all of the notification appliances within the zone shall be arranged to activate or deactivate simultaneously. iv. Fire alarm systems used for partial evacuation and relocation shall be designed and installed such that attack by fire within an evacuation signaling zone shall not impair control and operation of the notification appliances outside the evacuation signaling zone.

Table: - C.03-T1 : Specifications of Emergency Voice Evacuation or Communication Systems

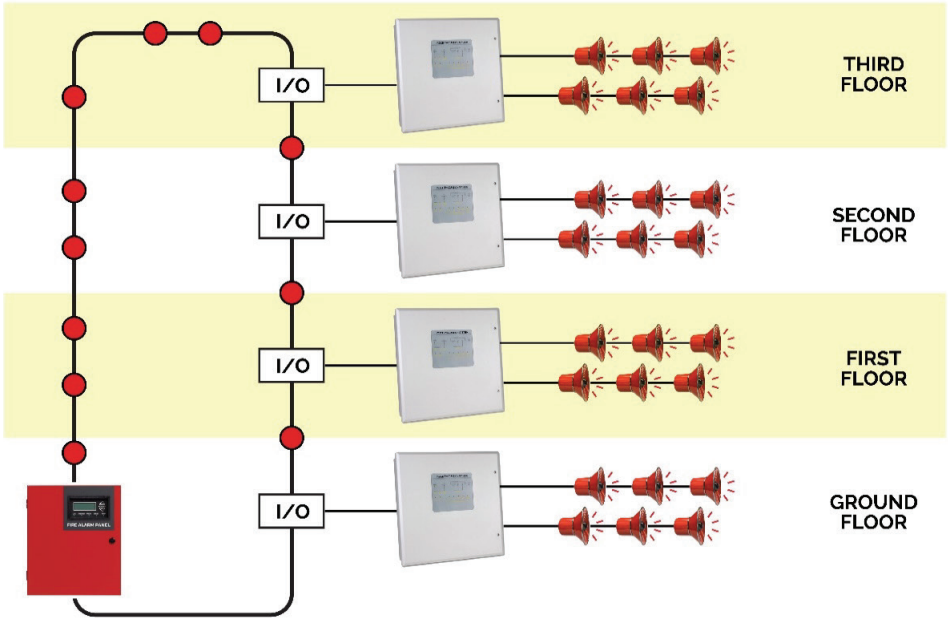
ITEMS	REQUIREMENTS
7. CONTROL SYSTEM	**1. GENERAL** i. EVC operating instructions shall be posted at the control system. ii. Manual controls shall be arranged to provide visible indication of the on/off status for their associated signaling zone. iii. Systems shall be provided with manual voice transmission capabilities selectively to one or more zones or on an all-call basis. **2. MESSAGE PRIORITY** i. Voice Evacuation messages shall override previously initiated signals, messages, music, communication signals etc. to the selected notification zone. ii. If such an initiated recorded Voice Evacuation message is interrupted by live voice instructions, upon release of the microphone, the previously initiated recorded messages to the selected notification zones shall not resume playing automatically unless triggered again manually or required by the emergency response plan. iii. Fire alarm signals shall be distinctive, clearly recognizable, and, with the exception of mass notification inputs, take precedence over any other signal even when a non–fire alarm signal is initiated first and shall be indicated as follows in descending order of priority. a. Signals associated with life safety b. Signals associated with property protection c. Trouble signals associated with life and/or property protection d. All other signals

8. ANCILIARY FUNCTIONS **(MULTI-PURPOSE, MUSIC, COMMUNICATIONS ETC.)**	i Ancillary functions (Non-emergency functions) such as Music, Commentary, Live shows, general communication messages etc., shall be permitted but shall not impair the required operation of the emergency voice evacuation or communications system. ii. Loudspeakers used for emergency communications system functions also providing ancillary functions shall meet the following conditions. a. The loudspeakers and associated audio equipment are installed or located with safeguards to resist tampering or misadjustment of those components essential for intended emergency notification. b. The monitoring integrity requirements continue to be met while the system is used for non-emergency purposes. iii. Ancillary functions shall be inspected and tested annually to verify they will not impair the operation of the fire alarm system or the emergency voice evacuation system. iv. Where emergency communications systems utilize Class N pathways that are also shared Level 1 or Level 2 pathways, as a means to support ancillary functions, devices, or interconnected systems, the shared pathways shall meet the requirements of Table: - C.03.T1.8

Table: - C.03-T1: Specifications of Emergency Voice Evacuation or Communication Systems

ITEMS	REQUIREMENTS
9. CIRCUITS AND WIRING	i. All the voice evacuation system circuits monitoring speakers shall be class A, addressable circuits, with redundant pathways. ii. Operational capability continues beyond a single open fault, which shall result in a trouble signal . iii. Conditions that affect the intended operation of the path are annunciated as a trouble signal. iv. Operational capability is maintained during the application of a single ground fault. v. A single ground condition shall result in the annunciation of a trouble signal. vi. All cables and wiring used for emergency voice evacuation or communication systems shall be 2-hour fire rated.
10. INSTALLATION	i. Controls that are intended to be accessed by authorized users **(refer with this chapter Sub section 5.2)** such as control units, including switches, microphone, latches and so forth, shall be located above the finished floor a minimum of 910 mm and a maximum of 122 mm where the horizontal reach is less than 25 cm. ii. If a horizontal reach of 25 cm to 61 cm is required, the maximum elevation shall be limited to 1070 mm above the finished floor and the minimum elevation shall be limited to 710 mm. iii. Text and visual indicators, including lamps, screens, displays, instructions or labels, associated with control or operation shall be visible within all points of elevation between 1020 mm and 1520 mm above the finished floor.

11. INTERFACING WITH FACP	i. A control unit having both Fire Detection and Alarm System (FACP) and Emergency Voice Evacuation or Communication System (ECV), combined is preferred by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain. ii. A single dedicated Emergency Voice Evacuation or Communication control panel shall also be permitted with interfacing to FACP in compliance to all the following requirements. iii. The fire alarm control interface shall coordinate signals to and from each system to accomplish the following: a. Indicate the failure at the system control unit that will be impaired b. Provide an audible and distinctive visible indication at the affected FACP to indicate the ECV is active. c. Cause the fire alarm system to deactivate all audible and visible notification appliances whose operation could interfere with the intelligibility of the mass notification message or that will deliver conflicting information to occupants. d. It is forbidden for the fire alarm system to switch off visible and auditory notification appliances for special suppression pre discharge notification, if any. e. Connected to General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain 24 X7 monitoring system for activation and trouble indication.



INTERFACING VOICE EVACUATION SYSTEM TO FIRE ALARM FOR ILLUSTRATION

3.5. Two-way Communication System (Two-way Telephone System) Specifications

3.5.1. Two-way Communication System or Two-way Telephone System requirements shall comply with Table: - C.03-T2

Table: - C.03-T2 Specifications of Two-way Communication Systems

ITEMS	REQUIREMENTS
1. USAGE	i. Two-way Communication Systems or Two-way Telephone Systems shall be provided for General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain personnel use, and it shall be collocated with the Emergency Voice Evacuation and Communication System.
2. LOCATION	i. As a code of practice, Two-way Communication Systems or Two-way Telephone Systems shall be common talk (i.e., a conference or party line circuit), providing at least one telephone station or telephone jack (Fireman's Phone Jack) located at the following locations. a. Inside stair on every floor landing b. Inside Fire Lift lobby c. Inside Each elevator car d. Inside Fire/Emergency Command Centre e. Inside Fire Pump Room f. Inside Area of Refuge, if any. ii. At least two handsets shall be stored at each control center for use by emergency responders. iii. Each telephone station or telephone jack shall be clearly and permanently labeled to allow the caller to identify his or her location to the control center by voice.
3. FEATURES	**1. GENERAL** i. Two-way telephone communications equipment shall be listed and permitted for two-way telephone communications service. ii. Monitoring of the integrity of two-way telephone communications circuits shall be provided. iii. Two-way telephone communications service shall be capable of permitting the simultaneous operation of any five telephone stations in a common talk mode. iv. A notification signal at the control equipment, distinctive from any other alarm, supervisory, or trouble signal, shall indicate the off-hook condition of a calling telephone circuit. If a selective talk telephone communications service is supplied, a distinctive visible indicator shall be furnished for each selectable circuit so that all circuits with telephones off-hook are continuously and visibly indicated. v. A means for silencing the audible call-in signal sounding appliance shall be permitted, provided that it is key operated or located in a locked cabinet, or provided with protection to prevent use by unauthorized persons. The means shall operate a visible indicator and sound a trouble signal whenever the means is in the silence position and no telephone circuits are in an off-hook condition. vi. If a selective talk system is used, means mentioned above shall be permitted, provided that subsequent telephone circuits going off-hook operate the distinctive off-hook signal.

Table:- C.03-T2 Specifications of Two-way Communication Systems

ITEMS	REQUIREMENTS
4. CIRCUITS AND WIRING	i. All circuits and wiring necessary for the operation of two-way telephone communication systems shall be 2 hour fire rated.
5. INSTALLATION	i. Wall-mounted telephone appliances or related jacks shall be not less than 910 mm and not more than 1680 mm above floor level with clear access to the appliance that is at least 760 mm wide. ii. If accessible to the general public, one telephone appliance per location shall be not more than 1220 mm above floor level.



TWO-WAY TELEPHONE JACK FOR FIRE FIGHTERS
FOR ILLUSTRATION

4.0 Application of Emergency Voice Evacuation system and Two-way telephone communication System

The application of Emergency Voice Evacuation or Communication System and Two-way Telephone Communication System shall be as per Table: - C.03-T3

Table C.03.T3 Application of Emergency Voice Evacuation or Communication System

LOCATION	REQUIREMENTS
1. SUPER HIGHRISE BUILDINGS	i. Emergency Voice Evacuation or Communication System (EVC), in accordance with Sub Section 3.4., Shall be provided. ii. Two-way Telephone System, in accordance with Sub Section 3.4, shall be provided.
2. HIGHRISE BUILDINGS	
4. ASSEMBLY OCCUPANCIES	
5. AMUSEMENT AND THEME PARKS	
6. EDUCATIONAL OCCUPANCIES	
7. HOTEL OCCUPANCIES	
8. DETENTION AND CORRECTIONAL OCCUPANCIES	
9. STORAGE AND INDUSTRIAL OCCUPANCIES HAVING BUILT-UP AREA MORE THAN 5000 m^2	

5.0 Design, Installation, Inspection and Maintenance of Emergency Voice Evacuation or Communication and Two -way Telephone System

5.1. Design/Specification and Submittals

5.1.1. Design, Specifications and Submittals to General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain for permit shall be main consultants responsibility. Consultant shall have competent and knowledgeable permitted personnel to understand the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain requirements and codes and standards.

5.1.2. Design submittals shall be complete with Emergency Voice Evacuation Speaker layouts, ceiling heights, manufacturer's specification for the spacing of speakers and intelligibility specifying average ambient sound levels in layout.

5.2. Installation

5.2.1. Installation of Voice evacuation System and Two-way telephone Systems shall be carried out only by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted and licensed Fire Detection and Alarm System contractors. General contractors, MEP Contractors, BMS Contractors, Home automation Contractors shall not be allowed to install Voice Evacuation Systems and Two-way telephone Systems.

5.2.2. Installation contractor qualification and permit from General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain is based on their training from respective system manufacturers, experience, understanding of codes and standards and workmanship.

5.2.3. Installation contractors shall apply to General Directorate of Civil Defence and secure passing marks in General Directorate of Civil Defence examination to gain license and be qualified as permitted Fire Detection and Alarm Systems contractors.

5.2.4. Installation contractor shall not commence work on site without receiving General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain stamped and permitted drawings from the Consultant.

5.2.5. It is contractor's responsibility to adhere to consultant's General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted drawings and Manufacturer's installation, acoustic guidelines and specifications.

5.3. Inspection and Acceptance

5.3.1. Inspection and acceptance shall be main consultant's responsibility.

5.3.2. Main consultant shall inspect contractor work during installations and during acceptance, ensure that Voice speakers are delivering intelligible messages, in accordance with Sub Section 5. of this chapter.

5.3.3. Consultant shall handover system inspection report, acoustic reports, permitted drawings, maintenance manuals to the owner.

5.4. Inspection and Maintenance

5.4.1. The building owner, his appointed representative and the facility management shall be responsible to ensure that Voice evacuation System and Two-way telephone systems are installed in compliance with this chapter.

5.4.2. Emergency Voice Evacuation System and Two-way telephone systems shall be inspected and maintained as per **Chapter 01, Section C. Fire Detection and Alarm System's schedule** and requirements.

6.0 Emergency Voice Evacuation or Communication System (EVC) Acceptance Test 7.

6.1. Intelligibility of Emergency Voice Evacuation or Communication Systems shall comply with Table: - C.03-T4

Table C.03-T4 Acceptance Test of Emergency Voice Evacuation or Communication Systems

ITEMS	REQUIREMENTS
1. ACCEPTANCE TEST	i. Speech intelligibility is not a physical quantity like meters, feet, amperes, volts, or even decibels. It is a benchmark for the degree to which we understand spoken language, and as such is a complex phenomenon affected by many variables. ii. There are two basic categories of intelligibility testing: a. Subject (human) based testing b. Instrument based test methods. iii. Test methods that use human subjects are only statistical predictions of how well speech might be understood at any other time for any other group of listeners. Several subject based test methods have been extensively researched, tested for reliability, and standardized. Examples include the Phonetically Balanced (PB) word scores (256 words or 1000 words) and Modified Rhyme Test (MRT). iv. Subject based test methods can gauge how much of the spoken information is correctly understood by a person or group of persons for that particular test. When properly done, that resulting value is a prediction of how much of the spoken word will be correctly understood by others at some other time. Therefore, the results of speech intelligibility testing are usually described as predictions, not measurements. V. However, most users of the instruments refer to the results as measurements, not as predictions. Since the use of portable instruments is the more common method in the alarm and emergency communications industries, in this document the results will be referred to as measurements to avoid confusion. However, in scientific and general acoustic literature, readers can see the measured values correctly referred to as predictions. v. Thus acceptance test for Voice evacuation Systems shall be completely based on the clear audibility, intelligibility and understanding of the voice messages delivered in a particular building.

7.0 Emergency Voice Evacuation System and Two-way Telephone System Material Test Standards and Permits.

7.1 Acceptable Test Standards and criteria

7.1.1. All the Speakers, Voice Equipment, Control Systems, Materials, Assemblies, wiring, fittings, Products and Accessories, referred to in this chapter shall be Listed, Permitted and Registered by the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain.

7.1.2. There is no year of edition mentioned against any test standards. It is the intent of General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain to convey to the customers seeking laboratory tests and the test laboratories to follow the "LATEST EDITION OF THE TEST STANDARD, AS AND WHEN THEY ARE UPGRADED/REVISED/AMENDED, TO THE DATE."

7.1.3. Emergency Voice Evacuation Systems

i. ANSI/UL 2572, Mass Notification Systems.

ii. UL 864, Standard for Control Units and Accessories for Fire Alarm Systems.

iii. FM 3010, Fire Alarm Signaling Systems

iv. FM 3011, Central Station Service for Fire Alarms and Protective Equipment Supervision.

v. EN 54-16, Voice Alarm Control and indicating equipment

vi. ISO 7240-16, Voice Alarm Control and indicating equipment

7.1.4. Speakers

i. ANSI/UL 1480, Standard for Speaker

ii. ULC-S541-07, Standard for Speaker

iii. FM 3150, Audible Notification Appliances for Automatic Fire Alarm Signaling

iv. EN 54-24, Loud Speakers

v. ISO 7240-24 Loudspeakers

7.1.5. Amplifiers

i. UL 864, Standard for Control Units and Accessories for Fire Alarm Systems

ii. UL 1711, Amplifiers for Fire Protective Signaling Systems

iii. EN 54-16, Voice Alarm Control and indicating equipment

7.1.6. 2-Way Telephone System

i. UL 864, Standard for Control Units and Accessories for Fire Alarm Systems

ii. EN 54-21, Alarm Transmission and fault warning routing equipment

7.1.7. Fire rated Cable, Certified for 120 minutes

i. EN 50200, Method of test for resistance to fire of unprotected small cables for use in emergency circuits

ii. UL 2196, Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control, and Data Cables

iii. BS 8434-2, Methods of test for assessment of the fire integrity of electric cables. Test for unprotected small cables for use in emergency circuits. BS EN 50200 with a 930° flame and with water spray.

iv. BS 7629-1, Electric cables. Specification for 300/500 V fire resistant screened cables having low emission of smoke and corrosive gases when affected by fire. Multicore and multipair cables. Test for Resistance to Fire.

v. BS 6387, Test method for resistance to fire of cables required to maintain circuit integrity under fire conditions.

vi. IEC 60331-1, Tests for electric cables under fire conditions.

vii. IEC 60331-2, Tests for electric cables under fire conditions.

viii. IEC 60332-2-2, Tests on electric and optical fiber cables under fire conditions.

ix. IEC 60332-3-10, Tests on electric and optical fiber cables under fire conditions.

x. UL 1724, Outline of Investigation for Fire Tests for Electrical Circuit Protective Systems.



Chapter 4

Emergency Lighting

Section C

Chapter 4

Emergency Lighting



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1.0 SCOPE

1.1 To provide design basis for Emergency Lighting System.

1.2 To provide illumination for exit routes during power failure to enable people to find and navigate exits swiftly and easily during emergencies.

1.3 To enable firefighters to locate firefighting equipment, to find trapped person/s and maneuver through building/s easily during emergencies and power failures.

1.4 Describing types of acceptable Emergency Lighting Systems.

1.5 Specifications for Emergency Lighting Systems

1.6 Installation and Maintenance of Emergency Lighting Systems

2.0 Definitions

2.1. General

2.1.1. Shall
It is a mandatory requirement from General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain.

2.1.2. Should
It is a recommendation by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain but not mandatory.

2.1.3. Listed
Permitted and registered by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain.

2.1.4. Lux
The SI unit of illumination equal to a luminous flux of 1 lumen per square meter. This is the luminous flux density at a given surface. **1 lux = 0.0929 foot-candle**

2.2. Emergency/Exit Lighting

2.2.1. Emergency/Exit Lighting

The lighting that is used to illuminate means of egress when there is a mains power or circuit failure or an Emergency situation.

2.2.2. Battery

Storage cells, storing energy and providing the power during mains failure. A lead- acid battery consisting of sealed cells furnished with a valve that opens to vent the battery whenever the internal pressure of the battery exceeds the ambient pressure by a set amount is called valve regulated Lead Acid. (VRLA). The lithium iron phosphate battery (LiFePO4 battery) is a type of lithium-ion battery using lithium iron phosphate (LiFePO4) as the cathode material, and a graphitic carbon electrode with a metallic backing as the anode.

2.2.3. Battery – Sealed

A battery where the electrolyte cannot be replaced. Where electrolyte is required to be replaced is called “vented”.

2.2.4. Battery Capacity

The capability of the battery under discharge condition measured in Ampere-hours (Ah, over one hour).

2.2.5. Central Battery System

A Central unit at centralized location that houses the batteries and the Control Unit. Control gears are in-built in the Emergency/Exit luminaires.

2.2.6. Self-Contained Emergency/Exit Light

An emergency / exit luminaire that houses all the electrical components. Typically, a light source, control gear and the battery.

2.2.7. Monitored type Emergency/Exit Light

A set of emergency lighting luminaire that is wired to control units to monitor and diagnose the health of the luminaires, circuit and the batteries.

2.2.8. Maintained Emergency/Exit Light

A luminaire that contains one or more light sources that are permanently illuminated during normal and emergency situations.

2.2.9. Non-Maintained Emergency Light

A Luminaire that contains one or more light sources and only illuminates during a mains or circuit failure situation.

2.2.10. Uninterruptible Power Supply (UPS)

A device that provides emergency power to a load when the main source fails. Typically, a luminaire is connected to the mains through a UPS, the UPS provides mains output to the luminaire when it detects a failure to the incoming mains.

2.2.11. Luminous Intensity (Cd)

The Power of the light source to emit light in a given direction measured in candela.

2.2.12. Rated Duration

The specified duration of light output from the luminaires operating from its battery supply. Typically, 1 to 3 hours on a fully charged battery.

2.2.13. Rated Load

The maximum load that can be placed on a system.

2.2.14. Emergency Power Supply System (EPSS)

A complete functioning EPS system coupled to a system of conductors, disconnecting means and overcurrent protective devices, transfer switches, and all control, supervisory and support devices up to and including the load terminals of the transfer equipment needed for the system to operate as a safe and reliable source of electric power.

2.2.15. Stored Emergency Power Supply System (SEPSS)

A system consisting of a UPS, a central battery system, or a motor generator, powered by a stored electrical energy source, together with a transfer switch designed to monitor preferred and alternate load power source and provide desired switching of the load, and all necessary control equipment to make the system functional.

2.2.16. Energy Conversion Equipment (ECE)

A system of either a UPS, a battery bank and battery charger (central battery system), or a rotating motor generator (with or without inertia flywheel), often supplied by a central battery system power source.

2.2.17. Automatic Transfer Switch

Self-acting equipment for transferring one or more load conductor connections from one power source to another.

2.2.18. Control Gear

An electrical Control gears is a device intended to limit the amount of current in an electric circuit. Without Control gear restriction, current would otherwise rise to luminaire destruction levels.

3.0 Emergency Lighting

3.1. Intention

3.1.1. The provisions of this chapter require that all exits and exit routes in a facility shall be provided with the luminaires that are backed up by Emergency power such as Battery or UPS. So that during the Fire emergencies and/or upon loss of power in the facility, means of egress is illuminated for evacuees with “emergency lighting”.

3.1.2. During emergencies or in condition where the occupied building's regular illumination fails, the purpose of emergency lighting is to

a. Indicate clearly and unambiguously the escape routes.
b. Provide illumination along such routes to allow safe movement towards and throughout the exits provided.
c. Ensure that fire alarm call point and firefighting equipment provided along escape routes can be readily located.
d. Permits continuity of High hazard operations to be terminated safely.

3.1.3. Such emergency lighting needs to be designed, installed and maintained to achieve its purpose during emergencies. This chapter addresses the design, performance of the system, installation and maintenance requirement for emergency lighting.

3.2. General

3.2.1. Three types of Emergency lighting systems depending on the nature of occupancy are permitted by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain.

a. Central Battery System.
b. Monitored Type Emergency Lighting System.
c. Self-Contained, standalone Emergency Lighting.

3.2.2. The emergency lighting system shall be arranged to provide the required illumination automatically in the event of any interruption of normal lighting due to any of the following:

a. Failure of a public utility or other outside electrical power supply.
b. Opening of a circuit breaker or fuse.
c. Manual act(s), including accidental opening of a switch controlling normal lighting Facilities.

3.2.3. The requirements in this chapter are minimum guidelines for performance requirements, design and installation of emergency lighting. It is consultant’s responsibility to refer to **NFPA 101, NFPA 70, NFPA 110 and Manufacturer’s design guidelines** for detailed design and performance requirements.

3.2.4. Proper planning shall be exercised by consultant to consider the emergency lighting requirements of the facility during design stage itself. Ignoring appropriate selection of system, Luminaire selection based on lumen output, spare capacity, wiring requirements and lux requirements can prove to be costly in the later stages of project.

4.0 Types of Emergency Lighting Systems

4.1. General Requirements of Emergency Lighting

4.1.1. The general requirements of emergency lighting shall be as per **Table: - C.04-T1**

Table:- C.04-T1: General Requirements of Emergency Lighting

ITEMS	REQUIREMENTS
1. PRE-DESIGN CONSIDERATIONS **(LOCATIONS OF EMERGENCY LIGHTING LUMINAIRE)**	i. Locate the number of emergency luminaries required in the facility by identifying locations such as at exit doors, outside exit stairs, inside exit stairs, at change in elevation on walking path, at walking path intersections, near fire fighting equipment, circulation areas, refuge areas, exit access corridors, exit corridors etc. ii. Every landing of each stair shall have emergency luminaire. iii. Every change in direction of the exit corridor, walking path shall have emergency luminaire. iv. Outside exit stair at the discharge level shall be provided with emergency luminaire. v. Every Fire Hose Cabinet (FHC) in the corridor shall be within 2m of emergency luminaire. vi. Every First Aid Box shall be within 2m of the emergency luminaire. vii. Every Exit Sign that is intended to be externally illuminated, requires emergency luminaire within 2m. viii. Additional emergency luminaires shall be required at toilets, elevators, car parks, escalators, plant rooms, fire pump rooms etc. See Table C.04-T6.
2. LUX REQUIREMENTS	i. Each compartment greater than 280 m2 shall have two luminaires, so that failure of one does not compromise the emergency illumination of the room and exit doors. ii. Emergency lighting shall provide an initial illumination not less than 1.1 lux at any point, measured at floor level along the egress path, or 1 m width of center line of this egress path. iii. Lux level shall be permitted to decline to not less than 0.65 lux at the end of 3 Hours at any point, measured at floor level along the egress path, or 1 m width of center line of this egress path. iv. The average initial illumination at floor level along the egress path, or 1 m width of center line of this egress path, shall not be less than 10.8 lux. v. Maximum to minimum ratio of illumination shall not exceed 40 to 1 (40:1) vi. Open areas that are not exit routes and where illumination is provided to avoid panicking of people due to darkness, lux level shall be permitted to be declined to 0.5 lux, at the end of 3 Hours, at any point. vii. High risk areas, where operations need to be shut-down or terminated safely, the initial average lux level shall not be less than 12 lux with no point in the area having lux level of less than 1.8 lux, at floor level.
3. DURATION	i. Emergency lighting shall be available for 3 Hours (180 minutes) immediately after the power failure. ii. Initial illumination shall not be less than be 1.1 lux at any point, measured at floor level along the egress path, or 1 m width of center line of this egress path. iii. Illumination shall be permitted to decline to not less than 0.65 lux at the end of 3 Hours at any point, measured at floor level along the egress path, or 1 m width of center line of this egress path.

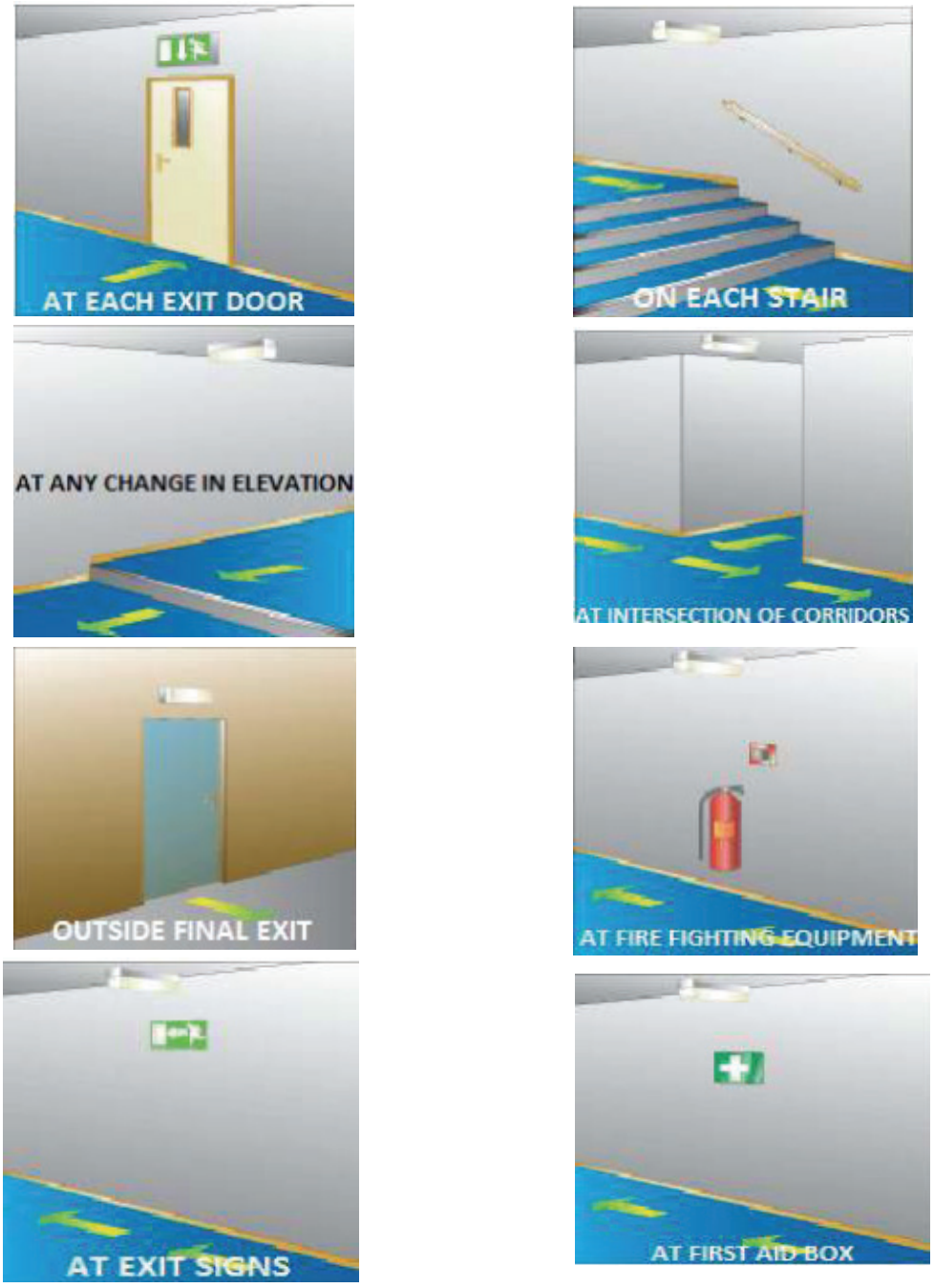


Figure:- C.04-F1: Locations of Mandatory Emergency Lighting Luminaires

Table:- C.04-T1: General Requirements of Emergency Lighting

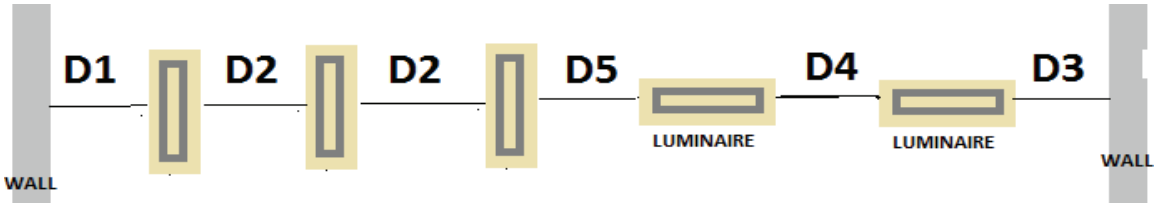
ITEMS	REQUIREMENTS
4. DISTRIBUTION OF LUMINAIRES	i. All emergency lighting luminaires (fixtures) shall be dedicated, marked with the maximum lamp wattage or electrical rating, manufacturer's name, trade-mark, or other suitable means of identification. ii. Distribution of emergency luminaries shall be based on authenticated luminaire spacing tables from manufacturer or shall be calculated from manufacturer's listed software calculating the spacing based on photometric tests. iii. Consultant shall furnish the calculations and lux distribution printouts from manufacturer's software and design approaches. iv. As a minimum guideline, the spacing of the emergency lighting luminaires in exit routes, exit corridors, escape routes, exit stairs, exit access corridors, where required minimum lux is 1.1 lux at any point at floor level along the egress path, shall not be less than that required by **Table:- C.04-T1.a.** v. As a minimum guideline, the spacing of the emergency lighting luminaires in open areas, where the lux level at any point at floor level is permitted to be declined to 0.5 lux, shall not be less than that required by **Table:- C.04-T1.b.** vi. However, these guidelines are for reference only. Actual spacing shall be from manufacturer's tested and authorized spacing tables. Consultant shall clearly mention "H, D1, D2, D3, D4, D5" distances in the design drawings for approval with manufacturer's table and software calculation for justifications.

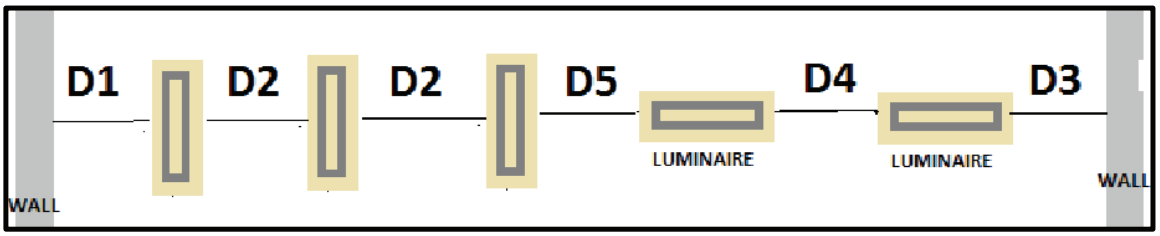
Table:- C.04-T1.a.: Spacing of Emergency Lighting Luminaires at Exit routes and Corridors (1.1 lux)

MOUNTING HEIGHT H	TRANSVERSE TO WALL D1	TRANSVERSE TO TRANSVERSE D2	AXIAL TO WALL D3	AXIAL TO AXIAL D4	TRANSVERSETO AXIAL D5
1. 2.5 m	2.7 m	7.2 m	1.5 m	4.6 m	3.65 m
2. 3 m	2.5 m	7.3 m	1.6 m	4.7 m	3.6 m
3. 4 m	2.1 m	7.5 m	1.7 m	4.8 m	3.45 m
4. 6 m	2 m	5.3 m	1.8 m	3.7 m	3.3 m

Table:- C.04-T1.b.: Spacing of Emergency Lighting Luminaires at Open Spaces (0.5lux)

MOUNTING HEIGHT H	TRANSVERSETO WALL D1	TRANSVERSE TO TRANSVERSE D2	AXIAL TO WALL D3	AXIAL TO AXIAL D4	TRANSVERSETO AXIAL D5
1. 2.5 m	2.5 m	8.5 m	2.3 m	7.4 m	4.95 m
2. 3 m	2.5 m	9 m	1.6 m	8 m	6.25 m
3. 4 m	2.6 m	9.8 m	2.3 m	8.6 m	3.6 m
4. 6 m	2.4 m	10.3 m	1.6 m	9.5 m	3 m





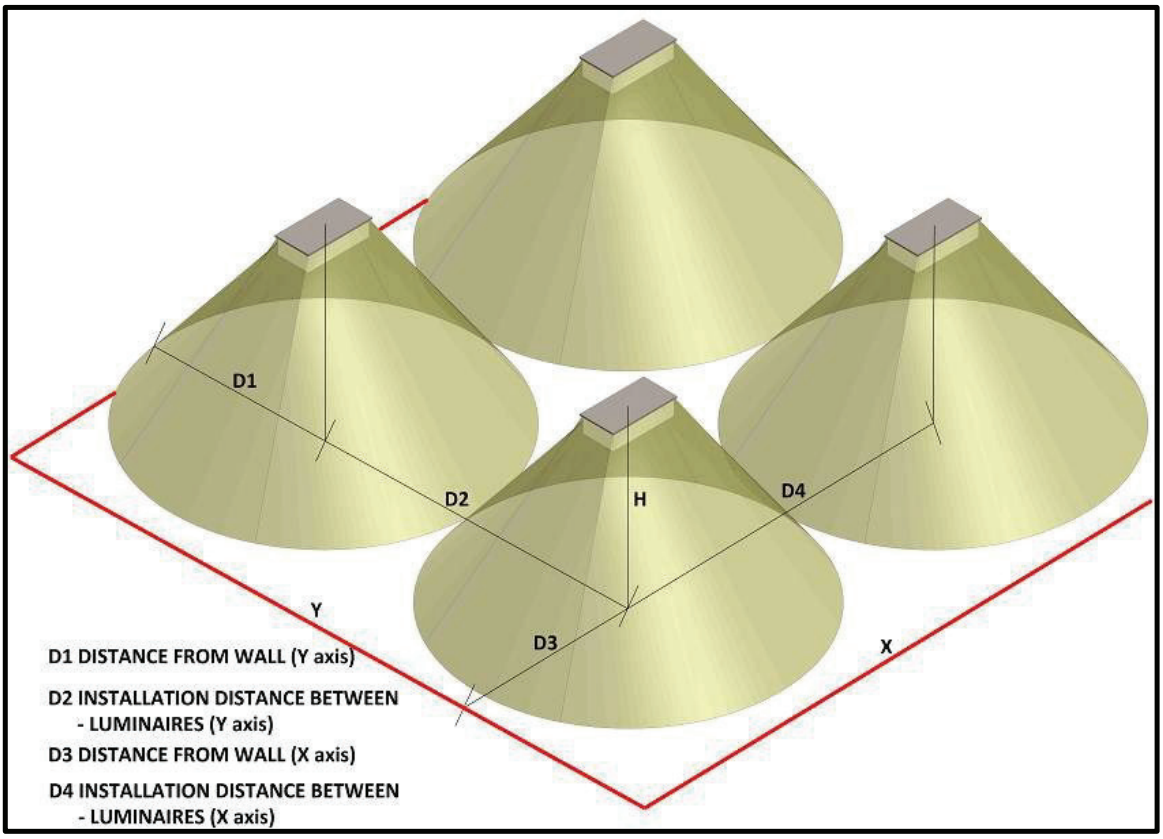


Figure:- C.04-F2.: Distances between luminaires with reference to Table C.04-T1.a. and C.04-T1.b.

4.2. Requirements of Central Battery Emergency Lighting

4.2.1. The requirements of Central Battery emergency lighting shall be as per **Table: - C.04-T2.**

Table:- C.04-T2: Specifications of Central Battery Emergency Lighting

ITEMS	REQUIREMENTS
1. TYPES OF POWER	i. The type of power available from central battery systems shall be at least Type 10, Class 1.5, Level 1 in accordance with **NFPA 111, Standard on Stored Electrical Energy Emergency and Standby Power Systems.** ii. The power System of the central battery system shall be of Type 10 which cut-in within 10 seconds of the failure of the mains. iii. The duration of the back-up of central battery power shall be of Class 3, that is for 3 hours (180 Minutes) iv. Power supply shall be of level 1 category which is installed where failure of the equipment to perform could result in loss of life. (Threat to building Life Safety)
2. BATTERIES	i. Batteries shall be central battery systems as follows. a. Open-rack type. b. Console or package type. c. Combination of a and b. ii. The (ECE) energy conversion equipment shall be restricted to a. UPS (Uninterruptible Power Supply) b. Central Battery System iii. The equipment, ECE, Battery Unit shall be certified by the manufacturer with test certificates, stating the compliance with required output voltages, wave-form, frequency, operating temperature range etc. iv. Operating temperature Range 0℃~50℃. v. Normal Operating Temperature Range 25℃±5℃ vi. The ECE shall be designed to function at humidity up to 85% max. vii. The ECE shall have the capacity to supply energy for 180 minutes, uninterrupted. viii. Following a full discharge after 180 minutes of full rated operation, ECE shall be capable of automatically resupplying the full rated load and full duration within 48 hours and of resupplying 60% of duration at full rated load within 24 hours. ix. Batteries shall be tested and approved for central battery emergency lighting system.
3. BATTERY ROOM VENTILATION	i. Vented batteries, such as flat plate lead acid (VRLA) emit potentially explosive gases under charge conditions. Therefore, it is important when selecting rooms for emergency lighting central battery systems with these types of battery, to calculate the amount of ventilation (Air Changes per Hour) required. ii. The required number of air changes per hour (A) is given by the following formula: A = 0.045 x N x I x V Where: N = Number of cells in the battery V = Volume of room in cubic meters I = Charge rate in Amperes iii. This formula will give the number of air changes per hour required during boost charge conditions. On float charge (systems are on float charge for most of them service life), the amount of gas emitted is approximately 1.5% of that liberated whilst on boost charge and under most circumstances this will be dissipated by natural ventilation, and will not present a hazard. However, the boost charge condition shall be allowed for at the design stage to ensure the appropriate decision on ventilation requirements is made.

Table:- C.04-T2: Specifications of Central Battery Emergency Lighting

ITEMS	REQUIREMENTS
4. SPARE CAPACITY	i. With any central battery system it is important to bear in mind that it is difficult to extend the system at a later date unless capacity has been allowed for at the design stage. ii. 5% spare capacity shall be included when selecting the central battery system rating.
5. CONTROL FEATURES	**1. GENERAL** i. The control equipment and accessories shall be tested and approved by the laboratories for Central battery system. The same shall be permitted and registered by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain. ii. System shall be addressable, self-diagnostic and automatic testing of luminaires. iii. Control unit operating temperature shall be 10^0C TO 35^0C. **2. MONITORING** i. The load source shall be monitored for undervoltage and overvoltage on all of its Ungrounded input lines. ii. The ECE and the utility shall be monitored for unacceptable conditions. iii. If a condition that is out of tolerance is sensed, the transfer switch shall automatically switch to the alternate source(s) of power, provided that the alternate source(s) of power itself is within tolerance. iv. When the preferred source of power returns to levels of output within equipment tolerance in its sensed parameters, the transfer switch shall initiate an automatic retransfer to the preferred source. v. An adjustable time delay shall be allowed to ensure that the preferred source is within its steady-state specification limits before such retransfer is performed. vi. Provision for retransfer to the preferred source also shall be available under manual command, provided the preferred source is within tolerance. vii. Retransfer shall be permitted to be sequenced if desired to pick up heavy loads without introducing further disturbances. **3. INTERLOCKING** i. Interlocking shall be provided to prevent inadvertent interconnection of the preferred and alternate power sources **4. TRANSFER SWITCH** i. Automatic transfer switches shall be listed for emergency service as a completely Factory-assembled and factory tested apparatus, and shall be electrically or electronically operated rated for all classes of load to be served. ii. Automatic transfer switches shall be integral part of approved ECE System. iii. Instruction and equipment shall be provided for the manual nonelectric transfer or bypass in the event the automatic transfer switch malfunctions. **5. TEST SWITCH** i. A test switch shall be provided on each automatic transfer switch that simulates failure of the preferred power source. **6. INTERFACE** i. Central Battery System shall be interfaced with Building Monitoring System, Fire Alarm control unit and the Computers.

Table:- C.04-T2: Specifications of Central Battery Emergency Lighting

ITEMS	REQUIREMENTS
6. LUMINAIRES	i. Central battery emergency lighting luminaires shall be listed and approved for the purpose. ii. Convertible light fittings shall not be permitted, unless approved and listed with test certification. iii. All emergency lighting luminaires (fixtures) shall be dedicated, marked with the maximum lamp wattage or electrical rating, manufacturer's name, trademark, or other suitable means of identification.
7. EXIT SIGNS	i. Where Exit signs are internally illuminated with central battery emergency lighting system (maintained type), the exit sign designs and specifications shall comply with **Section C, Chapter 05. Exit Signs**.
8. WIRINGS	i. Wiring of all the central battery system shall be 2 hours fire rated, throughout. Wiring shall be permitted to be wired in the same raceway of Emergency Systems but shall be totally independent of all other wiring and equipment.
9. CROSS ZONING	i. Central battery luminaires shall be fed by minimum of two circuits in each zone of coverage. ii. Each area shall be covered by central battery luminaire in cross zoned arrangement, overlapping each area by luminaires from two different circuits.
10. FIRE PROTECTION	i. Central Battery Room shall be protected with Automatic Clean Agent System as per **Section D, Chapter 11 and Chapter 9. Clean Agent Systems.**

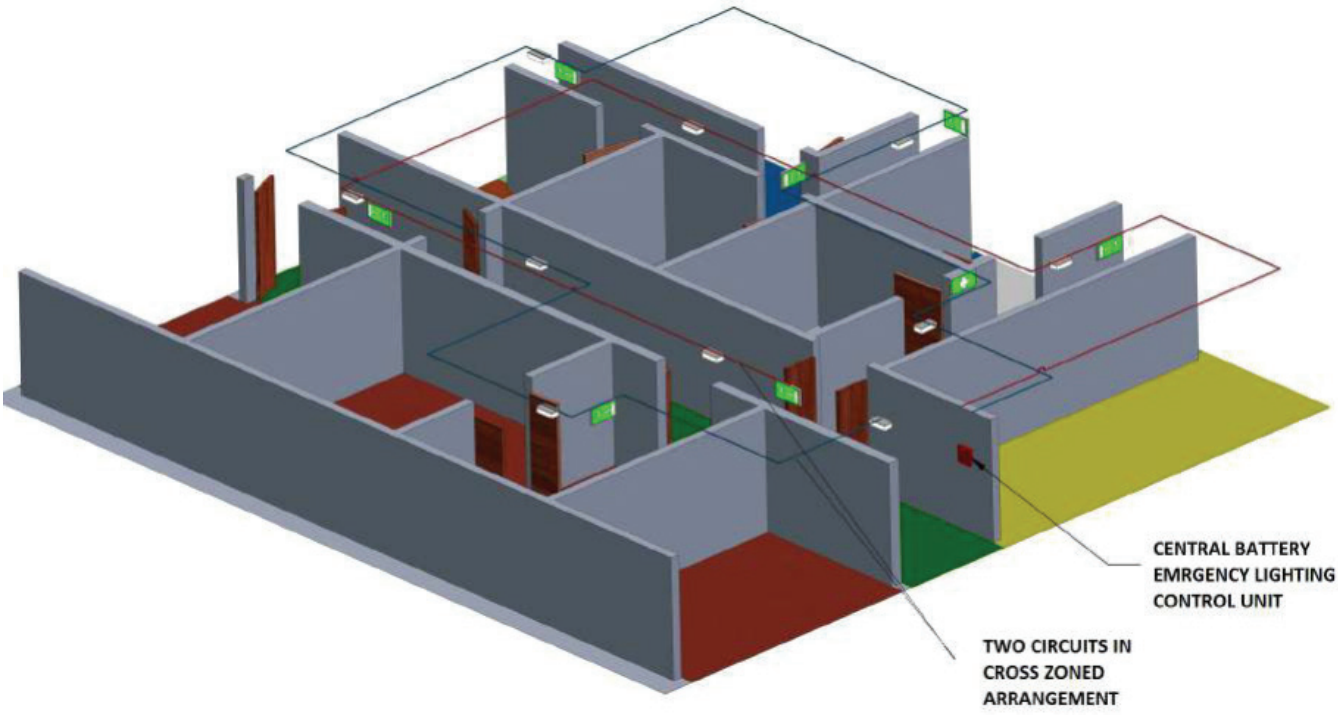


Figure:- C.04-F3: Typical Central Battery Emergency Lighting

4.3. Requirements of Monitored Type Self-contained Emergency Lighting

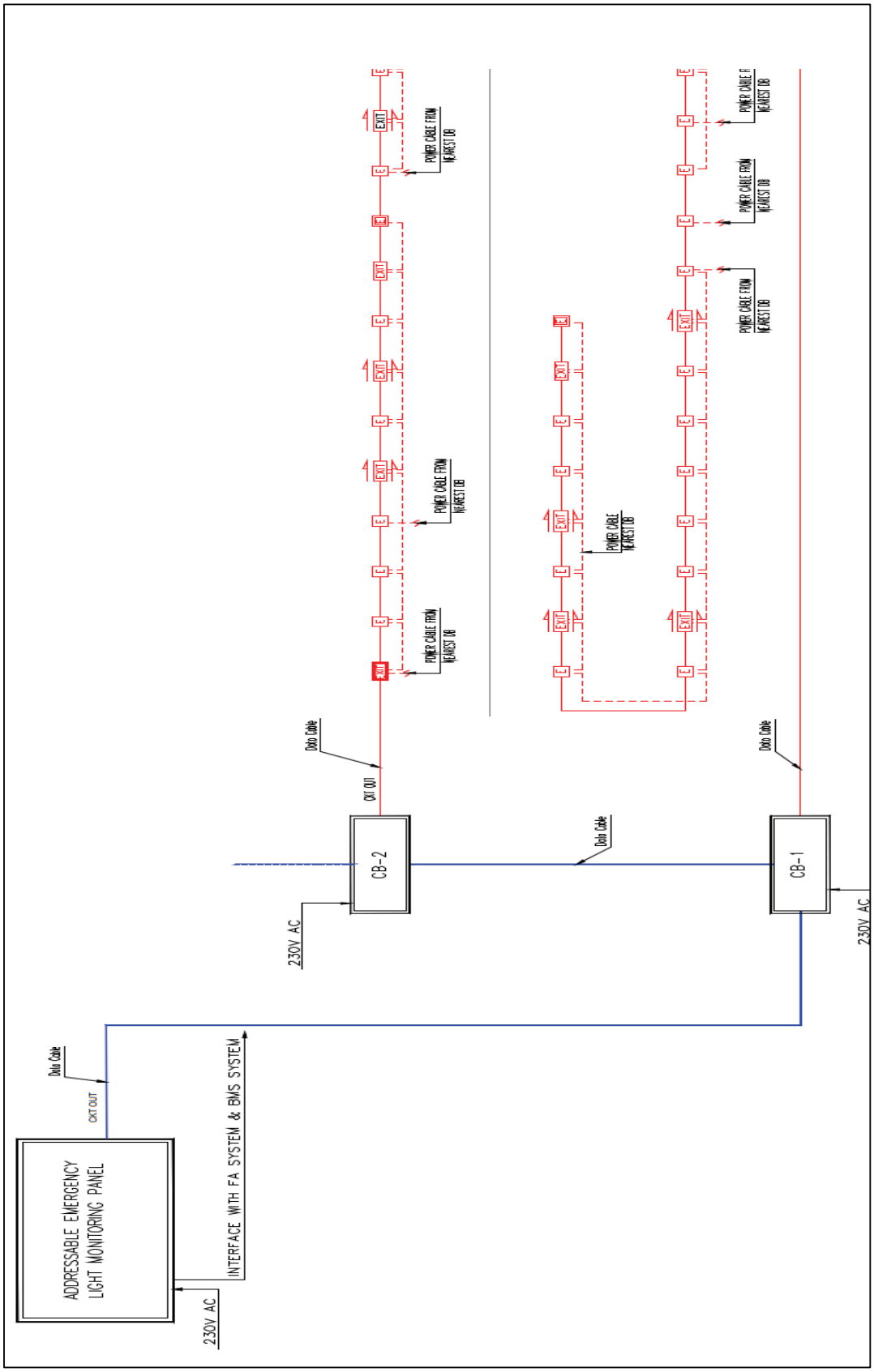
4.3.1. The requirements of Monitored Type Self-contained emergency lighting shall be as per **Table: - C.04-T3.**

Table:- C.04-T3: Specifications of Monitored Type Self-contained Emergency Lighting

ITEMS	REQUIREMENTS
1. TYPE OF POWER	i. The type of power systems for monitored type self-contained shall be at least Type 10, Class 3, Level 1 in accordance with **NFPA 111, Standard on Stored Electrical Energy Emergency and Standby Power Systems.** ii. The power System of the monitored type self-contained system shall be of Type 10 which cut-in within 10 seconds of the failure of the mains. iii. The duration of the back-up of self-contained battery power shall be of Class 3, that is for 3 hours (180 Minutes) iv. Power supply shall be of level 1 category which is installed where failure of the equipment to perform could result in loss of life. (Threat to building Life Safety)
2. SELF CONTAINED LUMINAIRES	**1. BATTERIES** i. Batteries shall be integral part of the luminaire, as 'self-contained unit'. ii. The luminaire, internal ECE and internal Battery Unit shall be certified by the manufacturer with test certificates, stating the compliance with required output voltages and operating temperature range etc. iii. Operating temperature of fixtures shall be 0^0C TO 45^0C. iv. Outdoor fixtures shall be weatherproof. v. The self-contained unit shall be designed to function at humidity from 5% to 95% vi. The self-contained emergency lighting unit shall have the capacity to supply energy for 180 minutes, uninterrupted. vii. Following a full discharge after 180 minutes of full rated operation, the self-contained unit shall be capable of automatically resupplying the full rated load and full duration within 24 hours and of resupplying 60% of duration at full rated load within 12 hours. viii. Batteries shall be tested and approved along with self-contained emergency lighting system. **2. LUMINAIRES** i. Luminaires shall be addressable. ii. Luminaire shall be tested and certified by the manufacturer for serving as a unit in monitored type self-contained emergency lighting system. iii. Convertible light fittings shall not be permitted, unless approved and listed with test certification. iv. All emergency lighting luminaires (fixtures) shall be dedicated, marked with the maximum lamp wattage or electrical rating, manufacturer's name, trademark, or other suitable means of identification.

Table:- C.04-T3: Specifications of Monitored Type Self-contained Emergency

ITEMS	REQUIREMENTS
3. SPARE CAPACITY	i. Any Emergency lighting system should be able to expand its network during later stage of the building life and it should be considered during design stage. ii. 5% spare capacity shall be included when selecting the monitored type self contained emergency lighting system.
4. MONITORING FEATURES	**1. GENERAL** i. The control equipment, self-contained luminaire and accessories shall be tested and approved by the laboratories as an assembly and as a "system" to be acceptable as Monitored Type self-contained emergency lighting system. ii. System shall be addressable, self-diagnostic and automatic testing of luminaires. iii. Control unit operating temperature for indoor application shall be 0^0C to 40^0C. **2. MONITORING** i. The load source shall be monitored for undervoltage and overvoltage on all of its ungrounded input lines. ii. Monitoring control unit shall automatically diagnose the real time health of batteries, battery output, luminary output level, circuit integrity. iii. Any abnormality in Control gear unit, mains supply, data circuit, battery faults etc. shall be signaled as specific trouble indication on the control unit in less than 5 seconds. **3. TESTING** i. All the connected self-contained luminaries shall be able to be tested and perform 'walk test' through central monitoring unit. ii. A test feature shall be available that simulates failure of the mains power supply. **4. INTERFACE** i. Monitored type self-contained system shall be interfaced with the Building Monitoring System, Fire Alarm control unit and the Computers.
5. EXIT SIGNS	i. Where Exit signs are internally illuminated with self-contained emergency lighting system (maintained type), the exit sign designs and specifications shall comply with **Section C, Chapter 05. Exit Signs**.
6. WIRING	i. Wiring of all the self-contained luminaires into central monitoring unit shall not be required to be fire rated.
7. CROSS ZONING	i. Not required



ADDRESSABLE SELF-CONTAINED EMERGENCY, EXIT LIGHT SCHEMATIC

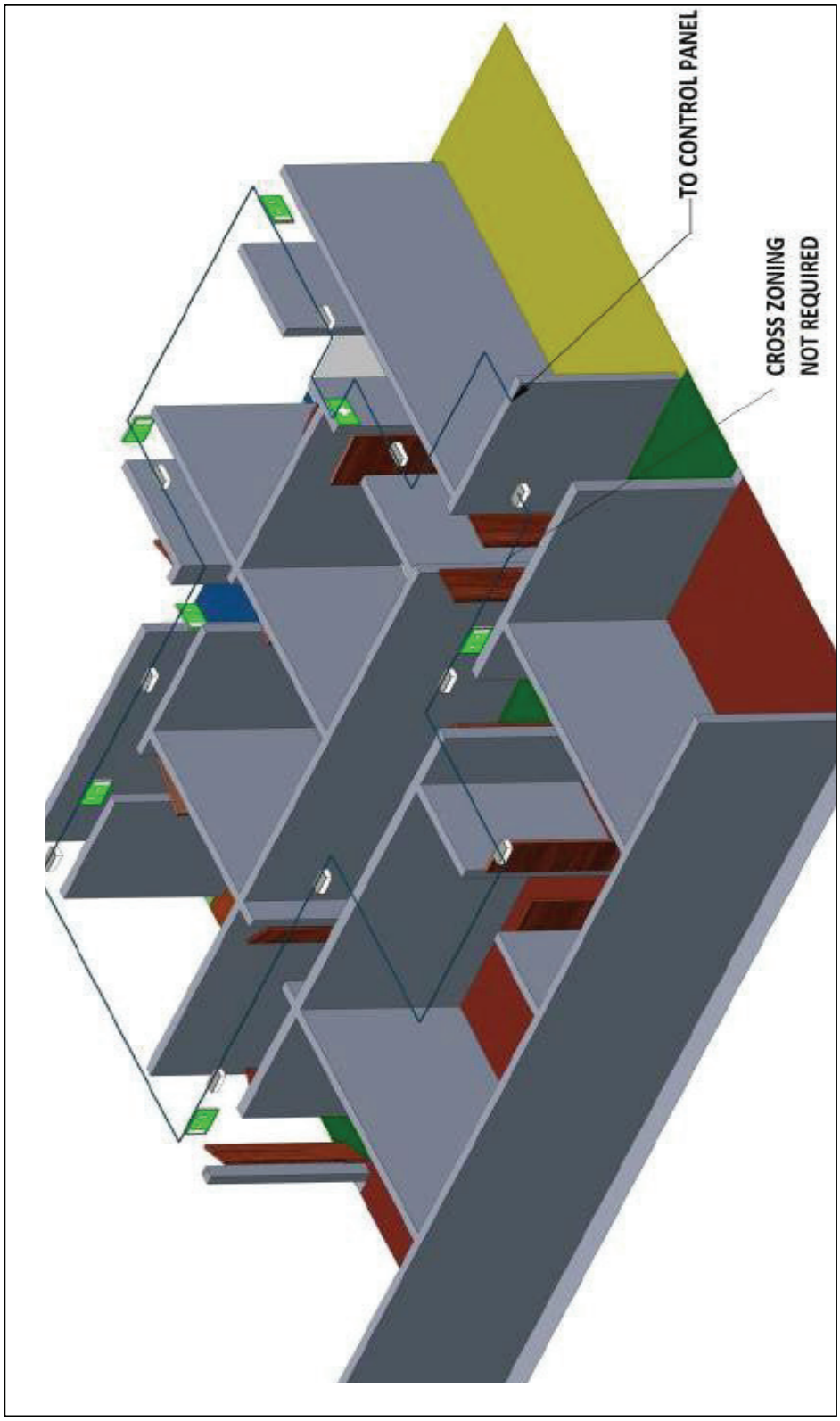


Figure: - C.04-F4: Typical Monitored Type Self Contained Emergency Lighting System

4.4. Requirements of Standalone Self-contained Emergency Lighting

4.4.1. The requirements of Standalone Self-contained emergency lighting shall be as per **Table: - C.04-T4.**

Table:- C.04-T4: Specifications of Standalone Self-contained Emergency

ITEMS	REQUIREMENTS
1. SELF CONTAINED LUMINAIRES	**1. POWER** i. The type of power systems available from standalone Self-contained luminaire shall be at least Type 10, Class 3, Level 1 in accordance with **NFPA 111, Standard on Stored Electrical Energy Emergency and Standby Power Systems.** ii. The standalone self-contained luminaire shall be of Type 10 which cut-in within 10 seconds of the failure of the mains. iii. The duration of the back-up of standalone self-contained battery power shall be of Class 3, that is for 3 hours (180 Minutes) iv. Power supply shall be of level 1 category which is installed where failure of the equipment to perform could result in loss of life. (Threat to building Life Safety) **2. BATTERIES** i. Batteries shall be integral part of the luminaire, as 'self-contained unit'. ii. The luminaire, internal ECE and internal Battery Unit shall be certified by the manufacturer with test certificates, stating the compliance with required out-put voltages and operating temperature range etc. iii. Operating temperature of fixtures shall be 0^0C TO 45^0C. iv. Outdoor fixtures shall be weatherproof. v. The self-contained unit shall be designed to function at humidity from 5% to 95%. vi. The self-contained emergency lighting unit shall have the capacity to supply energy for 180 minutes, uninterrupted. vii. Following a full discharge after 180 minutes of full rated operation, the self-contained unit shall be capable of automatically resupplying the full rated load and full duration within 24 hours and of resupplying 60% of duration at full rated load within 12 hours. viii. Batteries shall be tested and approved for self-contained emergency lighting system. **3. LUMINAIRES** i. Luminaire shall be tested and certified by the manufacturer for serving as a standalone type self-contained emergency lighting system. ii. All emergency lighting luminaires (fixtures) shall be dedicated, marked with the maximum lamp wattage or electrical rating, manufacturer's name, trade-mark, or other suitable means of identification.

5.0 Selection and Application of Emergency Lighting Systems

5.1. All the emergency lighting systems shall be designed and shall comply with general requirements of **Table: - C.04-T1.**

5.2. Where central battery or monitored type emergency lighting is required by **Table:- C.04-T5.**, a centralized Emergency Lighting system shall be provided for the entire facility, to be under one facility management, covering all individual tenants, offices, shops, mercantile units, warehouses etc. Buildings shall not be provided with multiple control equipment, multiple battery storage banks, serving individual tenants.

5.3. The selection of emergency lighting system for occupancies shall be in accordance with **Table: - C.04-T5.**

5.4. Applicability of emergency lighting luminaires at various locations, shall be as per **Table C.04-T6.**

Table:- C.04-T5: Selection of Emergency Lighting Systems

OCCUPANCY	REQUIREMENTS
1. SUPER HIGHRISE BUILDINGS **2. HIGHRISE BUILDINGS** **3. MALL** **4. AMUSEMENT BUILDINGS**	i. Central Battery Emergency Lighting System as per **Sub Section 4.2.**, complete with dedicated control equipment shall be provided. **OR** i. Monitored Type Self Contained Emergency Lighting System as per **Sub Section 4.3**, complete with dedicated control and monitoring equipment shall be provided.
5. MIDRISE BUILDINGS **6. LOW RISE BUILDINGS** **7. WAREHOUSES** **8. FACTORIES**	i. Monitored Type Self Contained Emergency Lighting System as per **Sub Section 4.3**, complete with dedicated control and monitoring equipment shall be provided.
9. PRIVATE VILLAS **10. COMMERCIAL VILLAS**	i. Emergency Lighting is Not Mandatory. However, emergency lighting is required for basements, if any.
11. BUSINESS, GROUP C **12. MERCANTILE, GROUP C** **13. FUEL DISPENSING STATIONS (MINI MARTS, RESTAURANTS, SERVICE STATIONS)** **14. PRIVATE AND COMMERCIAL VILLA BASEMENT**	i. Standalone Self-Contained Emergency Lighting System as per **Sub Section 4.4.**, shall be provided and permitted.

Table:- C.04-T6: Applicability of Emergency Lighting Luminaire

OCCUPANCY	REQUIREMENTS
1. INSIDE FIRE PUMP, EPS ROOM AND LARGE PLANT ROOMS 2. INSIDE AND OUTSIDE EMERGENCY COMMAND CENTER 3. INSIDE AND OUTSIDE STAIRWAYS 4. INSIDE LIFT LOBBY 5. INSIDE FIRE FIGHTERS LIFT LOBBY 6. IN EXIT CORRIDORS 7. INSIDE EXIT ACCESS CORRIDORS 8. INSIDE EXIT PASSAGEWAYS 9. INSIDE TUNNELS 10. ALL AREAS OF ENCLOSED BASEMENTS AND RAMPS 11. IN SERVICE CORRIDORS 12. IN EXIT DISCHARGE 13. RECEPTION 14. LOCATION OF FACP 15. LOCATION OF FIRE HOSE CABINET 16. LOCATION OF FIRE EXTINGUISHER 17. LOCATION OF FIRST AID KIT 18. LOCATION OF SMOKE CONTROL PANEL 19. LPG TANK LOCATION 20. INSIDE HOTEL GUEST ROOM 21. ASSEMBLY SEATING AREAS 22. INSIDE COMMERCIAL KITCHEN 23. KITCHEN DELIVERY AREAS 24. INDOOR LOADING AND UNLOADING AREAS 25. INSIDE LV ROOM 26. INSIDE TRANSFORMER ROOM 27. INSIDE WASH ROOMS	i. Emergency Lighting Luminaire is mandatory.
28. SCHOOL CLASS ROOMS 29. INSIDE PATIENT SLEEPING ROOMS 30. INSIDE PRISON CELLS 31. SCHOOL OPEN CORRIDORS 32. OFFICES LESS THAN 60 M^2 33. INSIDE GARBAGE ROOMS 34. INSIDE TYPICAL FLOOR ELECTRICAL ROOMS 35. INSIDE TYPICAL FLOOR TELEPHONE ROOM	i. Emergency Lighting Luminaire is NOT mandatory.

6.0 Design, Installation, Inspection and Maintenance of Exit Signs and Directional Signs

6.1. Design/Specification and Submittals

6.1.1. Design, Specifications and Submittals to General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain is permitted to consultant's responsibility. Consultant shall have competent and personnel to understand the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain requirements and carry their jobs in accordance with permits and procedures followed.

6.1.2. Design submittals shall be complete with appropriate selection lighting system, design calculations showing the spacing criteria from manufacturer, lumen output and spacing software printouts, location of emergency lighting units and layouts.

6.1.3. Consultant proposal shall comply with manufacturer's specifications and this chapter

6.2. Installation

6.2.1. Installation of Emergency Lighting Systems shall be carried out only by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted and licensed contractors. General contractors, MEP Contractors, Electrical contractors, BMS Contractors, Home automation Contractors, Fit out contractors shall not be allowed to install Emergency Lighting Systems.

6.2.2. Installation contractor qualification and approval from General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain is based on their training from respective system manufacturers, experience, understanding of codes and standards and workmanship.

6.2.3. Installation contractors shall apply to General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain and secure passing marks in General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain examination to permit the license and be qualified as "approved Emergency Lighting Systems contractors".

6.2.4. Installation contractor shall not commence work on site without receiving General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain stamped and approved drawings from the Consultant.

6.2.5. It is contractor's responsibility to adhere to consultant's General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain approved drawings, Manufacturer's installation guidelines and specifications along with the requirements of this chapter.

6.3. Inspection and Acceptance

6.3.1. Inspection and acceptance shall be main consultant's responsibility

6.3.2. Main consultant shall inspect contractor work during installations and ensure that Emergency Lighting locations and actual lux available on floor is as per approved drawings and calculations.

6.3.3. Consultant shall handover system inspection report, maintenance manuals to the owner.

6.4. Inspection and Maintenance

6.4.1. The building owner, his appointed representative and the facility management shall be responsible to ensure that the Emergency lighting system is inspected regularly and maintained to ensure its good working condition.

7.0 Emergency Lighting Systems Acceptance Test

7.1. The emergency lighting systems shall be tested as per **Table: - C.04-T7**. for acceptance.

Table C.04-T7: Acceptance Test for Emergency Lighting

ITEMS	REQUIREMENTS
1. LOCATION	i. Verify the number and locations of emergency lighting luminaire as per permitted drawings. ii. Ensure all the locations required by **Table: - C.04-T1.** are implemented on site.
2. TRANSFER AND LOAD	i. Upon completion of the installation, the system shall be tested to ensure conformity with the requirements of this chapter, **NFPA 70, NFPA 110 and NFPA 111** with respect to both power output and function. ii. With the batteries fully charged and with a connected load bank at rated value, a normal power failure shall be initiated by opening all switches or breakers supplying the normal power to that load. iii. For an emergency load that is not normally energized, the breakers to the monitored circuit that energizes the emergency load shall be opened. iv. The time delay between initiation of the power failure and the energizing of the load shall be observed and recorded. v. The voltage and current supplied to the emergency load and, where applicable, the frequency, waveform, and transients shall be recorded. vi. The load test shall be continued for 15 minutes and the following shall be observed and recorded: a. Voltage and current to the load b. Voltage and current of the battery bank c. Where applicable, the frequency vii. The normal power shall be restored to the monitored circuit. viii. The transfer time shall be observed. ix. Immediately following the test the system shall be connected to the normal power for 24 hours.
3. LUX	i. The emergency illumination available at floor level, at the centerline of exit routes and open spaces shall be measured. ii. The initial lux shall not be less than an average of 10.8 lux, and at any point not less than 1.1 lux, measured at floor level along the egress path, or 1 m width of center line of this egress path. iii. The lux shall permit to decline to not less than 0.65 at the end of 3 Hours at any point, measured at floor level along the egress path, or 1 m width of center line of this egress path. iv. Lux shall not be less than 0.5 at open spaces.
4. BATTERY ROOM	i. For central battery emergency lighting systems, battery room ventilation, proper storage arrangement shall be verified.
5. SELF-TEST	i. The self-diagnostic test shall be conducted through the control unit or computer and recorded.
6. HANDING OVER	i. Operating, Inspection, Maintenance and Battery usage manuals along with approved drawings shall be handed over to the owner of the building from the consultant. ii. Inspection report signed by Consultant, Contractors and Owner's representatives. iii. General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain NOC and completion certificates shall be handed over to the owner.

8.0 Inspection and Maintenance of Emergency / Exit Lighting

8.1. The emergency lighting systems shall be inspected as per **Table: - C.04-T8**.

Table:- C.04-T8: Inspection and Maintenance

ITEMS	REQUIREMENTS
1. MONTHLY	i. Functional test shall be conducted every month for 30 seconds of simulation of mains failure. ii. For central battery and monitored type emergency lighting systems, self-diagnostic "walk-through" test shall be conducted through control unit or computer and ensure that circuit integrity, battery and charger health and luminaire output are satisfactory. iii. Luminaire output, battery and charger health, circuit integrity etc. shall be recorded. iv. The battery and associated charger/control equipment shall be checked to verify that they are in a clean and satisfactory condition and that no exceptional environmental or other conditions exist that could damage or affect performance. v. Battery electrolyte levels shall be checked, where applicable, and refilled as necessary. vi. Terminals and intercell connectors shall be cleaned and greased, if necessary, and cell tops shall be cleaned. vii. Individual cell voltages shall be checked and recorded where practical. viii. The specific gravity of pilot cells shall be checked and recorded, where applicable. ix. The conditions of the plates and sediment of free-electrolyte, lead–acid batteries in transparent containers shall be noted. x. All indicator lamps, meters, and controls shall be checked to verify that they are operating correctly. xi. The load value shall be checked to ensure that it is within the equipment rating.
2. ANNUALLY	i. A Duration test shall be conducted annually for minimum of 3 hours. ii. The battery shall be discharged fully for 3 hours and availability of lux shall be verified. iii. System shall be put back to normal charging condition after 3 hours of Duration test. iv. The lux level shall not decline to not less than 0.65 at the end of 3 Hours, at any point, measured at floor level along the egress path, or 1 m width of center line of this egress path.

9.0 Emergency / Exit Lighting Material Test Standards and Approval.

9.1. Acceptable Test Standards and Criteria

9.1.1. All the Luminaires, Batteries, Fixtures, Materials, Systems, Assemblies, fittings, equipment, Products and Accessories, referred to in this chapter shall be Listed, Permitted and Registered by the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain.

9.1.2. There is no year of edition mentioned against any test standards. It is the intent of General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain to convey to the customers seeking laboratory tests and the test laboratories to follow the "LATEST EDITION OF THE TEST STANDARD, AS AND WHEN THEY ARE UPGRADED/REVISED /AMENDED, TO THE DATE."

9.1.3. Self-Contained Emergency Lighting Units

i. EN 60598-2-22, Emergency lighting luminaire
ii. ANSI/UL 924, Standard for Emergency Lighting and Power Equipment.

9.1.4. Monitored Type Emergency Lighting System

i. EN 60598-2-22, Emergency lighting luminaire
ii. EN 62034, Automatic Test Systems for Emergency Lighting and Power Equipment
iii. ANSI/UL 924, Standard for Emergency Lighting and Power Equipment.

9.1.5. Central Battery Emergency Lighting Systems

i. EN 50171, EN 50272-2, EN 50172 Standards for Central Battery Systems
ii. EN 60598-2-22, Emergency lighting luminaire
iii. EN 62034, Automatic Test Systems for Emergency Lighting and Power Equipment
iv. ANSI/UL 924, Standard for Emergency Lighting and Power Equipment.

9.1.6. Emergency Lighting Luminaires

i. EN 60598-2-22, Emergency lighting luminaire
ii. EN 60598-1, Emergency Lights, general requirements and tests

9.1.7. Exit Signs

i. ISO 7010, Standard for Exit pictographs
ii. BS 5499-1, Standard for Escape route signing
iii. ISO 3864-1, Standard for Fire Safety Signs, Safety Colors (Graphical Symbols)
iv. ANSI/UL 924, Standard for Emergency Lighting and Power Equipment.

9.1.8. Tactile Signs

i. UL 924, Standard for Emergency Lighting and Power Equipment

9.1.9. Fire rated Cable, Certified for 120 minutes

I. EN 50200, Method of test for resistance to fire of unprotected small cables for use in emergency circuits
II. UL 2196, Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control, and Data Cables
III. BS 8434-2, Methods of test for assessment of the fire integrity of electric cables. Test for unprotected small cables for use in emergency circuits. BS EN 50200 with a 930° flame and with water spray.
IV. BS 7629-1, Electric cables. Specification for 300/500 V fire resistant screened cables having low emission of smoke and corrosive gases when affected by fire. Multicore and multi pair cables.
V. BS 6387, Test method for resistance to fire of cables required to maintain circuit integrity under fire conditions.
VI. IEC 60331-1, Tests for electric cables under fire conditions.
VII. IEC 60331-2, Tests for electric cables under fire conditions.
VIII. IEC 60332-2-2, Tests on electric and optical fiber cables under fire conditions.
IX. IEC 60332-3-10, Tests on electric and optical fiber cables under fire conditions.
X. IEC 60331-2, Tests for electric cables under fire conditions.
XI. UL 1724, Outline of Investigation for Fire Tests for Electrical Circuit Protective Systems.



Chapter 5

Exit Signs

Chapter 5



Exit Signs

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1.0 SCOPE

1.1. This code provides general information on Exit signs and markings. To provide clear and visible exit signs and directional marking in a facility to enable people to find exits swiftly and easily during emergencies.

1.2. Standardize the exit signs, directional signs, and emergency evacuation plans.

1.3. Specifications of Exit Signs and Directional Markings.

1.4. Exit location and directional markings.

1.5. Definition of various types of Signage.

1.6. Standard Format of Emergency Evacuation plans.

2. DEFINITIONS

2.1. General

2.1.1. Shall
It is a mandatory requirement from General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain.

2.1.2. Should
It is a suggested requirement recommended by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain but not mandatory.

2.1.3. Listed
Permitted and registered by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain.

2.1.4. Lux
The SI unit of illumination equal to a luminous flux of 1 lumen per square meter.
1 lux = 0.0929 foot-candle

2.2. Types of Signage and Exit

2.2.1. Exit Sign
An Exit Sign is a visual marking with text and pictorial sign in a facility denoting the Identification of an exit in case of fire or other emergency.

2.2.2. Exit Directional Sign (Directional Marking)
A Directional Exit Sign is a visual marking with text and a pictorial sign in a facility denoting the direction and route to reach the closest emergency exit in case of fire or other emergency.

2.2.3. Tactile Sign
Tactile signing is a common means of communication used by people with both a sight and hearing impairment, which is based on a standard system of deaf manual signs.

2.2.4. Photo luminescent Sign

Signs made up of photo luminescent material where luminescence (visible light) results from the absorption of light or infrared or ultraviolet radiation.

2.2.5. Illumination

The intensity of light falling on a surface, the luminous flux incident per unit area, expressed in lumens per unit of area Intensity of a lighted surface.

2.2.6. Means of Egress

A continuous and unobstructed way of traveling from any point in a building or structure to a public way consisting of three separate and distinct parts: (1) the exit access, (2) the exit, and (3) the exit discharge.

2.2.7. Dead End

A path that leads to No Emergency Exits.

2.2.8. Exit Access

That portion of a means of egress that leads to an exit.

2.2.9. Exit

That portion of a means of egress that is separated from all other spaces of the interior spaces of building or structure by fire resistant rated construction and opening protective as required to provide a protected way of travel from exit access to the exit discharge.

2.2.10. Exit Discharge

That portion of a means of egress between the termination of an exit and a public way.

2.2.11. Area of Refuge.

An area that is either (*1*) a story in a building where the building is protected throughout by an approved, supervised automatic sprinkler system and has not less than two accessible rooms or spaces separated from each other by smoke-resisting partitions; or (*2*) a space located in a path of travel leading to a public way that is protected from the effects of fire, either by means of separation from other spaces in the same building or by virtue of location, thereby permitting a delay in egress travel from any level.

3. Exit Signs

3.1. Intention

3.1.1. **A**ll exits and exit routes in a facility must be identified and marked with visible and tactile signs to enable people to find their way out during fire emergencies.

3.1.2. Such exit signs and directional marking sizes, locations and maximum distance of signs shall be specified as per this chapter.

3.2. General

3.2.1. In all buildings, except for Single Family Dwelling, every exit on every floor shall be clearly indicated by an exit sign placed over the exit door. Such signs shall be placed so as to be clearly visible at all times.

3.2.2 The route to such emergency exit shall be identified with directional signs to indicate the path and direction to exits.

3.2.3. Exit signs are required to be illuminated either internally or externally while the building has normal electrical power and the building is occupied.

3.2.4 The Exit sign must be illuminated and clearly visible at all times the building is occupied.

3.2.5 During loss of power in the building, the exit signs shall be illuminated using building emergency power or building emergency lighting or Signs shall be Photo luminescent where upon loss of power, the signs are re- illuminated and clearly visible.

3.2.6. The requirements of this chapter are minimum guidelines. It is consultant's responsibility to refer to the international codes, standards and General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain signage practices that this chapter is based on, for clear understanding of signage requirements, visibility of signage, location of signage, illumination of signage etc.

3.2.7. Codes, Standards and documents referred for this chapter are **NFPA 101, NFPA 110, NFPA 111, NFPA 170, NFPA 70, ISO 3864.**

3.3. Exit Sign and Directional Sign Specifications

3.3.1. The exit Sign and Directional marking specification shall be as per **Table:- C.05-T1.**

Table:- C.05-T1: Specifications of Exit Signs and Directional Markings

ITEMS	REQUIREMENTS
1. EXIT SIGN	**1. SIZE OF LETTERS** i. Exit Signs shall read "EXIT" in English and Arabic in plainly legible letters. ii. Letters shall not be less than 150 mm (6") in height and principal strokes of letters not less than 19 mm (3/4") wide. Width of each letter shall not be less than 51 mm, proportionally. iii. Minimum spacing between letters shall be not less than 9.5 mm (3/8") iv. Signs using larger sizes than mentioned in **Table:- C.05-T1.1.1.ii**., shall use letter widths, strokes and spacing in proportion to their height. **2. SIZE OF RUNNING MAN** i. The image of Running man towards the exit door shall not be less than 150 mm (6") in height. ii. Minimum spacing between the running man image and EXIT letter shall not be less than 9.5 mm (3/8"). iii. The running man shall be heading towards an open door in the image. **3. COLOURS** i. Letter "EXIT" shall be in matte White colour on Green background. ii. The "RUNNING MAN TOWARDS AN OPEN DOOR" shall be in Green colour on



Figure:- C.05-F1.: EXIT SIGN

Table:- C.05-T1: Specifications of Exit Signs and Directional Markings

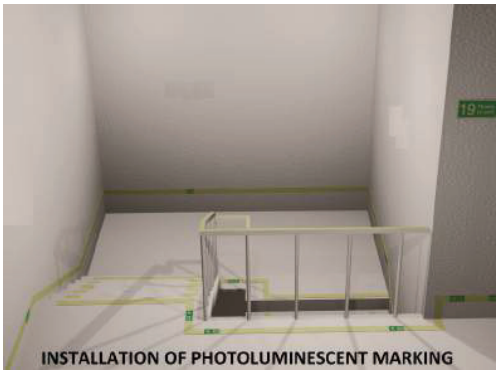
ITEMS	REQUIREMENTS
2. DIRECTIONAL EXIT SIGN	**1. SIZE OF LETTERS** i. Exit Signs shall read "EXIT" in English and Arabic in plainly legible letters. ii. Letters shall not be less than 150 mm (6") in height and principal strokes of letters not less than 19 mm (3/4") wide. Width of each letter shall not be less than 51 mm, proportionally. iii. Minimum spacing between letters shall be not less than 9.5 mm (3/8") iv. Signs using larger sizes than mentioned in **Table:- C.05-T1.2.1.ii**., shall use letter widths, strokes and spacing in proportion to their height. **2. SIZE OF DIRECTIONAL ARROW** i. The directional "arrow" indicator shall be located outside of the EXIT letters, not less than 9.5 mm (3/8") from any letter. ii. The directional "arrow" indicator s hall be of a chevron type. iii. The directional indicator shall be identifiable as a directional indicator at a distance of 12 m. iv. A directional arrow larger than the minimum established for compliance with as per **Table:- C.05-T1. 2.2.iii**., shall be proportionately increased in height, width, and stroke. v. The directional indicator shall be located at the end of the sign for the direction indicated. **3. SIZE OF RUNNING MAN** i. The image of Running man towards the exit door shall not be less than 150 mm (6") in height. ii. Minimum spacing between the running man image and EXIT letter shall not be less than 9.5 mm (3/8"). iii. The direction of running man's posture shall be towards the same direction as the directional "arrow" mark. iv. The running man shall be heading towards an open door in the image. **4. COLOURS** i. Letter "EXIT" shall be in matte White colour on Green background. ii. Directional "ARROW" shall be in White colour on Green background. iii. The "RUNNING MAN TOWARDS AN OPEN DOOR" shall be in Green colour on White, open door background.



Figure:- C.05-F2.: DIRECTIONAL EXIT SIGN

Table:- C.05-T1: Specifications of Exit Signs and Directional Markings

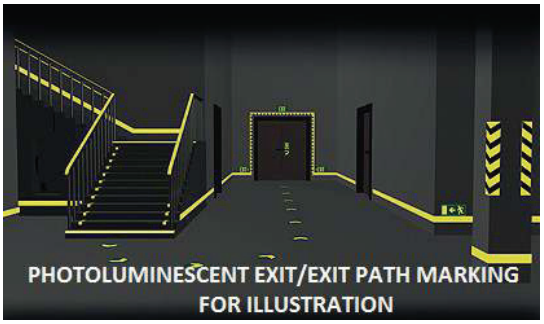
ITEMS	REQUIREMENTS
3. TACTILE SIGNS	i. Tactile signage shall comply with ICC/ANSI A117.1, American National Standard for Accessible and Usable Buildings and Facilities. ii. Refer to **Section A, Chapter 04. Accessibility, Table:- A.04-T4.2 Signs.**
4. PHOTOLUMINISCENT SIGNS AND STRIPS	i. The face of a Photoluminescent signs and strips shall be continually illuminated while the building is occupied. ii. Minimum of 54 lux (5 foot-candle) artificial light shall be illuminating the Photo luminescent surface during normal and emergency conditions. iii. The Photoluminescent signs and strips shall be within 3 m of such illumination source. iv. The illumination levels on the face of the Photoluminescent sign shall be in accordance with its listing. v. The charging illumination shall be a reliable light source, as per its listing. The charging light source, shall be of a type specified in the product markings. vi. Photoluminescent signs shall not be installed where continuous illumination is not available during non-emergency situations. (Photoluminescent signs need a specific minimum level of light on the face of the sign to ensure that the sign is charged for emergency operation and legibility in both the normal and Emergency modes. Additionally, the type of light source (e.g., incandescent, fluorescent, halogen, metal halide) is important. Each light source produces different types of visible and invisible light (e.g., UV) that might affect the ability of some Photo luminescent signs to charge and might also affect the amount of light output available during emergency mode.)



INSTALLATION OF PHOTOLUMINESCENT MARKING



PHOTOLUMINISCENT SIGN FOR ILLUSTRATION



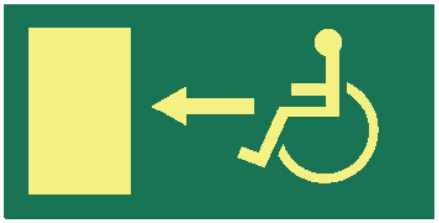
PHOTOLUMINESCENT EXIT/EXIT PATH MARKING FOR ILLUSTRATION

Table:- C.05-T1: Specifications of Exit Signs and Directional Markings

ITEMS	REQUIREMENTS
5. "NO EXIT" SIGN	i. The NO EXIT sign shall have the word NO in letters 51 mm (2") high, with a stroke width of 9.5 mm (3/8"), and the word EXIT in letters 25 mm (1") high, with the word EXIT below the word NO.
6. EVACUATION ELEVATOR SIGNS	i. Elevator signage is to indicate people if they can use the evacuation elevators during fire emergencies. ii. These elevator signs are to be used in place of regular "DO NOT USE ELEVATOR DURING FIRE" signs, if and only where the elevator is designed and accepted as a means of egress component to be an evacuation elevator as per Section **A, Chapt er 3, Sub Section 4.9.** and has been incorporated in building fire strategy. iii. These signs are for indicating usage of elevators during emergencies by both General Directorate of Civil Defence (GDCD) personnel and trained facility management. iv. These evacuation elevators shall be provided with signs reading " **In the event of Fire, this elevator will be used by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain for evacuation of people.** **PROTECTED ELEVATOR** **USABLE IN EMERGENCIES**" v. The minimum height of the letters in evacuation elevator signs shall not be less than 16 mm (5/8"), posted in every evacuation elevator lobby.
7. FLOOR PROXIMITY SIGNS	i. Floor proximity Exit Sign sizes and dimensions shall comply with **Table C.05-T1.1.** ii. Floor proximity Directional Exit Sign sizes and dimensions shall comply with **Table:-C.05-T1.2.**



NO EXIT SIGN
FOR ILLUSTRATION



EXIT SIGN FOR ACCESSIBLE EXIT ROUTE



EVACUATION ELEVATOR
SIGN FOR ILLUSTRATION

Table:- C.05-T1: Specifications of Exit Signs and Directional Markings

ITEMS	REQUIREMENTS
8. EVACUATION PLAN DIAGRAM	**1. GENERAL** i. Floor evacuation plans/diagrams reflecting the actual floor arrangement, exit locations AND DIRECTIONAL ARROWS TO SUCH EMERGENCY EXITS shall be posted. (Evacuation Plans are informational signs used to advise building occupants, be they employees, residents, patients, or visitors, of the best route(s) to egress the building. It is a pictorial representation of the building/floor layout showing the closest EXIT routes from a given point in the building.) **2. RESPONSIBILITY** i. Preparation of evacuation plans shall be consultant's responsibility. Final evacuation plans in compliance to this section, shall be fixed on each floor in the building. ii. Maintaining the evacuation plan shall be the responsibility of the owner. Damaged or faded or where areas and routes are modified, owner shall upgrade evacuation plans and replace with new one as per revised floor plans. **3. CONTENT** i. Evacuation plans shall contain English language and Arabic language. ii. Evacuation plans shall only contain simple floor plans with floor number, room names, emergency exits, routes to exits, location of stairs, elevators, refuge area location (If any), location of fire extinguishers, and location of fire hose cabinets. iii. Evacuation plans should not show structural details, furniture layouts, floor tiles, ceiling tiles, interior fixtures and lighting. However, evacuation plans shall include certain distinguished landmark features in the floor which enable occupants to identify the area immediately, such as fountains, statues, atriums. iv. Evacuation plans shall clearly show "YOU ARE HERE" location and symbol. v. The entire floor plan should be shown with the primary and secondary exit routes, exit stairs, and elevators clearly identified. vi. Routes and directional arrow marks shall not show paths which are not exit routes, which pass through lockable rooms, store rooms, hazardous rooms and terminate at dead ends. vii. Evacuation plans shall show exit discharge and assembly points only if they are in that floor. viii. xi. Below the heading shall be "FLOOR NUMBER/NAME" of 15 mm high letters. xii. A legend in showing meanings of symbols used such as fire extinguishers, fire hose cabinet etc., of 10 mm high, shall be at the bottom of the evacuation plan.

Table:- C.05-T1: Specifications of Exit Signs and Directional Markings

ITEMS	REQUIREMENTS
EVACUATION PLAN DIAGRAM	4. COLOURS i. Heading, EVACUATION PLAN shall be in Black colour. ii. FLOOR NAME/FLOOR NUMBER shall be in Black colour. iii. Floor plans shall be in Grey walls on White background. iv. Exit corridors, exit routes shall be FILLED in Green colour with Dark Green directional arrows. v. Exit doors and exit stairs shall have Bold EXIT word /EXIT SIGN in Green colour. vi. "YOU ARE HERE" word and symbol shall be in Red Colour. vii. Symbols or Fire Extinguishers and Fire Hose Cabinet shall be in Red Colour. viii. Room names shall be in Black Colour. ix. Assembly point shall be in Green Colour. x. LEGEND shall be in Black Colour. 5. FORMAT i. Evacuation plans shall be in 3D Format, showing elevated walls, stairs, rooms and floor plans in 3 dimensional perspective, as shown in **Figure:- C.05-F4. Sample Evacuation plan.** ii. The symbols, letters, words, directional arrows shall be in regular 2D format. iii. Evacuation plan shall be 350 mm in height and 500 mm wide. iv. Evacuation plans shall be framed and hanged on vertical walls. v. Evacuation plans shall not be stickers stuck on curved surfaces. vi. Evacuation plans shall be colored printouts, laminated or photo-framed with glass. vii. Evacuation plans shall not be on glossy background. viii. It is highly recommended to provide Photoluminescent evacuation plans. 6. LOCATION i. The evacuation plan shall be posted where it is unobstructed, clearly visible and readable, located on vertical walls at eye level. ii. Evacuation plans shall be posted in continuously illuminated place, where 10.8 lux is the minimum illumination. iii. Evacuation plans shall be located in main circulation areas, lift lobby, main corridor. iv. Evacuation plans shall not be located inside rooms, inside stairs and in hidden pockets on circulation areas. 7. NUMBERS i. The number of evacuation plans in each floor shall be based on the complexity of the floor design. However, there shall not be less than one evacuation plan located strategically in the middle of the floor circulation area where two emergency exits/exit stairs are shown in two opposite directions on evacuation plan. ii. For buildings with more than 2 exits/exit stairs, evacuation plans shall be posted in the middle of every 2 exits/exit stairs, showing 2 exit routes in opposite directions.



Figure:- C.05-F3.: Symbols to be used in Evacuation Plans

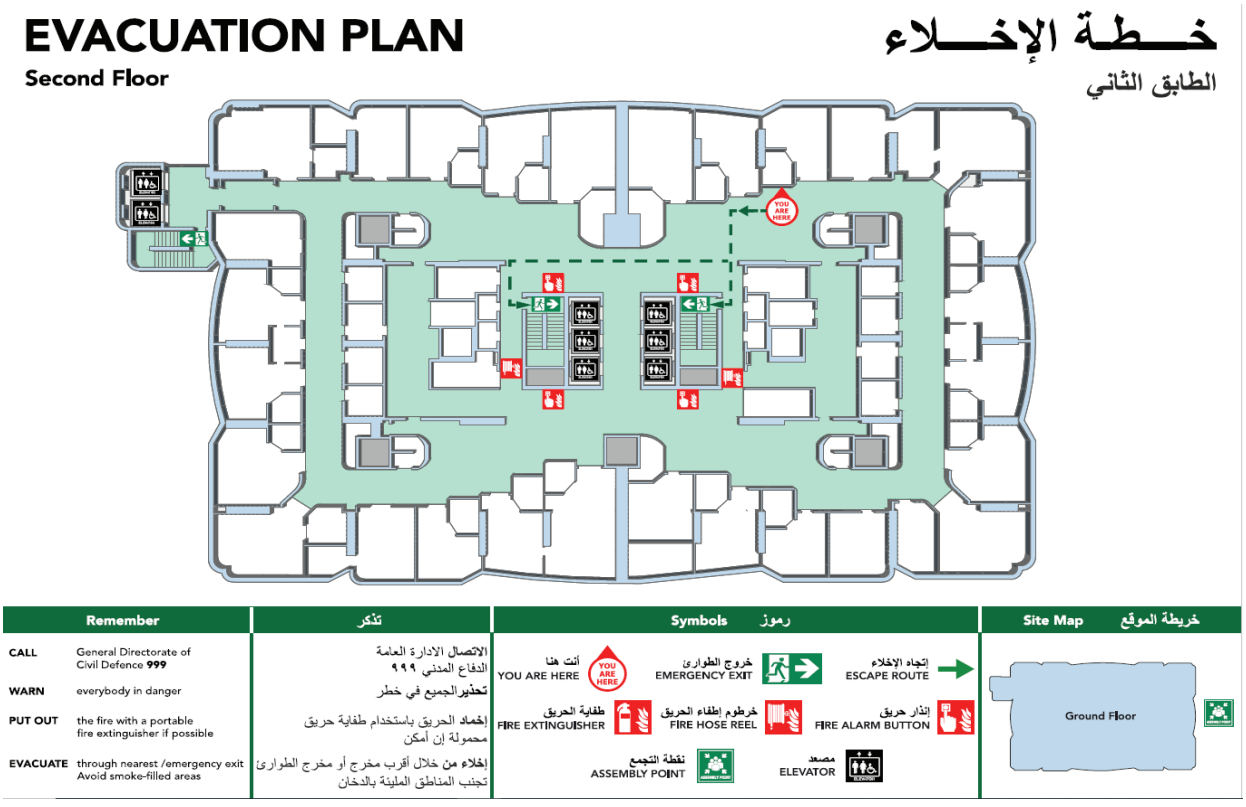


Figure:- C.05-F4.: Sample Evacuation Plan

3.4. Installation of Exit Sign and Directional Sign

3.4.1. The installation of exit Sign and Directional marking shall be installed as per **Table C.05-T2.**

Table:- C.05-T2: Installation of Exit Signs and Directional Markings

ITEMS	REQUIREMENTS
1. ILLUMINATION	**1. ILLUMINATION** i. Every sign shall be continuously illuminated. ii. Illumination of signs shall be permitted to be flash on and off upon fire alarm activation. **2. EXTERNALLY ILLUMINATED** i. Externally illuminated signs shall be illuminated by not less than 5 ft.-candles (54 lux) at the illuminated surface and shall have a contrast ratio of not less than 0.5. The viewing distance for externally illuminated Signs shall be approximately 15 m. ii. Externally illuminated signs shall be visible from 100 X H meters, where his height of the Sign board. (Approximately 15 m) **3. INTERNALLY ILLUMINATED** i. Internally illuminated exit signs and directional markings shall be approved and registered by General Directorate of Civil Defence (GDCD) for the purpose. The viewing distance for internally illuminated Signs shall be approximately 30 m. ii. Internally illuminated signs are visible from 150 X H meters, where H is the height of the Sign board. (Approximately 30 m)
2. MOUNTING	i. The bottom of Exit Sign shall be located at a vertical distance of not more than 1000 mm above the top edge of the egress opening intended for designation by that marking. ii. Exit Sign shall be located at a horizontal distance of not more than 1000 mm, as measured from the edge of the egress opening intended for designation by that marking to the nearest edge of the marking. iii. Directional Exit Sign shall be installed at a height between 3000 mm—4000 mm from the finished floor. iv. Directional Exit Signs shall be installed at every change of direction and shall be perpendicular to the direction of egress. v. Floor proximity Exit Signs and Directional Signs shall be installed such that bottom of the sign shall not be less than 150 mm but not more than 455 mm above the finished floor. vi. Where floor proximity Exit Signs and Directional Signs are required to be provided for exit door. It shall be mounted adjacent to the door within 100 mm from door frame.
3. VISIBILITY	i. Every sign required shall be located and of such size, distinctive color, and design that it is readily visible and shall provide contrast with decorations, interior finish, or other signs. ii. No decorations, furnishings, or equipment that impairs visibility of a sign shall be permitted. No brightly illuminated sign (for other than exit purposes), display, or object in or near the line of vision of the required exit sign that could detract attention from the exit sign shall be permitted.
4. DISTANCE	i. No point in exit corridor or exit access corridor shall be in excess of the rated viewing distance or 30 m, whichever is less, from nearest Exit Sign/Directional Sign/ Floor proximity Sign.

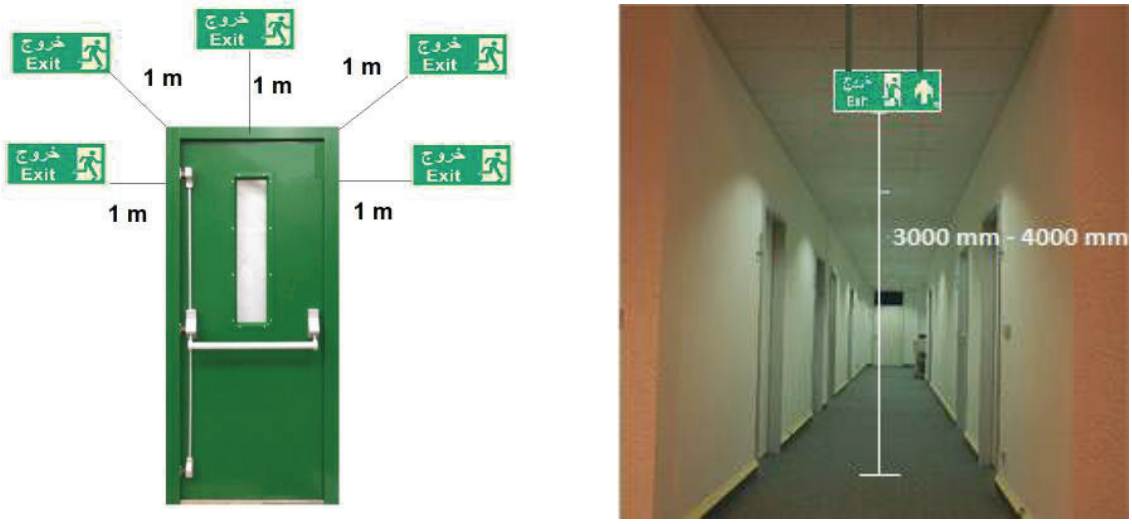


Figure:- C.05-F5.: EXIT SIGN and DIRECTIONAL EXIT SIGN MOUNTING

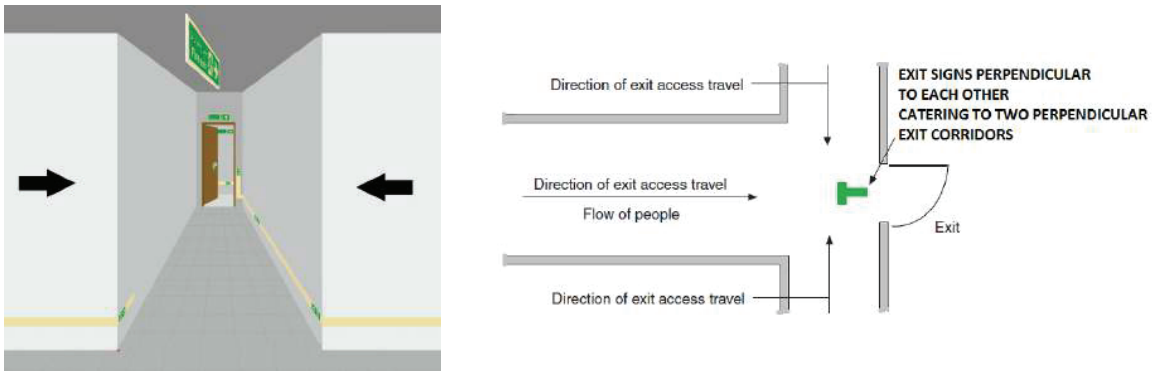


Figure:- C.05-F6.: EXIT SIGNS Mounting to cater to intersection

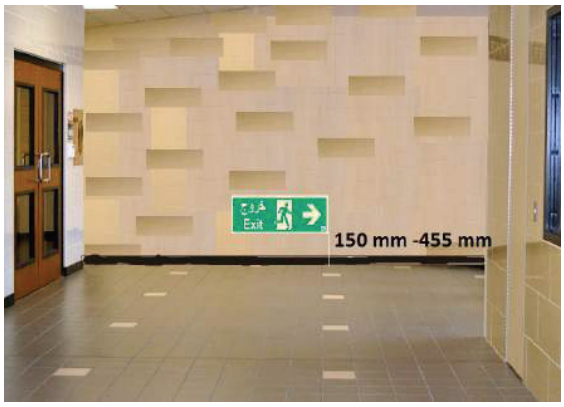


Figure:- C.05-F7.: Floor Proximity Exit Sign Mounting

4.0 Application of Exit Signs and Directional marking

4.1. The application of exit Signs and Directional marking shall be as per **Table:- C.05-T3.**

4.2. The Installation of Exit Signs, Directional Signs and Floor proximity Signs shall comply with **Table:- C.05-T2.**

Table:- C.05-T3: Application of Exit Signs and Directional Markings

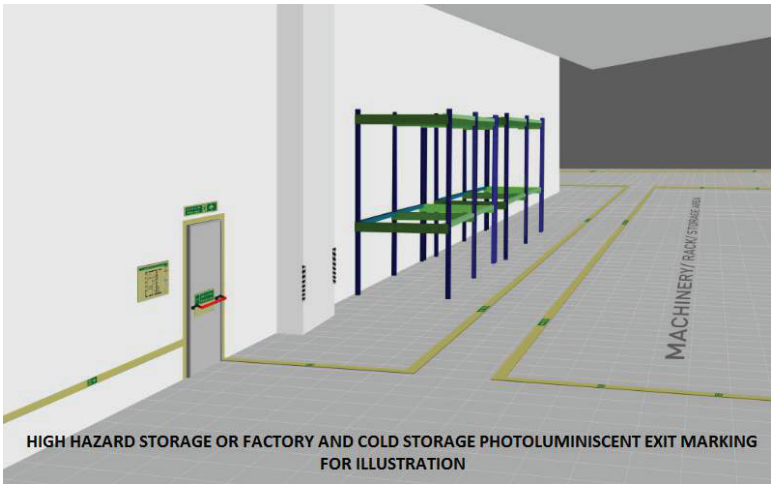
LOCATION	REQUIREMENTS
1. AT EXIT DOORS	i. Exit Doors, at exit corridors, providing exits that lead to Exit discharge or to assembly points shall be provided with Exit Signs complying to **Table:- C.05-T1.1.** ii. Doors in Horizontal Exits shall be provided with Exit Signs complying to **Table:- C.05-T1.1.** iii. Tactile Signs, in compliance with **Table:- C.05-T1.3.** shall be installed at every exit location where Exit Signs are required by **Table:- C.05-T2.** iv. Floor proximity Exit signs shall comply with **Table:- C.05-T1.7.**
2. AT EXIT STAIR	i. Exit stairs, providing exits that lead to Exit discharge or to assembly points shall be provided with Exit Signs complying to **Table:- C.05-T1.1.** ii. Tactile Signs, in compliance with **Table:- C.05-T1.3.** shall be installed at every exit location where Exit Signs are required by **Table:- C.05-T2.** iii. Floor proximity Exit signs, if provided shall comply with **Table:- C.05-T1.7.**
3. EXIT ACCESS CORRIDORS	i. The Directional Signs shall be provided in compliance with **Table:- C.05-T1.2.** ii. Floor proximity Directional signs, if provided shall comply with **Table:- C.05-T1.7.**
4. DEAD ENDS	i. NO EXIT signs shall be provided at any door, passage or stair that is neither an exit nor Way of exit access and that is located or arranged that it is likely to be mistaken for an exit. ii. NO EXIT sign shall comply with **Table:- C.05-T1.5.**
5. ELEVATORS SIGNS	i. Any elevator that qualifies as evacuation elevator as defined in **Section A, Chapter 3. Section 4.9.,** shall be provided with Evacuation Elevator Sign in compliance with **Table:- C.05-T1.6.**
6. ASSEMBLY OCC`UPANCIES	i. Exit Signs and Directional Signs shall be provided as per **Sub Section 4.** ii. All assembly occupancies shall be provided with Floor proximity Signs as per **Table:- C.05-T1.7.** iii. Tactile Signs, in compliance with **Table:- C.05-T1.3.** shall be installed at every exit. iv. Wash rooms shall be provided with Directional Signs as per **Table:- C.05-T1.2.** v. In special amusement buildings where mazes, mirrors, or other designs are used to confound the egress path, Directional exit marking in compliance with **Table:- C.05-T1.2.,** that becomes apparent in an emergency shall be provided. vi. All amusement parks, indoor rides, theme parks, play areas shall be provided with Photoluminescent Exit Marking strips per **Table:- C.05-T1.4.** vii. Night Clubs and Discos shall be provided with Photoluminescent Exit Marking strips per **Table:- C.05-T1.4.** viii. Theaters and Cinemas shall be provided with Photoluminescent Exit Marking strips as per **Table:- C.05-T1.4.** ix. Evacuation Plan shall be provided in each floor and at multiple locations as per **Table:- C.05-T1.8.**

Table:- C.05-T3: Application of Exit Signs and Directional Markings

LOCATION	REQUIREMENTS
7. BUSINESS OCCUPANCIES	i. Exit Signs and Directional Signs shall be provided as per **Sub Section 4.** ii. Evacuation Plan shall be provided in each floor and at multiple locations as per Table**:- C.05-T1.8.** iii. Evacuation plans shall not be required inside individual tenant spaces which are open plan offices and main exit is visible.
8. EDUCATIONAL	i. Exit Signs and Directional Signs shall be provided as per Sub Section 4. ii. Nurseries shall be provided with Photoluminescent Exit Marking strips as per **Table:- C.05-T1. 4.** iii. Auditoriums shall be provided with Photoluminescent Exit Marking strips as per **Table:- C.05-T1. 4.** iv. Evacuation Plan shall be provided in each floor and at multiple locations as per Table:- C.05-T1.8.
9. HEALTHCARE OCCUPANCIES	i. Exit Signs and Directional Signs shall be provided as per **Sub Section 4. .** ii. Tactile Signs, in compliance with **Table:- C.05-T 1.3.** shall be installed at every exit. iii. Patient rooms shall not be required to be provided with Exit Signs. iv. Evacuation Plan shall be provided in each floor and at multiple locations as per **Table:- C.05-T1.8.**
10. RESIDENTIAL OCCUPANCIES	i. Exit Signs and Directional Signs shall be provided at exit passageways and corridors as per **Sub Section 4.** ii. Residential apartments and dwelling units shall not be required to be provided with exit signs. iii. Evacuation Plan shall be provided in each floor and at multiple locations as per **Table:- C.05-T1.8.**
11. HOTEL	i. Exit Signs and Directional Signs shall be provided as per **Sub Section 4.** ii. Tactile Signs, in compliance with **Table:- C.05-T1.3.** shall be installed at every exit iii. All hotel occupancies shall be provided with Floor proximity Signs as per **Table:- C.05-T1.7.** iv. Guest rooms shall not be required to be provided with exit signs. v. Evacuation Plan shall be provided in each floor, in each guest room and at multiple locations as per **Table:- C.05-T1.8.**
12. DAY CARE OCCUPANCIES	i. Exit Signs and Directional Signs shall be provided as per **Sub Section 4.** ii. Evacuation Plan shall be provided in each floor and at multiple locations as per **Table:- C.05-T1.8.**
13. DETENTION AND CORRECTIONAL OCCUPANCIES	i. Exit Signs shall not be required in dwelling cell areas. ii. General public areas, offices and areas accessible to general public shall be provided with Exit Signs and Directional Signs as per **Sub Section 4.** iii. Tactile Signs, in compliance with **Table:- C.05-T1.3.** shall be installed at every exit iv. Evacuation Plan shall be provided in each floor and at multiple locations as per **Table:- C.05-T1.8.**
14. MERCANTILE OCCUPANCIES	i. Exit Signs and Directional Signs shall be provided as per **Sub Section 4.** ii. Directional Signs as per **Table:- C.05-T1.2.** shall be provided for aisles and rack areas where exit is not directly visible. iii. Evacuation Plan shall be provided in each floor and at multiple locations as per **Table:- C.05-T1.8.**

Table:- C.05-T3: Application of Exit Signs and Directional Markings

LOCATION	REQUIREMENTS
15. STORAGE AND INDUSTRIAL OCCUPANCIES	i. Exit Signs and Directional Signs shall be provided as per **Sub Section 4.** ii. High hazard areas (GROUP A-1 and GROUP A-2), Robotic storage and cold storage areas, industrial basements, Cable spread areas, shall be provided with Photoluminescent Exit Marking strips as per **Table:- C.05-T1. 4.** iii. Evacuation Plan shall be provided in each floor and at multiple locations as per **Table:- C.05-T1.8.**
16. MALLS	i. Exit Signs and Directional Signs shall be provided as per **Sub Section 4.** ii. Tactile Signs, in compliance with **Table:- C.05-T1.3.** shall be installed at every exit. iii. Play areas, Food courts and Cinema areas shall be provided with Photo luminescent Exit Marking strips as per **Table:- C.05-T1. 4.** iv. Evacuation Plan shall be provided in each floor and at multiple locations as per **Table:- C.05-T1.8.** v. Evacuation plans shall not be required at individual tenants.
17. PARKING	i. Exit Signs and Directional Signs shall be provided as per **Sub Section 4.** ii. The vehicle exit route Signs shall be clearly distinguishable in size, in colour and in format from Exit Signs and Directional Signs as required by this chapter. iii. Robotic/Mechanical parking shall be provided with Photoluminescent Exit Marking strips on access walkways as per **Table:- C.05-T1.4.** iv. Evacuation Plan shall be provided in each floor and at multiple locations as per **Table:- C.05-T1.8.**
18. PRIVATE VILLA	i. Exit Signs are not required, unless usage has changed and converted into another occupancy.
19. COMMERCIAL VILLA	i. Exit Signs are not required, unless usage has changed and converted into another occupancy.
20. FUEL DISPENSING STATION	i. Exit signs are not necessary unless the buildings have facilities with more than one storey.



HIGH HAZARD STORAGE OR FACTORY AND COLD STORAGE PHOTOLUMINISCENT EXIT MARKING FOR ILLUSTRATION

5.0 Design, Installation, Inspection and Maintenance

5.1. Design/Specification and Submittals

5.1.1. Design, Specifications and Submittals to General Directorate of Civil Defence (GDCD for approval shall be main consultant's responsibility. Consultant shall have competent and knowledgeable personnel to understand the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain requirements and codes and standards.

5.1.2. Design submittals shall be complete with appropriate Exit Sign and Directional Signs shown on the layouts.

5.1.3. Consultant shall prepare Evacuation Plans in compliance with this chapter.

5.2. Installation

5.2.1. Installation of Exit Signs and Directional Signs shall be carried out by the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain approved contractors under supervision of Consultant.

5.2.2. Installation of Evacuation Plans shall be carried out by the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain approved contractors under supervision of Consultant.

5.2.3. Installation contractor shall not commence work on site without receiving General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain stamped and permitted drawings from the Consultant.

5.2.4. It is contractor's responsibility to adhere to consultant's General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted Drawings and Manufacturer's installation guidelines and specifications.

5.2.5. Consultant shall ensure that all Exit Signs and Directional Signs are installed appropriately and where continuous illumination is available.

5.3. Inspection and Acceptance

5.3.1. Inspection and acceptance shall be main consultant's responsibility.

5.3.2. Main consultant shall inspect contractor work during installations and ensure that Exit Signs and Directional Signs are accurate and convey directions to exits as per site conditions.

5.3.3. Consultant shall verify Evacuation Plans location fixed by the contractors.

5.4. Inspection and Maintenance

5.4.1. The building owner, his appointed representative and the facility management shall be responsible to ensure that all the Exit Signs, Directional Signs and Evacuation Plans are free of damage, wear and tear and in visible location, in compliance with this chapter.

5.4.2. Every 30 days, owner appointed facility management shall verify visually for operation of Illumination sources.

5.4.3. Exit signs and Directional Signs connected to, or provided with, a battery-operated emergency illumination source, shall be tested and maintained in accordance with **Section C, Chapter 04.**

6.0 Exit Sign Material Test Standards and Approval.

6.1. Acceptable Test Standards and criteria

6.1.1. All the Signage Materials, Systems, Assemblies, Products and Accessories, referred to in this chapter shall be Listed, Permitted and Registered by the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain.

6.1.2. There is no year of edition mentioned against any test standards. It is the intent of General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain to convey to the customers seeking laboratory tests and the test laboratories to follow the "LATEST EDITION OF THE TEST STANDARD, AS AND WHEN THEY ARE UPGRADED/REVISED/AMENDED, TO THE DATE."

6.1.3. Exit Signs

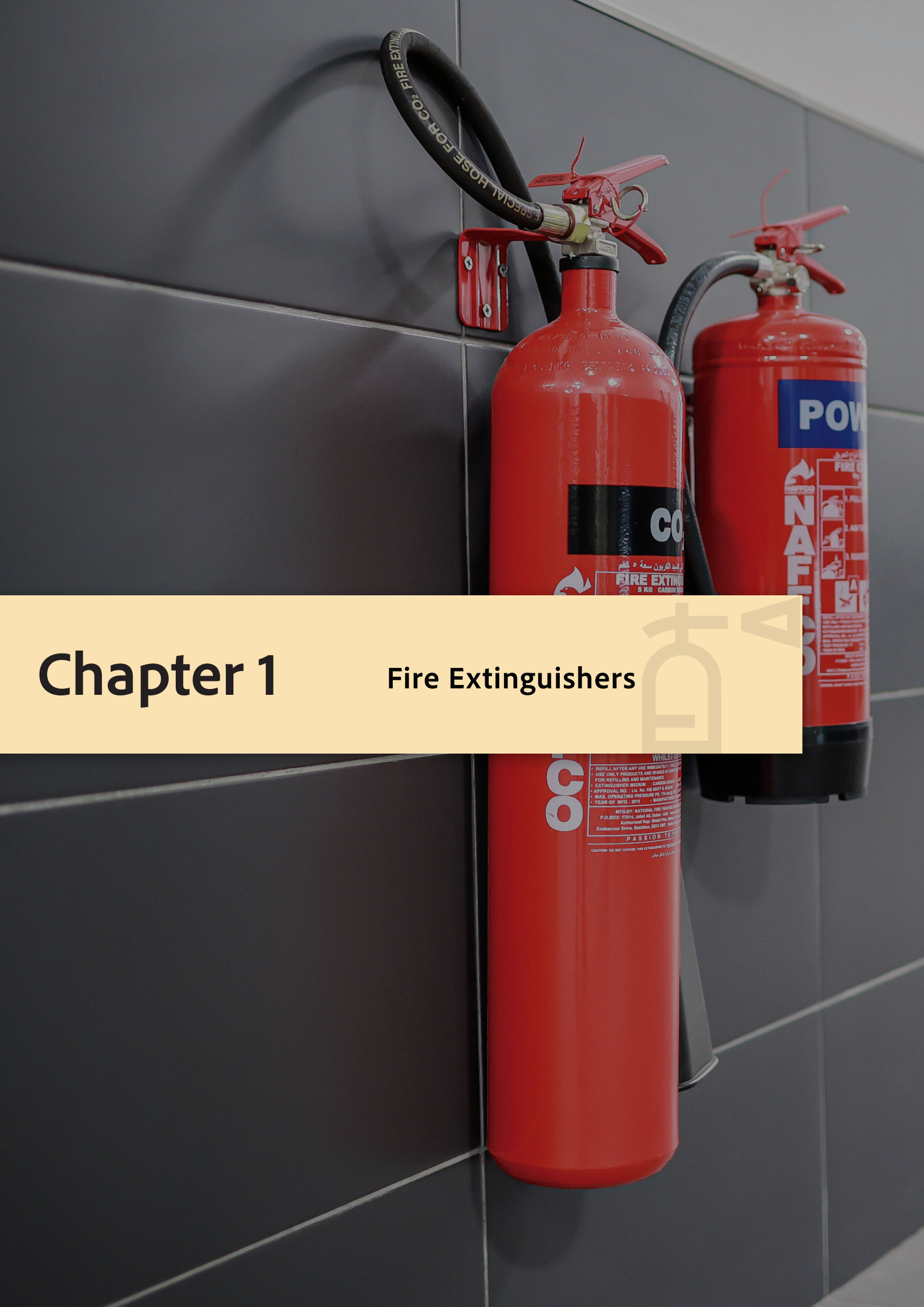
i. ANSI/UL 924, Standard for Emergency Lighting and Power Equipment.
ii. BS ISO 3864, Standard for Fire Safety Signs
iii. BS 5499-1, Standard for Exit Signs

6.1.4. Tactile Signs

i. UL 924, Standard for Emergency Lighting and Power Equipment.
ii. ICC – International Code Council

6.1.5. Photoluminescent Signs

i. UL 1994, Standard for Luminous Egress Path Marking Systems.



Chapter 1

Fire Extinguishers

Section D

Chapter

D4 Fire Extinguishers



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1.0 SCOPE

1.1 This code provides general information on portable extinguishers, including selection, performance requirements, design, installation, approvals, listing and maintenance.

1.2 To familiarize end users of various types of Fire Extinguishers

1.3 To enable designers and owners to choose extinguishers appropriately according to the hazard

1.4 To regulate the inspection and maintenance of Fire Extinguishers.

1.5 Definition of various types of fire extinguishers

1.6 Classes of Fires and applicable categories of fire extinguishers

2.0 Definitions

2.1. General

2.1.1. Shall

It is a mandatory requirement from General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain.

2.1.2. Should

It is a recommendation from the General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain, but not mandatory.

2.1.3. Listed

Permitted and registered by the General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain.

2.1.4. Unit of Measurement

The Unit of Measurement in this code are international system of units. (SI).

- 1 U.S. gal = 3.785 L.,
- 1 inch =25.4 mm
- 1 ft = 0.305 m
- 1 lb (mass) = 0.454 kg.
- 1 psi = 0.0689 bar
- (32°F − 32) × 5/9 =0°C

2.2. Classifications of Fire

2.2.1. Class A Fire

Fires in ordinary combustible materials, such as wood, cloth, paper, rubber, and many plastics.

2.2.2. Class B Fire

Fires in flammable liquids, combustible liquids, petroleum greases, tars, oils, oil-based paints, solvents, lacquers, alcohols, and flammable gases.

2.2.3. Class C Fire

Fires that involve energized electrical equipment

2.2.4. Class D Fire

Fires in combustible metals, such as magnesium, titanium, zirconium, sodium, lithium, and potassium

2.2.5. Class K Fire

Fires in cooking appliances that involve combustible cooking media (vegetable or animal oils and fats)

2.3. Hazard Classifications

2.3.1. Light (Low) Hazard

Light hazard occupancies are locations where the total amount of Class A combustible materials, including furnishings, decorations, and contents, is of minor quantity. This can include some buildings or rooms occupied as offices, classrooms, churches, assembly halls, guest room areas of hotels/motels, and so forth. This classification anticipates that the majority of content items are either noncombustible or so arranged that a fire is not likely to spread rapidly. Small amounts of Class B flammables used for duplicating machines, art departments, and so forth, are included, provided that they are kept in closed containers and safely stored.

2.3.2. Ordinary (Moderate) Hazard

Ordinary hazard occupancies are locations where the total amount of Class A combustibles and Class B flammables are present in greater amounts than expected under light (low) hazard occupancies. These occupancies could consist of dining areas, mercantile shops and allied storage, light manufacturing, research operations, auto showrooms, parking garages, workshop or support service areas, and warehouses containing Class I or Class II commodities as defined in Fire Fighting Systems, Definitions.

2.3.3. Extra (High) Hazard

Extra hazard occupancies are locations where the total amount of Class A combustibles and Class B flammables present, in storage, production, use, finished product, or combination thereof, is over and above those expected in occupancies classed as ordinary (moderate) hazard. These occupancies could consist of woodworking; vehicle repair; aircraft and boat servicing; cooking areas; individual product display showrooms; product convention center displays; and storage and manufacturing processes such as painting, dipping, and coating, including flammable liquid handling. Also included is warehousing of or in-process storage of other than Class I and Class II commodities.

2.4. Types of Fire Extinguishing Mediums

2.4.1. Carbon Dioxide

A colorless, odorless, electrically nonconductive inert gas that is a suitable medium for extinguishing Class B and Class C fires.

2.4.2. Dry Chemical

A mixture of finely divided solid particles, usually sodium bicarbonate-, potassium bicarbonate-, or ammonium phosphate–based with added particulate material supplemented by special treatment to provide resistance to packing, and moisture absorption (caking), and to promote proper flow characteristics.

2.4.3. Wet Chemical

Wet chemicals include, but are not limited to, solutions of water and potassium acetate, potassium carbonate, potassium citrate, or any combinations thereof

2.4.4. Dry Powder

Solid materials in powder or granular form are designed to extinguish Class D combustible metal fires by crusting, smothering, or heat-transferring means.

2.4.5. Film Forming Foam

The film-forming foam agents referenced in this standard are AFFF (aqueous film-forming foam) and FFFP (film-forming fluoroprotein foam).

2.4.6. Halocarbon Agents

Halocarbon agents include hydrochlorofluorocarbon (HCFC), hydrofluorocarbon (HFC) perfluorocarbon (PFC), and fluoroiodocarbon (FIC) types of agents.

2.5. Cylinders

2.5.1. High Pressure Cylinder

For the purposes of this standard, high-pressure cylinders (and cartridges) are those containing nitrogen, compressed air, carbon dioxide, or other gases at a pressure higher than 500 psi (3447 kPa) at 70°F (21°C).

2.5.2. Low Pressure Cylinder

For the purposes of this standard, low-pressure cylinders are those containing a fire extinguishing agent (medium), nitrogen, compressed air, or other compressed gases at a service pressure of 500 psi (3447 kPa) or lower at 70°F (21°C).

2.6. Extinguisher Types

2.6.1. Portable Fire Extinguisher

Portable fire extinguishers are intended as a first line of defense to cope with fires of limited size. They are needed even if the property is equipped with automatic sprinklers, standpipes and hoses, or other fixed protection equipment.

A portable device, carried or on wheels and operated by hand, containing an extinguishing agent that can be expelled under pressure for the purpose of suppressing or extinguishing fire.

2.6.2. Wheeled Type Extinguisher

A portable fire extinguisher equipped with a carriage and wheels is intended to be transported to the fire by one person.

2.6.3. Cartridge-operated Fire Extinguisher

A fire extinguisher in which the expellant gas is in a separate container from the agent storage container.

2.6.4. Rechargeable Extinguisher

A rechargeable (refillable) fire extinguisher is capable of undergoing complete maintenance, including internal inspection of the pressure vessel, changing the extinguishing agent, replacement of all substandard parts and seals, which for some kinds of fire extinguishers also require replacing the expellant and hydrostatic testing.

2.6.5. General Use Residential Extinguisher

A fire extinguisher that has been specifically investigated, tested, and listed for use only in and around the home (one- and two-family dwellings and living units within multifamily structures) for the purpose of suppressing or extinguishing a fire.

2.6.6. Self-Expellant Fire Extinguisher

A fire extinguisher in which the agents have sufficient vapor pressure at normal operating temperatures to expel themselves

2.7. Servicing

2.7.1. Consists of at least one of the following:

- Hydrostatic testing,
- Refilling, and
- Maintenance.

2.7.2. Service and Test Pressure

Service pressure is the standard operating pressure that a fire extinguisher's cylinder or nameplate will indicate. Test pressure is used to test a shell when it is being manufactured. The nameplate displays this pressure.

3.0 Fire Extinguishers

3.1. Intention

3.1.1. Portable fire extinguishers are the best available first response to tackle the fire at its incipient stage. The intention of this chapter is to provide a guideline about the types of extinguishers applicable to various types of fires.

3.1.2. However, the usage of fire extinguishers shall be limited to informed and trained personnel. Any fire can grow into a catastrophe within minutes. It is not the intention of General Directorate of Civil Defence nor recommendation for people to stay within fire vicinity to fight fires with portable extinguishers, unless the fire is “on” a manageable scale and the person using the extinguisher is trained.

3.2. Basic Awareness

3.2.1. The following are the basic steps necessary to put a fire extinguisher into operation:

a. Recognition of equipment as a fire extinguisher
b. Selection and suitability of a fire extinguisher
c. Transport of a fire extinguisher to the fire
d. Actuation of the fire extinguisher
e. Application of the extinguishing agent to the fire

3.2.2. When a fire extinguisher is being selected, the following physical conditions should be considered.

3.2.2.1. Gross Weight.

In the selection of a fire extinguisher, the physical ability of the user should be considered. When the hazard exceeds the capability of a hand portable fire extinguisher, wheeled fire extinguishers or fixed systems should be considered.

3.2.2.2. Corrosion.

In some fire extinguisher installations, there exists a possibility of exposing the fire extinguisher to a corrosive atmosphere. Where this is the case, consideration should be given to providing the fire extinguishers so exposed with proper protection or providing fire extinguishers that have been found suitable for use in these conditions.

3.2.2.3. Agent Response.

The possibility of adverse reactions, contamination, or other effects of an extinguishing agent on either manufacturing processes or on equipment or both, should be considered in the selection of a fire extinguisher.

3.2.2.4. Wheeled Units.

Where wheeled fire extinguishers are used, consideration should be given to the mobility of the fire extinguisher within the area in which it will be used. For outdoor locations, the use of proper rubber-tired or wide-rimmed wheel designs should be considered according to terrain. For indoor locations, the size of doorways and passages should be large enough to permit the ready passage of the fire extinguisher.

3.2.2.5. Wind and Draft.

If the hazard is subject to winds or drafts, the use of fire extinguishers and agents with sufficient range to overcome these conditions should be considered.

3.2.2.6. Availability of Personnel.

Consideration should be given to the number of persons available to operate the fire extinguishers, the degree of training provided, and the physical capability of the operators.

3.2.3. Extinguishers should be kept near a door that can be used as an escape route.

3.2.4. Stay low. Avoid breathing the heated smoke, vapors, or fumes as much as possible, as well as the extinguishing agents.

3.2.5. If you feel confident in attacking the fire, use the appropriate fire-fighting equipment. If the fire is not extinguished quickly, get out of the building, closing the door(s) behind you, and do not re-enter until the facility management handles the incident and General Directorate of Civil Defence personnel evaluate the situation.

3.2.6. A fire creates conditions of stress and intense tension. Under these conditions, the choice of the correct fire extinguisher needs to be made quickly. The protection planner/Facility Management/Authorized First Responder can help to ensure selection of the correct fire extinguisher by using the following procedures:

a. Locating the fire extinguisher near fire hazards for which they are suitable.
b. Using fire extinguishers suitable for more than one class of fire
c. Clearly indicating the intended use.
d. Training employees in the proper use of fire extinguishers.

3.2.7. The use of conspicuous markings to readily identify a fire extinguisher's suitability is particularly important where fire extinguishers are grouped or where multiple fire hazards are present in an area.

3.2.8. Obsolete Extinguishers

3.2.8.1. The following types of extinguishers are considered obsolete and shall be removed from service and replaced:

a. Soda acid types
b. Chemical foam (excluding film-forming agents)
c. Carbon tetrachloride, methyl bromide and chlorobromomethane(CBM)
d. Cartridge-operated water
e. Cartridge-operated loaded stream
f. Copper or brass shell fire extinguishers (excluding pump tanks) joined by soft solder or rivets
g. Carbon dioxide extinguishers with metal horns
h. Extinguishers rated prior to 1955 and marked B-1, C-1 on the name- plate
i. Fire extinguishers not listed or labeled
j. Halon 1211 and Halon 1301 Agents
k. Vaporizing liquid

3.2.9. Training

3.2.9.1. At least 10 % of the security personnel, occupiers, employees and Supervisory personnel of each occupancy shall be trained on basic fire awareness, types, use and operation of fire extinguishers in emergency situations.

3.2.9.2. The training shall be conducted by an authorized agency by the General Directorate of Civil Defence or by the General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain department personnel.

3.3. General Requirements

3.3.1. The General requirements of Fire Extinguisher shall be as per **Table:- D.01-T1**

Table:- D.01-T1 : General Requirements of Fire Extinguishers

ITEMS	REQUIREMENTS
1. EXTINGUISHER RATING	**THE RATING CRITERIA ARE AS FOLLOWS, PER THE TEST LABORATORIES:** i. Class **A** Rating. Tested on Woods ii. Class **B** Rating. Tested on 5.1 cm depth n-heptane fires in square pans. iii. **Class C** Rating. No fire test. Agent must be a nonconductor of electricity iv. **Class D** Rating. Special tests on specific combustible metal fires v. **Class K** Rating. Special tests on cooking appliances using combustible cooking media (vegetable or animal oils and fats)
2. EXTINGUISHER CLASSIFICATION	i. The classification of fire extinguishers shall consist of a letter that indicates the class of fire on which a fire extinguisher has been found to be effective, preceded by a rating number (Class A and Class B only) that indicates the relative extinguishing effectiveness. ii. Fire extinguishers classified for use on Class C, Class D, or Class K hazards shall not be required to have a number preceding the classification letter. **1. LABELING** i. An extinguisher labeling for example (UL Listed), "2-A:10-B:C" conveys the following information. a. Class A fire Extinguisher to be rated on the basis of tests for rating class 1-A through 6-A shall be subjected to the appropriate wood crib and wood panel test fires. Class A extinguishers for rating class 10-A or higher shall be rated on the basis of appropriate wood crib test fires only. b. Class B extinguisher to be rated on the basis of flammable liquid fire test, pan size & heptane used for testing. Indoor fire test rating from 1-B to 20-B. outdoor fire test from rating 30-B to 640-B. c. Extinguisher is also applicable to Class C fires and is non-conductive (Usually there are no numbers against C) ii. An extinguisher labeling for example (LPCB/ Kitemark Permitted), **"34-A: 183-B**" conveys the following information. a. 34-A denotes the extinguisher is capable of extinguishing Class A fire with minimum fire rating duration of 12 seconds. b. 183-B denotes the extinguisher is capable of extinguishing Class B fire with minimum fire rating duration of 15 seconds.

Table:- D.01-T1: General Requirements of Fire Extinguishers	
ITEMS	**REQUIREMENTS**
3. PLANNING	**THE FOLLOWING ITEMS SHOULD BE EVALUATED BEFORE SELECTING, INSTALLATION AND DISTRIBUTING PORTABLE FIRE EXTINGUISHERS IN A BUILDING:** i. Area and arrangement of the building occupancy conditions ii. Severity of the hazard iii. Anticipated classes of fire iv. Other protective systems or devices v. Distances to be traveled to reach fire extinguishers vi. Anticipated rate of fire spread vii. Intensity and rate of heat development viii. Smoke contributed by the burning materials ix. Accessibility of a fire to close approach with portable fire extinguishers
4. INSTALLATION	i. Portable fire extinguishers shall be maintained in a fully charged and operable condition and shall be kept in their designated places at all times when they are not being used. ii. Fire extinguishers shall be conspicuously located where they will be readily accessible and immediately available in the event of fire. Preferably, they shall be located along normal paths of travel, including exits from areas. iii. Before installing any fire-extinguishing equipment, read and understand the installation and use instructions, including the limitations, cautions, and warnings contained on the equipment and in the owner's manual. iv. Portable extinguishers shall be installed in an accessible spot, free from blocking by storage and equipment, and near room exits that provide an escape route. So that the top of the extinguisher is not more than 1.5 m above the floor and not less than 30 cm from the bottom of extinguisher to the finished floor. v. The extinguisher should be easy to reach and remove and should be placed where it will not be damaged. vi. Portable extinguishers shall be installed on hangers or in the brackets supplied by the manufacturer, mounted in cabinets, or placed on shelves. vii. Extinguishers shall be placed so that the operating instructions on the extinguisher face outward. viii. Fire extinguishers shall not be installed / placed in any areas where the temperatures outside of the listed temperature range shown on the fire extinguisher label. Generally the fire extinguishers are permitted to be installed in the areas where temperatures ranging from 4°C to 49°C. ix. Fire extinguishers cabinets shall not be kept locked in any case with in the facility. While installation, all the fire extinguishers shall be fully charged and ready for use in case of an emergency.



Figure:- D.01-F1:- Symbols for Fire Extinguisher

Table:- D.01-T1: General Requirements of Fire Extinguishers	
ITEMS	
5. SAFETY PRECAUTIONS	i. Most fires produce toxic decomposition products of combustion, and some materials can produce highly toxic gases. Fires can also consume available oxygen or produce dangerously high exposure to convicted or radiated heat. All of these can affect the degree to which a fire can be safely approached with extinguishing equipment. ii. Discharging portable fire extinguishers from too close a distance on cooking grease fires can cause splashing of the burning grease or oil and spread the fire. The recommended distance for operating portable fire extinguishers is shown on the label. iii. Portable fire extinguishers should not be installed adjacent to the location of a potential fire hazard but should be accessible to the hazard. iv. Halogenated agent extinguisher labels contain information such as the minimum volume of room that can be properly and safely protected. v. When using these extinguishers, avoid breathing the discharged agent or the gases produced by the thermal decomposition of the agent. vi. Evacuate and ventilate the area immediately after use. vii. Carbon dioxide fire extinguishers contain an extinguishing agent that will not support life when used in sufficient concentration to extinguish a fire. The use of a carbon dioxide extinguisher(s) in an unventilated space can dilute the oxygen supply. Prolonged occupancy of such spaces can result in loss of consciousness due to oxygen deficiency. viii. Extinguishers not classified for Class C hazards present a shock hazard if used on fires involving energized electrical equipment. ix. Dry chemical extinguishers, when used in a small unventilated area, can reduce visibility for a period of up to several minutes. x. For confined spaces, prominent caution labels on the fire extinguisher, warning signs at entry points, provision for remote application, extra-long-range fire extinguisher nozzles, special ventilation, provision of breathing apparatus and other personal protective equipment, and adequate training of personnel are among the measures that should be considered.
6. OPERATION AND USE	**1. GENERAL** i. Persons who are expected to use a fire extinguisher should be made familiar with all information contained in the manufacturer's nameplate(s) and the instruction manual. ii. Proper operation of a fire extinguisher requires the operator to execute several basic steps in a certain sequence. The fire extinguisher designer, the permitted agencies, the installer, and the protection planner can influence significantly the ease and likelihood of these steps being accomplished properly. iii. Where employees have not been trained, operation of fire extinguishers could be seriously delayed, the extinguishing material could be wasted due to poor iv. Application techniques, and more fire extinguishers could have to be used, or the fire could possibly not be extinguished.

Table:- D.01-T1: General Requirements of Fire Extinguishers	
ITEMS	**REQUIREMENTS**
6. OPERATION AND USE	**2. RECOGNITION OF EQUIPMENT AS AN EXTINGUISHER** i. Permanent marking on the front of fire extinguishers shall be present, indicating their purpose, content and usage. . ii. Additional signage, not a part of the device, shall be provided to indicate the location of a fire extinguisher. These preferably should be standardized throughout the property so that all fire extinguishers are easily "spotted." These markings could be in the form of electric lights, placards, mounting boards, overhead signs, colour panels or stripes, or cabinets. iii. If fire extinguishers are located along the normal exit paths from an area, personnel are more inclined to take them and return to the site of a fire. **3. TRANSPORT OF A FIRE EXTINGUISHER TO THE FIRE** i. A fire extinguisher should be mounted and located so it can be easily removed in a fire emergency and brought to the site of the fire as quickly as possible. It should be readily accessible without need for moving or climbing over stock, materials or equipment. ii. Quick transport of an extinguisher depends on several factors such as weight of the extinguisher, travel distance to fire location, using stairs, using gloves, congestion of premises, physical ability of the user. Preplanning shall address all these issues to successful and efficient use of fire extinguishers. iii. In the case of wheeled fire extinguishers, the width of aisles and doorways and the nature of the flooring and outside grounds over which the fire extinguisher needs to be moved should be taken into account. **4. USAGE OF FIRE EXTINGUISHER** i. Once the fire extinguisher has been transported to the fire site, it should be placed into operation without delay. Employees should be familiar with any steps needed to actuate any fire extinguisher. Here is where previous training is most valuable, since there is little time to stop and read operating instructions on the nameplate. ii. **Position for Operation.** The intended position for operation is usually marked on the fire extinguisher. When the position of operation is obvious (such as when one hand holds the fire extinguisher and the other hand holds the nozzle), this information can be omitted. iii. **Removal of Restraining or Locking Devices**. Many fire extinguishers have an operation safeguard or locking device that prevents accidental actuation. The most common device is a lock pin or ring pin that needs to be withdrawn before operation. iv. **Start of Discharge**. This requires one or more of several actions such as turning or squeezing a valve handle or lever, pushing a lever, or pumping. v. **Agent Application.** This act involves direction of the stream of extinguishing agent onto the fire. Nameplate information has advisory notes regarding the application of the agent to different types of fires. vi. Remember the "PASS" word.

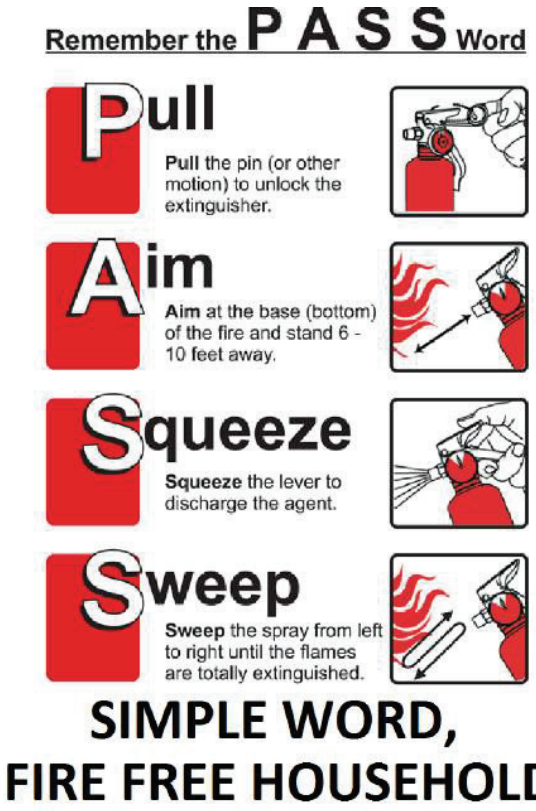







Figure:- D.04-F2: Fire Extinguisher Signage for various locations

3.4. Types and Selection of Fire Extinguishers

Table:- D.01-T2a : Types and Selection of Fire Extinguishers	
ITEMS	**REQUIREMENTS**
1. WATER TYPE	**1. DESCRIPTION** i. The most popular type is the 6 Liters stored-pressure water fire extinguisher. These fire extinguishers are being used to replace inverting types of water fire extinguishers (soda acid and cartridge-operated water) that are no longer manufactured. An important advantage of the stored-pressure water type, as opposed to inverting types, is its ability to be discharged intermittently. Some models are suitable for use at freezing conditions when charged as specified on the nameplate. ii. Water, antifreeze, a wetting agent, and loaded stream fire extinguishers are all included in this. The primary purpose of these fire extinguishers is to put out Class A fires. Initially, the stream should be pointed toward the flames' base. It should be directed widely towards smoldering or incandescent surfaces once the flames have been extinguished. Applying should start as near to the flames as feasible. In order to completely extinguish a deep-seated fire, it may be necessary to "break apart" the fire and soak it completely. iii. Fire extinguishers of these types are usually available in hand portable models of 6L & 9L .These fire extinguishers having minimum fire ratings of 13A to 21A; 70B to 233 B and IV B respectively. **2. APPLICATION** i. Class A fires., The materials include wood, paper, textiles, furniture, household plastic, and interior décor. **3. NOT SUITABLE FOR** i. Class B fires. Flammable Liquids. ii. Class C fires., Electrical equipment, Office equipment, Computers. iii. Class K Fires, Cooking fires, Kitchen, grease, oil fires.
 WATER TYPE EXTINGUISHER FOR ILLUSTRATION	

Table:- D.01-T2b : Types and Selection of Fire Extinguishers

ITEMS	REQUIREMENTS
2. FOAM TYPE	**1. DESCRIPTION** i. AFFF (aqueous film-forming foam) and FFFP (film-forming fluoroprotein)-type fire extinguishers are rated for use on both Class A and Class B fires. They are not suitable for use in freezing temperatures. An advantage of this type of extinguisher when used on Class B flammable liquid fires of appreciable depth is the ability of the agent to float on and secure the liquid surface, which helps to prevent reignition. ii. Fire extinguishers of these types are usually available in hand portable models of 3L(0.79gln) to 9L(2.37gln) and in wheeled models 50L(13.2gln) ,100L(26.42gln) & 135L(35.67gln).These fire extinguishers having minimum fire ratings of 8A to 34A; 70B to 233 B and IV B respectively. iii. The extinguishing agent is a solution of film-forming surfactant in water that forms mechanical foam when discharged through an aspirating nozzle. On Class A fires, the agent acts as both a coolant and penetrant to reduce temperatures to below the ignition level. On Class B fires, the agent acts as a barrier to exclude air or oxygen from the fuel surface. iv. On flammable liquid fires of appreciable depth, best results are obtained when the discharge from the fire extinguisher is played against the inside of the back wall of the vat or tank just above the burning surface to permit the natural spread of the agent back over the burning liquid. If this cannot be done, the operator should stand far enough away from the fire to allow the agent to fall lightly upon the burning surface — the stream should not be directed into the burning liquid. Where possible, the operator should walk around the fire while directing the stream to get maximum coverage during the discharge period. v. For fires in ordinary combustible materials, the agent can be used to coat the burning surface directly. For flammable-liquid spill fires, the agent could be flowed over a burning surface by bouncing it off the floor just in front of the burning area. vi. Film-forming foam agents are not effective on flammable liquids and gases escaping under pressure or cooking-grease fires. **2. APPLICATION** i. Class A fires., The materials include wood, paper, textiles, furniture, household plastic, and interior décor. ii. Class B fires., Flammable Liquids. **3. NOT SUITABLE FOR** i. Class C fires., Electrical equipment, Office equipment, Computers. ii. Below 4°C ambient temperatures



FOAM TYPE EXTINGUISHER FOR ILLUSTRATION

Table:- D.01-T2c : Types and Selection of Fire Extinguishers

ITEMS	REQUIREMENTS
3. CO2 TYPE	**1. CARBON DIOXIDE (CO2)** i. The principal advantage of CO2 (carbon dioxide) fire extinguishers is that the agent does not leave a residue after use. This can be a significant factor where protection is needed for delicate and costly electronic equipment. ii. Carbon dioxide extinguishers are listed for use on a Class B and Class C fire. Since the agent is discharged in the form of a gas/snow cloud. iii. Thus, initial application needs to start reasonably close to the fire. On all fires, the discharge should be directed at the base of the flames. The discharge should be applied to the burning surface even after the flames are extinguished to allow added time for cooling and to prevent possible reflash. iv. The most commonly used method of agent application on contained flammable liquid fires is to start at the near edge and direct the discharge in a slow, side-to-side sweeping motion, gradually progressing toward the back of the fire. The other method is called overhead application. The discharge horn is directed in a dagger or downward position (at an angle of about 45 degrees) toward the center of the burning area. Generally, the horn is not moved, as in the other method, because the discharge stream enters the fire from above and spreads out in all directions over the burning surface. For spill fires, the side-to-side sweeping motion could give better. v. On fires involving electrical equipment, discharge should be directed at the source of the flames. It is important to de-energize the equipment as soon as possible to eliminate the potential of reignition. These agents are not suitable for use on pressurized fuel fires or cooking-grease fires. vi. Fire extinguishers of these types are usually available in hand portable models of 5LBS to 20LBS, 2kg to 5kg and in wheeled models 10kg & 30kg. These fire extinguishers having minimum fire ratings of 5B: C to 10B: C, 34B to 70B respectively. Please refer **NFPA 10 & BSEN Standards** **2. APPLICATION** i. Class C fires., Electric equipment, office equipment, computers, printing ma-Chines, copy machines. ii. Class B fires. Flammable Liquids. **3. NOT SUITABLE FOR** i. Water soluble flammable liquids such as alcohol, acetone, esters, ketones.
	 CO2 TYPE EXTINGUISHER FOR ILLUSTRATION

Table:- D.01-T2d : Types and Selection of Fire Extinguishers	
ITEMS	**REQUIREMENTS**
4. DRY CHEMICAL POWDER TYPE	**1. DRY CHEMICAL POWDER** i. Due to the different designs and the various types of dry chemical agents, choosing the most suitable dry chemical fire extinguisher requires careful evaluation. ii. Hand portable models have a discharge stream that ranges from 10 ft. to 30 ft. (3 m to 9 m), depending on fire extinguisher size. Compared with carbon dioxide or halogenated agent fire extinguishers, they will also perform better under windy conditions. iii. Dry chemical fire extinguishers are available in two basic styles: stored pressure and cartridge-operated. The stored-pressure (rechargeable) type is the most widely used and is best suited where infrequent use is anticipated and where skilled personnel with professional recharge equipment are available. iv. The cartridge-operated type has the advantage of being quickly refilled in remote locations without the need for special equipment. v. Some dry chemical models can be equipped with long-range (high-velocity) nozzles or applicators that are beneficial in applying the agent under certain special fire-fighting conditions. vi. The potassium and urea-potassium base bicarbonate agents are selected in preference to sodium bicarbonate, principally because of their greater fire-extinguishing capabilities. If corrosion is not a factor, potassium chloride can also be included in this group. vii. The ammonium phosphate base agent (multipurpose) is the only dry chemical agent that is suitable for Class A protection. In addition to Class B and Class C protection, the residues of multipurpose dry chemical, when left in contact with metal surfaces, can cause corrosion. viii. Where dry chemical fire extinguishers are utilized for Class C protection, it is important to consider that the residue of potassium chloride is more corrosive than other dry chemicals and that a multipurpose base agent will be more difficult to remove because it first softens when in contact with hot surfaces and then hardens when it cools. ix. The multipurpose dry powder (ABC) shall have a minimum 85% MAP(Mono Ammonium Phosphate) content. The BC power shall have minimum 80% Potassium Bi-Carbonate or sodium bicarbonate content. x. the powder shall be UL or EN 615 compliance. xi. Stored-pressure fire extinguishers are available in capacities from 2.5 lb to 20 lb (1.13 kg to 9.07 kg) for hand fire extinguishers having minimum fire rating 1- A to 6-A and 10-B:C to 80-B:C or Capacities from 1 kg to 12 kg having fire rating from 8A to 55A and 34 B to 233B and wheeled models capacities from 25 Kg to 100Kg with fire extinguishment ratings of IIB to IVB. **2. APPLICATION** i. Class A fires., Wood, Paper, Textile, Garbage, Furniture, Residential Plastic, Interior décor. ii. Class B fires. Flammable Liquids. iii. Class C fires., Electric equipment, office equipment, computers, printing machines, copy machines. iv. Class D fires., Metal fires involving magnesium, titanium, zirconium, sodium, lithium, and potassium. **3. NOT SUITABLE FOR** i. Class rating should be strictly followed.

	 DRY POWDER EXTINGUISHER FOR ILLUSTRATION

Table:- D.01-T2e : Types and Selection of Fire Extinguishers

ITEMS	REQUIREMENTS
5. WET CHEMICAL TYPE	**1. WET CHEMICAL** i. Fire extinguishers of this type are available in hand portable models of 2L, 3L & 6L. The extinguishing agent can be comprised of, but is not limited to, solutions of water and potassium acetate, potassium carbonate, potassium citrate, or a combination of the aforementioned chemicals (which are conductors of electricity). The liquid agent typically has a pH of 9.0 or less. ii. On Class A fires, the agent works as a coolant. On Class K fires (cooking-oil fires), the agent forms a foam blanket to prevent reignition. The water content of the agent aids in cooling and reducing the temperature of the hot oils and fats below their auto ignition point. The agent, when discharged as a fine spray directly at cooking appliances, reduces the possibility of splashing hot grease and does not present a shock hazard to the operator. iii. In recent years, the development of high-efficiency cooking equipment with high-energy input rates and the widespread use of vegetable oils with high auto ignition temperatures has highlighted the need for a new Class K fire extinguisher. The wet chemical extinguisher was the first extinguisher to qualify to the new Class K requirements. IV. In addition to offering rapid fire extinguishment, a thick foam blanket is formed to prevent reignition while cooling both the appliance and the hot cooking oil. Wet chemical extinguishers also offer improved visibility during fire fighting as well as minimizing clean-up afterwards. V. Stored-pressure fire extinguishers are available in capacities from 2L to 6L for hand fire extinguishers having minimum fire rating 8A to 13 A & 5F to 75F **2. APPLICATION** i. Class A fires., Wood, Paper, Textile, Garbage, Furniture, Residential Plastic, Interior décor. ii. Class K fires., Kitchen fires, deep seated cooking, fryer oil fires. **3. NOT SUITABLE FOR** i. Class rating should be strictly followed. ii. Class B fires., Flammable Liquids. iii. Class C fires., Electric equipment, office equipment, computers, printing machines, copy machines. iv. Class D fires., Metal fires involving magnesium, titanium, zirconium, sodium, lithium, and potassium.



WET CHEMICAL EXTINGUISHER FOR ILLUSTRATION

Table:- D.01-T2f : Types and Selection of Fire Extinguishers

ITEMS	REQUIREMENTS
6. HALOCARBON (CLEAN AGENT) TYPE	**1. HALOCARBON (CLEAN AGENT)** i. Halocarbon agents are similar to halon agents in that they are nonconductive, noncorrosive, and evaporate after use, leaving no residue. ii. Larger models of halocarbon fire extinguishers are listed for Class A as well as Class B and Class C fires, which makes them quite suitable for use on fires in electronic equipment. iii. Compared to carbon dioxide on a weight-of-agent basis, halocarbon agents are at least twice as effective. When discharged, the agent is in a combined form of a gas/mist with about twice the range of carbon dioxide. To some extent, windy conditions or strong air currents could make extinguishing difficult. iv. On flammable liquid fires, best results are obtained when the discharge from the fire extinguisher is employed to sweep the flame off the burning surface, applying the discharge first at the near edge of the fire and gradually progressing toward the back of the fire by moving the discharge nozzle slowly from side to side. v. In using fire extinguishers of this type in unventilated places, such as small rooms, closets, or confined spaces, operators and other persons should avoid breathing the extinguishing agent or the gases produced by thermal decomposition. vi. Stored-pressure fire extinguishers are available in capacities from 5 lb to 15.5 lb. and 4kg to 12 kg for hand fire extinguishers having minimum fire rating 5B:C to 10B:C , 1A to 2A and 5A to 13A , 34B to 70B. **2. APPLICATION** i. Class A fires., Wood, Paper, Textile, Garbage, Furniture, Residential Plastic, Interior décor. ii. Class B fires., Flammable Liquids, excluding pressurized fuels iii. Class C fires., Electric equipment, office equipment, computers, printing machines, copy machines **3. NOT SUITABLE FOR** i. Pressurized fuels. ii. Class K fires., Cooking and grease fires. iii. Outdoors and unenclosed spaces.



HALOCARBON / CLEAN AGENT FIRE EXTINGUISHER FOR ILLUSTRATION

Table:- D.01-T2g : Types and Selection of Fire Extinguishers	
ITEMS	**REQUIREMENTS**
7. WHEELED TYPE	**1. WHEELED TYPE EXTINGUISHER** i. The selection of any type of wheeled fire extinguisher is generally associated with a recognized need to provide additional protection for special hazards or large, extra-hazard areas. ii. Where wheeled fire extinguishers are to be installed, consideration should be given to mobility within the area in which they will be used. iii. For outdoor locations, models with rubber tires or wide-rim wheels will be easier to transport. iv. For indoor locations, doorways, aisles, and corridors need to be wide enough to permit the ready passage of the fire extinguisher. v. Because of the magnitude of the fire it will generally be used on, this type of fire extinguisher should be reserved for use by operators who have actually used the equipment, who have received special instructions on the use of the equipment, or who have used the equipment in live fire training.  **WHEELED TYPE EXTINGUISHERS FOR ILLUSTRATION**
8. FIRE BLANKET	**1. FIRE BLANKLET** i. Fire blankets shall be made from 340g/m² fire resistant glass fiber fabric with silicone coating and withstand temperature up to 550°C. It is primarily intended for extinguishing cooking oil fires in the kitchen. ii. Blankets are electrical resistant not less than 1MΩ to ensure that in the event of use where live electrical equipment is concerned, the potential for an electrical shock is minimized. iii. Fire Blankets shall be of any one of the sizes; 1.1m x 1.1m , 1.2m x 1.2m , 1.2m x 1.8m. iv. Standard reference is conforming to BS EN 1869

3.5. Application of Fire Extinguishers

2.5.1. The application of Fire Extinguishers for various hazards shall be as per Table:- D.01-T3.

Table:- D.01-T3 : Application of Fire Extinguishers

HAZARD	AREA	TYPE OF EXTINGUISHERS	DISTRIBUTION
CLASS A FIRES 	**1. ASSEMBLY** i. Seating areas ii. Corridors iii. Waiting areas iv. Exit routes **2. BUSINESS** i. Office areas ii. Shops iii. Corridors iv. Exit routes **3. EDUCATIONAL** i. Corridors ii. Reception iii. Auditoriums iv. Assembly halls v. Locker rooms **4. HEALTHCARE** i. Patient rooms ii. Nurse Stations iii. Corridors iv. Waiting areas v. Exit routes **5. RESIDENTIAL** i. Apartments ii. Corridors **6. HOTEL** i. Guest Rooms ii. Corridors iii. Reception iv. Dining areas v. Exit routes **7. DAYCARE** i. Corridors ii. Reception iii. Exit routes	**i. Multi- purpose Dry Powder** **(ONE)** 4-A:60-B:C 21A 113B 4 Kg  **AND** **ii. CO2 Type** **(ONE)** 5 kg 	i. Each extinguisher of size mentioned serves approximately 280 m² of the area. ii. Maximum travel distance to such an extinguisher shall not be more than 30 m. That is from any point of the area, there shall be one extinguisher within a distance of 30 m. iii. Extinguishers shall be placed along the corridors, waiting areas, shops, supermarkets, service corridors, staff and reception areas etc., where people can easily find and use them during fire accidents. iv. As a practice fire extinguishers are placed in Fire Hose Cabinets. Such cabinets shall clearly have signage that indicates presence of extinguishers inside the Fire Hose Cabinet (FHC)

Table:- D.01-T3 : Application of Fire Extinguishers

HAZARD	AREA	TYPE OF EXTINGUISHERS	DISTRIBUTION
1. CLASS A FIRES 	**8. DETENTION AND CORRECTION** i. Corridors ii. Waiting areas iii. Assembly areas iv. Dining areas v. Exit routes **9. MERCANTILE** i. Office areas ii. Shops iii. Supermarkets iv. Retail areas v. Corridors vi. Exit routes **10. MALLS** i. Corridors ii. Information Desk iii. Service Corridor iv. Mall circulation areas v. Play areas vi. Food courts vii. Exit routes **11. STORAGE (WAREHOUSE) AND FACTORIES** i. Office areas ii. Corridors **12. ANIMAL HOUSING** i. Office areas ii. Corridors iii. Storage areas **12. FUEL DISPENSING** i. Mini Marts ii. Restaurant seating areas	**i. Multi- purpose Dry Powder (ONE)** 4-A:60-B:C 21A 113B 4 Kg  **OR** **i. Clean Agent Type (ONE)** 4 kg  **AND** **ii. CO2 Type (ONE)** 5 kg 	i. Each extinguisher of size mentioned serves approximately 280 m^2 of the area. ii. Maximum travel distance to such an extinguisher shall not be more than 30 m. That is from any point of the area, there shall be one extinguisher within a distance of 30 m. iii. Extinguishers shall be placed along the corridors, waiting areas, shops, supermarkets, service corridors, staff and reception areas etc., where people can easily find and use them during fire accidents. iv. As a practice fire extinguishers are placed in Fire Hose Cabinets. Such cabinets shall clearly have signage that indicates presence of extinguishers inside the Fire Hose Cabinet (FHC)

Table:- D.01-T3 : Application of Fire Extinguishers

HAZARD	AREA	TYPE OF EXTINGUISHERS	DISTRIBUTION
2. CLASS B FIRES 	**1. ASSEMBLY** i. Bars ii. Pubs iii. Night Clubs **2. EDUCATIONAL** i. Laboratories ii. Cleaning solvent stores **3. HEALTHCARE** i. Chemical Stores ii. Linen Stores iii. Waste Storage iv. Cleaning solvent stores **4. HOTEL** i. Chemical Stores ii. Linen Stores iii. Waste Storage iv. Cleaning solvent stores **5. MERCANTILE** i. Chemical Stores ii. Flammable liquid Stores **6. MALLS** i. Service Corridor ii. Cleaning solvent stores **7. STORAGE (WAREHOUSE) AND FACTORIES** i. Chemical Storage and activity ii. Flammable liquid Storage and activity iii. Flammable material Storage and activity	**i. Foam Type (ONE)** 9 Liters (3 Gal)  **OR** **i. Multi- purpose Dry Powder (ONE)** 4-A:60-B:C 21A 113B 4 Kg 	i. Each extinguisher of size mentioned serves approximately 280 m^2 of the area. ii. Maximum travel distance to such an extinguisher shall not be more than 15 m. That is from any point of the area, there shall be one extinguisher within a distance of 15 m. iii. Extinguishers shall be placed along the corridors, waiting areas, shops, supermarkets, service corridors, staff and reception areas etc., where people can easily find and use them during fire accidents. iv. As a practice fire extinguishers are placed in Fire Hose Cabinets. Such cabinets shall clearly have signage that indicates presence of extinguishers inside the Fire Hose Cabinet (FHC)

Table:- D.01-T3 : Application of Fire Extinguishers

HAZARD	AREA	TYPE OF EXTINGUISHERS	DISTRIBUTION
3. CLASS B FIRES 	**1. FUEL DISPENSING STATIONS** i. Petrol Filling Station **2. STORAGE (WAREHOUSE) AND FACTORIES** i. Bulk storage of flammable liquids ii. Group A Plastic storage and activity **3. DIESEL GENERATOR ROOM, DIESEL GENERATOR SET/SHED** **4. PARKING AREAS**	**i. Wheeled Type Foam (ONE)** 50 Liters (13 Gal)  **AND** **ii. Multi- purpose Dry Powder (ONE)** 4-A:60-B:C 21A 113B 4 Kg 	i. Maximum travel distance to such an extinguisher shall not be more than 15 m. That is from any point of the area, there shall be one extinguisher within a distance of 15 m. ii. Extinguishers shall be placed near the hazard in protected environment as per manufacturer's guidelines.
4. CLASS C FIRES 	**1. ELECTRICAL/LV ROOM** **2. TELEPHONE ROOM** **3. LIFT MACHINE ROOM** **4. AHU ROOM** **5. MECHANICAL PLANT ROOM** **6. CABLE SPREAD-ING ROOMS** **7. RMU ROOMS** **8. SWITCHGEAR ROOM**	**i. CO2 Type (ONE)** 5 kg  **OR** **i. Clean Agent Type (ONE)** 5 kg 	i. Maximum travel distance to such an extinguisher shall not be more than 9 m. That is from any point of the area, there shall be one extinguisher within a distance of 9 m. ii. Extinguisher shall be placed inside the room next to exit.
5. CLASS C FIRES 	**1. HV ROOM** **2. TRANSFORMER ROOM** **3. ELECTRICAL HEAVY EQUIP-MENT AND MACHINARY**	**i. Wheeled CO2 Type (ONE)** 10 Kg or 30kg	i. Maximum travel distance to such an extinguisher shall not be more than 9 m. That is from any point of the area, there shall be one extinguisher within a distance of 9 m. ii. Trolley mounted extinguisher shall be placed inside the room, next to exit.

Table:- D.01-T3 : Application of Fire Extinguishers			
HAZARD	**AREA**	**TYPE OF EXTINGUISHER**	**DISTRIBUTION**
6. CLASS K FIRES 	**1. KITCHEN, HOMES**	**i. Dry Chemical Powder (ONE)** 3-A:30-B:C 13A, 70B 	i. Extinguishers shall be placed inside kitchen next to Kitchen exit door.
7. CLASS K FIRES 	**1. COMMERCIAL KITCHENS** **2. RESTAURANT KITCHENS** **3. FOOD COURT KITCHENS**	**i. Wet Chemical Type (ONE)** 9 Liters (3 Gal) **OR** **i. CO2 Type (ONE)** 5 Kg 	i. Extinguishers shall be placed inside kitchen next to Kitchen exit door.
8. CLASS D FIRES 	**1. ACTIVITIES WHERE COMBUSTIBLE METALS SUCH AS MAGNESIUM, TITANIUM, ZIRCONIUM, SODIUM, LITHIUM, AND POTASSIUM ARE STORED AND HANDLED**	**i. Wheeled D Type (ONE)** 25 Kg 	i. Maximum travel distance to such an extinguisher shall not be more than 15 m. That is from any point of the area, there shall be one extinguisher within a distance of 15 m.
9. FIRE BLANKET	**1. KITCHEN, HOMES** **2. COMMERCIAL KITCHENS** **3. RESTAURANT KITCHENS** **4. FOOD COURT KITCHENS**	**i. Fire blanket (ONE)**	i. Fire Blanket shall be placed inside kitchen next to Kitchen exit door.

4. Design, Installation, Inspection and Maintenance of Fire Fire Extinguishers

4.1. Design/Specification and Submittals

4.1.1. Design, Specifications and Submittals to General Directorate of Civil Defence for Permitted shall be main consultants responsibility. Consultant shall have competent and knowledgeable personnel to understand the General Directorate of Civil Defence requirements and codes and standards.

4.1.2. Design submittals shall be complete with appropriate selection of fire extinguishers, location on layouts as per maximum travel distances and table of number of fire extinguishers, in compliance with this code.

4.2. Installation

4.2.1. Installation of Fire Extinguishers shall be carried out only by Civil Defense permitted and licensed contractors. General contractors, Civil contractors and MEP Contractors, fit out Contractors shall not be allowed to install Fire extinguishers, unless they are licensed.

4.2.2. Fire extinguisher Installation contractor qualification and Permitted from General Directorate of Civil Defence is based on their training from respective system manufacturers, experience, understanding of codes and standards and workmanship.

4.2.3. Fire extinguisher Installation contractors shall apply to General Directorate of Civil Defence and secure passing marks in General Directorate of Civil Defence examination to gain license and be qualified as “Permitted Fire extinguisher contractors”.

4.2.4. Installation contractor shall not commence work on site without receiving General Directorate of Civil Defence stamped and permitted drawings from the Consultant.

4.2.5. It is contractor’s responsibility to adhere to consultant’s General Directorate of Civil Defence permitted drawings and Manufacturer’s installation guidelines and specifications.

4.3. Inspection and Acceptance

4.3.1. Inspection and acceptance shall be main consultant’s responsibility.

4.3.2. Main consultant shall inspect contractor work during installations and ensure that fire extinguishers are charged, installed, inspected, commissioned and performing as per the General Directorate of Civil Defence permitted drawings, manufacturer’s design and installation guidelines, acceptance criteria and their intended purpose.

4.3.3. Consultant shall handover total number, types, location of fire extinguishers, inspection report and maintenance manuals to the owner.

4.4. Inspection and Maintenance

4.4.1. The building owner, his appointed representative and the facility management shall be responsible to ensure that all the Fire Extinguishers in the facility are inspected regularly, maintained, charged and repaired to serve their intended purpose during fire accidents.

4.4.2. The inspection and maintenance of Fire Extinguishers shall be as per **Table:- D.01-T4**

4.4.3. The fire extinguishers shall be serviced and maintained once every year.
The **Table:- D.01-T4** are minimum guidelines. **NFPA 10** shall be referred for further details and maintenance requirements

Table:- D.01-T4 : Inspection and Maintenance of Fire Extinguishers

ITEM	REQUIREMENTS
1. ACCEPTANCE INSPECTION	i. The location, designated place and appropriate type/rating of extinguisher for the hazard shall be verified and ensure that it is as per consultant and General Directorate of Civil Defence permitted drawings. ii. Extinguisher shall be installed at proper height as per this chapter. iii. The extinguisher shall be free of obstruction and in compliance with maximum travel distance requirements as per this chapter. iv. Safety seals and tamper indicators shall be in place and not damaged or missing. v. Operating instructions and labels on nameplates shall be legible and facing forward and visible. vi. Extinguisher shall be fully charged, weighing correctly as per manufacturer's specification. vii. Fire extinguishers shall be free of physical damage, dents, corrosion, leakage. viii. Nozzles and spray horns shall be free of clogging. ix. Pressure gauge reading or indicator shall be in the acceptable range as per manufacturer's specifications. x. Where wheeled or trolley mount extinguishers are installed, condition of tires, wheels, carriage, hose and nozzles shall be in good working condition. xi. Visual signage, pointing at the location of extinguisher, both in Arabic and English shall be in place and visible. xii. Corrective actions shall be taken if any of the above inspections result in unacceptable conditions. xiii. A record of the acceptance test shall be maintained in the facility.
2. DAILY INSPECTIONS	i. Facility management should check daily, but not more than monthly, the location and presence of appropriate extinguisher as per hazard and ensure that extinguishers are not shuffled from their suitable locations. ii. Pressure gauge of extinguishers shall be verified to be in acceptable range.
3. MONTHLY INSPECTIONS	i. Facility management shall check monthly the location and presence of appropriate extinguisher as per hazard and ensure that extinguishers are not shuffled from their suitable locations. ii. Pressure gauge of extinguishers shall be verified to be in acceptable range. iii. Extinguishers shall be taken out from their hangers, cleaned and put back onto their hangers. iv. If any of the extinguisher is taken out for repair or recharging, a replacement extinguisher of the same type and rating shall be installed in its place.
4. ANNUAL INSPECTIONS	i. Stored-pressure types containing a loaded stream agent shall be disassembled on an annual basis and subjected to complete maintenance. Prior to disassembly, the fire extinguisher shall be fully discharged to check the operation of the discharge valve and pressure gauge. The loaded stream charge shall be permitted to be recovered and re-used, provided it is subjected to agent analysis in accordance with manufacturer's instructions. ii. A conductivity test shall be conducted annually on all carbon dioxide hose assemblies. Hose assemblies found to be nonconductive shall be replaced. Carbon dioxide hose assemblies that pass a conductivity test shall have the test information recorded on a suitable metallic label or equally durable material. iii. Pressure regulators provided with wheeled-type fire extinguishers shall be tested for outlet static pressure and flow rate in accordance with manufacturer's instructions.

Table:- D.01-T4 : Inspection and Maintenance of Fire Extinguishers	
ITEM	**REQUIREMENTS**
5. MAINTENANCE	**1. EQUIPMENT/CYLINDERS** i. Extinguishers shall be in charged condition as per manufacturer's specifications. ii. All mechanical parts shall be inspected for smooth operation. iii. Hydrostatic tests shall be conducted or extinguishers shall be replaced if there are signs of corrosion, mechanical damage, denting or abrasion. iv. Damaged threads, damaged gauges, damaged seals and locks etc. shall be replaced. v. Deformed nozzles, clogged nozzles, blocked nozzles shall be replaced/cleaned and ensured that it is in good working condition. vi. Damaged, cracked or torn hose assemblies shall be replaced. vii. Valves, gauges, pressure indicating devices shall be free of damage. if damaged, shall be replaced. viii. If puncture mechanism is damaged, dull, shall be replaced. ix. Corroded, damaged carriage for trolley type extinguishers, shall be repaired or replaced. x. Damaged, wheels, spokes, jammed wheels shall be replaced in wheel type extinguishers. xi. Damaged gaskets, "O" rings and seals shall be replaced. xii. Corroded, damaged gas tubes, siphon or pickup tube shall be replaced. **2. EXTINGUISHING AGENT** i. WATER: If improper fill level, refill. ii. FOAM: If recharge date is due, empty, clean and recharge. iii. CO2: If improper weight, recharge to proper weight. iv. DRY CHEMICAL/DRY POWDER: If agent is contaminated or caking, empty, clean and refill. If improper weight, refill to specifications. If cartridge is damaged, tampered or punctured, replace cartridge. v. WET CHEMICAL: IF improper weight, empty, clean and refill. if pressure not in acceptable range, re-pressurize.

5. Fire Extinguisher Material Test Standards and Permits.

5.1. Acceptable Test Standards and criteria

5.1.1. All the Extinguishers, Extinguishing agents, Materials, Systems, Assemblies, Hose, Pipes, nozzles and fittings, equipment, Products and Accessories, referred to in this chapter shall be Listed, Permitted and Registered by the General Directorate of Civil Defence.

5.1.2. There is no year of edition mentioned against any test standards. It is the intent of General Directorate of Civil Defence to convey to the customers seeking laboratory tests and the test laboratories to follow the "LATEST EDITION OF THE TEST STANDARD, AS AND WHEN THEY ARE UPGRADED/REVISED/AMENDED, TO THE DATE."

5.1.3. Portable Extinguisher (General)

i. ANSI/UL 711, Standard for Rating and Fire Testing of Fire Extinguishers
ii. ANSI/NFPA 10, Portable Fire Extinguishers
iii. BS EN3 Portable fire extinguishers. Characteristics, performance requirements and test methods.

5.1.4. Mobile (Wheeled/Trolley) Type Extinguisher

i. EN 1866-1, 2, 3. Mobile fire extinguishers Characteristics performance and test methods.

5.1.5. CO2 Extinguisher

i. ANSI/UL 154, Standard for Carbon Dioxide Fire Extinguishers;
ii. BS EN3 Portable fire extinguishers. Characteristics, performance requirements and test methods.
iii. EN 1866-1, Standard for Carbon Dioxide Wheeled Fire Extinguishers.
iv. EN ISO 5923, Equipment for fire protection and fire fighting. Fire extinguishing media. Carbon dioxide

5.1.6. Dry Chemical/Dry Powder Extinguisher

i. UL 299, Standard for Dry Chemical Fire Extinguishers;
ii. BS EN3 Portable fire extinguishers. Characteristics, performance requirements and test methods.
iii. EN 615, Fire protection, fire extinguishing media specifications for powder (other than class D powders)

5.1.7. Water Type Extinguisher

i. ANSI/UL 626, Standard for Water based Fire Extinguishers;
ii. BS EN3 Portable fire extinguishers. Characteristics, performance requirements and test methods.

5.1.8. Foam Type Extinguisher

i. ANSI/UL 8, Standard for Foam Fire Extinguishers.
ii. BS EN3 Portable fire extinguishers. Characteristics, performance requirements and test methods.

4.1.9. Halocarbon Type Extinguisher

i. ANSI/UL 2129, Standard for Halocarbon Agent Fire Extinguishers
ii. BS EN3 Portable fire extinguishers. Characteristics, performance requirements and test methods.

5.1.10. Fire Blankets

i. EN 1869, Standard for Fire Blanket

ii. BS 7944, Type 1 heavy duty fire blankets and type 2 heavy duty heat protective blankets.



Chapter 2

Fire pumps



Chapter 2

Fire pumps



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1.0 Scope

1.1 This standard deals with the selection and installation of pumps supplying liquid for private fire protection.

1.2 The scope of this document shall include liquid supplies; suction, discharge, and auxiliary equipment; power supplies, including power supply arrangements; electric drive and control; diesel engine drive and control; steam turbine drive and control; and acceptance tests and operation.

1.3 To familiarize end users of various types of Fire Pumps.

1.4 To enable designers and owners to choose Fire Pumps appropriately.

1.5 To regulate the inspection and maintenance of Fire Pumps.

2.0 Definitions

2.1 General

2.1.1 Shall

It is a mandatory requirement by General Directorate of Civil Defence – Kingdom of Bahrain

2.1.2 Should

It is a recommendation but it is not mandatory by General Directorate of Civil Defence – Kingdom of Bahrain.

2.1.3 Listed

Permitted and registered by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain.

2.1.4 Unit of Measurement

Unit of Measurement in this code are international system of units. (SI).

- 1 ft = 0.3048 m
- 1 m = 3.281 ft
- 1 in. = 25.4 mm
- 1 mm = 0.03937 in.
- 1 gal = 3.785 L
- 1 L = 0.2642 gal
- 1 gal = 3.785 dm^3
- 1 ft3 = 0.0283 m^3
- 1 m3 = 35.31 ft^3
- 1 psi = 6894.757 Pa
- 1 bar = 10^5 Pa
- 1 Pa = 0.000145 psi
- 1 bar = 14.5 psi
- 1 Pa = 10^{-5} bar
- 1 psi = 0.0689 bar

2.1.5 Bar (bar)

Unit of measurement for pressure. Though it is not a SI unit, it is a common practice to use this unit of measurement in fire protection.

2.1.6 US Gallons (Gal.)

Unit of measurement for volume. Though it is not a SI unit, it is a common practice to use this unit of measurement for water volume in fire protection.

2.1.7 GPM (Gallons per minute)

Unit of measurement for flow. Though it is not a SI unit, it is widely a practice to use this unit of measurement for water flow per square feet in fire protection.

2.1.8 Fire Pump Unit

An assembled unit consisting of a fire pump, driver, controller, and accessories.

2.1.9 Fire Pump

A pump that is a provider of liquid flow and pressure dedicated to fire protection.

2.1.10 Fire Pump Controller

A group of devices that serve to govern, in some predetermined manner, the starting and stopping of the fire pump driver and to monitor and signal the status and condition of the fire pump unit.

2.1.11 Engine battery

A battery used to provide sufficient electrical energy to crank the engine to achieve engine start and the necessary energy for system controls.

2.1.12 Flooded suction

The condition where water flows from an atmospheric vented source to the pump without the average pressure at the pump inlet flange dropping below atmospheric pressure with the pump operating at 150 percent of its rated capacity.

2.1.13 Head

A quantity used to express a form (or combination of forms) of the energy content of water per unit weight of the water referred to any arbitrary datum.

2.1.14 Net Positive Suction Head

The total suction head in feet (meters) of liquid absolute, determined at the suction nozzle, and referred to datum, less the vapor pressure of the liquid in feet (meters) absolute.

2.1.15 Total Head, Horizontal Pumps

The measure of the work increase, per pound (kilogram) of liquid, imparted to the liquid by the pump, and therefore the algebraic difference between the total discharge head and the total suction head. Total head, as determined on test where suction lift exists, is the sum of the total discharge head and total suction lift. Where positive suction head exists, the total head is the total discharge head minus the total suction head.

2.1.16 Total Head, Vertical Turbine Pumps

The distance from the pumping water level to the center of the discharge gauge plus the total discharge head.

2.1.17 Total Discharge Head

The reading of a pressure gauge at the discharge of the pump, converted to meters (feet) of liquid, and referred to datum, plus the velocity head at the point of gauge attachment.

2.1.18 Total Rated Head

The total head developed at rated capacity and rated speed for centrifugal pump.

2.1.19 Total Suction Head

Suction head exists where the total suction head is above atmospheric pressure. Total suction head, as determined on test, is the reading of a gauge at the suction of the pump, converted to meters (feet) of liquid, and referred to datum, plus the velocity head at the point of gauge attachment.

2.1.20 No Flow (Churn, Shutoff).

The condition of zero flow when the fire pump is running but the only water passing through the pump is a small flow that is discharged through the pump circulation relief valve or supplies the cooling for a diesel engine driver.

2.1.21 Centrifugal Pump

A pump in which the pressure is developed principally by the action of centrifugal force.

2.1.22 Centrifugal Fire Pump Capacities

gpm	lpm	gpm	lpm
25	95	1000	3785
50	189	1250	4731
100	379	1500	5677
150	568	2000	7570
200	757	2500	9462
250	946	3000	11355
300	1136	3500	13247
400	1514	4000	15140
450	1703	4500	17032
500	1892	5000	18925
750	2839		

2.1.23 Packaged Fire Pump Assembly.

Fire pump unit components assembled at a packaging facility and shipped as a unit to the installation site. The scope of listed components (where required to be listed by this standard) in a preassembled package includes the pump, driver, controller, and other accessories identified by the packager assembled onto a base with or without an enclosure.

2.1.24 Rated Flow

The capacity of the pump at rated speed and rated pressure as marked on the manufacturer's nameplate.

2.1.25 Rated Pressure

The net pressure (differential pressure) at rated flow and rated speed as marked on the manufacturer’s nameplate.

2.1.26 Service Factor

A multiplier of an ac motor that, when applied to the rated horsepower, indicates a permissible horsepower loading that can be carried at the rated voltage, frequency, and temperature. For example, the multiplier 1.15 indicates that the motor be permitted to be overloaded to 1.15 times the rated horsepower.

2.1.27 Speed

2.1.27.1 Engine speed

The speed indicated on the engine nameplate.

2.1.27.2 Motor speed

The speed indicated on the motor nameplate.

2.1.27.3 Rated speed

The speed for which the fire pump is listed and that appears on the fire pump nameplate

2.1.28 Automatic Transfer Switch

Self-acting equipment for transferring the connected load from one power source to another power source.

2.1.29 Diesel Engine

An internal combustion engine in which the fuel is ignited entirely by the heat resulting from the compression of the air supplied for combustion. The oil-diesel engine, which operates on fuel oil injected after compression is practically completed, is the type usually used as a fire pump driver.

2.1.30 Electric Motor.

A motor that is classified according to mechanical protection and methods of cooling.

2.1.31 Anti-vortex plate

Where a tank is used as the suction source for a fire pump, the discharge outlet of the tank shall be equipped with an assembly that controls vortex flow

2.2 Types of Fire Pumps

2.2.1 Horizontal Pump

A pump with the shaft normally in a horizontal position.

2.2.2 Horizontal Split-Case Pump

A centrifugal pump characterized by a housing that is split parallel to the shaft.

2.2.3 Pressure Maintenance (Jockey or Make-Up) Pump.

A pump designed to maintain the pressure on the fire protection system(s) between preset limits when the system is not flowing water.

2.2.4 Vertical Line shaft Turbine Pump

A vertical shaft centrifugal pump with rotating impeller or impellers and with discharge from the pumping element coaxial with the shaft. The pumping element is suspended by the conductor system, which encloses a system of vertical shafting used to transmit power to the impellers, the prime mover being external to the flow stream.

2.2.5 End Suction Pump

A single suction pump having its suction nozzle on the opposite side of the casing from the stuffing box and having the face of the suction nozzle perpendicular to the longitudinal axis of the shaft.

2.3 Applications of Fire Pumps

Applications of fire pump Systems discussed in this chapter are limited to the General Directorate of Civil Defence – Kingdom of Bahrain listed and permitted Systems. Any system that is not already listed or registered by General Directorate of Civil Defence – Kingdom of Bahrain is not mentioned in this Chapter.

2.3.1 Water based Fire Protection Systems

Water is the most widely used and available fire-extinguishing agent. Water is effective in fire suppression. The techniques and mechanisms using water and its heat absorbing, cooling and fire extinguishing properties to fight and extinguish fires are Water Based Fire Protection System such as,

2.3.1.1 Dry Riser System (DRS)
2.3.1.2 Wet Riser System (WRS)
2.3.1.3 Yard Hydrant System (YHS)
2.3.1.4 Fire Hose Reel/Rack System (FHS)
2.3.1.5 Automatic Sprinkler System (AS)
2.3.1.6 Pre-action Sprinkler System (YHS)
2.3.1.7 Water Spray System (WSS)
2.3.1.8 Water Mist System (WMS)
2.3.1.9 Water Deluge System (WDS)

2.3.2 Foam and Water based Fire Protection Systems

2.3.2.1 Foam Sprinkler System (FSS)
2.3.2.2 Foam Monitor System (FMS)
2.3.2.3 Foam Injection System (FIS)
2.3.2.4 Foam Deluge System (FDS)
2.3.2.5 Foam Pouring System (FPS)
2.3.2.6 Foam Hand Hose System (FHS)

3.0 Fire pumps

3.1. General requirement

The general requirements for fire pumps, pipes, fittings, fire water tanks that are components of water based fire protection system shall be as per **Table:- D.02-T1.**

Table:- D.02-T1: General Requirements of Fire Pumps

ITEMS	REQUIREMENTS
1. FIRE PUMP ASSEMBLY	i. Fire Pumps shall be restricted to a centrifugal or Horizontal Displacement, single stage and multistage pumps of Horizontal or Vertical Turbine shaft type only. ii. Fire pumps shall be dedicated to and listed for fire protection service. iii. All fire pumps, complete with driver, control panel and fuel supply shall be tested as an assembly as per Sub Section 6 of this chapter and registered and listed by General Directorate of Civil Defence. iv. The fire pump assembly, consisting of Pump, Driver, Controller, Automatic Transfer Switch and Accessories shall perform in accordance with the requirements of this Code and the manufacturer's specifications, as an entire unit when installed or when components are replaced or when repairs are performed on installed system. This “Fire Pump Unit Performance” shall be declared by a single entity as having the “Unit Responsibility”. General Directorate of Civil Defence designates the Fire Pump manufacturer as such “Unit Responsibility Holder” and the Fire pump manufacturer shall declare such unit responsibility in an undertaking and shall be submitted to General Directorate of Civil Defence as part of documentation during system commissioning and acceptance. v. The complete fire pump unit shall be field acceptance tested for proper and intended performance. vi. The net pump shutoff (churn) pressure plus the maximum static suction pressure, adjusted for elevation, shall not exceed the pressure for which the system components are rated. vii. A centrifugal fire pump shall be selected to operate at less than or equal to 150 % of the rated capacity. viii. The selection of fire pump shall be such that the pressure in the system it is serving shall not exceed 24 bar at any point, at any time with fire pump shut-off pressure not exceeding the 140% of rated operational pressure. ix. Fire Pumps shall have a permanent steel nameplate clearly showing the name, UL/FM stamp, pressure ratings, flow ratings, working temperatures etc. x. All fire pumps shall have a flooded water supply from the dedicated fire water tank. If the flooded positive supply of water to fire pumps is not possible then vertical turbine type fire pumps shall be provided. xi. During the preliminary planning and design stage of the construction, all factors that affect the fire pump suction pressure shall be determined in such a way that sufficient suction pressure is available at the pump suction flange of the End Suction Centrifugal type or Horizontal Split Case Centrifugal type pumps. These factors affecting suction pressure include, but are not limited to, the distance between the Fire Water Tank and Fire Pumps, water tank puddle flange size and elevation, suction pipe sizes, suction header size, pipe routing, type and number of fittings in the suction pipeline. Similarly, during the preliminary planning and design stage of the construction, factors affecting the submergence of the pump bowls (such as the depth of the water tank) of the Vertical shaft turbine-type pump shall be determined to ensure sufficient submergence is provided for the reliable operation of the fire pump unit. The sufficiency of the suction pressure (for End Suction Centrifugal type or Horizontal Split Case Centrifugal type pumps) or the sufficiency of the submergence (for Vertical shaft turbine-type pump) must be strictly evaluated

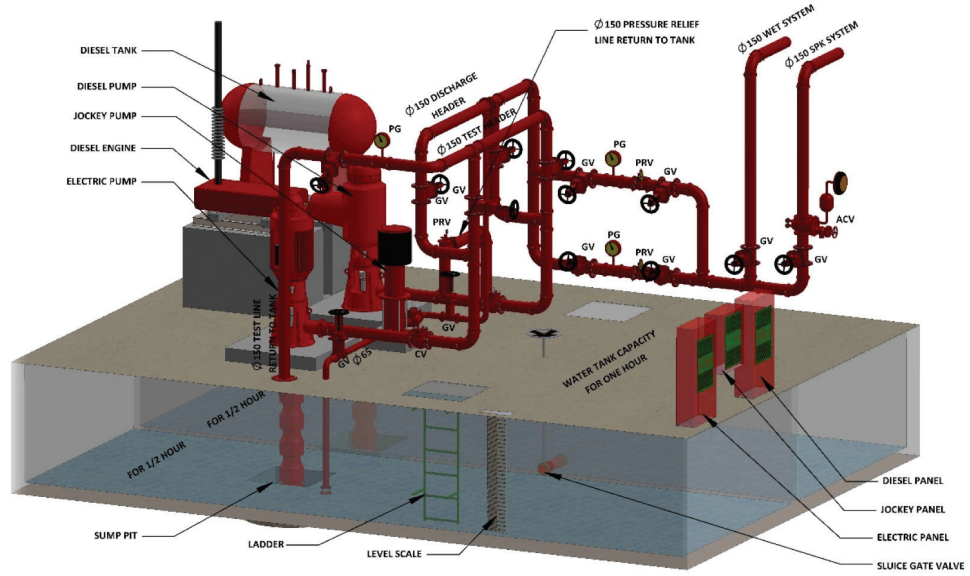
FIRE PUMP ASSEMBLY	in accordance with NFPA 20 at this initial stage itself to prevent issues in later stages. xii. The Fire Pump set provided for fire protection shall be a "Set" consisting of 1 Electric driven fire pump, 1 diesel driven fire pump and 1 Jockey pump to maintain the system pressure, complete with controllers. xiii. The Fire Pump provided at higher levels, other than lowest level, for fire protection in Super high rise buildings shall be permitted to be a "Set" consisting of 2 Electric driven fire pumps, a main and a standby along with 1 Jockey pump to maintain the system pressure, complete with controllers. In such an arrangement, the standby fire pump shall be connected to an alternate power source such as generator power supply using ATS in addition to the main power source. xiv. The fire pump package shall include a listed automatic fuel filtration system that removes water, sludge, and contaminants from tanks, stabilizes the diesel fuel, eliminates microbial contamination, and complies with NFPA requirements. This system should consist of a magnetic fuel conditioner, self-priming fuel pump with an electric motor, automatic weekly timer, water level controller, automatic and manual water draining system, fuel leak detection float switch, industrial controller with visual indications, common alarm relay, alarm indicator, and selector switch for automatic and manual operation. Stagnation and frequent changing of diesel fuel. xv. Fire Pump set shall be located at the lowest level of the system in the building. However, from lowest level of the building to the ground floor level with fire access, is acceptable. xvi. See Section A, Chapter 2., Table: - A.02-T9.1., for Pump room sizes and construction. xvii. Elbows and tees with a centerline plane parallel to a horizontal split case pump shaft shall only be permitted in the suction line where the distance between the flanges of the pump suction intake and the elbow and tee is greater than 10 times the suction pipe diameter. xviii. An exclusive, dedicated fire pump test line shall be provided from the fire pump discharge header. xix. Pump manufacturer shall be fully capable of providing complete services such as design, selection, shop drawings, installation or supervision of installation, commissioning, training, after sales services and maintenance. xx. Major components of fire pump set such as fire pumps, drivers (subject to product range and stock availability), and controllers shall be from a single manufacturer. Fire pump manufacturer shall bear the unit responsibility for the total packaged fire pump set. Unit responsibility certificate must be submitted from the manufacturer. xxi. Each fire pump should be tested according to applicable standards at an advanced technology testing facility as per its related certification. For End Suction Centrifugal type or Horizontal Split Case Centrifugal type pumps, the factory performance test shall be conducted for fire pumps using actual job motor and actual job engine. If the electric fire pump motor of Vertical shaft turbine-type pump is of Vertical Hollow Shaft construction, then the factory performance test shall be conducted for that fire pump using actual job motor. In addition to the performance test, for End Suction Centrifugal type or Horizontal Split Case Centrifugal type pumps, a string test shall also be conducted at the factory, prior to dispatch, with actual job pump, actual job driver, and actual job controller, together as a unit simulating the field operation. Each engine and controllers installed with Vertical shaft turbine type pump shall be tested individually at the pump manufacturer's facility. Certificates showing the successful completion of these tests shall be submitted for review and permit.

Table:- D.02-T1: General Requirements of Fire Pumps

ITEMS	REQUIREMENTS
2. FIRE PUMP FOUNDATION	i. Concrete foundation which is heavy enough to provide permanent and rigid support to the entire pump. ii. The foundation must be capable of absorbing any vibration, normal strain or shock. iii. The weight of the concrete foundation should be 2.5 times the total weight of the pump.
3. MOUNTING	i. All equipment shall be mounted in a substantial manner on a single noncombustible supporting structure.
4. COMPONENTS OF FIRE PUMP	i. The fire pumps, fire pump motor, fire pump engine and fire pump controllers shall be listed for fire pump applications. ii. The fire pumps, its drivers and controllers shall be in accordance with NFPA 20. iii. Each pump with its engine or motor shall be assembled at pump manufacturer's factory. iv. The fire pump shall consist of Electric Motor driven pump to act as duty pump, and Diesel Engine driven pump to act as standby pump and Electric motor driven Jockey pump. v. Duty and standby fire pumps shall be designed to meet the hundred percentage of the system requirement so that one pump can meet the system requirement even if the other one fails. vi. The fire pump(s) shall be designed to deliver 150 % of the rated flow capacity at not less than 65% of the rated head in conformance to NFPA 20. Shutoff head shall not exceed 140% of rated head. vii. Fire Pumps shall be of either End Suction Centrifugal type or Horizontal Split Case Centrifugal type or Vertical shaft turbine-type. viii. End Suction Centrifugal type and Horizontal Split Case Centrifugal type pumps shall not be used where a static suction lift is required. ix. Where the water supply is located below the discharge flange centerline and the water supply pressure is insufficient to deliver the water to the fire pump, only a vertical shaft turbine-type pump shall be used. x. Fire pump electric motor shall be horizontal mounted with ODP enclosure or vertical hollow shaft type with WP1 enclosure and the peak power required by the pump shall not exceed the motor rated horsepower multiplied by the service factor. xi. The engine shall be of the four-stroke compression-ignition mechanical injection type with all necessary basic features. xii. The jockey pump capacity shall be 1% of the rated capacity of the fire pump or the next higher capacity according to the availability of a suitable pump. If 1% of the fire pump's capacity exceeds the water flow required by a single sprinkler or hose reel, whichever is lesser, then the jockey pump capacity should be limited to a flow rate less than that. The rated pressure of the jockey pump shall be 10 psi (0.7 bar) higher than that of the fire pump. Any listing or certification is not required for the jockey pump. Jockey pump construction shall be either a vertical multi-stage type or a submersible type.
5. FIRE PUMP ACCESSORIES	The Fire Pumps shall be provided with the following accessories, as required by NFPA 20: i. Flow Metering Device (One for complete fire pump package unit). It shall be of the Orifice / Venturi type. ii. Air release valve (for each Horizontal Split Case fire pump and Vertical Turbine Fire Pump only). iii. Suction pressure gauge (for each End Suction Centrifugal type and Horizontal Split Case Centrifugal type fire pump only).

	iv. Discharge pressure gauge (for each fire pump). v. Main relief valve (for diesel engine driven fire pumps only and only if required based on evaluation criteria specified in NFPA 20). vi. Casing circulation relief valve (for each electric motor driven End Suction Centrifugal type and Horizontal Split Case Centrifugal type fire pump only). vii. Each diesel engine shall be provided with dedicated fuel supply tank, sized for a minimum of 12 hours of engine run time based on the fuel consumption rate requirements of the engine as indicated on the manufacturer's published data, plus 5 percent volume for expansion and 5 percent volume for sump. viii. Right angle gear drive and Universal Joint Drive Shaft (when Vertical shaft turbine-type pump is driven be a horizontally mounted driver). ix. Jaw type flexible coupling or Universal Joint Drive Shaft (when an End Suction Centrifugal type or Horizontal Split Case Centrifugal type is driven by a horizontally mounted driver)
6. ELECTRICAL POWER SUPPLY	i. The Primary Power Supply to the main electrical Fire Pump and the Jockey Pump shall be directly from the power utility company, in a dedicated distribution board located inside the pump room. ii. Where 2 electrical fire pumps are permitted in accordance with **Table:- D.02-T1.1.xii.,** power supply for main electrical pump shall be in accordance with **Table:- D.02-T1.6.i.** The standby electrical fire pump shall be connected to a separate power source such as building UPS, Diesel generator or alternative power source in addition to the main power source using ATS. iii. Where the fire pump set consists of 1 electrical and 1 diesel fire pump, the diesel fire pump shall have 12 hour operating capacity and such diesel fire pump shall not be required to have secondary power supply back-up. iv. The power supply from the power utility company to fire pumps shall be directly from the transformer without passing through building distribution boards, with only one lockable disconnecting source. See **Figure:- D.02-F1.a. and Figure:- D.02-F1.b.** v. Such disconnecting means shall be remote, separate from the building disconnecting means, clearly identified with the sign in bold- "Fire Pump Disconnect/ DO NOT SWITCH OFF". vi. The power supply to multiple electrical fire pumps shall be through dedicated wiring, separate for each pump., vii. All the wiring from the power utility company to the Fire pump controllers and to the pumps shall be 2 hour fire rated in a separate metal conduit. viii. All electrical equipment /installation methods shall comply with NFPA 70, Article 695.
7. CONTROLLERS	i. Fire pump controllers shall be listed and permitted by international testing laboratories, certified by international conformity certification bodies and listed by General Directorate of Civil Defence – Kingdom of Bahrain. ii. This controllers shall be wired, assembled, programmed, tested, certified and ready for immediate installation. iii. Controllers shall not be assembled at site. iv. Fire pump controllers with inbuilt and listed VFD (Variable Frequency Drive) shall be permitted. v. Fire pump controllers shall be microprocessor based, wye-delta open transition starting type, and shall include all necessary basic features. vi. The Jockey Pump Controller shall be relay logic based and listed as an industrial control panel. Starting type shall be direct on line or star-delta, and shall include all necessary basic features.

8. MONITORING SYSTEM	i. Permitted fire pump monitoring system must be employed to accurately measure and record the specified parameters below. This is essential for the detection and reporting of fire pump system failures and performance trends: Monitoring Points – All Pumps a. Fire pump controller A/C power failure. b. Fire pump running. c. Fire pump fails to start. d. Fire pump suction and discharge pressures.

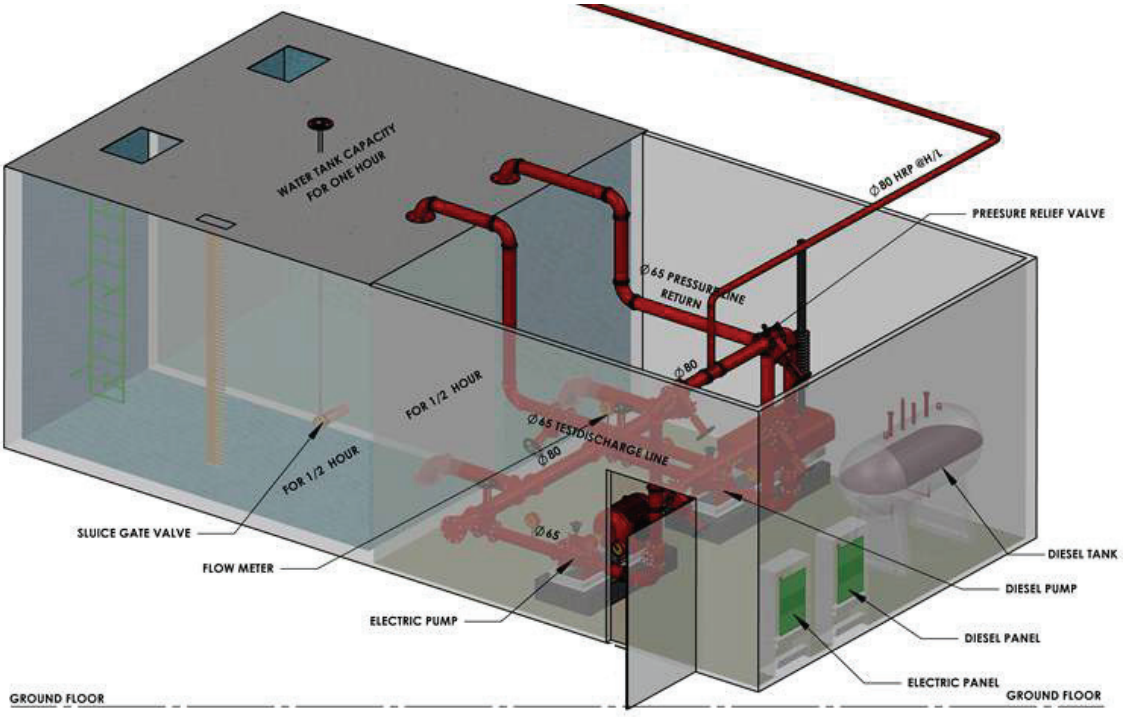


VERTICAL TURBINE		
	MIN	MAX
GPM	50	2500
3 - STAGE	1165	2135
6 - STAGE	-	3060
10 - STAGE	2105	-

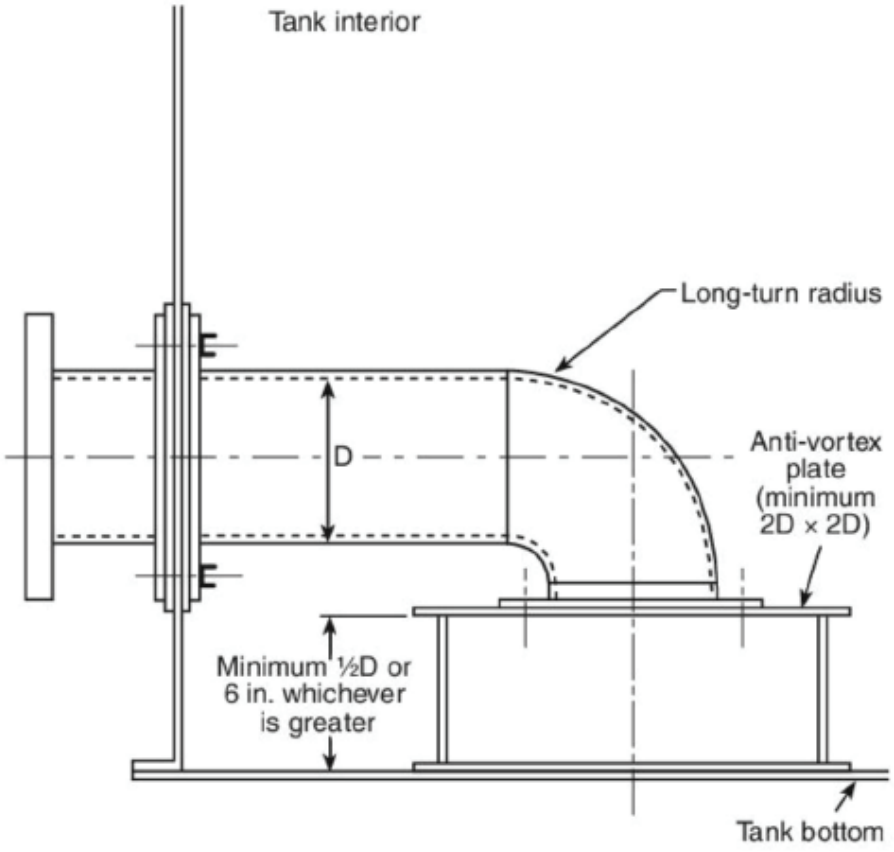
PUMP ROOM		
PUMP RANGE (GPM)	LENGTH	WIDTH
50 - 250	3000	5000
250 - 500	4000	6000
500 - 750	5000	6000
750 - 1000	6000	8000
1000 - 1250	6000	8000
1250 - 1500	6000	8000
1500 - 2500	8000	10000

GV - GATE VALVE
CV - CHECK VALVE
PG - PRESSURE GAUGE
PRV - PRESSURE REDUCING VALVE
PRV - PRESSURE RELIEF VALVE
ACV - ALARM CHECK VALVE

VERTICAL TURBINE PUMP FOR ILLUSTRATION



HORIZONTAL FIRE PUMP FOR ILLUSTRATION



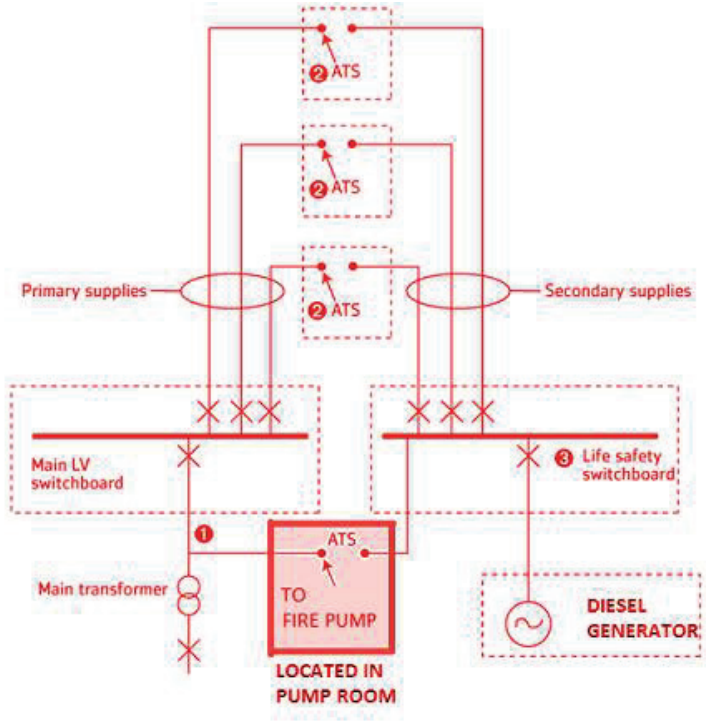
ANTI-VORTEX PLATE ASSEMBLY.

Table:- D.02-T1: General Requirements of Fire Pumps

ITEMS	REQUIREMENTS
9. FIRE WATER TANK	i. The fire water shall be stored in a permanent "Fire Water Tank" having two compartments or in two interconnected tanks with total effective fire water reserve to cater the pumping demand of not less than the duration required by individual systems and occupancies as required by other sections of this chapter. ii. Interconnection between water tank compartments shall be with isolation valves, such that each compartment is able to be isolated. Such isolation vales shall be locked in normally open position. iii. Water tank cleaning or maintenance process shall be allowed one compartment at a time such that the fire water supply from one compartment shall always be available for the fire protection systems. iv. The domestic water reserve shall be permitted and preferred to be combined with a fire water reserve, to prevent stagnation, provided the fire reserve level is maintained at all times. v. Fire water tanks shall be provided with a filling connection directly from the power utility company with a float operated valve for an automatic refilling. vi. Fire water, where not supplied directly from power utility company, shall be potable type or TSE. Where TSE (Tested Sewage Effluent) water is used, it shall be tested and certified to be used for fire protection purposes. vii. Fire water tanks shall be located and constructed such that the fire pump set gets flooded water supply in case of fire pumps are of horizontal centrifugal type. viii. The discharge pipe size shall not be less than 6 in. (150 mm) for tanks up to and including a 25,000 gal (94.63 m3) capacity and shall not be less than 8 in. (200 mm) for capacities of 30,000 gal to 100,000 gal (113.55 m3 to 378.50 m3), or 10 in. (250 mm) for greater capacities. ix. The fire water tanks shall be provided with drain arrangement, overflow connection access manhole, ladders, level indicators, low level switch, etc. x. An permitted water level gauge and indicator shall be installed and interfaced with BMS and 24x7 General Directorate of Civil Defence – Kingdom of Bahrain monitoring system. xi. See **Section A Chapter 2, Table:- A.02-T9.3A. and Table:- A.02-T9.3B** for Water Tank construction.
10. DRAINAGE	i. The Fire water tank area shall be provided with an adequate drainage facility and an arrangement such that over filling tank shall not flood the area and the pump room. ii. The pump room and floor corridors shall be provided with a drainage facility to drain the dripped and leaked water OR water flooded during firefighting operation.
11. PIPING	i. Pipes shall be comply to **Section D, Chapter 11**, **Table:- D.11.T1.** ii. Pipe sizes connecting to Fire Pump System shall be as per **Table:- D.02-T1.a.**
12. FITTINGS	i. Fittings shall be comply to **Section D, Chapter 11, Table: - D.11.T1.**
13. ISOLATION CONTROL VALVES	i. The valve on downstream side of the flow meter in the fire pump test line shall be a globe type valve for the ease of throttling. ii. The valves of the suction side of fire pumps and water tank outlets shall be O.S.&Y type gate valve only. iii. Isolation valves shall be comply to **Section D, Chapter 11, Table:- D.11.T1.**
14. CHECK VALVE	i. Where cushion tanks are used with automatic fire pumps, no check valve is required in the cushion tank connection. ii. Check valves shall be comply to **Section D, Chapter 11, Table:- D.11.T1.**

Table:- D.02-T1: General Requirements of Water Based Fire Protection Systems

ITEMS	REQUIREMENTS
15. ATS (AUTOMATIC TRANSFER SWITCH/ POWER TRANSFER SWITCH) **ATS IS NOT REQUIRED WHERE PUMP SET PROVIDED IS** **1 ELECTRICAL** **1 DIESEL &** **1 JOCKEY**	i. Where required, a dedicated ATS (Automatic Transfer Switch) shall be provided in the pump room for power transfer from primary supply, power utility company to secondary, (diesel generator/UPS) standby power provisions. See **Figure:- D.02-F1a.** ii. ATS can be built in as integral part of a permitted and fire pump controller or dedicated ATS as a separate product. iii. ATS or power transfer from primary source of power to alternate source of power to the fire pump shall be essentially located inside the pump room, at or near the fire pump controller. iv. Where dedicated ATS is provided, it shall be permitted and listed for the fire controller. v. The power transfer switch shall not have short circuit or overcurrent protection as part of the switching mechanism of the transfer switch. vi. A means to prevent the sending of the signal for starting of the alternate source generator when commanded by the ATS, if the alternate isolating switch or the alternate circuit breaker is in the open or tripped position. vii. The (ATS) power transfer switch shall be electrically operated and mechanically held. viii. The power transfer switch shall be suitable for the available short-circuit currents at the transfer switch normal and alternate input terminals. ix. The power transfer switch shall have an ampere rating not less than 115 percent of the motor full-load current and also be suitable for switching the motor locked rotor current.



❶ FIRE PUMP IS CONNECTED DIRECTLY FROM TRANSFORMER, ON THE LIVE SIDE
❷ ATS FOR OTHER ESSENTIAL LIFE SAFETY SERVICES (SMOKE CONTROL, FIRE LIFT, FIRE/SMOKE CURTAINS)
❸ DEDICATED SWITCHBOARD FOR LIFE SAFETY ESSENTIAL SERVICES

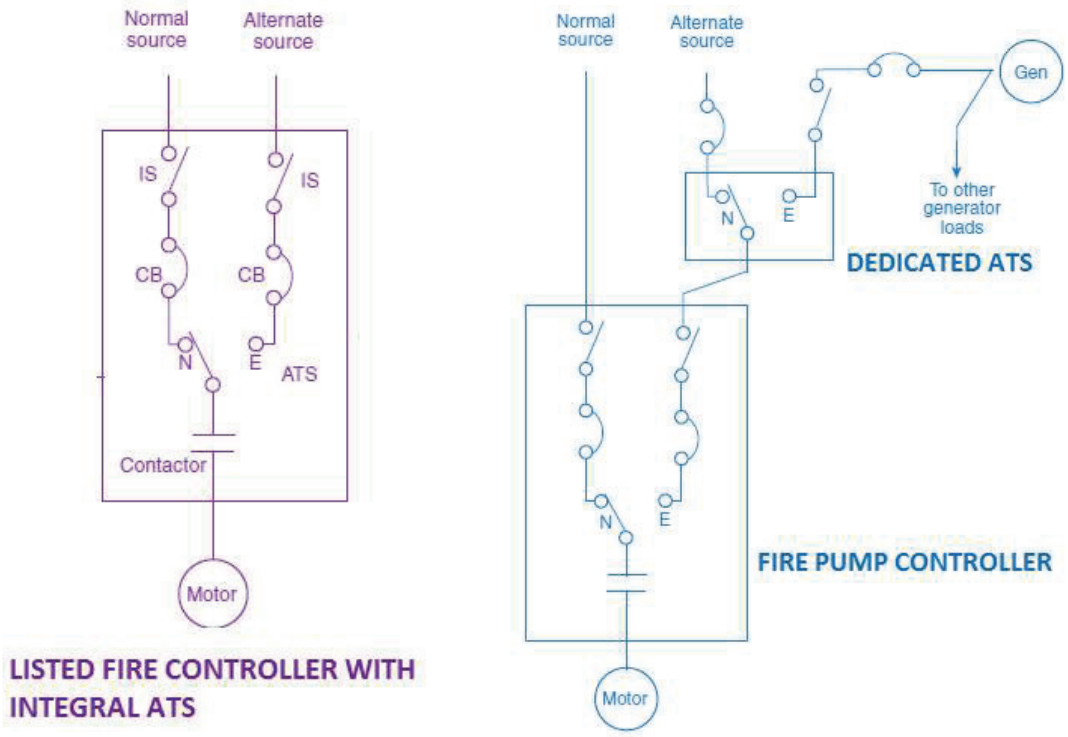


Figure:- D.02-F1a.: Various ATS arrangements

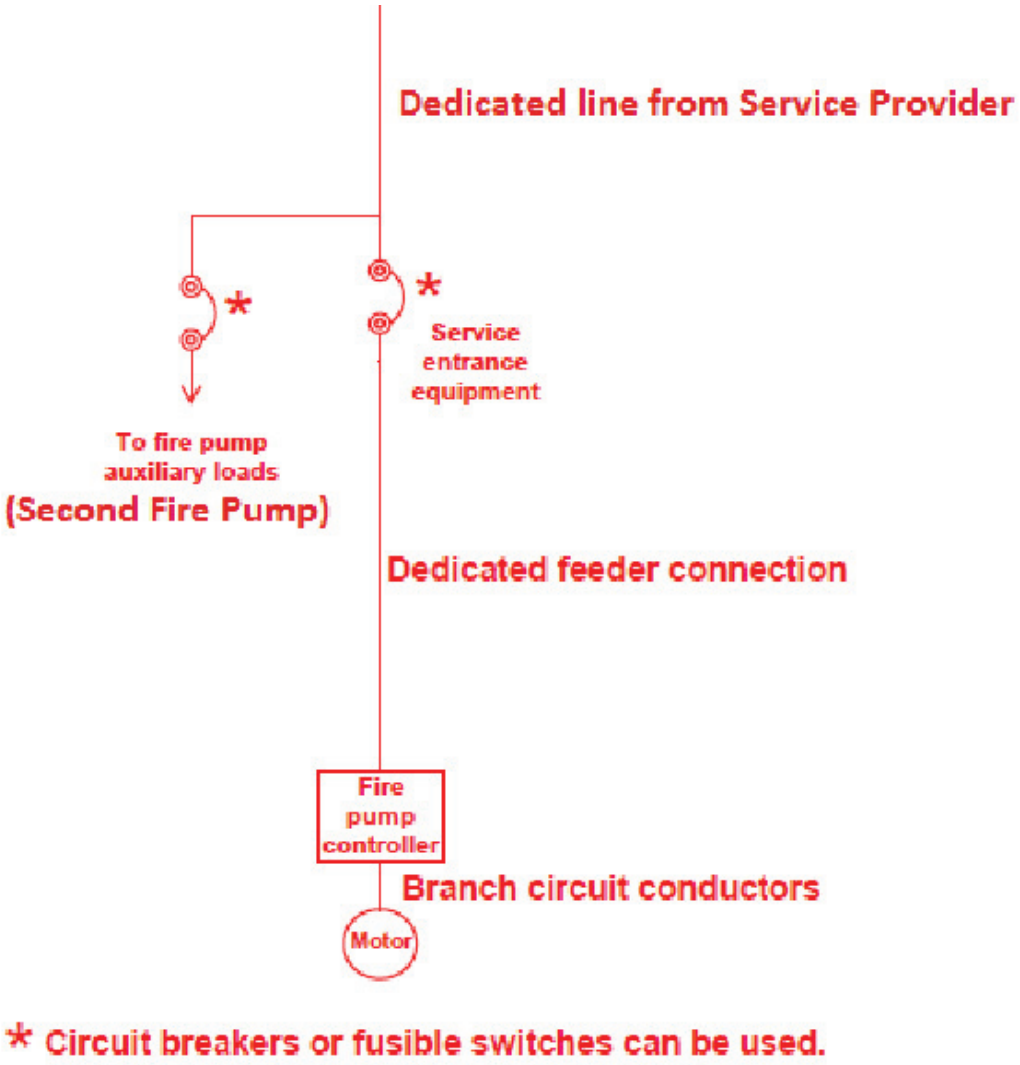


Figure:- D.02-F1b.: Typical Power Supply Arrangement from Power Source to Fire Pump Motor

Table: - D.02-T1a.: Pipe Sizes Connecting to Centrifugal Fire Pump

PUMP RATING	SUCTION	DIS-CHARGE	RELIEF VALVE	RELIEF VALVE DIS-CHARGE	METER DEVICE	NUMBER/ SIZE OF HOSE VALVES	HOSE HEADER SUPPLY
25 gpm	25mm (1")	25mm (1")	19mm (¾")	25mm (1")	32mm ($1^{1/4"}$)	1-38mm($1^{1/2"}$)	25mm (1")
50 gpm	38mm ($1^{1/2"}$)	32mm ($1^{1/4"}$)	32mm ($1^{1/4"}$)	38mm ($1^{1/2"}$)	50mm (2")	1-38mm($1^{1/2"}$)	38mm ($1^{1/2"}$)
100 gpm	50mm (2")	50mm (2")	38mm ($1^{1/2"}$)	50mm (2")	65mm($2^{1/2"}$)	1-38mm($1^{1/2"}$)	65mm ($2^{1/2"}$)
150 gpm	65mm ($2^{1/2"}$)	65mm($2^{1/2"}$)	50mm (2")	65mm($2^{1/2"}$)	75mm (3")	1-65mm($2^{1/2"}$)	65mm ($2^{1/2"}$)
200 gpm	75mm (3")	75mm (3")	50mm (2")	65mm($2^{1/2"}$)	75mm (3")	1-65mm($2^{1/2"}$)	65mm ($2^{1/2"}$)
250 gpm	85mm ($3^{1/2"}$)	75mm (3")	50mm (2")	65mm($2^{1/2"}$)	85mm ($3^{1/2"}$)	1-65mm($2^{1/2"}$)	75mm (3")
300 gpm	100mm (4")	100mm (4")	65mm($2^{1/2"}$)	85mm ($3^{1/2"}$)	85mm ($3^{1/2"}$)	1-65mm($2^{1/2"}$)	75mm (3")
400 gpm	100mm (4")	100mm (4")	75mm (3")	125mm (5")	100mm (4")	2-65mm($2^{1/2"}$)	100mm (4")
450 gpm	125mm (5")	125mm (5")	75mm (3")	125mm (5")	100mm (4")	2-65mm($2^{1/2"}$)	100mm (4")
500 gpm	125mm (5")	125mm (5")	75mm (3")	125mm (5")	125mm (5")	2-65mm($2^{1/2"}$)	100mm (4")
750 gpm	150mm (6")	150mm (6")	100mm (4")	150mm (6")	125mm (5")	3-65mm($2^{1/2"}$)	150mm (6")
1000 gpm	200mm (8")	150mm (6")	100mm (4")	200mm (8")	150mm (6")	4-65mm($2^{1/2"}$)	150mm(6")
1250 gpm	200mm (8")	200mm (8")	150mm (6")	200mm (8")	150mm (6")	6-65mm($2^{1/2"}$)	200mm (8")
1500 gpm	200mm (8")	200mm (8")	150mm (6")	200mm (8")	200mm (8")	6-65mm($2^{1/2"}$)	200mm (8")
2000 gpm	250mm (10")	250mm (10")	150mm (6")	250mm (10")	200mm (8")	6-65mm($2^{1/2"}$)	200mm (8")
2500 gpm	250mm (10")	250mm (10")	150mm (6")	250mm (10")	200mm (8")	8-65mm($2^{1/2"}$)	250mm (10")
3000 gpm	300mm (12")	300mm (12")	200mm (8")	300mm (12")	200mm (8")	12-65mm ($2^{1/2"}$)	250mm (10")
3500 gpm	300mm (12")	300mm (12")	200mm (8")	300mm (12")	250mm (10")	12-65mm ($2^{1/2"}$)	300mm(12")
4000 gpm	350mm (14")	300mm (12")	200mm (8")	350mm (14")	250mm (10")	16-65mm ($2^{1/2"}$)	300mm(12")
4500 gpm	400mm (16")	350mm (14")	200mm (8")	350mm (14")	250mm (10")	16-65mm ($2^{1/2"}$)	300mm(12")
5000 gpm	400mm (16")	350mm (14")	200mm (8")	350mm (14")	250mm (10")	20-65mm ($2^{1/2"}$)	300mm(12")

4.0 Design, Installation, Inspection and Maintenance of Fire Protection Systems

4.1 Design/Specification and Submittals

4.1.1 Design, Specifications and Submittals to General Directorate of Civil Defence – Kingdom of Bahrain for permit shall be the main consultant's responsibility. The consultant shall have competent and knowledgeable personnel to understand the General Directorate of Civil Defence requirements and codes and standards.

4.1.2 The design submittals shall be complete with system hydraulic calculations, design criteria, appropriate selection of types of systems and their components, in compliance with this code.

4.2 Installation

4.2.1 The installation of Fire Protection Systems shall be carried out only by General Directorate of Civil Defence permitted and licensed contractors. General contractors, MEP contractors and plumbing contractors shall not be allowed to install fire protection systems.

4.2.2 The qualification and permit of the installation by General Directorate of Civil Defence – Kingdom of Bahrain is based on their training from the respective system manufacturers, their experience and their understanding of codes and standards and workmanship.

4.2.3 Installation contractors shall apply to Civil Defence and secure passing marks in General Directorate of Civil Defence examination to gain the license and be qualified as "permitted fire contractors".

4.2.4 The installation contractor shall not commence work on site without receiving the General Directorate of Civil Defence stamped and permitted drawings from the Consultant.

4.2.5 It is the contractor's responsibility to adhere to consultant's General Directorate of Civil Defence – Kingdom of Bahrain permitted drawings and specifications.

4.3 Inspection and Acceptance

4.3.1 Inspection and acceptance shall be the main consultant's responsibility.

4.3.2 The main consultant shall inspect the contractor's work during installations and ensure that all systems are installed, tested, commissioned and performing as per the General Directorate of Civil Defence permitted drawings and their intended purpose.

4.3.3 The consultant shall handover the system inspection and acceptance reports and the maintenance manuals to the owner.

4.4. Inspection and Maintenance

4.4.1 The building owner, his appointed representative and the facility management shall be responsible to ensure that all the Fire Protection Systems in the facility are inspected regularly, maintained and repaired to serve their intended purpose during emergencies.

Fire Pumps-acceptance test and maintenance

5.1. Fire Pumps shall be inspected and maintained as per minimum guidelines in accordance with **Table:- D.02-T12.** However, detailed acceptance, inspection tests and maintenance shall be as per **Manufacturer's instruction manual**, **NFPA 20 and NFPA 25.**

Table:- D.02-T2.: Fire Pump Testing, Inspection and Maintenance

ITEM	REQUIREMENTS
1. ACCEPTANCE TEST	**1. FLUSHING** i. The suction piping shall be flushed prior to hydrostatic tests. ii. Where the maximum flow available from the water supply cannot provide a flow of 150 percent of the rated flow of the pump, the flushing flow rate shall be the greater of 100 percent of the rated flow of the connected fire pump or the maximum flow demand of the fire protection system. **2. HYDROSTATIC TEST** i. Suction and discharge piping shall be hydrostatically tested at not less than 200 psi (13.8 bar) pressure or at 50 psi (3.4 bar) in excess of the maximum pressure to be maintained in the system, whichever is greater. ii. The pressure shall be maintained for 2 hours. iii. The installing contractor shall furnish a certificate for flushing and hydro-static test prior to the start of the fire pump field acceptance test. **3. FIELD ACCEPTANCE TEST** i. All electric wiring to the fire pump motor(s), including control (multiple pumps) interwiring, normal power supply, alternate power supply, and jockey pump, shall be completed and checked by the electrical contractor prior to the initial startup and acceptance test. ii. A copy of the manufacturer's certified pump test curve shall be available for comparison with the results of the field acceptance test. iii. The test procedures as per the manufacturer's manual shall be followed and their results shall be verified. iv. The actual unadjusted fire pump discharge flows and pressures installed shall meet or exceed the fire protection system's demand. v. The fire pump shall perform at minimum, rated, and peak loads without an objectionable overheating of any component. vi. Vibrations of the fire pump assembly shall not be of a magnitude to pose potential damage to any fire pump component. vii. Where simultaneous operation of multiple pumps is required as part of a system design, the acceptance test shall include a flow test of all pumps operating simultaneously. viii. The maximum flow available shall be 150% of the rated flow of the pump. ix. For electric motors operating at a rated voltage and frequency, the ampere demand on each phase shall not exceed the product of the full-load ampere rating times the allowable service factor as stamped on the motor nameplate. x. The voltage at the motor contactor ouput lugs shall not vary more than 5% below or 10% above rated (nameplate) voltage during the test xi. The fire pump or foam concentrate pump shall be in operation for not less than 1 hour. xii. Consultant shall hand over one set of stamped record drawings and one copy of the completed test report to the building owner.

ITEM	REQUIREMENTS
2. WEEKLY INSPECTION	**1. VISUAL OBSERVATION** i. Piping is free of leakage. ii. Pressure gauges reading are satisfactory. iii. The controller pilot light is illuminated to ensure power is on. iv. The transfer switch normal pilot light is illuminated. v. The pump suction and discharge and bypass valves are fully open vi. The suction line pressure gauge reading is within acceptable range. vii. The system line pressure gauge reading is within acceptable range. viii. The suction reservoir has the required water level. ix. The wet pit suction screens are unobstructed and in place. x. The water flow test valves are in the closed position. xi. The ventilating louvers at the pump room are free to operate. xii. The reverse phase alarm pilot light is off/the normal phase rotation pilot light is on. xiii. The oil level in the vertical motor sight glass is within acceptable range. xiv. The power to pressure maintenance (jockey) pump is provided. xv. The diesel engine fuel tank is at least two-thirds full. xvi. The diesel engine controller selector switch is in auto position. xvii. The diesel engine batteries' voltage readings are within acceptable range. xviii. All alarm pilot lights are off. xix. The diesel Engine running time meter is reading. xx. The oil level in the right angle gear drive is within acceptable range. xxi. The crankcase oil level is within acceptable range. xxii. The cooling water level is within acceptable range. xxiii. The electrolyte level in batteries is within acceptable range. xxiv. Battery terminals are free from corrosion.
3. WEEKLY TESTS	**1. GENERAL** i. A non-flow test shall be conducted for electric motor-driven pump and diesel engine-driven fire pumps without recirculating water back to the pump suction. ii. The test shall be conducted by starting the pump automatically. iii. The electric pump shall run a minimum of 10 minutes. iv. The diesel pump shall run a minimum of 30 minutes **2. FOLLOWING OBSERVATION RECORDS AND MAINTENANCE ADJUSTMENTS SHALL BE CARRIED OUT WHILE PUMP IS RUNNING** i. Record the pump starting pressure from the pressure switch /pressure transducer. ii. Record the system suction and discharge pressure gauge readings. iii. Inspect the pump packing glands for slight discharge, adjust gland nuts if necessary iv. Inspect for unusual noise or vibration. v. Inspect packing boxes, bearings, or pump casing for overheating vi. Record pressure switch or pressure transducer reading and compare to the pump discharge gauge. vii. For pumps that use electronic pressure sensors to control the fire pump operation, record the current pressure and the highest and the lowest pressure shown on the fire pump controller event log. viii. For electric motor and radiator cooled diesel pumps, check the circulation relief valve for operation to discharge water. ix. Observe the time for motor to accelerate to full speed. x. Record the time controller is on first step (for reduced voltage or reduced current starting) xi. Record the time pump runs after starting (for automatic stop controllers) xii. Observe the time for diesel engine to crank. xiii. Observe the time for diesel engine to reach running speed xiv. Observe the engine oil pressure gauge, speed indicator, water and oil temperature indicators periodically while the engine is running xv. Record any abnormalities and initiate repair or maintenance or parts replacement through General Directorate of Civil Defence – Kingdom of Bahrain permitted fire contractor.

Table:- D.02-T2.: Fire Pump Testing, Inspection and Maintenance

ITEM	REQUIREMENTS
4. ANNUAL TESTING	i. Annually, each pump set shall be tested by qualified and General Directorate of Civil Defence – Kingdom of Bahrain permitted personnel, for no flow (churn), rated flow and 150% of pump rated flow along with water discharge through hose and other permitted test devices. ii. Any parts that needs to be repaired or replaced shall be handled through Civil Defence permitted fire contractor.

5.0 Material Test Standards, Permit and registration.

5.1 Acceptable Test Standards and criteria

5.1.1 All the Valves, Pumps, Piping, Hose, Nozzles, Devices, Sprinklers, Motors, Materials, Systems, Assemblies, equipment, Products and Accessories, referred to in this chapter with respect to Life Safety, Fire Safety and Emergency Services shall be Listed, permitted and Registered by the General Directorate of Civil Defence – Kingdom of Bahrain**.**

5.1.2 There is no year of edition mentioned against any test standards. It is the intent of General Directorate of Civil Defence – Kingdom of Bahrain to invite the customers seeking laboratory tests and the test laboratories to follow the "LATEST EDITION OF THE TEST STANDARD, AS AND WHEN THEY ARE UPGRADED/REVISED/AMENDED, TO THE DATE"

5.1.3 Fire Pump., Tested successfully at 150% of the rated flow.

- **i.** UL 448, Standard for Centrifugal Stationary Pumps for Fire-Protection Service.
- **ii.** UL 448B, Standard for residential Fire Pumps intended for one and two family dwellings and manufactured homes.
- **iii.** UL 448C, Standard for Stationary, Rotary type, positive displacement pumps for Fire Protection Service.
- **iv.** FM 1319, Permit Standard for Centrifugal Fire Pumps (Horizontal, End Suction Type)
- **v.** FM 1370, Permit l Standard for Centrifugal Fire Pumps (Vertical Shaft, Turbine Type, Barrel).
- **vi.** FM 1313, Permit Standard for Positive Displacement Fire Pumps (Rotary Gear Type)
- **vii.** FM 1312, Permit Standard for Centrifugal Fire Pumps (Vertical Shaft, Turbine Type).
- **viii.** UL 162A, Fixed water motor coupled pumps for foam concentrate proportioning.
- **ix.** LPS 1131, Requirements and testing methods for pumps for automatic sprinkler installation pump sets.
- **x.** EN 12259-12, Fixed firefighting systems — Components for sprinkler and water spray systems — Part 12: Pumps
- **xi.** LPS 1240, Requirements for LPCB permitted fire sprinkler pump sets used in automatic sprinkler installations

5.1.4 Fire Pump Motor

- **i.** UL 1004-5, Standard for Fire Pump Motor.

5.1.5 Diesel Engine

- **i.** UL 1247, Standard for Diesel Engines for Driving Stationary Fire Pumps.
- **ii.** FM 1333, Diesel Engine Fire Pump Drivers
- **iii.** LPS 1239, Requirements and testing procedures for the LPCB Permit and listing of diesel engines for sprinkler pump sets

5.1.6 Fire Pump Controller.

- **i.** UL 218, Standard for Fire Pump Controller.
- **ii.** FM 1321/1323, Standard for Fire Pump Controller for Electric Motor and Diesel Engine Driven Fire Pumps.
- **iii.** LPS 1236, Requirements for control panels for diesel engine driven pumps used in automatic sprinkler installations.
- **iv.** LPS 1237, Requirements for control panels for electric motor driven pumps used in automatic sprinkler installations

5.1.7 Valves

i. FM 1041, Permit Standard for Alarm Check Valve
ii. FM 1021, Dry Pipe Valves
iii. FM 1020, Automatic Water Control Valves
iv. FM 1120, 1130, Fire Service Water Control Valves (OS & Y and NRS Type Gate Valves)
v. FM 1210, Swing Check Valves
vi. FM 1362, Pressure Reducing Valves
vii. FM 1031, Quick Opening Devices (Accelerators and Exhausters) for Dry Pipe Valves
viii. FM 1042, Water flow Alarm Indicators (Vane Type)
ix. FM 1045, Water flow Detector Check Valves
x. FM 1140, Quick Opening Valves 1⁄4 Inch Through 2 Inch Nominal Size
xi. FM 1111, Permit Standard for Post Indicator Valve assembly
xii. FM 1112, Indicating Valves (Butterfly or Ball Type)
xiii. ANSI/UL 193, Alarm Valves for Fire Protection Service
xiv. ANSI/UL 260, Dry Pipe and Deluge Valves for Fire Protection Service
xv. UL 1478, Fire Pump Relief Valves
xvi. UL 1726, Automatic Drain Valves for Standpipe Systems
xvii. UL 2573, Air release valve
xviii. UL 258, Shutoff Valves for Trim and Drain Purposes
xix. UL 668, Hose Valves for Fire Protection Service
xx. UL 1486, quick Opening Devices for Dry Pipe Valves for Fire Protection Service
xxi. UL 1468, Pressure Reducing Valve
xxii. UL 1726, Automatic Drain Valves for Standpipe Systems
xxiii. UL 258, Shutoff Valves for Trim and Drain Purposes
xxiv. UL 262, Gate Valves for Fire Protection Service
xxv. ANSI/UL 312, Check Valves for Fire Protection Service
xxvi. UL 1091, Butterfly Valves for Fire Protection Service
xxvii. ANSI/UL 1468, Direct Acting Pressure Reducing, Restricting Valves
xxviii. ANSI/UL 1739, Pilot-Operated Pressure-Control Valves
xxix. EN 12259-2, Fixed firefighting systems. Components for sprinkler and water spray systems. Wet alarm assemblies.
xxx. EN 12259-3, Fixed firefighting systems. Components for sprinkler and water spray systems. Dry alarm valve assemblies.
xxxi. BS 5041-1, Fire hydrant systems equipment. Specification for landing valves
xxxii. for wet risers.
xxxiii. BS 5041-2, Fire hydrant systems equipment. Specification for landing valves for dry risers.
xxxiv. BS 5041-4, Fire hydrant systems equipment. Specification for boxes for landing valves for dry risers.
xxxv. BS 12094-13, Fixed firefighting systems. Components for gas extinguishing systems. Requirements and test methods for check valves and non-return valves.

5.1.8 Fire Pump Assembly

i. UL 448 D, Outline of Investigation for Fire Pump, Driver and Controller Assembly Rating Compatibility.



Chapter 3

Fire hose systems



Chapter 3

Fire hose systems



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1.0 Scope

1.1. This chapter provides general information about fire hose system and its apparatus, design, installation , permits , listing and maintenance.

1.2. To familiarize end users of fire hose system.

1.3. To enable designers and owners to choose fire hose system according to the hazard.

1.4. To regulate the inspection and maintenance of fire hose system.

2.0 Definitions

2.1. General

2.1.1. Shall
It is a mandatory requirement by General Directorate of Civil Defence - Kingdom of Bahrain.

2.1.2. Should
It is a recommendation but it is not mandatory by General Directorate of Civil Defence - Kingdom of Bahrain.

2.1.3. Listed
Permitted and registered by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain.

2.1.4. Bar
Unit of measurement for pressure. Though it is not a SI unit, it is a common practice to use this unit of measurement in fire protection.

2.1.5. Unit of Measurement
The Unit of Measurement in this code are international system of units. (SI).

- 1 ft = 0.3048 m
- 1 in. = 25.4 mm
- 1 gal = 3.785 L
- 1 gal = 3.785 dm^3
- 1 psi = 6894.757 Pa
- 1 psi = 0.0689 bar
- 1 bar = 10^5 Pa

2.1.6. GPM (Gallons per minute)
Unit of measurement for flow. Though it is not a SI unit, it is widely a practice to use this unit of measurement for water flow per square feet in fire protection.

2.2. Fire Hose Systems

2.2.1 Fire Hose Cabinet (FHC)

A cabinet housing combination of instantaneous connection outlets for Landing Valve, Hose reel along with, nozzle and fire extinguishers.

2.2.2 Landing Valve

A 65 mm diameter instantaneous water outlet normally located near the staircase for trained or General Directorate of Civil Defence - Kingdom of Bahrain fire fighters to use during fire.

2.2.3 Hose Reel or Hose Rack

A 25 mm Hose reel or 40 mm diameter Hose rack, instantaneous water outlet with a connected hose for trained occupants or General Directorate of Civil Defence - Kingdom of Bahrain fire fighters to use during fire.

2.2.4 Standpipe

The vertical portion of the system piping that delivers the water supply for hose connections (and sprinklers on combined systems), vertically from floor to floor. The term standpipe can also refer to the horizontal portion of the system piping that delivers the water supply for two or more hose connections (and sprinklers on combined systems) on a single level.

2.2.5 Combined System

A piping system that feeds both Landing valves, Hose systems and Sprinkler system network.

2.2.6 Dry Riser System (Manual Standpipe System)

Dry riser systems are normally dry without permanent water connection to them and depend on the General Directorate of Civil Defence - Kingdom of Bahrain fire truck to pump water into the system. Dry riser system comprises of one or multiple vertical riser pipes or horizontal runs of piping that are terminated to the two way breeching inlets located at the ground level and connected to the 65mm diameter landing (Fire Department) valve outlets coupled or uncoupled with 65mm diameter, 30 m long reinforced rubber lined (RRL) hose with multipurpose hose nozzle that are placed inside a cabinet for the use of General Directorate of Civil Defence - Kingdom of Bahrain personnel or other trained fire fighting personnel.

2.2.7 Wet Riser System (Wet Standpipe System)

Wet riser systems are normally pressurized with water having permanent water supply from fire water pumps and fire water storage tanks. Wet riser system comprises of one or multiple vertical riser pipes or horizontal runs of piping that feed the Sprinkler System, Water Spray System as well as Hose and Landing Valve connections. These risers are connected to fire pumps and fire water storage tanks located within the buildings. 25mm for Hose Reel System, 40 mm for Hose Rack system, 65 mm diameter for Landing Valve tapping will be made from the wet riser in each floor level and fitted with multipurpose hoses and nozzles that are placed inside a cabinet for the use of General Directorate of Civil Defence - Kingdom of Bahrain personnel or other trained fire fighting personnel. In addition the four way breeching inlets located at ground level are connected to the bottom of the wet riser to pump water from the General Directorate of Civil Defence - Kingdom of Bahrain fire truck as supplementary water supply.

2.2.8. Wet Riser Zoning

A vertical subdivision of a standpipe system by height.

2.2.9. High Zone

The high zone within a subdivided standpipe system, which is usually due to pressure limitations of the design. (When wet riser FHC height exceeds 45 m from pump location or when pressure in the system exceeds 12 bar, standpipe is arranged in a separate looped zone, known as High Zone).

2.2.10. Low Zone

The low zone within a subdivided standpipe system, which is usually due to pressure limitations of the design. (When wet riser FHC height exceeds 45 m from pump location or when pressure in the system exceeds 12 bar, lower section of standpipe is arranged in a separate zone, within 12 bar range, known as Low Zone).

2.2.11. Static Pressure

Pressure acting on a point in the piping with no flow from the system.

2.2.12. Residual Pressure

Pressure acting on a point in the piping with flow being delivered or discharged.

2.2.13. Pressure Reducing Valve

A valve designed for the purpose of reducing the downstream water pressure under both flowing (residual) and no flowing (static) conditions.

2.2.14. Rated Capacity

The flow available from an outlet, at the designated residual pressure.

2.2.15. Breeching inlet

A connection through which the General Directorate of Civil Defence – Kingdom of Bahrain fire department can pump supplemental water into the sprinkler system, standpipe, or other system, furnishing water for fire extinguishment or to supplement existing water supplies.

2.2.16. Fire Vehicle (Fire Fighting Apparatus)

Fire Vehicle or Fire Fighting Apparatus is designed for fire fighters and is used by General Directorate of Civil Defence - Kingdom of Bahrain trained fire fighters to carry water and equipment to fight fires. These Vehicles are equipped with Water, pumps, extinguishing agents, extinguishers, Rescue and smoke venting tools and equipment. Please see **Section A, Chapter 01.**

2.2.17. Fire Suppression

Sharply reducing the heat release rate of a fire and preventing its regrowth by Means of direct and sufficient application of extinguishing agents such as water burning fuel surface.

3.0. Types of Hose System

3.0.1 Class I Hose System

Class I systems comprises of 65 mm diameter Landing Valve outlets coupled or uncoupled with 65mm diameter, 30 m long, double jacket synthetic fiber reinforced hose with a multipurpose hose nozzle for the use of General Directorate of Civil Defence - Kingdom of Bahrain department personnel or other trained fire fighting personnel.

3.0.2. Class II Hose System

Class II systems comprise of 25 mm diameter bore for Hose Reel System or 40 mm diameter bore for a Hose Rack System, 30 m long double jacket synthetic fiber reinforced, coupled with 6 or 8 mm bore multipurpose nozzle, for the use of occupants to extinguish small fires or when the fire is at its incipient stages until the arrival of General Directorate of Civil Defence - Kingdom of Bahrain fire fighters.

3.0.3. Class III Hose System

Class III system is a combination of both Class I & Class II systems for the use of trained personnel and as well as General Directorate of Civil Defence – Kingdom of Bahrain use. In general the class I system equipment are installed in lower compartment of the FHC and class II system equipment in upper compartment of FHC.

3.1. General Requirements

3.1.1 The general requirements for Fire Hose system, Hose , Cabinets that are components of water based fire protection system shall be as per **Table:-D.03-T1.**

3.1.2. Fire Protection Systems discussed in this chapter are limited to the General Directorate of Civil Defence permitted and registered Systems. Any system that is not already permitted or registered by General Directorate of Civil Defence is not mentioned in this Chapter.

3.1.3. Water based Fire Protection Systems

3.1.3.1. Dry Riser System (DRS)
3.1.3.2. Fire Hose Reel/Rack System (FHS)
3.1.3.3. Wet Riser System (WRS)

Table:- D.03-T1 : General Requirements of Fire Hose Systems

TEMS	REQUIREMENTS
1. HOSE CABINET	i. Hose cabinet shall be of a size sufficient to accommodate the corresponding piping, landing valve, hose, nozzle and extinguishers. ii. Within the cabinet, installation shall be such that there is 25.4 mm space between any part of the cabinet and landing valve handle, either in closed position or open position. iii. Where a fire resistance rated construction is penetrated by a hose cabinet, especially at fire resistance rated corridors, such fire-resistance rating of the wall construction shall be maintained by a fire-resistance rated cabinet and installation. iv. Fire Hose Cabinets shall be located next to the exit doors at ground floor and exit Stair door at typical floors, in the exit corridor in each floor of the building. v. Where Horizontal Exit is provided in a building, Fire Hose Cabinets shall be installed on both sides of such horizontal exits. vi. The fire hose cabinet shall not be more than 6 m away from the exit stair door. Additional Fire Hose Cabinets shall be installed in exit corridors of each floor such that any part of the building, in each floor is within 30 m from the Fire Hose Cabinet. vii. The hose Cabinet shall have signage both in Arabic and English, clearly identifying the class of the hose connection.
2. HOSE	i. The hose diameter shall be of size as required by other sections of this chapter as per the Hose System classification (Class I, Class II and Class III). ii. The hose length shall be 30 m long, Permitted and registered by General Directorate of Civil Defence - Kingdom of Bahrain as per material test standards mentioned in **Sub Section 8.0. of this chapter.**
3. NOZZLE	i. The hose Nozzle diameter shall be of the size as required by other sections of this chapter as per the Hose System classification (Class I, Class II and Class III) and Permitted and registered by General Directorate of Civil Defence test standards mentioned in **Sub Section 8.0. of this chapter.**
4. PROTECTION	i. Dry & wet riser piping in any building, shall be installed within a protected enclosure having fire-resistance rating of not less than 2 hours. ii. If the building is fully protected by an automatic sprinkler system, the protection of horizontal branches and mains shall not be required.
5. PAINT COLOR	i. All steel pipes & fittings used for firefighting service shall be painted in red color. ii. There shall be directional arrow marks to indicate the direction of water flow in the system.
6. INSTALLER QUALIFICATIONS	i. The installation of fire protection systems shall be carried out only by General Directorate of Civil Defence permitted and registered “Fire Protection Contractors”. ii. The installation personnel shall be qualified or shall be supervised by persons who are qualified in the installation, inspection and testing of fire protection systems. iii. Qualifications or certification of the personnel and General Directorate of Civil Defence license shall be provided at any time when requested by the General Directorate of Civil Defence – Kingdom of Bahrain.

4.0 Dry Riser Systems

4.1 The requirements for Dry Riser System Material, design, installation shall be as per **Table:- D.03-T2.** and the General Requirements of **Table:- D.03-T1.**

Table:- D.03-T2 : Dry Riser System Requirements

ITEMS	REQUIREMENTS
1. DEFINITION	i. Dry riser systems are normally dry without a permanent fire pump or water connection to it and depend on the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain fire truck to pump water into the system. Dry riser system comprises of one or multiple vertical riser pipes or horizontal runs of piping that are terminated to the two way breeching inlets located at ground level on the external wall above ground and connected to the 65mm diameter landing (Fire Department) valve outlets coupled or uncoupled with 65mm diameter, 30 m long, General Directorate of Civil Defence permitted hose with multipurpose hose nozzle that are placed inside a cabinet for the use of General Directorate of Civil Defence personnel or other trained firefighting personnel.
2. COMPONENTS	i. Pipes, fittings, landing valve, hose cabinet, hose , nozzle, breeching inlet and signs.
3. PIPE SIZES	i. Pipes shall comply to **Section D, Chapter 11, Table:- D.11-T1** ii. The minimum pipe size for serving a single 65 mm diameter hose valve shall be not less than 65 mm in diameter and the pipe line serving two or more hose valves shall be not less than 100 mm diameter. iii. Minimum wall thickness shall be as per schedule 40. iv. Pipes shall be rated for working pressure of 6.9 bar at the most remote point of the piping network.
4. FITTINGS	i. Fittings shall comply to **Section D, Chapter 11, Table:- D.11-T1**
5. LANDING VALVE	i. Landing Valves shall be Class I, 65 mm, instantaneous connection outlet, permitted and listed by General Directorate of Civil Defence as per tests mentioned in **Sub Section 8.0. of this chapter.** ii. The installation of the landing valve shall be such that it is easily accessible and operable. iii. The landing valve shall be installed at a height of not less than 900 mm and not more than 1200 mm from the finished floor level.
6. FLOW AND PRESSURE	i. Landing valves, piping, fittings, breeching inlet and connections shall designed to withstand 250 gpm at 6.9 bar. ii. If the residual pressure exceeds 7 bar at the fire hose connection, an permitted pressure reducing valve shall be introduced to restrict the pressure to 7 bar.
7. HOSE	i. Hose shall be 65 mm, 30 m long, permitted and listed by General Directorate of Civil Defence - Kingdom of Bahrain as per material test standards mentioned in **Sub Section 8.0 of this chapter.**
8. HOSE CABINET	i. The hose Cabinet shall comply to **Table:- D.03-T1.1.**
9. NOZZLE	i. The nozzle shall comply to **Table:- D.03-T1.3.**
10. SIGNAGE	i. The hose Cabinet shall have signage both in Arabic and English, clearly identifying the class and type of the hose connection as “Dry Riser System”
11. LOCATION	i. The hose Cabinet location shall comply to **Table:- D.03-T1.1.**
12. BREECHING INLET	i. The dry riser stand pipe system shall be terminated to a 2-way breeching inlet connection having 100 mm diameter flanged outlet with 2 no's of 65 mm diameter instantaneous male coupling inlets and to comply **Table:-D.03-T1.8**

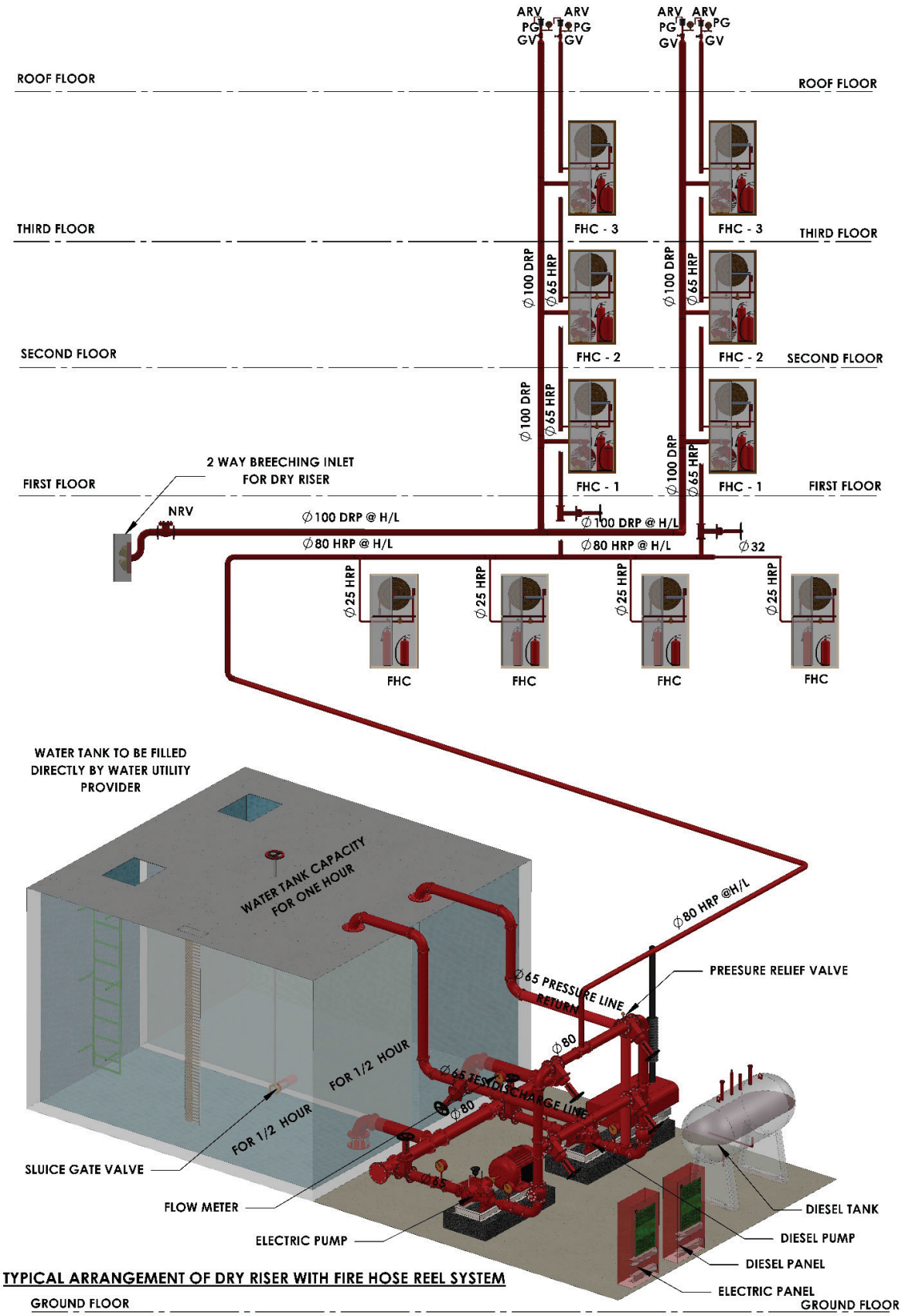

Figure:- D.03-F1 : Dry Landing valve riser with Hose reel System

5.0 Hose Reel Systems

5.1. The requirements for Hose Reel System material, design, installation shall be as per **Table:- D.03-T3** and the General Requirements of **Table:- D.03-T1.**

Table:- D.03-T3 : Fire Hose Reel System Requirements

ITEMS	REQUIREMENTS
1. DEFINITION	i. Fire hose reel systems are Class II systems, pressurized with water having a permanent water supply from fire water pumps and fire water supply from fire water pumps and fire water storage tanks. The fire hose reel system comprises of one or multiple vertical riser pipes or horizontal runs of piping that are connected to the 25 mm diameter outlet valve, 30 m long reinforced rubber lined (RRL) Polyester yarn hose with hose nozzle that are placed inside the fire hose cabinet for the use of trained fire fighting personnel or by occupants as first response if it is safe to do so. ii. Fire hose rack systems are class II systems, pressurized with water having permanent water supply from fire water pumps and fire water storage tanks. Fire hose rack system comprises of one or multiple vertical riser pipes or horizontal runs of piping that are connected to the 40 mm diameter outlet valve, 30 m long fire hose, folded vertically and attached over the pins in a permitted manner. The system is for the use of trained fire fighting personnel or by occupants as first response if it is safe to do so.
2. COMPONENTS	i. Fire Pumps, Controller, Fire Water Tank, Pipes, Fittings, outlet valve, Hose Cabinet, Hose Reel/Hose Rack , Nozzle, Breeching inlet and Signs.
3. FIRE PUMP CAPACITY	i. The fire pump set shall consist of 1 Electric driven pump and 1 diesel driven pump complete with controllers. ii. Pump capacities shall comply with **Section D, Chapter 02.** in accordance with the occupancy type. iii. Pump pressure shall be such that the most remote Hose Reel or Hose Rack pressure shall not be less than 4.5 bar.
4. PIPES	i. Pipes shall comply to **Section D, Chapter 11, Table:- D.11-T1** ii. Pipes shall be rated a for working pressure of 4.5 bar at the most remote point of the piping network. iii. The minimum pipe size for serving a single fire hose reel shall not be less than 25 mm diameter, and serving single hose rack shall not be less than 40 mm and the pipe line serving two or more hose connections shall not be less than 50 mm in diameter. iv. The minimum wall thickness shall be as per Schedule 40.
5. FITTINGS	i. Fittings shall comply to **Section D, Chapter 11, Table:- D.11-T1** ii. Fittings shall be rated for working pressure of 4.5 bar at the most remote point of the Piping network
6. VALVE OUTLET	i. The valve outlet shall be 25 mm for the hose Reel System or 40 mm for the hose Rack System.
7. HOSE	i. The hose for the hose reel system shall be 25 mm in diameter, 30 m long reinforced rubber lined (RRL) Polyester yarn hose with hose nozzle, wrapped on a rotating drum. ii. The hose for the Flat Fire Hose or hose rack system shall be 65mm or 40 mm diameter outlet valve respectively, 30 m long fire hose.

Table:- D.03-T3 : Fire Hose Reel System Requirements

ITEMS	REQUIREMENTS
8. HOSE CABINET	i. The hose cabinet shall comply with **Table:- D.03-T1.1**
9. NOZZLE	i. The nozzle shall comply to **Table:- D.03-T1.3**
10. SIGNAGE	i. The hose Cabinet shall have a signage both in Arabic and English, clearly identifying the class and type of the hose connection as "Fire Hose Reel/Rack System"
11. LOCATION	i. The hose Cabinet location shall comply with **Table:- D.03-T1.1.**
12. FIRE WATER TANK.	i. Fire water tanks shall comply with **Section D, Chapter 02, Table:- D.-2-T1.9** with the duration categorized in **Section D, Chapter 11, Sub-Section 4.0.**

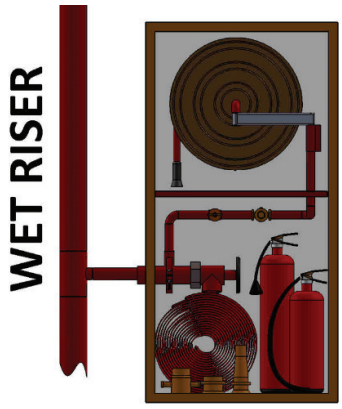

Figure:- D.03-F2.a Typical Class III wet Hose reel

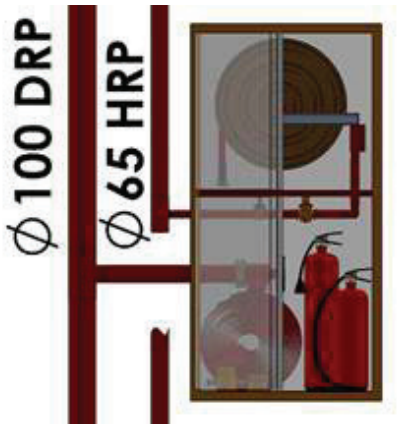

Figure:- D.03-F2.b Typical Dry Landing Valve with wet Hose reel

5.2 Generally, the fire hose reel/rack system is accompanied by a dry riser system, where the hose cabinet houses both hose reel/racks and landing valves as shown below. Such systems shall comply both with **Sub Section 4.0 and 5.0**.

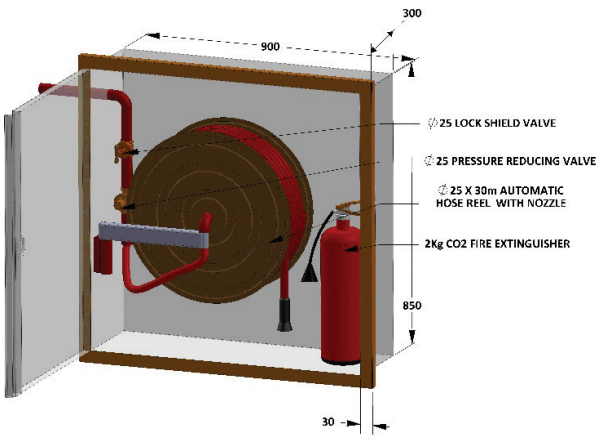

Figure:- D.03-F2.c : Class II Hose reel tapping without landing valve

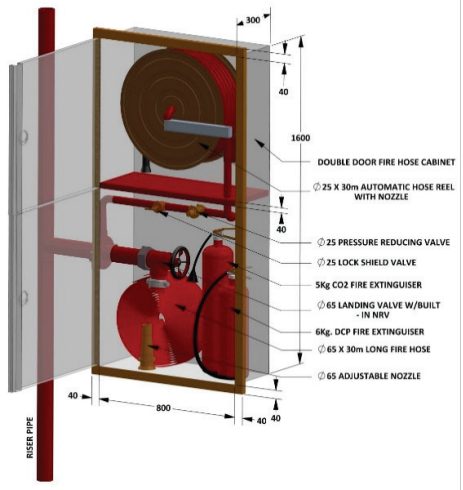

Figure:- D.03-F2.d Typical combined Hose cabinet

6.0 Wet Riser Systems

6.1. The requirements for the Wet Riser System material, design, installation shall be as per **Table:- D.03-T4.** and the General Requirements of **Table:- D.03-T1.**

Table:- D.03-T4 : Wet Riser System Requirements

ITEMS	REQUIREMENTS
1. DEFINITION	i. Wet riser systems are pressurized with water having a permanent water supply from fire water pumps and fire water storage tanks. The wet riser system comprises of one or multiple vertical riser pipes or horizontal runs of piping that feed the Landing Valve connections. These risers are connected to fire pumps and fire water storage tanks located within the buildings. A 25mm diameter for Hose Reel System or 40 mm diameter for Hose Rack system AND, 65 mm diameter for the landing Valve tapping will be made from the wet riser in each floor level and fitted with multipurpose hoses and nozzles that are placed inside a cabinet, known as Class III hose systems, for the use of the General Directorate of Civil Defence - Kingdom of Bahrain personnel or other trained firefighting personnel. In addition four way breeching inlets located at a ground level are connected to the bottom of the wet riser to pump water from the General Directorate of Civil Defence - Kingdom of Bahrain fire truck as supplementary water supply.
2. COMPONENTS	i. Fire Pumps, Controller, Fire Water Tank, Pipes, Fittings, Hose connection valve, Landing Valve, Hose Cabinet, Hose Reel/Hose Rack , Hose, Nozzle, Breeching inlet and Signs.
3. FIRE PUMP CAPACITY	i. The fire pump set shall consist of 1 Electric driven pump, 1 diesel driven pump and 1 electric Jockey pump, complete with controllers. ii. The fire Pump capacities and selection shall comply with **Section D, Chapter 01.** iii. Pump pressure shall be such that the most remote landing valve pressure shall not be less than 6.9 bar.
4. PIPES	i. Pipes shall comply to **Section D, Chapter 11, Table:- D.11-T1** ii. The minimum pipe size for serving a single 65 mm diameter hose valve shall be not less than 65 mm in diameter and the pipe line serving two or more hose valves shall be not less than 100 mm diameter. iii. Minimum wall thickness shall be as per schedule 40. iv. Pipes shall be rated for working pressure of 6.9 bar at the most remote point of the piping network. v. 25 mm Hose reel or 40 mm Hose rack and 65 mm Landing valve tapping shall be made from the same wet riser
5. FITTINGS	i. Fittings shall comply to **Section D, Chapter 11, Table:- D.11-T1** ii. Fittings shall be rated for working pressure of 6.9 bar at the most remote point of the Piping network
6. HYDRAULIC CALCULATIONS	i. The hydraulic calculation shall be performed using the General Directorate of Civil Defence - Kingdom of Bahrain listed and permitted software based on the following criteria. a. Two numbers of landing valves on top most point of the hydraulically most unfavorable wet riser providing 250 gpm flow at 7 bar per outlet and one Landing valve outlet on the topmost point of the adjacent wet risers providing 250 gpm flow at 7 bar per outlet. ii. If a horizontal wet riser system provides supply for 3 or more landing valve outlets in a floor, the hydraulic calculation shall be based on 3 numbers of landing valve at remotest point of the hydraulically most unfavorable wet riser pipe providing 250 gpm flow at 7 bar per outlet and one landing valve outlet at the topmost point of each adjacent wet riser pipes providing 250 gpm flow at 7 bar per outlet.

Table:- D.03-T4 : Wet Riser System Requirements

ITEMS	REQUIREMENTS
7. VALVE OUTLET	i. The valve outlet shall be 25 mm for the hose Reel System or 40 mm for the hose Rack System. ii. The valve outlet shall be 65 mm for the landing Valve & Fire Hose.
8. HOSE	i. The hose for the hose reel system shall be 25 mm diameter, 30 m long with a hose nozzle , wrapped on a rotating drum. ii. The hose for the Flat Fire Hose or hose rack system shall be 65mm or 40 mm diameter outlet valve respectively, 30 m long fire hose. iii. The hose for landing valve shall be 65 mm in diameter and 30 m long reinforced rubber lined (RRL) or Polyester yarn hose with multipurpose nozzle.
9. LOCATION	i. Fire Hose Cabinets (FHC) shall be within 6 m from Exit Stair door. FHC shall not be located inside the stair core. Installation of landing valve alone in the stair is not permitted as an alternative to the fire hose cabinet. ii. Fire Hose Cabinets shall consist of the following. a. 65 mm Landing Valve outlet. b. 40/25 mm outlet with Hose Reel/Hose Rack. c. CO2 Fire Extinguisher. d. Dry Chemical Powder Fire Extinguisher. e. 65mm, 30 m Fire Hose with nozzle. iii. The hose Cabinet location shall comply with **Table:- D.03-T1.1. See Figure:- D.03-F4.**

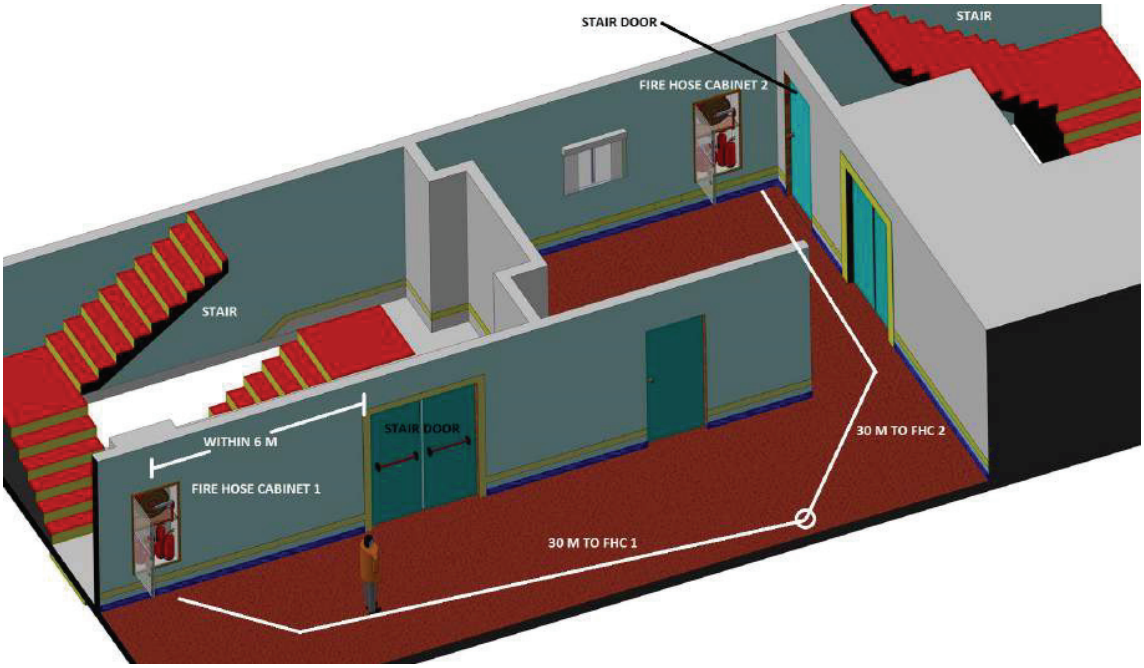

Figure:- D.03-F4 : Hose Cabinet Locations

Table:- D.03-T4 : Wet Riser System Requirements

ITEMS	REQUIREMENTS
10. NOZZLE	i. The nozzle shall comply with **Table:- D.03-T1.3**
11. SIGNAGE	i. The hose Cabinet shall have signage both in Arabic and English, clearly identifying the class and type of the hose connection as "Fire Hose Reel/Rack System"
12. BREECHING INLET	i. A 4-way breeching inlet connection having 150 mm diameter flanged outlet with 4 no's of 65 mm diameter instantaneous male coupling inlets shall be provided. ii. Breeching inlets shall also comply with requirements of **Table:- D.03-T1.8.**
13. ZONING OF WET RISERS (MULTI-LEVELS)	i. The maximum pressure anywhere in the wet riser system shall not exceed 24 bar with a fire pump set to cut-off at 140% of the rated operational pressure. ii. Where multiple wet risers are provided in other than Lowrise buildings, they shall be interconnected at the highest level they are serving. iii. The vertical wet riser system pressure exceeds 12 bar with a fire pump set to cut -off at 140% of the rated operational pressure., or when most remote landing valve is located at a height 45 m from the fire pump location, the risers shall be zoned into "High Zone" and "Low Zone" with looping as shown in **Figure D.03-F5.B .** iv. When the vertical wet riser system pressure exceeds 24 bar with fire pump set to cut-off at 140% of the rated operational pressure., or when the most remote landing valve is located at a height of 90 m from the fire pump location, the second set of fire pumps and dedicated water tanks shall be provided to feed such wet risers from that level. See **Figure:- D.03-F6.A. and Figure:- D.03-F6.B.** for illustration.
14. TEST RISERS AND DRAINS	i. Each wet riser shall have drainage arrangement, at least on every alternative floors. ii. Drain risers shall be fitted with 65 mm diameter instantaneous male coupling with a built-in spring loaded non return valve with a blank cap beside each landing valve outlet to facilitate the landing valve test during the routine testing. iii. The drain riser shall be terminated back to the fire water tank or to open drain. iv. Each wet riser shall be provided with drain arrangements having not less than 50 mm diameter on the down stream side of the riser isolation valve and where ever the riser pipe changes its direction which leaves water trapped in those sections.
15. FIRE WATER TANK.	i. Fire water tanks shall comply with **Section D, Chapter 02, Table:- D.-2-T1.9** with the duration categorized in **Section D, Chapter 11, Sub-Section 4.0.**

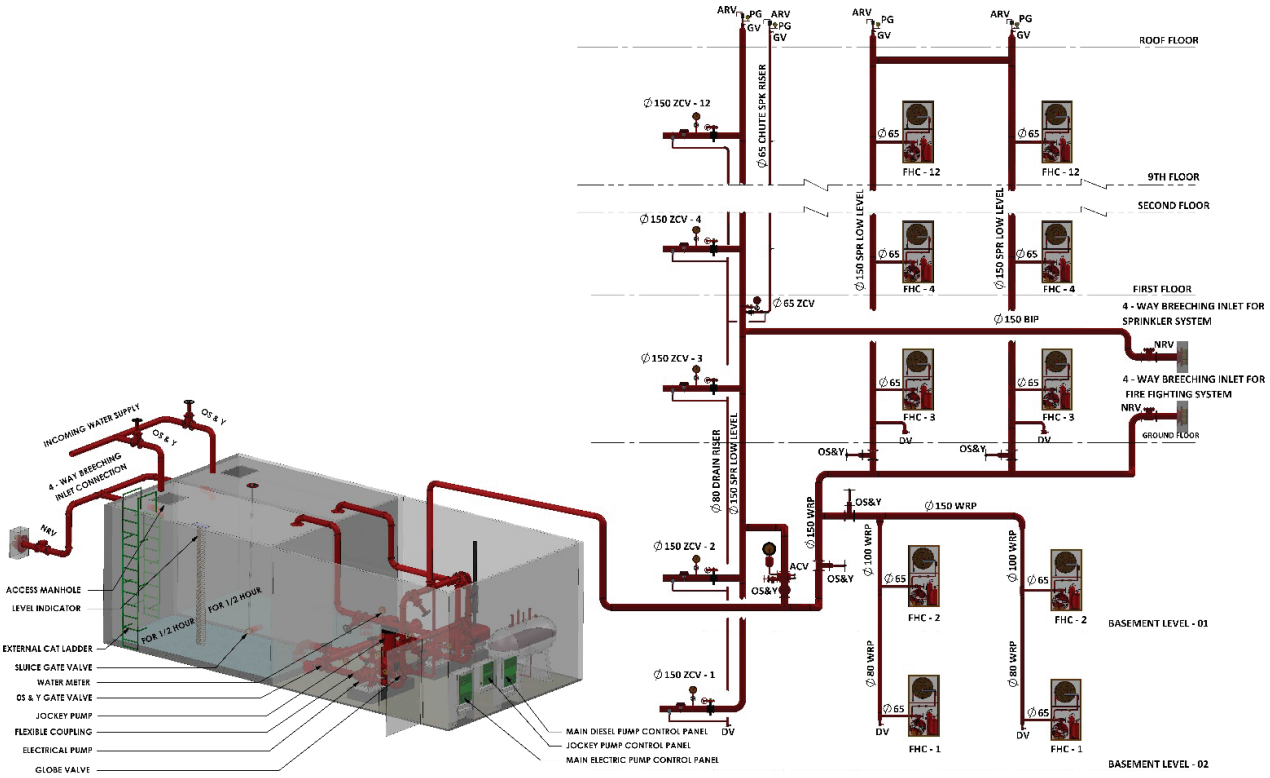

Figure:- D.03-F5.A.: Typical Wet Riser System

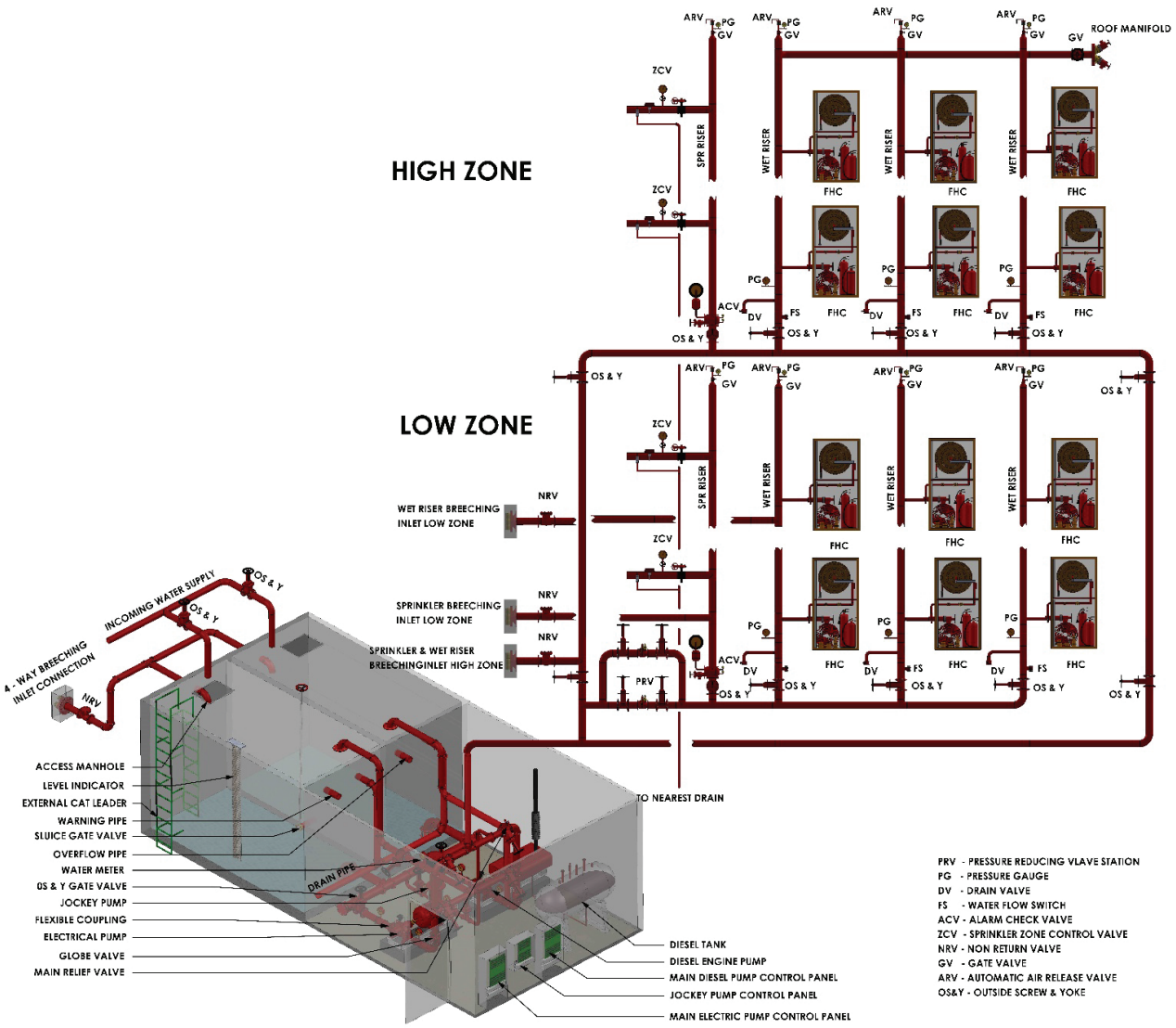

Figure:- D.03-F5.B.: Typical Wet Riser System with High Zone and Low

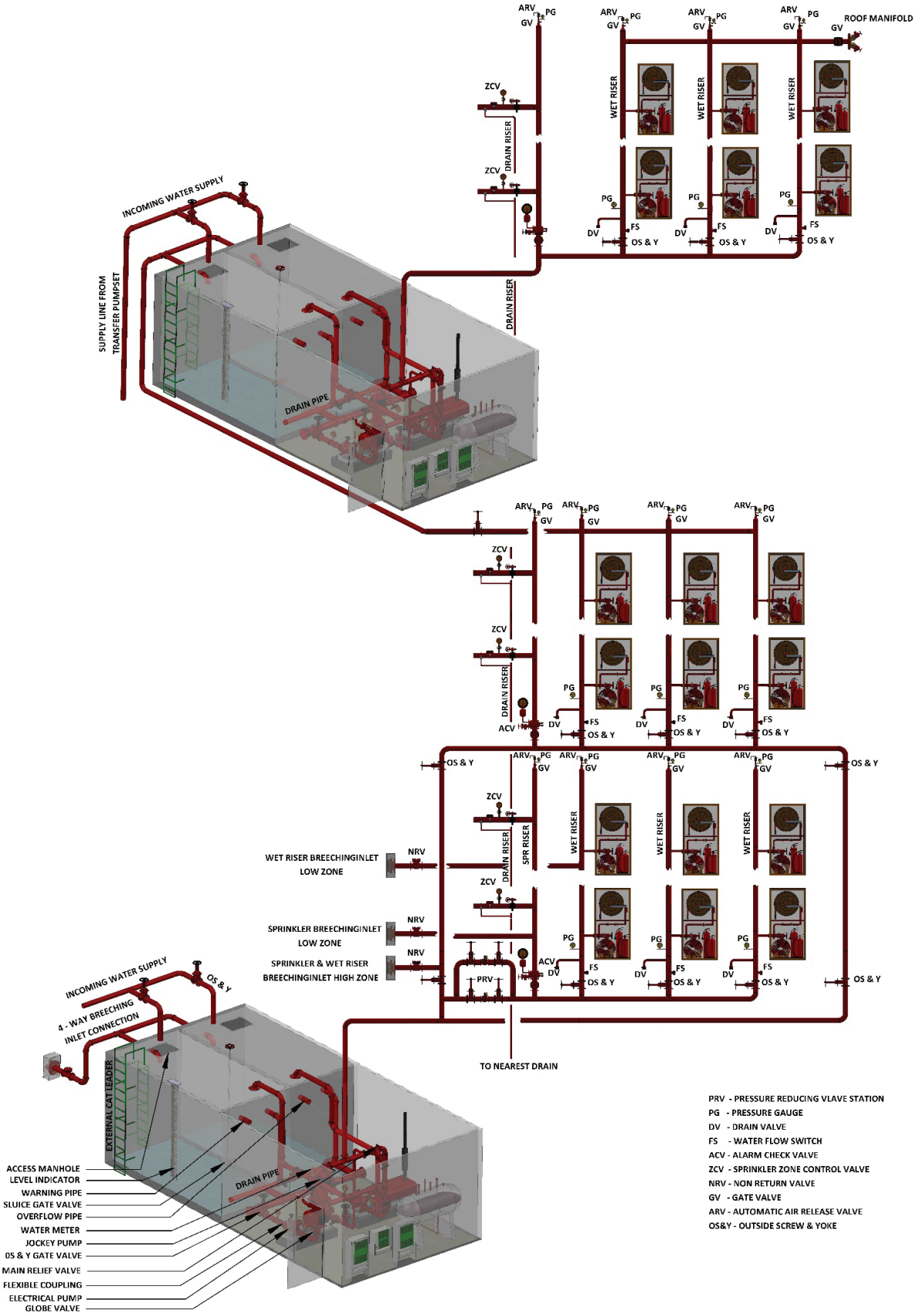

Figure:- D.03-F6.A.: Multi-level pump and water tank for Wet Riser System

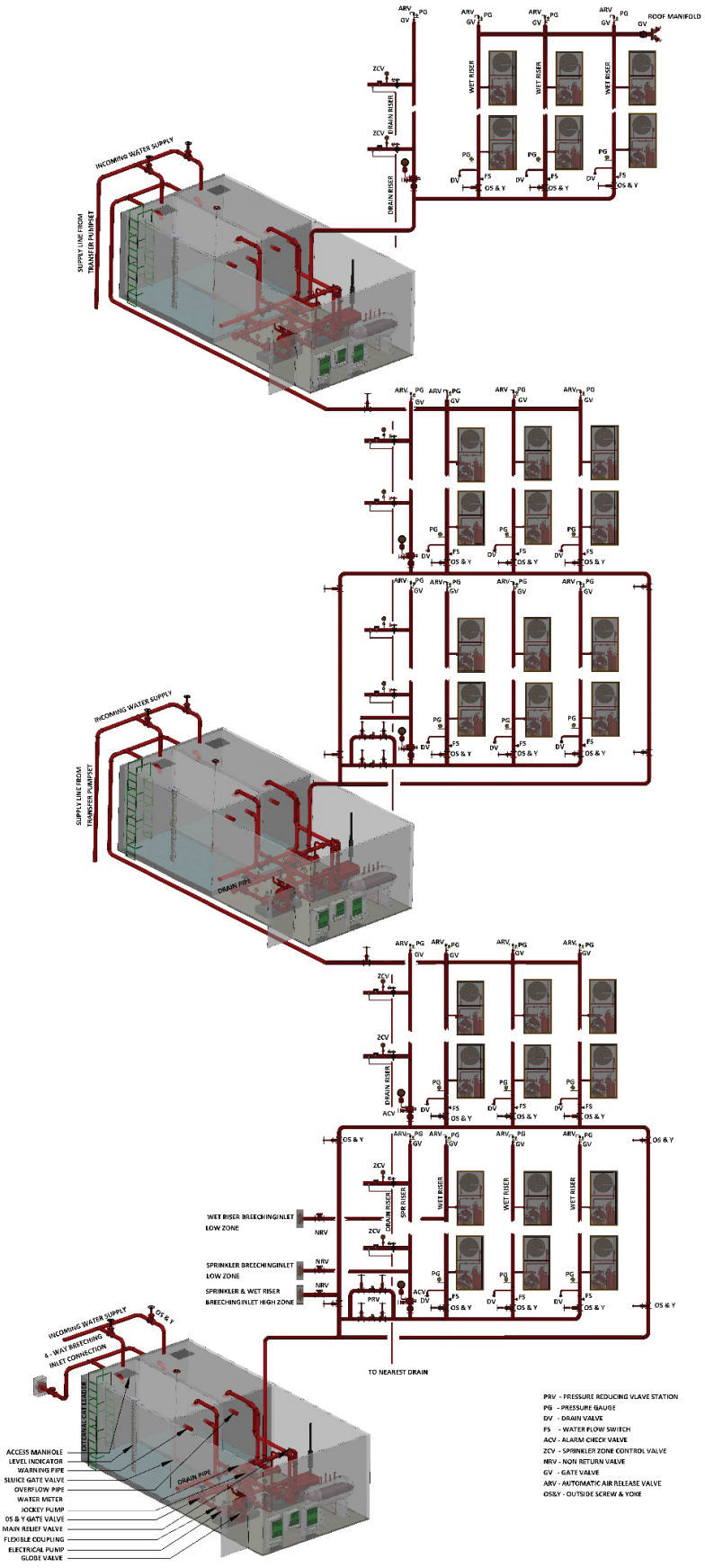

Figure:- D.03-F6.B.: Multi-level pump and water tank for Wet Riser System

7.0. Standpipe and Hose Systems (Dry/Wet) - Acceptance Test and Maintenance

7.1. Standpipe and Hose Systems shall be inspected and maintained as per minimum guidelines in accordance with **Table:- D.03-T5 .** However, detailed acceptance,

Table:- D.03-T5 : Standpipe (Dry and Wet Riser) Testing, Inspection and Maintenance

ITEM	REQUIREMENTS
1. ACCEPTANCE TEST	**1. FLUSHING** i. The underground Piping shall be flushed. ii. The piping between the fire department connection and the check valve in the in-let pipe shall be flushed with a sufficient volume of water in order to remove any construction debris and trash accumulated in the piping prior to the completion of the system and prior to the installation of the General Directorate of Civil Defence - Kingdom of Bahrain connection. iii. The minimum flow rate shall not be less than the hydraulically calculated water demand flow rate of the system plus hose demands. **2. HYDROSTATIC TEST** i. All new systems, including the yard piping and fire department connections, shall be tested hydrostatically at not less than 13.8 bar (200 psi) of pressure for 2 hours, or at 3.5 bar (50 psi) in excess of the maximum pressure where the maximum pressure is in excess of 10.3 bar (150 psi). Pressure shall be maintained for 2 hours. ii. The inside standpipe system piping shall show no leakage. iii. Any leakage that results in a loss of pressure in excess of 0.1 bar (1½ psi) during a continuous 24-hour period shall be corrected. iv. The installing contractor shall furnish a certificate for flushing and hydrostatic test prior to the start of the fire pump and field acceptance test. v. Hose connections and General Directorate of Civil Defence - Kingdom of Bahrain breeching inlet connections shall be tested for compatibility (connections are instantaneous coupling type). vi. The piping between the fire department connection and the check valve in the inlet pipe shall be tested hydrostatically in the same manner. vii. During the hydrostatic test, the pressure gauge at the top of each standpipe shall be observed and the pressure recorded. **3. FIELD ACCEPTANCE TEST** i. Testing shall be conducted while fire pumps are running for wet riser systems. ii. The water supply shall be tested to verify compliance with the design. This test shall be conducted by flowing water from the hydraulically most remote hose connections. iii. For a Dry Riser standpipe, a fire department pumper or portable pump of a capacity to provide required flow and pressure shall be used to verify the system design by pumping into the fire department connection. iv. A flow test shall be conducted at each roof outlet to verify that the required pressure is available at the required flow. v. The maximum flow to be demonstrated from a single hose connection shall be 946 L/min (250 gpm) for a 65-mm (2½-in.) connection and (379 L/min) 100 gpm for a 40-mm (1½-in.) connection and 50 gpm for a 25 mm connection.

Table:- D.03-T5: Standpipe (Dry and Wet Riser) Testing, Inspection and Maintenance

ITEM	REQUIREMENTS
1.ACCEPTANCE TEST	vi. The filling arrangement for suction tanks shall be verified by shutting down all supplies to the tank, draining the tank to below the designated low water level, and then opening the supply valve to ensure operation of its automatic features. vii. Each pressure-regulating device shall be tested to verify that the installation is correct, that the device is operating properly, and that the inlet and outlet pressures at the device are in accordance with the design. viii. Signs, both in English and Arabic shall be verified on site. ix. The consultant shall hand over one set of stamped record drawings and one copy of the completed test report to the building owner.
2. WEEKLY INSPECTION	**VISUAL OBSERVATION** i. The piping is free of leakage. ii. Pressure gauges are in good condition and reading are satisfactory. iii. The hose cabinet is in good condition and contains equipment, nozzle, hose and hose outlets as per design (Class I, II or III). iv. The landing valve and Hose outlets' caps are in good condition and in place. v. There are no obstructions to the Fire Hose Cabinet.
3. MAINTENANCE	i. Hose connection caps shall be replaced where missing or damaged. ii. Valves shall be lubricated to ensure their smooth operation. iii. Hose, gaskets, nozzles shall be inspected for damage by removing from the cabinet and reeled back into racks or stands. iv. The hose shall always be connected to hose outlet valve. v. Repair any leakages in the piping, valves and joints. vi. Lubricate hose cabinet doors and replace them if corroded. vii. Fire extinguishers in the cabinet shall be in a good working condition with satisfactory pressure readings. viii. Pumps and controllers of the system shall be tested, maintained as per **Table:- D.11-T15.**
4. ANNUAL TESTING	i. A flow test shall be conducted every year on all standpipe systems to verify that the required flow and pressure are available at the hydraulically most remote hose valve outlet(s) while flowing the standpipe system demand. ii. The standpipe system demand shall include 500 gpm (1892 L/min) for the first standpipe and 250 gpm (946 L/min) for each additional standpipe until the total system demand is simultaneously flowing. iii. The 250 gpm (946 L/min) required from each additional standpipe shall be allowed to be flowed from the most convenient hose valve on that standpipe. iv. A main drain test shall be performed on all standpipe systems. v. Pressure and flow gauges shall be replaced every 5 years. vi. Any parts that need to be repaired or replaced shall be handled through General Directorate of Civil Defence - Kingdom of Bahrain permitted fire contractor.



Chapter 4 Fire Hydrant Systems

Section D

Chapter 4

Fire Hydrant Systems



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1.0 SCOPE

1.1 This code provides general information on External Fire Hydrant, Fire service main and its design, installation, approvals, listing, inspection and maintenance.

1.2 To provide a reasonable degree of protection for life and property from fire through installation requirements for private fire service main system.

2.0. Definitions

2.1. General

2.1.1. Shall

It is a mandatory requirement by General Directorate of Civil Defence – Kingdom of Bahrain.

2.1.2. Should

It is a recommendation but it is not mandatory by General Directorate of Civil Defence - Kingdom of Bahrain.

2.1.3. Listed

Permitted and registered by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain.

2.1.4. Bar (bar)

Unit of measurement for pressure. Though it is not a SI unit, it is a common practice to use this unit of measurement in fire protection.

2.1.5. Unit of Measurement

The Unit of Measurement in this code are international system of units. (SI).

- 1 gal = 3.785 L
- 1 gpm/ft^2 = (40.746 L/min)/ m^2
- 1 gal = 3.785 dm^3
- 1 psi = 6894.757 Pa
- 1 psi = 0.0689 bar
- 1 bar = 10^5 Pa

2.1.6. GPM (Gallons per minute)

Unit of measurement for flow. Though it is not a SI unit, it is widely a practice to use this unit of measurement for water flow per square feet in fire protection.
1 GPM (gpm/minute) = 3.78 Liter/minute (LPM)

2.1.7 Fire Service Access Level

Level where General Directorate of Civil Defence - Kingdom of Bahrain Fire Appliances (Fire Truck/Engine) are deployed and where fire fighters have direct access into the building .

2.1.8 Fire Access Roadway

The road to the building or structure to allow access for General Directorate of Civil Defence - Kingdom of Bahrain firefighting and rescue apparatus.

2.1.9. Fire Accessway

The path adjacent to the building or structure to allow operational setup for General Directorate of Civil Defence - Kingdom of Bahrain firefighting and rescue apparatus such as Aerial Appliances.

2.1.10 Rated Capacity

The flow available from a hydrant at the designated residual pressure (rated pressure), either measured or calculated.

2.1.11 Residual Pressure

The pressure that exists in the distribution system, measured at the residual hydrant at the time the flow readings are taken at the flow hydrants.

2.1.12 Static Pressure

The pressure that exists at a given point under normal distribution system conditions measured at the residual hydrant with no hydrants flowing.

2.1.13 Dry Barrel Hydrant

A type of Hydrant with the main control valve below the frost line between the foot piece and the barrel.

2.1.14 Wet Barrel Hydrant

A type of hydrant that is intended for use where there is no danger of freezing weather and where each outlet is provided with a valve and an outlet.

2.1.15 Flow Hydrant

The Hydrant that is used for measuring static and residual pressure during a flow test.

2.1.16 Private Hydrant

A valved connection on a water supply system having one or more outlets that is used to supply hose and fire department pumpers with water on private property.

2.1.17 Public Hydrant

A valved connection on a water supply system having one or more outlets that is used to supply hose and fire department pumpers with water.

2.1.18 Residual Hydrant

The Hydrant that is used for measuring static and residual pressure during a flow test.

3.0 Fire Hydrant

3.1. General Requirements

3.1.1. The General requirements for Yard Hydrant System material and components shall **Table:- D.04-T1.**

Table:- D.04-T1 : Yard Hydrant System Requirements

ITEMS	REQUIREMENTS
1. DEFINITION	i. A fire hydrant system is a water supply with a sufficient pressure and flow delivered through pipes around the protected premises, at open yards or along the fire access road in public spaces to a strategically located network of hydrant valves for fire-fighting purposes or to refill the General Directorate of Civil Defence - Kingdom of Bahrain water tankers. ii. Consideration should be given to establish Public Fire Hydrant System as part of infrastructure. iii. Private Fire Hydrant Systems are the Hydrant network System provided on private property specifically to protect the buildings and structures within that particular property.
2. APPLICATION	i. Where a private Fire Hydrant network is required by the General Directorate of Civil Defence - Kingdom of Bahrain, the Fire Hydrant network system shall be 'dedicated'. Combined networks with irrigation, processes or domestic use are not allowed. ii. All new developments greater than 20,000 m^2 shall be provided with private yard hydrant system. iii. All storage, warehouse and factories, having a built area and/or storage yard exceeding 3600 m^2 shall be provided with a private yard hydrant system.
3. COMPONENTS	i. Fire Pumps, Control System, Fire Water Tank, Pipes, Fittings, Hydrant pillar with instantaneous coupling valve outlets, pressure gauges, Isolation valves, Hose, Signs. ii. All components of the yard hydrant system shall be listed and permitted by General Directorate of Civil Defence (GDCD). iii. System components shall be rated for the maximum working pressure to which they are exposed, but not less than 12.1 bar (175 psi).
4. HYDRANTS	i. Hydrants shall not be less than 6 inch. (152 mm) in diameter. ii. Hydrants shall be of wet type and above ground. iii. Hydrant outlet shall be of instantaneous coupling for hose connection.
5. VALVES	i. Valves shall comply to **Section D, Chapter 11, Table:- D.11-T1.**

4.0 Design and Installation

4.1 The General requirements for Yard Hydrant System design, installation shall be as per **Table:- D.04-T2.**

Table:- D.04-T2 : Yard Hydrant System Requirements

ITEMS	REQUIREMENTS
1. FLOW AND PRESSURE	i. The minimum flow rate for each fire hydrant shall be 500 Gallons per Minute at 250 gpm per outlet (1900 LPM at 950 LPM/outlet). ii. Two number of fire hydrants shall be considered for hydraulic demand calculations which is, a total flow requirement of 1000GPM (3800 LPM) per single yard hydrant system. iii. The minimum Pressure required for the most remote fire hydrant in the system loop is 6.9 bars. iv. Private Fire Hydrant Water supply for high hazard occupancies shall be for 2 hours.
2. PIPING	i. Pipes and Fittings used for the fire Hydrant system shall be permitted and registered by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain. ii. Steel piping shall not be used for general underground service. iii. The type and class of pipe for a particular underground installation shall be determined through consideration of factors such as Corrosion, working pressure and temperature, soil conditions, susceptibility of pipe to external loads of earth and traffic. iv. The underground Hydrant piping shall be HDPE (High Density Polyethylene), with a minimum of standard dimension ratio (SDR) 9.
3. WATER	i. The water for the Hydrant System shall be potable. ii. TSE (Treated Sewage Affluent) water, tested and permitted by relevant authority for firefighting purposes shall be acceptable. iii. Lake and Pond (Sweet) water shall be acceptable, provided that an adequate water level reserve is ensured at all times.
4. INSTALLATION	i. Hydrants shall be installed along the fire access road around the premises to be protected. ii. The hydrant piping shall be looped without open ends, such that any isolation from one side will not hamper the water supply from the other end to any hydrant. iii. The maximum allowed hydrant piping wing without looping is 45 m. iv. The piping shall not be installed beneath buildings. v. The Depth of the piping shall be measured from the top of the pipe to the final grade. vi. A pipe under driveways shall be buried at a minimum depth of 0.9 m. (A) (Figure:- D.04-F1) vii. A pipe under railroad tracks shall be buried at a minimum depth of 1.2 m. (A) (Figure:- D.04-F1) viii. Valves shall be installed within 6.1 m (B) of the hydrant (Figure:- D.04-F1) ix. Hydrants shall be set on flat stones or concrete slabs and shall be provided with small stones (or the equivalent) placed around the drain to ensure drainage. x. The center of a hose outlet shall be not less than 457 mm and not more than 914mm above final grade. xi. Hydrants shall be protected with barricades if subject to mechanical damage, Vehicular accidents. Such means of hydrant protection shall be arranged in a manner that does not interfere with the connection to, or operation of, hydrants. xii. Check Valves, Detector Check Valves and Backflow Prevention Valves shall not be installed in the service stub between the fire hydrant and the water supply piping. xiii. All hydrants shall be with an isolation valve connection in a valve chamber.

5. LOCATION AND SPACING	i. Fire hydrants shall be located at not less than 2 m and not more than 12 m from the building to be protected. ii. The spacing between Hydrants along the fire access road shall be as follows. a. Occupancies other than storage and industrial shall be 120 m. b. Light and Ordinary hazard Storage/Industrial occupancies shall be 100 m. c. High Hazard storage and industrial occupancies shall be 60 m. d. Logistics warehouse and Waste dumping lands shall be 60 m.

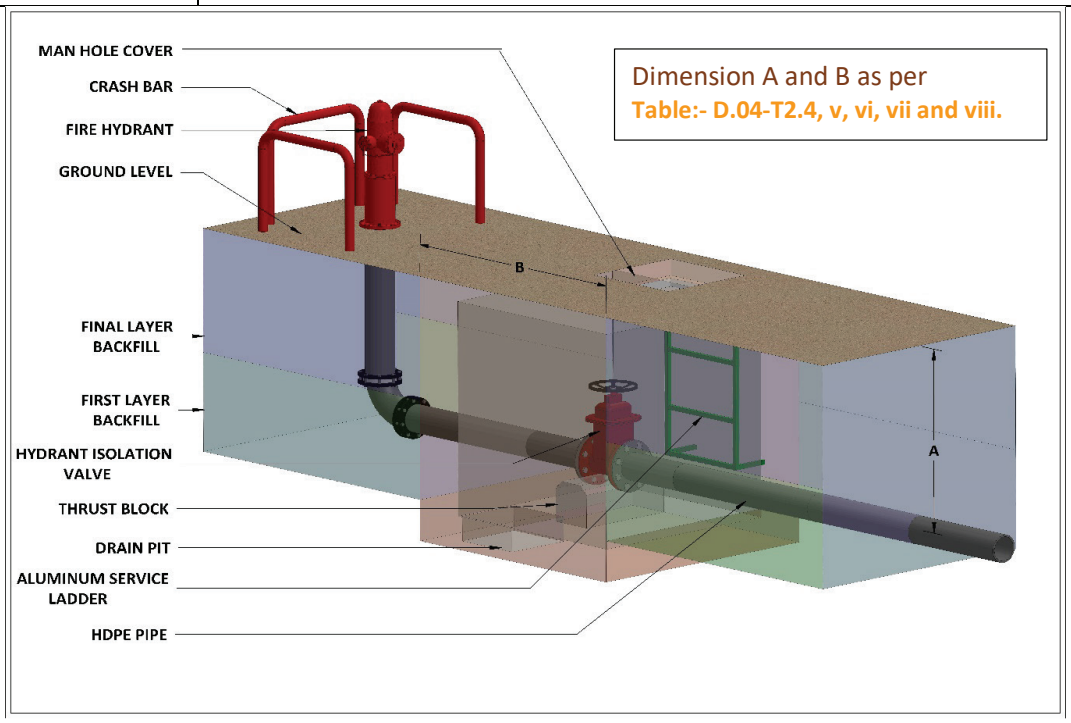


Figure:- D.04-F1 : Hydrant Typical Installation and Isolation valve chamber

5.0. Inspection and Maintenance.

5.1. Inspection and acceptance shall be the main consultant's responsibility.

5.2. The main consultant shall inspect the contractor's work during installations and ensure that equipments are installed, tested, commissioned and performing as per the General Directorate of Civil Defence approved drawings and their intended purpose.

5.3. The consultant shall handover the system inspection and acceptance reports and the maintenance manuals to the owner.

5.4 Fire Hydrant shall be inspected and maintained as per minimum guidelines in accordance with **Table:- D.04-T3.** However, detailed acceptance, inspection tests and maintenance shall be as per **Manufacturer's instruction manual**, **NFPA 20, NFPA 24 and NFPA 25.**

Table:- D.04-T3 : Fire Hydrant Testing, Inspection and Maintenance

ITEM	REQUIREMENTS
1. ACCEPTANCE TEST	**1. FLUSHING** i. The underground Piping shall be flushed after completing installation and before energizing the system. ii. The piping between the Fire Hydrant connection and the valve in the inlet pipe shall be flushed with a sufficient volume of water in order to remove any construction debris and trash accumulated in the piping prior to the completion of the system and prior to the installation of the General Directorate of Civil Defence connection. iii. The minimum flow rate shall not be less than the hydraulically calculated water demand flow rate of the system. **2. HYDROSTATIC TEST** i. The following procedure is for pressure testing a hydrant above line pressure. This test may be performed to verify that hydrant is leak free at rated working pressure (i.e., 200 psi) ii. The pressure shall be maintained for 2 hours. iii. The installing contractor shall furnish a certificate for flushing and hydrostatic test iv. Consultant shall hand over one set of stamped record drawings and one copy of the completed test report to the building owner. V. Flow measurements should be periodically recorded for each hydrant as per
2. INSPECTION	**1. VISUAL OBSERVATION** i. Hydrants should be inspected and exercised at least annually ii. A record should be kept on the performance of routine maintenance by the Building maintenance contractor as part of Annual Maintenance contract, findings during inspection, and recommended actions. iii. Piping is free of leakage. iv. inspect hydrant inlet flange joint, outlet nozzles, valve seats, and stem inserts for leaks. v. Inspect cap chains and cap rings for binding. Cap rings should rotate freely. vi. Inspect outlet nozzle threads for damage or foreign material buildup vii. Visually inspect the valve disc from the outlet nozzle opening.

6.0. Material Test Standards and Approval.

6.1. Acceptable Test Standards and criteria

6.1.1. Underground Pipes and Fittings

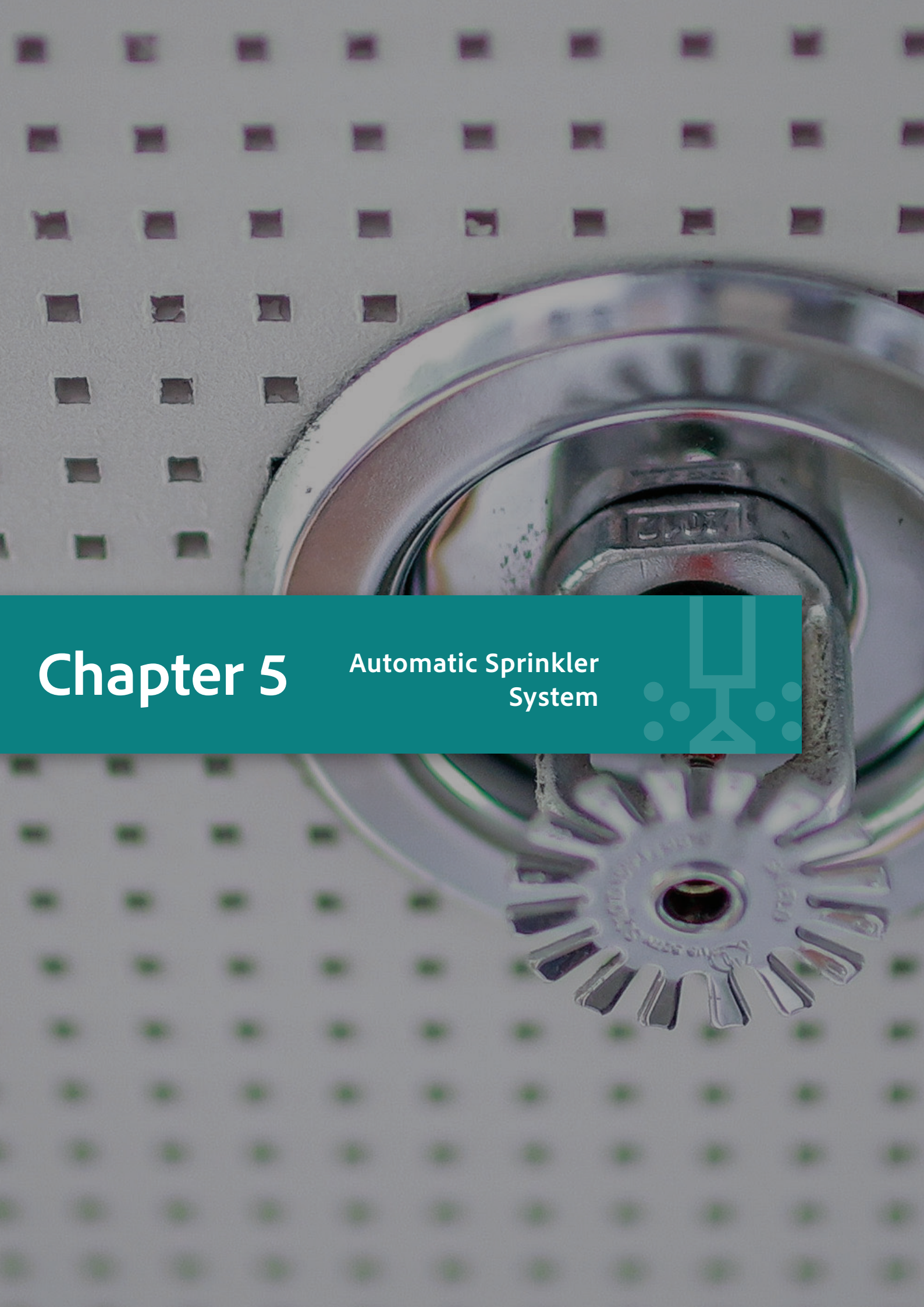
i. FM 1613, Approval Standard for Polyethylene (PE) Pipe and Fittings for underground fire protection service, in accordance with NFPA 24 and AWWA C906, minimum DR-9 with temperature and pressure rating not less than the system working pressure.
ii. FM 1614, Approval Standard for Fiber Reinforced Composite (FRC) Pipes and Fittings for underground fire protection service.
iii. FM 1620, Approval Standard for Pipe joints and anchor fittings for underground fire protection service.
iv. UL 1285 Pipe and Couplings, Polyvinyl Chloride (PVC), and Oriented Polyvinyl Chloride (PVCO) for Underground Fire Service
v. UL 1713 Pressure Pipe and Couplings, Glass Fiber-Reinforced, for Underground Fire Service
vi. UL 194 Gasketed Joints for Ductile-Iron Pipe and Fittings for Fire Protection Service

6.1.2. Valves

i. FM 1120, 1130, Fire Service Water Control Valves (OS & Y and NRS Type Gate Valves)
ii. FM 1111, Approval Standard for Post Indicator Valve assembly
iii. FM 1112, Indicating Valves (Butterfly or Ball Type)
iv. UL 2573, Air release valve
v. UL 668, Hose Valves for Fire Protection Service
vi. UL 262, Gate Valves for Fire Protection Service
vii. UL 1091, Butterfly Valves for Fire Protection Service
viii. BS 5041-1, Fire hydrant systems equipment. Specification for landing valves for wet risers.
ix. BS 5041-2, Fire hydrant systems equipment. Specification for landing valves for dry risers.
x. BS 5041-4, Fire hydrant systems equipment. Specification for boxes for landing valves for dry risers.
xi. BS 5041-3, Fire hydrant systems equipment. Specification for inlet breechings for dry Riser inlets.
xii. BS 5041-5, Fire hydrant systems equipment. Specification for boxes for foam inlets and dry riser inlets.
xiii. BS 5154, Gate Valve.

6.1.3. Yard Hydrant System, Wet Barrel, above ground

i. UL 246, Standard for Hydrants for Fire Protection.
ii. FM 1510/1511 - Fire Hydrants (Dry/Wet Barrel Type) for Private Fire Service.
iii. EN 1074-6, Fitness for verification test, Hydrants



Chapter 5

Automatic Sprinkler System

Section D

Chapter 5

Automatic Sprinkler System



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1.0 Scope

1.1 This standard provides the minimum requirements for the design and installation of automatic fire sprinkler system and exposure protection sprinkler system covered within this chapter.

1.2 This chapter is written with the assumption that the sprinkler system shall be designed to protect against a single fire originating within the building.

1.3 To enable designers and owners to choose Sprinkler system and its design criteria appropriately according to the hazard.

1.4 Definition of various types sprinkler system such as dry type and Pre-action system.

1.5 To Ensure Fire systems are designed, installed, Inspected and Maintained as per international standards.

2.0 Definition

2.1. General

2.1.1. Shall

It is a mandatory requirement by General Directorate of Civil Defence – Kingdom of Bahrain.

2.1.2. Should

It is a recommendation but it is not mandatory by General Directorate of Civil Defence - Kingdom of Bahrain.

2.1.3. Listed

Permitted and registered by General Directorate of Civil Defence (GDCD) –Kingdom of Bahrain.

2.1.4. Bar (bar)

Unit of measurement for pressure. Though it is not a SI unit, it is a common practice to use this unit of measurement in fire protection.

1 Bar = 14.5 psi.

1 psi = 0.0689 bar.

2.1.5. US Gallons (Gal.)

Unit of measurement for volume. Though it is not a SI unit, it is a common practice to use this unit of measurement for water volume in fire protection.

1 Gal. = 3.785 L (Liters)

1 L = 0.264 Gal.

1 Cubic Meter = 1000 L

1 Cubic Meter = 264.17 Gal.

2.1.6. Unit of Measurement

Unit of Measurement in this code are international system of units. (SI).

- 1 in. = 25.4 mm
- 1 ft = 0.3048 m
- 1 in^2. = 645.2 mm^2
- 1 ft^2 = 0.0929 m^2
- 1 in^3. = 16,387 mm^3
- 1 ft^3 = 0.02832 m^3
- 1 fl oz = 0.029571 gal = 3.785 L
- 1 gpm = 3.7848 L/min
- 1 psi = 0.0689 bar
- 1 gpm/ft^2 = (40.746 mm/min
- 1 gpm/ft^2 = (40.746 L/min)/ m^2
- 1 gpm/$(psi)^2$ = 14.285 L/min. (bar)
- 1 lb = 0.4536 Kg
- 1 lb/ ft^3 = 16.02 Kg/m^3
- F° = 9/5 x C° +32
- C° = 5/9 (F°-32)
- 1 mph = 1.609 km/h
- 1 lb force = 4.44822 N
- 12 gauge = 2.8 mm
- 14 gauge = 1.98 mm
- 16 gauge = 1.57 mm
- 22 gauge = 0.78 mm
- 24 gauge = 0.63 mm

2.1.7. GPM (Gallons per minute)

Unit of measurement for flow. Though it is not a SI unit, it is widely a practice to use this unit of measurement for water flow per square feet in fire protection.
1 GPM (gpm/minute) = 3.78 Liter/minute (LPM).

2.1.8. Breeching inlet

A connection through which the General Directorate of Civil Defence - Kingdom of Bahrain fire department can pump supplemental water into the sprinkler system, standpipe, or other system, furnishing water for fire extinguishment or to supplement existing water supplies. **See Section D, Chapter 11, Table D.11-T1.**

2.1.9. Fire Suppression

Sharply reducing the heat release rate of a fire and preventing its regrowth by means of direct and sufficient application of extinguishing agents such as water or gas or chemicals through the fire plume to the burning fuel surface.

2.1.10. Water based Fire Protection Systems

Water is the most widely used and available fire-extinguishing agent. Water is effective in fire suppression. The techniques and mechanisms using water and its heat absorbing, cooling and fire extinguishing properties to fight and extinguish fires are Water Based Fire Protection Systems such as Automatic Sprinkler Systems, Dry Sprinkler and Pre-action sprinkler Systems.

2.1.11. High-Challenge Fire Hazard

A fire hazard typical of that produced by fires in combustible high-piled storage.

2.2. Hazard Classification for Sprinkler Protection

2.2.1. Light Hazard

The areas and occupancies which and contain low quantity and low combustible materials which are expected to release low heat release rates during fire condition shall be classified as light hazard occupancies. Occupancies considered as light hazard may include:

a. Assembly, Group C
(Art galleries, Community halls, Mosques, Churches, Temples, Court- rooms, Funeral parlors, Gymnasiums, Fitness Centers, Seminar halls, Libraries, Museums, Open air Theaters, Amphitheaters, Parks, Beaches)

b. Assembly, Group B
(Amusement Parks, Grandstands, Stadiums, Bleachers, Swimming Pools, Skating Rinks, Indoor Kid's Play Areas, Bowling alleys, Pool/billiard parlors, waiting areas in transportation terminals, Airport Terminal Buildings, Restaurant seating areas, Food courts seating areas)

c. Educational, Group A
(Nurseries, Kindergartens, Preschool center, Talent Grooming centers for kids)

d. Educational, Group B
(Schools for up to 12th grade students)

e. Educational, Group C
(Colleges, Universities, Training centers for adults)

f. Healthcare, Group B
(Clinics)

g. Healthcare, Group C
(Ambulatory healthcare centers)

h. Residential, Group A
(Residential buildings, Apartments, assisted Living homes)

i. Residential, Group B
(Staff accommodation, Hostels, Monasteries, School boarding house)

j. Residential, Group C
(Labor accommodation)

k. Daycare, Group A
(Child day care, old age day care)

l. **Daycare, Group B**
(Adult day care)

m. Detention and Correctional, Group A
(Adult Prisons, Adult Detention centers, Adult Jails, Adult Correctional centers, Adult Pre-release centers)

n. Detention and Correctional, Group B
(Juvenile Prisons, Juvenile Detention centers, Juvenile Correctional centers)

o. Detention and Correctional, Group C
(Medical quarantines, Airport quarantines)

p. Industrial, Group C
(Beverages (non-alcoholic), Brick and masonry, Gypsum, Ice, Metal products (fabrication and assembly), Telecommunications signal processing, Telephone exchanges, GSM Switching Stations)

q. Animal Housing, Group A
(Animal Market, Pet Shops, Bird Market, Veterinary Clinic)

r. Animal Housing, Group C
(Zoo)

2.2.2 Ordinary Hazard, Group 1

The areas and occupancies which contains medium quantity and moderate combustible materials and the storages up to 2.4 meters which are expected to release moderate heat release rates during fire condition shall be classified as Ordinary Hazard group-1. Occupancies considered as ordinary hazard are:

a. Assembly, Group A
(Banquet halls, Night clubs, Discos, Restaurants with more than 50 people, Pubs, Bars, Theaters, Concert Halls, Cinemas, Indoor Stadiums, Studios with audience, Exhibition halls, Casinos)

b. Hotel, Group A
(Hotels, Hotel apartments, time share properties)

c. Hotel, Group B
(Dormitories, Motels, Lodging)

d. Hotel, Group C
(Resorts)

e. Mercantile, Group A
(Hardware Stores, Paint Stores, Chemical Stores, Furniture Stores, Motor Vehicle Showrooms, Restaurants)

f. Mercantile, Group B
(Department Stores, Supermarkets, Hypermarkets, Shopping Centers, Anchor stores, Showrooms, Retail stores, Whole sale stores, Boutiques, Drugstores, Gift Shops)

g. Storage, Group C
(Frozen Food, Asbestos, Glass or ceramic, Cement in bags, Chalk and crayons, Dairy products in nonwaxed coated paper containers, Dry cell batteries, Electrical coils, Electrical motors, Empty cans, Foods in non- combustible containers, Fresh fruits and vegetables in nonplastic trays or containers, Frozen foods, Glass bottles, empty or filled with noncombustible liquids, Gypsum board, Inert pigments, Ivory, Meats, Metal cabinets, Metal desks with plastic tops and *trim* Metal parts, Metals, Mirrors, Oil-filled and other types of distribution transformers, Parking garages, open or enclosed, Porcelain and pottery, Stoves, Talc and soapstones, Washers and dryer)

h. Industrial, Group B
(Appliances, Athletic equipment, Automobiles, Bakeries, Beverages (alcoholic), Bicycles, Boat building, Brooms or brushes, Business ma- chines, Cameras and photo equipment, Cold Storage, Canvas or similar fabric, Carpets and rugs, Clothing, Construction, Disinfectants, Dry- cleaning /dyeing, Electric light plants and power houses, Substations, Electronics, Engines, Food processing,)

2.2.3. Ordinary Hazard, Group 2

The areas and occupancies which are used for commercial & industrial uses and contain medium quantity and moderate to high combustible materials and the storages up to 3.6 meters which are expected to release moderate heat release rates and the storages up to 2.4 meters which are high heat release rates during fire condition shall be classified as Ordinary Hazard group-2, such as;

a. Animal Housing, Group B
(Stable, Animal sheds, Livestock Shelter, Slaughter Houses)

b. Malls, Group A
(Covered Malls)

c. Industrial, Group B
(Paper and pulp mill, Paper process plants, Piers and wharves, Plastics fabrication, including blow molding, extruding, and machining; excluding operations using combustible, hydraulic fluids, Post offices, Printing and publishing, Racetrack stable/kennel areas, including those stable/kennel areas, barns, and associated buildings at state, county, and local fairgrounds, Repair garages, Resin application area, Stages, Textile manufacturing, Tire manufacturing, Tobacco products manufacturing, Wood machining, Wood product assembly).

2.2.4. Extra Hazard, Group 1

The areas and occupancies which are used for industrial uses and contains high quantity and very high combustible materials which will support fast development of fire and are expected to release very high heat release rates during fire condition and having less or no combustible or flammable liquids & gases shall be classified as Extra high hazard group 1. Occupancies with high hazard, Group 1 are:

a. Storage/Industrial, Group B
(Storage and activities involving Aircraft hangar, Bags: cloth/burlap/ paper, Bamboos and rattan, Baskets, Belting: canvas/leather, Books and paper in rolls or packs, Boots and shoes, Buttons, Cardboard , its boxes, Clothing, woolen wearing apparel, Cordage, Dry boat storage (indoor), Furniture, Furs, Glues, mucilage, pastes, Grains, Horns and combs, other than celluloid, Leather, Linoleum, Lumber, Motor vehicle repair garages, Photo engravings, Resilient flooring, Silks, Soaps, Sugar, Tobacco, cigars, cigarettes and snuff etc.

Upholstery and mattresses, Wax candles, Combustible hydraulic fluid use areas, Die casting, Metal extruding, Plywood and particleboard manufacturing, Printing using inks having flash points below 100°F, (38°C)+, Rubber reclaiming, compounding, drying, milling, vulcanizing, Saw mills, Textile picking, opening, blending, garneting, or carding, combining of cotton, synthetics, wool shoddy, or burlap Upholstering with plastic foams)

2.2.5. Extra Hazard, Group 2

The areas and occupancies which are used for industrial uses and contain moderate to high quantity of flammable & combustible liquids and gases which will support rapid growth of fire and expected to release very high heat release rates during fire condition shall be classified as Extra High Hazard group 2.

a. Storage/Industrial, Group A

(Storage and activities involving Explosives, Detonators, Pyrophoric material, Unstable (Reactive) material, Organic Peroxide, Oxidizer, Fire Works, Aerosols Level 1,2,3, Combustible Liquid Class I, II, III, Combustible Fiber, Combustible Dust, Pyrotechnic Material, Cryogenics, Flammable, Oxidizing, Flammable Gas, Flammable Liquid, IA, IB, IC, Flammable Solid, Oxidizing Gas, Water Reactive Material, Perfumes, Baled Cotton, Corrosive Material, Toxic Material, Plastic products, Tires, Asphalt saturating, Flammable liquids spraying, Flow coating, Manufactured home or modular building assemblies, where finished enclosure is present and has combustible interiors), Open oil quenching, Plastics manufacturing, Solvent cleaning, Varnish and paint dipping etc.)

b. Parking, Group B

(Robotic, Mechanical parking)

2.2.6. Commodity Class –I

Class I commodity are the noncombustible materials that are

a. stored directly on wooden pallets
b. single layer corrugated cartons with or without pallets
c. Or shrink wrapped or paper wrapped as unit load with or without pallets.

See **Table:- D.05-T2**

2.2.7. Commodity Class-II

Class II commodity are the noncombustible materials that are stored in slatted wooden crates, solid wood boxes, multiple-layered corrugated cartons, or other similar combustible packaging material, with or without pallets. See **Table:- D.05-T2**

2.2.8. Commodity Class-III

Class III commodity are the materials manufactured from wood, paper, natural fibers or Group C plastics with or without cartons, boxes or crates and with or without pallets. The materials that contain 5% by volume or by weight of group C plastics products may also be considered as class 3 commodities. See **Table:- D.05-T2**

2.2.9. Commodity Class-IV

Class IV commodity are the materials manufactured from group B plastics or from free flowing group A plastics or contain within itself or its packing 5 – 15 % by weight or by volume of group A plastics. See **Table:- D.05-T2**

2.2.10. Group –A Plastics

Examples of Group A plastic materials are ABS (acrylonitrile-butadiene-styrene copolymer), Acetyl (polyformaldehyde), Acrylic (polymethyl methacrylate), Butyl rubber, EPDM (ethylene-propylene rubber), FRP (fiberglass-reinforced polyester), Natural rubber (if expanded), Nitrile- rubber (acrylonitrile-butadiene-rubber), PET (thermoplastic polyester), Polybutadiene, Polycarbonate, Polyester elastomer, Polyethylene, Poly- propylene, Polystyrene, Polyurethane, PVC (polyvinyl chloride — highly plasticized, with plasticizer content greater than 20 percent) (rarely found), SAN (styrene acrylonitrile) and SBR (styrene-butadiene rubber). See **Table:- D.05-T2**

2.2.11. Group –B Plastics

Examples of Group B plastic materials are Cellulosics (cellulose acetate, cellulose acetate butyrate, ethyl cellulose), Chloroprene rubber, Fluoro- plastics (ECTFE — ethylene-chlorotrifluoro-ethylene copolymer; ETFE — ethylene-tetrafluoroethylene-copolymer; FEP — fluorinated ethylene-propylene copolymer), Natural rubber (not expanded), Nylon (nylon 6, nylon 6/6) and Silicone rubber.

2.2.12. Group –C Plastics

Examples of Group C plastic materials are Fluoroplastics (PCTFE — poly-chlorotrifluoroethylene; PTFE — polytetrafluoroethylene), Melamine (melamine formaldehyde), Phenolic, PVC (polyvinyl chloride — flexible — PVCs with plasticizer content up to 20 percent), PVDC (polyvinylidene chloride), PVDF (polyvinylidene fluoride), PVF (polyvinyl fluoride) and Urea (urea formaldehyde).

2.2.13. Rolled paper Store

A rolled paper storage facility can be further subdivided in to four classes based on its weight to determine the sprinkler system design criteria.

2.2.13.1. Heavy weight Class

Heavyweight class shall include paperboard and paper stock having a basis weight per 92.9 m^2 of 9.1 kg.

2.2.13.2. Medium weight Class

Medium weight class shall include all the broad range of papers having a basis weight per 92.9 m^2 of 4.5 kg to 9.1 kg.

2.2.13.3. Lightweight class

Light weight class shall include all papers having a basis weight per 92.9 m^2 of 4.5 kg.

2.2.13.4. Tissue

Shall include the broad range of papers of characteristic gauzy texture, which, in some cases, are fairly transparent such as crepe wadding and the sanitary class including facial tissue, paper napkins, bathroom tissue, and toweling.

2.3. Light Hazard Material List and Industrial Activity

2.3.1 Light or Low Hazard Storage Material List

The Light or Low hazard materials for sprinkler protection criteria shall be as per **Table:- D.05-T1.A.**

Table:- D.05-T1.A.: Light / Low Hazard Material List

CATEGORY	LIST OF MATERIALS
1. FOOD AND BEVERAGE IN LESS THAN 5 GAL. CAPACITY CONTAINERS	i. Alcoholic beverages – up to 12% alcohol in metal, glass or ceramic material. ii. Canned food – In cartons. iii. Coffee – canned in carton. iv. Fish products – frozen, non-waxed, non plastic packaging, canned, carton. v. Frozen food – non-waxed, non-plastic packaging. vi. Fruit – fresh, non-plastic trays or containers with wood spacers. vii. Ice-cream. viii. Meat products canned, carton, frozen, non-waxed, non-plastic containers. ix. Milk and dairy products– waxed or non-waxed paper and plastic containers. x. Nuts – canned, carton. xi. Poultry product- canned, carton, frozen, non-waxed, non-plastic containers. xii. Salt – bagged. xiii. Syrup – drummed metal containers.
2. METAL	i. Cans – empty metal. ii. File cabinets – metal, wrap by cardboard. iii. Metal desk – with plastic tops and trim. iv. Metal doors and windows v. Metal furniture vi. Metals, structural steel, cast iron vii. Empty cargo containers viii. Precision dies ix. Empty cylinders x. Metal wires xi. Scrap metal
3. ELECTRICAL	i. Batteries – Dry cells, non-lithium, in cartons, filled automobile batteries. ii. Electric coil iii. Motor – electric iv. Transformer (Non-energized) – dry v. Wire – bare wire on metal spools, on wood skids. vi. Computer vii. Cookers, electric stoves viii. Water heaters ix. Air condition, refrigeration spare parts x. Antennas xi. Telephone and telecommunication equipment xii. Global positioning systems xiii. Type writers, photocopy machines

Table:- D.05-T1.A .: Light / Low Hazard Material List

CATEGORY	LIST OF MATERIALS
4. CONSTRUCTION	i. Cement – in bags. ii. Ready Mix concrete iii. Paint – water based, carton. iv. Cement blocks, Bricks and Masonry v. Building hardware vi. Tiles, Flooring vii. Sand, Gravel and Stones viii. Sanitary ware ix. Tanks and Silos x. Ironmongery xi. Pipes and Fittings xii. Scaffolding xiii. Marble
5. AGRICULTURAL	i. Seeds, Flowers, Plants ii. Plant Nurseries iii. Agricultural Tools, Equipment iv. Garden Tools and Equipment v. Irrigation Tools and Equipment
6. MISCELLANEOUS	i. Appliances like stove, refrigerator – not packaged, no exterior plastic material. ii. Bottles, Jars – Empty glass, filled with noncombustible liquids or non-combustible powders. iii. Chalk and crayons. iv. Fertilizers – Bagged, phosphates. v. Glass and mirrors. vi. Porcelain and pottery. vii. Stables, Sheds viii. Washers and Driers ix. Occupational Safety Equipment, hygiene. x. Watches and clocks xi. Laboratory equipment xii. Medical equipment xiii. Solar energy equipment xiv. Diving equipment xv. Loading, handling equipment xvi. Laundry equipment xvii. Industrial equipment and tools xviii. Jewelry trading xix. Pearls and precious stones xx. Automobile spare parts

2.3.2. Light or Low Hazard Industrial Activity List

The Light or Low hazard activity list for sprinkler protection criteria shall be as per **Table:- D.05-T1.B.**

Table:- D.05-T1.B: Light / Low Hazard Activity List

CATEGORY	LIST OF MATERIALS
1. FOOD AND BEVERAGE	i. Non alcoholic beverage—bottling and production. ii. Ice—Production
2. METAL	i. Metal products (fabrication and assembly)
3. ELECTRICAL	i. Telecommunications signal processing ii. GSM Switching stations iii. Telephone exchanges iv. Repair shops v. Workshops without wood work, welding, cutting
4. CONSTRUCTION	i. Cement blocks, Bricks and Masonry—Production ii. Ready mix concrete production iii. Foundries iv. Quarries
5. MISCELLANEOUS	i. Ceramic, Porcelain and Pottery—Production ii. Glass products—Production iii. Mirror works iv. Automobile workshops

2.3. Commodity Classes

2.3.1. Identification of Classes of Materials (Commodity Classes)

The identification of classes of materials for sprinkler design consideration shall be as per **Table:- D.05-T2 (NFPA Table A.5.6.3.),** in alphabetical order.

Table:- D.05-T2: Classes of Materials/ Commodity

PRODUCT CATEGORY	PRODUCTS	COMMODITY CLASS
1. BATTERIES	i. Dry cells (excludes lithium, lithium-ion, and other similar exotic metals or combustible electrolyte); without blister packing (if blister packed refer to commodity classification definitions)	Class I
	ii. Vehicle; any size (e.g., automobile or truck); Empty plastic casing.	Group A Nonexpanded
	iii. Nonexpanded Vehicle; large (e.g., truck or larger); dry or wet (excludes lithium-ion and other cells containing combustible electrolyte) cells.	Group A Nonexpanded
	iv. Vehicle; small (e.g., automobile); wet (excludes lithiumion and other cells containing combustible electrolyte) cells	Class I
2. EMPTY CONTAINERS	i. Noncombustible	Class I
	ii. PET, bottles or jars	Class IV
	iii. Wood; solid sided (e.g., crates, boxes)	Class II
	iv. Rigid plastic (not including PET), up to 32 oz. (1 L)	Group A Expanded
3. FILM ROLLS, PHOTOGRAPHIC ROLLS	i. Film (polypropylene, polyester, polyethylene); rolled on any reel type.	Class II
	ii. Film; 35 mm metal film cartridges in polyethylene cans; cartoned.	Class III
	iii. Film; motion picture or bulk rolls in polycarbonate, polyethylene or in metal cans; polyethylene bagged; cartoned.	Class II
	iv. Film; rolls in polycarbonate plastic cassettes; cartooned.	Class IV
	v. Photographic paper; sheets; bagged in polyethylene; cartoned	Class III
4. FLAMMABLE / COMBUSTIBLE LIQUIDS	i. Aerosol; Level	Class III
	ii. Lighters; butane; blister-packed; cartoned.	Group A Nonexpanded
	iii. Liquids; up to 20 percent alcohol (e.g., alcoholic beverages, flavoring extracts); greater than 5 gallon (20 L) plastic containers with wall thickness greater than ¼ in. (6 mm)	Group A Nonexpanded
	iv. Liquids; up to 20 percent alcohol (e.g., alcoholic beverages, flavoring extracts); metal, glass or ceramic containers.	Class I
	v. Liquids; up to 20 percent alcohol (e.g., alcoholic beverages, flavoring extracts); wood, plastic containers greater than 5 gallons (20 L) and wall thickness up to ¼ in. (6 mm)	Class II
	vi. Liquids; up to 20 percent alcohol (e.g., alcoholic beverages, flavoring extracts); up to 5 gallons (20 L) plastic bottles or jars.	Class I

Table:- D.05-T2: Classes of Materials/ Commodity

PRODUCT CATEGORY	PRODUCTS	COMMODITY CLASS
5. FOOD PRODUCTS —FROZEN	i. Frozen foods; nonwaxed or nonplastic packaging. ii. Frozen foods; plastic trays. iii. Frozen foods; waxed or plastic-coated paper packaging	Class I Class III Class II
6. FOOD PRODUCTS —NON FROZEN	i. Butter (stick or whipped spread) or margarine (up to 50 percent oil) ii. Dry foods (such as baked goods, candy, cereals, cheese, chocolate, cocoa, coffee, grains, granular sugar, nuts, etc.); bagged or Cartoned iii. Foods (e.g., coffee, fish products, fruit, meat products, nuts, poultry, etc.); metal cans iv. Fruits and vegetables (noncombustible semi-liquids); crushed; plastic containers up to 5 gallons (20 L) v. Fruits and vegetables; fresh; wood spacers, non-plastic trays or containers vi. Margarine; over 50 and up to 80 percent oil vii. Meat; fresh; no plastic packaging; uncartoned viii. Meat; fresh; no plastic packaging; cartoned ix. Meat; fresh; plastic trays x. Milk; any container; stored in solid plastic crates xi. Milk; paper containers, or plastic bottles or jars up to 5 gallons (20 L) plastic bottles or jars. xii. Salt; bagged xiii. Salt; cartoned xiv. Snack foods (e.g., potato chips); plasticized aluminum bags; cartoned xv. Syrup; wooden container	Class III Class III Class I Class I Class I Group A Nonexpanded Class I Class II Class III Group A Nonexpanded Class I Class I Class II Group A Nonexpanded Class II
7. FURNITURE AND BEDDING	i. Furniture and bedding; with foam cushioning ii. Furniture; metal (e.g., file cabinets or desks with plastic trim); cartoned iii. Furniture; wood (e.g., doors, windows, cabinets, etc.); no plastic coverings or foam cushioning iv. Furniture; wood; plastic coverings nonexpanded plastic trim v. Box spring; standard (minimal plastic materials) vi. Box spring; wrapped in plastic cover vii. Mattress; foam (in finished form)	Group A Expanded Class I Class III Class IV Class III Class IV Group A Expanded

Table:- D.05-T2: Classes of Materials/ Commodity

PRODUCT CATEGORY	PRODUCTS	COMMODITY CLASS
8. HOUSING MATERIALS/ APPLIANCES	i. Appliances; major (e.g., stoves, refrigerators); no appreciable plastic interior or exterior trim; cartoned. ii. Appliances; major (e.g., stoves, refrigerators); no appreciable plastic interior or exterior trim; uncartoned Appliances; no appreciable plastic exterior trim (interior of unit can have appreciable plastic). iii. Carpet tiles; cartoned iv. Fiberglass insulation; paper-backed rolls; bagged or unbagged v. Floor coverings; vinyl, stacked tiles vi. Floor coverings; vinyl; rolled vii. Gypsum board viii. Housing materials (such as sinks, countertops, etc.); noncombustible, cartoned or crated ix. Paint; oil-based; friction-top metal containers; cartoned x. Paint; water-based (latex); friction-top metal containers; cartoned xi. Roofing shingles; asphalt-coated fiberglass xii. Roofing shingles; asphalt-impregnated felt	Class II Class III Group A Nonexpanded Class IV Class IV Group A Nonexpanded Class I Class II Class IV Class I Class III Class IV
9. MISCELLANEOUS	i. Ammunition; small arms and shotgun; cartoned ii. Charcoal; mineral spirit impregnated; bagged iii. Charcoal; standard (non-mineral spirit impregnated); bagged iv. Leather hides; baled Class II Leather; finished products (e.g., shoes, jackets, gloves, bags, luggage, belts) v. Motors; electric vi. Shock absorbers; metal dust cover vii. Shock absorbers; plastic dust cover viii. Skis; composite materials (plastic, fiberglass, foam, etc.) ix. Tobacco products; cartoned x. Toys; stuffed; foam or synthetic xi. Transformer; dry or empty (i.e., void of oil)-filled xii. Automobile spare parts, Automobile workshop	Class IV Group A Expanded Class III Class III Class I Class II Class III Class IV Class III Group A Expanded Class I Class II

Table:- D.05-T2: Classes of Materials/ Commodity

PRODUCT CATEGORY	PRODUCTS	COMMODITY CLASS
10. NONCOMBUSTIBLE LIQUIDS	i. Liquids or semi-liquids; PET containers greater than 5 gallons (20 L) having a nominal wall thickness greater than 0.25 in (6 mm)	Class IV
	ii. Liquids or semi-liquids; PET containers up to 5 gallons (20 L) or greater than 5 gallons (20 L) having a nominal wall thickness up to 0.25 in (6 mm)	Class I
	iii. Liquids or semi-liquids (e.g., crushed fruits and vegetables); plastic containers up to 5 gallons (18.9 L) Capacity.	Class I
	iv. Liquids or semi-liquids; plastic (except PET) containers greater than 5 gallons (20 L) capacity having a nominal wall thickness greater than 0.25 in. (6 mm)	Group A Nonexpanded
	v. Liquids or semi-liquids; plastic (except PET) containers greater than 5 gallons (20 L) capacity having a nominal wall thickness up to 0.25 in. (6 mm)	Class II
	vi. Liquids; cardboard drink boxes, plastic-coated, waxcoated, and/or aluminum-lined; uncartoned or on corrugated carton trays with plastic sheeting.	Class I
	vii. Liquids; cardboard drink boxes, plastic-coated, waxcoated, and/or aluminum-lined; stored in plastic containers	Group A Nonexpanded
	viii. Liquids; glass bottles or jars; cartoned	Class I
	ix. Liquids; pharmaceuticals (nonflammable); glass bottles or jars; cartoned.	Class II
	x. Liquids; plastic bottles or jars; stored in open or solid plastic crates	Group A Nonexpanded
11. PAPER PRODUCTS	i. Paper Products Book signatures (paper part of book without hard cover)	Class II
	ii. Cartons (i.e., cardboard flats); corrugated; partially assembled.	Class IV
	iii. Cartons (i.e., cardboard flats); corrugated; unassembled in neat piles.	Class III
	iv. Cartons; wax-coated, single-walled corrugated	Group A Nonexpanded
	v. Cellulosic paper products; nonwax-coated (e.g., books, cardboard games, cartoned tissue products, magazines, newspapers, paper cups, paper plates, paper towels, plastic-coated paper food containers, stationery)	Class III
	vi. Cellulosic paper products; wax-coated (e.g., paper plates, cups); loosely packed; cartoned.	Group A Nonexpanded
	vii. Cellulosic paper products; wax-coated (e.g., paper plates, cups); nested; cartoned	Class IV
	viii. Matches; paper-type; cartoned	Class IV
	ix. Matches; wooden; cartoned	Group A Nonexpanded
	x. Rolled; lightweight; in storage racks	Class IV
	xi. Rolled; medium or heavyweight; in storage racks or on-side	Class III
	xii. Tissue products; plastic-wrapped; cartoned	Class III
	xiii. Tissue products; plastic-wrapped; uncartoned	Group A Nonexpanded

Table:- D.05-T2: Classes of Materials/ Commodity

PRODUCT CATEGORY	PRODUCTS	COMMODITY CLASS
12. PLASTIC / RUBBER	i. ABS (Acrylonitrile-butadienestyrene copolymer)	Group A Non-expanded
	ii. Acetyl (polyformaldehyde)	Group A Non-expanded
	iii. Acrylic (polymethyl methacrylate)	Group A Non-expanded
	iv. Automobile bumpers and dashboards	Group A Non-expanded
	v. Butyl rubber Cellulose Acetate Class IV	Class IV
	vi. Cellulose Acetate Butyrate	Group A Non-expanded
	vii. Chloroprene rubber	Class IV
	viii. Containers; nonexpanded plastic gridded or solid; collapsed or nested with no air spaces	Group A Non-expanded
	ix. ECTFE (ethylene-chlorotrifluoroethylene copolymer)	Class IV
	x. EPDM (ethylene-propylene rubber)	Group A Non-expanded
	xi. ETFE (ethylene-tetrafluoroethylene copolymer)	Class IV
	xii. Ethyl Cellulose	Group A Non-expanded
	xiii. FEP (fluorinated ethylene-propylene copolymer)	Class IV
	xiv. FRP (fiberglass-reinforced polyester)	Group A Non-expanded
	xv. Melamine (melamine formaldehyde)	Class III
	xvi. Nitrile Rubber (acrylonitrile-butadiene rubber)	Group A Non-expanded
	xvii. Nylon (nylon 6, nylon 6/6)	Group A Non-expanded
	xviii. PCTFE (polychlorotrifluoroethylene)	Class III
	xix. PET (Polyethylene Terephthalate —thermoplastic polyester)	Group A Non-expanded
	xx. Phenolic	Class III
	xxi. Plastics; stored in fully closed and solid (no openings), metal containers	Class I
	xxii. Polybutadiene	Group A Non-expanded
	xxiii. Polycarbonate	Group A Non-expanded
	xxiv. Polyester elastomer	Group A Non-expanded
	xxv. Polyethylene	Group A Non-expanded
	xxvi. Polypropylene	Group A Non-expanded
	xxvii. Polystyrene; foam products (plates, cups, etc.)	Group A Expanded
	xxviii. Polystyrene; rigid products	Group A Non-expanded
	xxix. Polyurethane	Group A Expanded
	xxx. PTFE (polytetrafluoroethylene)	Class III
	xxxi. PVC (polyvinyl chloride) products, up to 20% plasticizer	Class III
	xxxii. PVC (polyvinyl chloride) products, greater than 20% plasticizer	Group A Nonexpanded
	xxxiii. PVC resins; bagged	Class III
	xxxiv. PVDC (polyvinylidene chloride)	Class III
	xxxv. PVDF (polyvinylidene fluoride)	Class III
	xxxvi. PVF (polyvinyl fluoride)	Group A Non-expanded
	xxxvii. Rubber; natural in blocks; cartoned	Group A Non-expanded
	xxxviii. Rubber; natural; expanded	Group A Expanded
	xxxix. Rubber; natural; nonexpanded	Group A Non-expanded
	xl. Rubber; synthetic (santoprene)	Group A Non-expanded
	xli. SAN (styrene acrylonitrile)	Group A Non-expanded
	xlii. SBR (styrene-butadiene rubber)	Group A Non-expanded
	xliii. Silicone rubber Class IV	Class IV
	xliv. Urea (urea formaldehyde)	Class III

Table:- D.05-T2: Classes of Materials/ Commodity

PRODUCT CATEGORY	PRODUCTS	COMMODITY CLASS
13. PLASTIC CONTAINERS	i. Plastic Containers Bottles or jars (except PET) greater than 1 gallon (4 L) containing noncombustible solids	Group A Non-expanded
	ii. Bottles or jars (except PET) up to 1 gallon (4 L) containing noncombustible solids	Group A Non-expanded
14. POWDERS/ PILLS	i. Pharmaceutical pills; glass bottles or jars; cartoned	Class II
	ii. Pharmaceuticals pills; plastic bottles or jars; cartoned	Class IV
	iii. Polyvinyl Alcohol (PVA) resins; bagged	Class IV
	iv. Powders; combustible (ordinary such as sugar or flour); free-flowing; bagged	Class II
	v. Powders; noncombustible free-flowing powdered or granular materials (cement, calcium chloride, clay, iron oxide, sodium chloride, sodium silicate, etc.)	Class I
	vi. Powders; noncombustible; glass bottles or jars; cartooned	Class I
	vii. Powders; noncombustible; PET bottles or jars	Class II
	viii. Powders; noncombustible; plastic (other than PET) bottles or jars; uncartoned	Group A Non-expanded
	ix. Powders; noncombustible; plastic bottles or jars greater than 1 gallon (4 L) capacity	Group A Non-expanded
	x. Powders; noncombustible; plastic bottles or jars up to 1 gallon (4 L) capacity; cartooned	Class IV
15. TEXTILE MATERIALS	i. Cloth; natural fibers; baled	Class III
	ii. Cloth; synthetic cloth Class IV	Class IV
	iii. Clothing; natural fibers (e.g., wool, cotton) and viscose	Class III
	iv. Cotton; cartoned	Class III
	v. Diapers; cotton or linen	Class III
	vi. Diapers; plastic or nonwoven fabric; cartoned Class IV	Class IV
	vii. Diapers; plastic or nonwoven fabric; plastic-wrapped; uncartoned	Group A Non-expanded
	viii. Fabric; rayon and nylon	Class IV
	ix. Fabric; synthetic (except rayon and nylon); greater than 50/50 blend	Group A Non-expanded
	x. Fabric; synthetic (except rayon and nylon); up to 50/50 blend	Class III
	xi. Fabric; vinyl-coated (e.g., tablecloth);	Group A Nonexpanded
	xii. Fibers; rayon and nylon; baled	Class IV
	xiii. Fibers; synthetic (except rayon and nylon); baled	Group A Nonexpanded
	xiv. Thread or yarn; rayon and nylon; wood or paper spools	Class IV
	xv. Thread or yarn; rayon or nylon; plastic spools	Group A Nonexpanded
	xvi. Thread or yarn; synthetic (except rayon and nylon); greater than 50/50 blend; paper or wood spools	Class IV
	xvii. Thread or yarn; synthetic (except rayon and nylon); greater than 50/50 blend; plastic spools	Group A Nonexpanded
	xviii. Thread or yarn; synthetic (except rayon and nylon); up to 50/50 blend; plastic spools	Group A Nonexpanded
	xix. Thread or yarn; synthetic (except rayon and nylon); up to 50/50 blend; wood or paper spools	Class III

Table:- D.05-T2: : Classes of Materials/ Commodity

PRODUCT CATEGORY	PRODUCTS	COMMODITY CLASS
16. WAX	i. Candles Group A Expanded ii. Paraffin or petroleum wax; blocks Group A Expanded	Group A Expanded Group A Expanded
17. WIRE/ CABLE/ SPOOLS	i. Spools; plastic; empty ii. Spools; wood; empty iii. Wire or cable; PVC insulated; metal or wood spools iv. Wire or cable; PVC insulated; plastic spools v. Wire; bare; metal spools, uncartoned vi. Wire; bare; metal spools; cartoned vii. Wire; bare; plastic spools; cartoned viii. Wire; bare; plastic spools; uncartoned ix. Wire; bare; wood or cardboard spools	Group A Nonexpanded Class III Class II Class IV Class I Class II Class IV Group A Nonexpanded Class II
18. WOOD PRODUCTS	i. Wood patterns ii. Wood products (e.g., fiberboard, lumber, particle board, plywood, pressboard with smooth ends and edges); bundled solid blocks iii. Wood products (e.g., fiberboard, lumber, particle board, plywood, pressboard with smooth ends and edges); un-bundled or non-solid blocks iv. Wood products (e.g., toothpicks, clothespins and hangers	Class IV Class II Class III Class III

2.5. Automatic Sprinkler Systems

2.5.1. Automatic Sprinkler

A fire suppression or control device that operates (bursts) automatically when its heat-activated element is heated to its thermal rating or above, allowing water to discharge over a specified area.

2.5.2. Automatic Sprinkler System

For fire protection purposes, the sprinkler system installation includes one or more automatic water supplies. The portion of the sprinkler system is a network of specially sized or hydraulically designed piping installed in a building, structure, or area, generally overhead, and to which sprinklers are attached in a systematic pattern. The valve controlling each system riser is located in the system riser or its supply piping. Each sprinkler system riser includes a device for actuating an alarm when the system is in operation. The system is usually activated by heat from a fire and discharges water over the fire area.

2.5.3. High-Piles storage

Solid-piled, palletized, rack storage, bin box, and shelf storage in excess of 3.7 m in height.

2.5.4. Hydraulically Designed System

A calculated sprinkler system in which pipe sizes are selected on a pressure loss basis to provide a prescribed water density, in gallons per minute per square foot (mm/min), or a prescribed minimum discharge pressure or flow per sprinkler, distributed with a reasonable degree of uniformity over a specified area.

2.5.5. Pipe Schedule System

A sprinkler system in which the pipe sizing is selected from a schedule that is determined by the occupancy classification and in which a given number of sprinklers are allowed to be supplied from specific sizes of pipe.

2.5.6. System Working Pressure

The maximum anticipated static (non flowing) or flowing pressure applied to sprinkler system components exclusive of surge pressures.

2.5.7. Closed loop Sprinkler System

A wet pipe sprinkler system having non–fire protection connections to automatic sprinkler systems in a closed-loop piping arrangement for the purpose of utilizing sprinkler piping to conduct water for heating or cooling, where water is not removed or used from the system but only circulated through the piping system.

2.5.8. Dry pipe Pre-action Sprinkler System

A sprinkler system employing automatic sprinklers attached to a piping system containing air under pressure with a supplemental detection system installed in the same areas as the sprinklers. The operation of the detection system actuates tripping devices that open dry pipe valves simultaneously and without loss of air pressure in the system. The operation of the detection system also opens listed air exhaust valves at the end of the feed main, which usually precedes the opening of sprinklers. The detection system also serves as an automatic fire alarm system.

2.5.9. Deluge Sprinkler System

A sprinkler system employing open sprinklers that are attached to a piping system that is connected to a water supply through a valve that is opened by the operation of a detection system installed in the same areas as the sprinklers. When this valve opens, water flows into the piping system and discharges from all sprinklers attached thereto.

2.5.10. Branch line

The pipes in which the sprinklers are placed, either directly or through risers.

2.5.11. Cross Mains

The pipes supplying the branch lines, either directly or through risers.

2.5.12. Feed Mains

The pipes supplying cross mains, either directly or through risers.

2.5.13. Closed Array

A storage arrangement where air movement through the pile is restricted because of 6-in. (152-mm) or less vertical flues.

2.5.14. Open Array

A storage arrangement where air movement through the pile is enhanced because of vertical flues larger than 6 in. (152 mm).

2.5.15. Bin Box Storage

Storage in five-sided wood, metal, or cardboard boxes with open face on the aisles. Boxes are self-supporting or supported by a structure so designed that little or no horizontal or vertical space exists around boxes.

2.5.16. Clearance

The distance from the top of storage to the ceiling sprinkler deflectors.

2.5.17. Encapsulation

A method of packaging consisting of a plastic sheet completely enclosing the sides and top of a pallet load containing a combustible commodity or a combustible package or a group of combustible commodities or combustible packages. Combustible commodities individually wrapped in plastic sheeting and stored exposed in a pallet load also are to be considered encapsulated.

2.5.18. Expanded (Foamed or Cellular) Plastics

Those plastics, the density of which is reduced by the presence of numerous small cavities (cells), interconnecting or not, dispersed throughout their mass.

2.5.19. Exposed Group A Plastics

Those plastics not in packaging or coverings that absorb water or otherwise appreciably retard the burning hazard of the commodity. (Paper wrapped or encapsulated, or both, should be considered exposed.)

2.5.20. Palletized Storage

Storage of commodities on pallets or other storage aids that form horizontal spaces between tiers of storage.

2.5.21. Shelf Storage

Storage on structures less than 30 in. (76.2 cm) deep with shelves usually 2 ft. (0.6m) apart vertically and separated by approximately 30-in. (76.2-cm) aisles.

2.5.22. Rack

Any combination of vertical, horizontal, and diagonal members that supports stored materials. Some rack structures use solid shelves. Racks can be fixed, portable, or movable. Loading can be either manual, using lift trucks, stacker cranes, or hand placement or automatic , using machine-controlled storage and retrieval systems.

2.5.23. Double Row Racks

Two single-row racks placed back-to-back having a combined width up to 3.7 m, with aisles at least 1.1 m on each side.

2.5.24. Single Row Racks

Racks that have no longitudinal flue space and that have a width up to 1.8 m with aisles at least 1.1 m from other storage.

2.5.25. Multiple Row Racks

Racks greater than 3.7 m wide or single- or double-row racks separated by aisles less than 1.1 m wide having an overall width greater than 3.7 m.

2.5.26. K-factor

K-factor is a dimensionless number used in fire protection hydraulics.

$Q = K \quad P$ OR $K = Q/P^{0.5}$ Where,

Q is $\sqrt{\ }$ the Flow in gpm (L/Min),
P is the Pressure in psi (bar)
K is a flow constant factor

2.6. Types of Sprinklers

2.6.1. Types of Sprinklers, based on installation orientation

2.6.1.1. Upright Sprinkler Head

A sprinkler designed to be installed in such a way that the water spray is directed upwards against the deflector.

2.6.1.2. Pendent Sprinkler Head

A sprinkler designed to be installed in such a way that the water stream is directed downward against the deflector. In pendent there are two types based on its mounting application.

2.6.1.3. Recessed Pendent Sprinkler Head

A sprinkler in which all or part of the body, other than the shank thread, is mounted within a recessed housing.

2.6.1.4. Concealed Pendent Sprinkler Head

A recessed sprinkler concealed with cover plates.

2.6.1.5. Conventional Sprinkler Head

A sprinkler that is designed to install both pendent or upright position.

2.6.1.6. Sidewall Sprinkler Head

A sprinkler having special deflectors that are designed to discharge most of the water away from the nearby wall in a pattern resembling one-quarter of a sphere, with a small portion of the discharge directed at the wall behind the sprinkler.

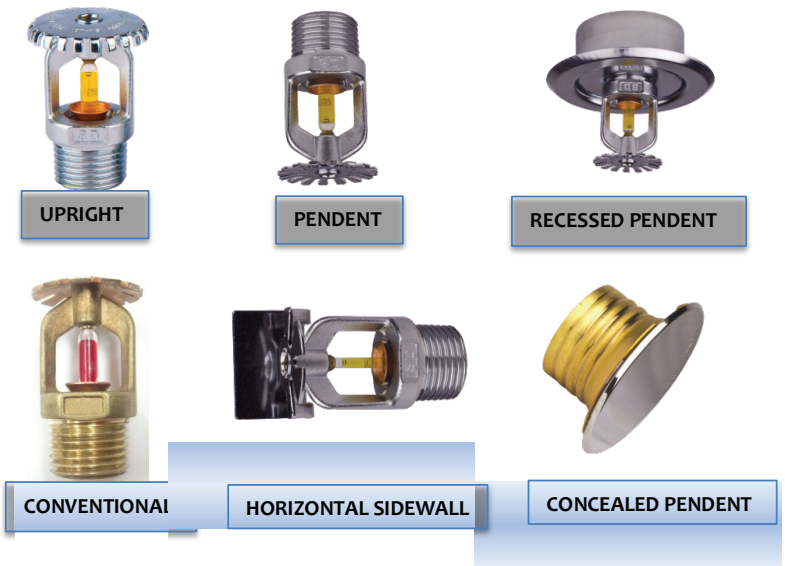


Figure:- D.05-F1.: Types of Sprinklers based on orientation

2.6.2. Types of Sprinklers, based on Coverage

2.6.2.1. Standard Coverage Sprinkler Head

A sprinkler that directs from 40 percent to 60 percent of the total water initially in a downward direction and that is designed to be installed with the deflector either upright or pendent. Nominal K-factors for standard ½ in (12.7 mm) sprinklers are K5.6 (U.S) or K80(Metric).

2.6.2.2 Extended Coverage Sprinkler Head

Extended coverage sidewall sprinklers are used in the horizontal position. They have larger areas of coverage than the areas of coverage allowed for standard sidewall sprinklers. They may be used in light- hazard occupancies.

2.6.2.3. Large Drop Sprinkler Head

A type of specific application control mode sprinkler sprinklers with a nominal K-factor of 11.2 (Km = 160) The deflector of a large drop sprinkler is specially designed and, combined with the greater discharge, produces large drops of such size and velocity as to enable the spray to penetrate strong updrafts generated by high-challenge fire hazards.

2.6.3. Types of Sprinklers, based on Heat Sensing Element

2.6.3.1. Standard Response Sprinkler Head

A type of spray sprinkler that has thermal sensitivity measured in response time index (RTI) of 80 (meters-seconds)$^{1/2}$ or more.

2.6.3.2. Early Suppression Fast-Response (ESFR) Sprinkler

A type of fast-response sprinkler that has thermal sensitivity measured in response time index (RTI) of 50 (meter-seconds)$^{1/2}$ or less and is listed for its capability to provide fire suppression of specific high-challenge fire hazards.

3.0. General Requirements

3.1. The General requirements for Automatic Sprinkler System material shall be as per **Table:- D.05-T3.** and the General Requirements of **Table:- D.11-T1.**

Table:- D.05-T3. : Automatic Sprinkler System General Requirements

ITEMS	REQUIREMENTS
1. DEFINITION	i. Automatic sprinkler heads are individually heat activated and fixed into a piping network with water under pressure. When the heat of a fire raises the sprinkler temperature to its operating point, (a variety of temperature ratings, from 57 to 260 degrees) a liquid- filled glass bulb will shatter or a solder link will melt to open that single sprinkler, allowing water to discharge. The water is directed onto a diffuser or deflector which is designed to not only break the water into droplets of a specific size, but also to direct the spray to cover a specific floor and wall area.
2. COMPONENTS	i. The Fire Pumps, Controller, Fire Water Tank, Pipes, Fittings, Sprinkler Heads, Isolation valves, Alarm Check valves (ACV), Floor Zone Control Valve (ZCV), Pressure gauge, Flow Switch, Test connection, Drains, Breeching inlet and Signs.
3. FIRE PUMP CAPACITY	i. The Fire Pump set shall consist of 1 Electric driven pump, 1 diesel driven pump and 1 electric Jockey pump, complete with controllers. ii. The Pump capacity shall be as per **Section D, Chapter 11.** iii. Fire Pumps shall be as per **Section D, Chapter 02.**
4. PIPES	i. Pipe sizes for the automatic sprinkler System shall be established using Hydraulic calculations but shall not be less than the minimum diameters mentioned in **Table:- D.05-T3.A.** ii. However, the number of sprinklers shall be permitted to be increased when acceptable hydraulic calculations are performed and justified. iii. The minimum wall thickness shall be as per schedule 40. iv. Pipes shall be rated for a working pressure of 12 bar at the most remote point of the piping network. v. The sprinkler Piping shall be dedicated, serving only a sprinkler system. vi. Sprinkler pipes shall be supported in such a way that it allows free movement due to the expansion and contraction and the supports shall be installed near the joints, elbows and tee branches as much as possible. vii. The required special expansion joints & expansion loops shall be provided to allow the free movement of the pipe installation due to the expansion and contraction of the building structure and of the piping. viii. Pipes shall also comply as per **Section D, Chapter 11, Table:- D.11-T1.** ix. It shall be permitted to provide minimum 25 mm (1 inch) outlets with hexagonal bushings to accommodate sprinklers attached directly to branch line fittings to allow for future system modifications

Table:- D.05-T3.A: Minimum Pipe Sizes and Maximum Number of Sprinkler allowed

NOMINAL STEEL PIPE DIAMETER	MAXIMUM NUMBER OF SPRINKLERS IN LIGHT HAZARD	MAXIMUM NUMBER OF SPRINKLERS IN ORDINARY AND STORAGE HAZARD	MAXIMUM NUMBER OF SPRINKLERS IN ABOVE FALSE CEILING AND BE-LOW RAISED FLOOR
1. 25 mm	2	2	2
2. 32 mm	3	3	4
3. 40 mm	5	5	7
4. 50 mm	10	10	15
5. 65 mm	30	20	30
6. 80 mm	60	40	60
7. 100 mm	100	100	100
8. 150 mm	230	275	300

Table:- D.05-T3: Automatic Sprinkler System General Requirements

ITEMS	REQUIREMENTS
5. FITTINGS	i. Fittings shall be rated for a working pressure of 12 bar at the most remote point of the piping network. ii. Fittings shall be as per **Section D, Chapter 11, Table:- D,11-T1**
6. SPRINKLERS	i. All sprinklers shall be permanently marked with a one- or two-character manufacturer symbol, followed by three or four numbers, so as to identify a unique sprinkler identification for every change in orifice size or shape, deflector characteristic, pressure rating, and thermal sensitivity. ii. Spare sprinklers not less than six numbers in quantity in each type & temperature range installed within the building shall be kept maintained in stock within the premises
7. CORROSION RESISTANT	i. Listed corrosion-resistant sprinklers shall be installed in locations where chemicals, moisture, or other corrosive vapors sufficient to cause corrosion of such devices exist.
8. PAINT/ COLOR	i. Sprinklers shall not be painted unless they are listed and permitted with paint from the manufacturer.
9. COVER PLATES	i. Cover plates and Escutcheons used with recessed/flush-type or concealed sprinklers shall be part of the listed sprinkler assembly.
10. ISOLATION OR SECTION CONTROL VALVES	i. Isolation Valves shall comply as per **Section D, Chapter 11, Table:- D.11-T1.** ii. All the isolation and section control valves installed in the sprinkler system shall be supervised O.S. & Y gate valve or supervised butterfly valves installed with a tamper or supervisory switch connected to the building fire alarm system for monitoring or secured in open position by a padlock or riveted strap unless otherwise specified and permitted by the General Directorate of Civil Defence - Kingdom of Bahrain. iii. An isolation valves shall be installed in each sprinkler riser on upstream side of an alarm check valve such that the isolation of single sprinkler riser will not interrupt the water supply to other sprinkler risers from the same source of supply. iv. All the isolation / section or Zone control valves shall be installed in an easily accessible & visible locations. v. All the valves shall be rated for the system working pressure and water temperature service, permitted by General Directorate of Civil Defence - Kingdom of Bahrain as per **Sub Section 04. of this chapter.**
11. CHECK VALVE	i. Check valves shall comply as per **Section D, Chapter 11, Table:- D.11-T1.**
12. VALVE SUPERVISION	i. Valves Supervision shall comply as per **Section D, Chapter 11, Table:- D.11-T1.**
13. BREECHING INLET	i. Breeching Inlet shall comply as per **Section D, Chapter 11, Table:- D.11-T1.**
14. PRESSURE GAUGE	i. Pressure Gauge shall comply as per **Section D, Chapter 11, Table:- D.11-T1.**
15. INSTALLER QUALIFICATIONS	i. Installer Qualification shall comply as per **Section D, Chapter 11, Table:- D.11-T1.**

4.0. Design Requirements

4.1. The General requirements for Automatic Sprinkler System design and installation shall be as per **Table:- D.05-T4.**

Table:- D.05-T4: Automatic Sprinkler System Design Requirements

ITEMS	REQUIREMENTS
1. OPERATING PRESSURE	i. The minimum operating pressure of any sprinkler for determining the water supply requirements shall be not less than 0.5 bar (7 psi) in the light hazard occupancy and 1.0 bar (14.5 psi) in the ordinary hazard occupancies. ii. The maximum operating pressure in a sprinkler system shall not be more than 12 bar. iii. Where a higher operating pressure is used for the sprinkler system, all the sprinklers, pipes and fittings shall be rated, permitted and listed by General Directorate of Civil Defence for the higher operating pressure. However, the operating pressure shall not be more than 16 bar in any case.
2. K-FACTORS	i. Standard sprinklers shall have the thread size of not less than ½ in. (12.7 mm) NPT having nominal orifice size of ½ in. (12.7 mm) with K-factor 5.6 (Metric factor 80). ii. Sprinklers having a K-factor exceeding K-5.6 (80) and having ½ in. (15 mm) NPT shall not be permitted to be installed in new sprinkler systems. iii. Where design density required is greater than 8.1 LPM/m^2 (2.1 gpm/m^2) but lesser than 13.9 LPM/m^2 (3.7 gpm/m^2), the sprinklers having K-factor 8.0 (Metric factor K-116) shall be used. iv. If the required design density is greater than 13.9 LPM/m^2(3.7 GPM/m^2), the sprinklers having K-factor 11.2 (Metric factor K-161) or higher shall be used as per the permitted listing.

Table:- D.05-T4: Automatic Sprinkler System Design Requirements

ITEMS	REQUIREMENTS
3. DESIGN DENSITY	i. The water supply requirement for sprinklers only shall be calculated from the density/area curves shown in **Figure:-D.05-F2** ii. The hand line hose stream water demand shall be added to the sprinkler water demand according to the type of proposed fire fighting hose system based on the occupancy classification. iii. The calculations shall satisfy any single point on the appropriate density/area curve. iv. The design Density based on the Hazard categories and Density—Area curve on a single design point shall be as per **Table:- D.05-T4.B.**

Table:- D.05-T4.B.: Design Densities based on Occupancy Hazard

HAZARD	DESIGN DENSITY	AREA OF OPERATION (m^2) Ft^2	WATER DEMAND ONLY FOR SPRINKLERS (gpm)
1. Light Hazard	(4.1) 0.10	(139) 1500	150
2. Ordinary 1 Hazard	(6.1) 0.15	(139) 1500	225
3. Ordinary 2 Hazard	(8.1) 0.20	(139) 1500	300
4. Extra Hazard Group 1	(12.2) 0.30	(232) 2500	750
5. Extra Hazard Group 2	(16.3) 0.40	(232) 2500	1000

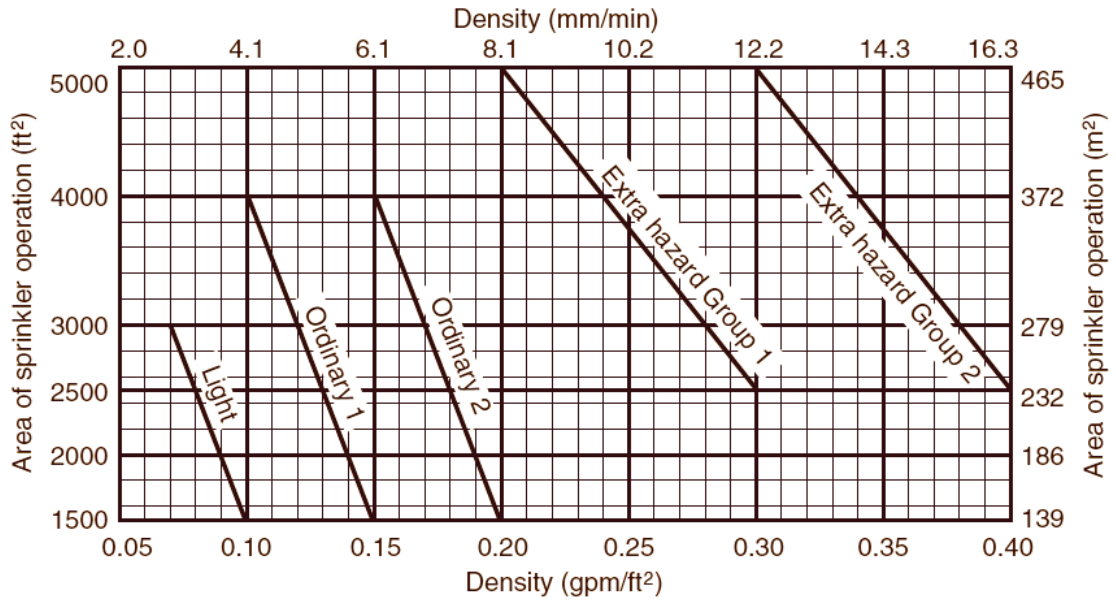


Figure:-D.05-F2 : Density– Area Curves

Table:- D.05-T4: Automatic Sprinkler System Design Requirements

ITEMS	REQUIREMENTS
4. SPRINLER OPERATING TEMPERATURE	i. The operating temperature of the proposed sprinklers shall be based on the maximum room temperature expected at the ceiling level at any time. Automatic sprinklers shall have their frame arms, deflector, coating material, or liquid bulb colored in accordance with the requirements of **Figure:-D.05-F3 .** ii. The maximum temperature of water in the sprinkler piping shall not exceed 37.8°C. iii. The minimum temperature of water in the sprinkler piping shall not drop be low 4°C. iv. For the air-conditioned areas, the operating temperature of the sprinkler shall be 68°C, Quick Response type. v. For the non air-conditioned areas, the operating temperature of the sprinkler shall be 79°C, Standard Response type.

Table:- D.05-T4.C: Sprinkler Operating Temperature and Color Classification

MAXIMUM CEILING TEMPERATURE	TEMPERATURE RATING OF SPRINKLER HEAD	TEMPERATURE CLASSIFICATION	COLOUR CODE	GLASS BULB COLOURS
1. 38°C	**57°C—77°C**	Ordinary	Uncolored or Black	Orange or Red
2. 66°C	**79°C—107°C**	Intermediate	White	Yellow or Green
3. 107°C	**121°C—149°C**	High	Blue	Blue
4. 149°C	**163°C—191°C**	Extra High	Red	Purple
5. 191°C	**204°C—246°C**	Very Extra High	Green	Black
6. 246°C	**260°C—302°C**	Ultra High	Orange	Black
7. 329°C	**343°C**	Ultra High	Orange	Black



Figure:-D.05-F3 Sprinkler Bulb Color codes and Marking for illustration

Table:- D.05-T4: Automatic Sprinkler System Design Requirements

ITEMS	REQUIREMENTS
5. INSPECTOR TEST VALVE	i. An permitted alarm test valve shall be provided in each sectional or floor zone control valve assembly on the downstream side of the water flow switch. The test valve shall be not less than 25 mm of diameter in size and shall have an orifice diameter to give a flow equal to or less than one sprinkler of a type having the smallest orifice installed on the particular system to test each water flow alarm device for each system. ii. The inspectors test valve shall be located at an easily accessible & visible location with an identification sign board in a visible location in both Arabic & English. iii. Where the test valve is located in a closed room, shaft access door or panel, it shall be provided with an identification sign board in a visible location in both Arabic & English.
6. DRAINS	i. The complete sprinkler system piping shall be designed and installed in such a way that the entire water can be drained. ii. A main drain valve shall be installed on each sprinkler system main riser on the downstream side of an Alarm Check valve. The system main drain valve can be a part of an alarm check valve. iii. The size of the main drain valve (alarm check valve) shall not be less than 50mm in diameter. Auxiliary drains shall be provided where a change in piping direction prevents the drainage of the system piping through the main drain valve. iv. In addition, where the sectional zone or floor control valve is provided, it shall be equipped with a drain connection having a minimum size not less than 25 mm in diameter to drain that portion of the system controlled by the sectional valve. A listed and permitted combined test & drain valve is permitted to be used in the sectional or floor zone control valve assembly. v. The main sprinkler riser drain should discharge to an open drain outside the building at a point free from the possibility of causing water damage. Where it is not possible to discharge the building wall outside, the drain should be piped to a sump, which in turn should discharge by gravity or be pumped to a waste water drain or sewer. The main sprinkler riser drain connection should be of a size sufficient to carry off water from the fully open drain valve while it is discharging under normal water system pressures. Where this is not possible, a supplementary drain of equal size should be provided for test purposes with free discharge, located at or above grade. vi. The drain riser may be permitted to terminate back to the fire water tank if the tanks do not serves for domestic use. In such case, the drain discharge shall conform to any health or water department regulations.

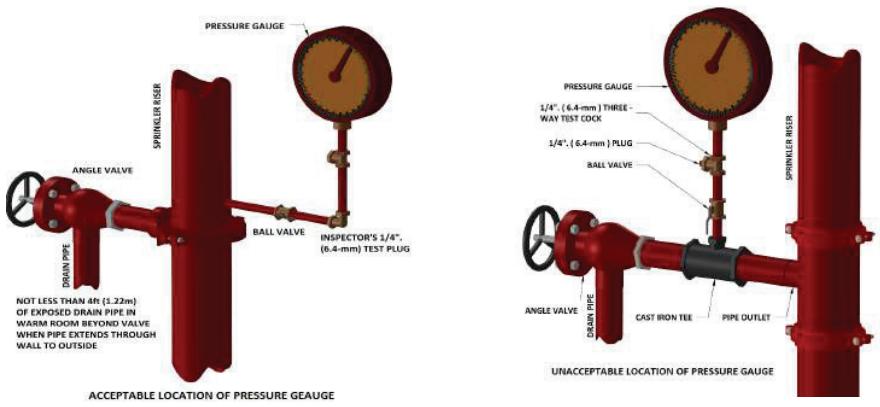


Figure:-D.05-F4.: Acceptable and unacceptable Pressure gauge location

Table:- D.05-T4: Automatic Sprinkler System Design Requirements

ITEMS	REQUIREMENTS
7. ALARM CHECK VALVE	i. An Alarm check valve assembly shall be installed in each sprinkler system riser as per the maximum sprinkler protection zone area limitations as per **Table:- D.05-T4.7.ii**, which shall consists of the following equipment and accessories. a. An alarm check Valve complete with trim kits & retarding device. b. A water Motor Alarm Gong. c. An electric Alarm pressure switch. d. Pressure Gauges (Upstream & Down stream) ii. Maximum sprinkler zone limitation a. Light Hazard—4831 m^2 b. Ordinary Group 1—4831 m^2 c. Ordinary Group 2—4831 m^2 d. Extra Hazard Group 1– 3716 m^2 e. Extra Hazard Group 2– 3716 m^2 iii. The alarm valve shall be installed in each sprinkler system supply risers complete with the required trims in all sprinkler system installations. iv. The Alarm valve trims shall consist of a basic trim with all the required pipes, fitting & valves, water motor alarm gong, retard chamber, electric alarm pressure switch, upstream & down stream pressure gauges etc. v. The alarm pressure switch shall be interconnected with the building fire alarm system to activate the fire alarm. vi. A 20 mm diameter by pass line shall be provided connecting the upstream and downstream side of the alarm check to allow the water pressure surge with out lifting the valve clapper off its seat, which will prevent the false alarm. vii. Alarm check valves shall be rated for the system working pressure and water temperature service and permitted by the General Directorate of Civil Defence - Kingdom of Bahrain. viii. All the check valves shall be installed in easily accessible & visible locations. ix. Alarm check valves shall be installed vertically with an adequate clearance space around it for testing and maintenance purposes. x. Retarding device shall be installed in the alarm line to prevent the false alarm due to the water pressure fluctuation in the sprinkler system. xi. The alarm check valve shall be permitted and listed with the General Directorate of Civil Defence - Kingdom of Bahrain as per test standards of **Sub Section 10.0**

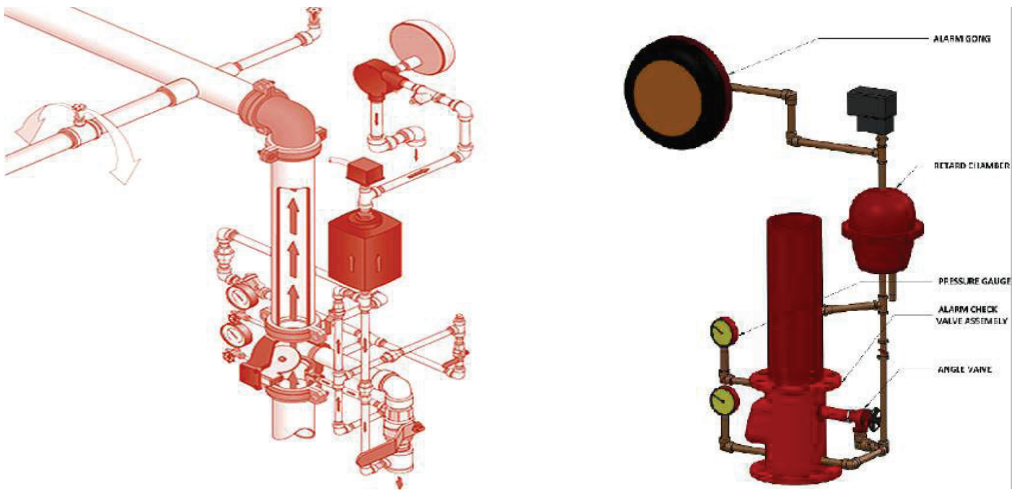


Figure:- D.05-F5.: Alarm Check Valve

Table:- D.05-T4: Automatic Sprinkler System Design Requirements

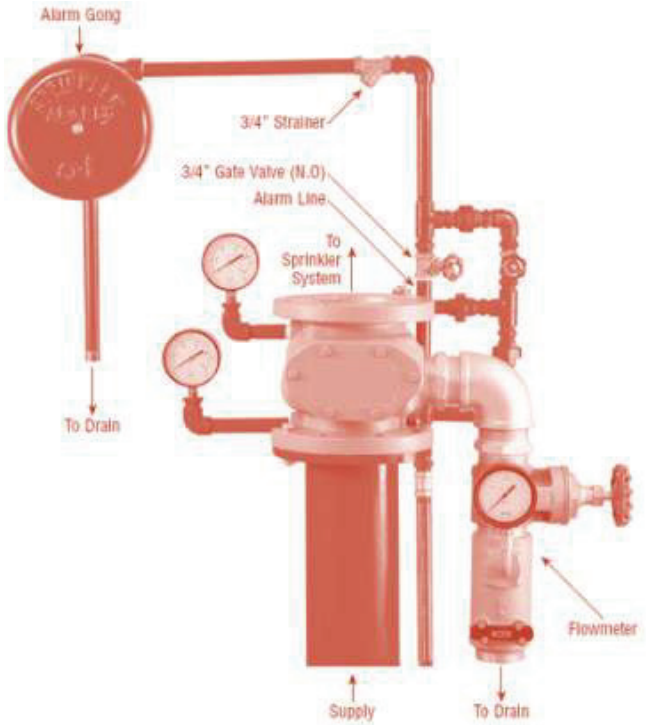
ITEMS	REQUIREMENTS
8. WATER MOTOR ALARM GONG	i. The sprinkler system shall be fitted with an permitted water motor alarm, which shall be located at a distance not exceeding 25 m from the alarm valve, and at a height not to exceed 6m above the alarm valve. ii. The used pipe work and fittings used shall be galvanized and to the sizes determined by the manufacturers data sheet. iii. The pipe work shall be arranged to drain through a fitting having an orifice not exceeding 3 mm in diameter. The orifice plate may form an integral part of the fitting but shall be manufactured from a non-ferrous material to prevent the hole from becoming blocked by corrosion or foreign matter. iv. A 15 mm test valve shall be installed on the installation side of each alarm valve. v. Permitted identification signs, shall be provided for the outside alarm devices. The sign should be located near the device in a conspicuous position and should be in English and Arabic.
9. ELECTRIC ALARM PRESSURE SWITCH	i. Electric alarm pressure switches shall be installed in the system and they shall be mounted on a vertical branch pipe at least 300 mm long. ii. The pressure switch may be of diaphragm bellows or bourdon tube operated type, and shall be sufficiently sensitive to operate when only one sprinkler is discharging. iii. The pressure switch shall be provided with volt free contracts to interconnect with the building fire alarm system for monitoring. iv. The pressure switch shall be rated for the system working pressure and water temperature service and permitted by the General Directorate of Civil Defence-Kingdom of Bahrain.
	

Figure:- D.05-F6.: Water Motor Gong Connection

Table:- D.05-T4: Automatic Sprinkler System Design Requirements

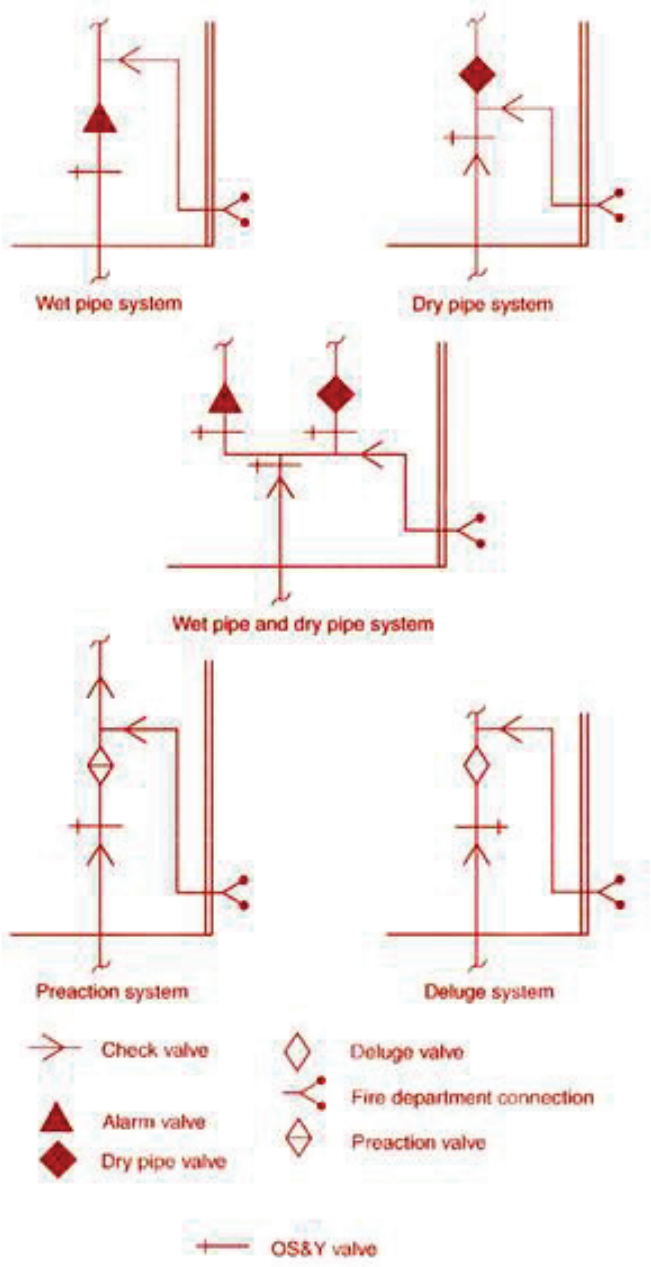
ITEMS	REQUIREMENTS
10. CONTROL VALVES	i. Each sprinkler system shall be provided with a listed indicating valve in an accessible location, so located as to control all automatic sources of water supply. ii. At least one listed indicating valve shall be installed in each source of water supply but not for fire department connections. There shall be no shutoff valve in the Breeching inlet.
	

Figure:- D.05-F7.: Acceptable Isolation Valve arrangements

Table:- D.05-T4: Automatic Sprinkler System Design Requirements

ITEMS	REQUIREMENTS
11. PRESSURE REDUCING VALVE (PRV STATION)	i. In portions of systems where all components are not listed for pressure greater than 12.1 bar and the potential exists for normal (non-fire condition) water pressure in excess of 12.1 bar, a listed pressure-reducing valve shall be installed and set for an outlet pressure not exceeding 11 bar at the maximum inlet pressure. ii. Pressure gauges shall be installed on the inlet and outlet sides of each pressure-reducing valve. iii. A relief valve of not less than 13 mm in size shall be provided on the discharge side of the pressure-reducing valve set to operate at a pressure not exceeding 12.1 bar. iv. A listed indicating valve shall be provided on the inlet side of each pressure-reducing valve, unless the pressure-reducing valve meets the listing requirements for use as an indicating valve. v. Means shall be provided downstream of all pressure-reducing valves for flow tests at sprinkler system demand. vi. Pressure reducing valve shall be a valve station in an assembly with redundancy. vii. Pressure reducing valve must be permitted by General Directorate of Civil Defense – Kingdom of Bahrain. viii. Pressure relief valve shall not be used as pressure reducing valve.

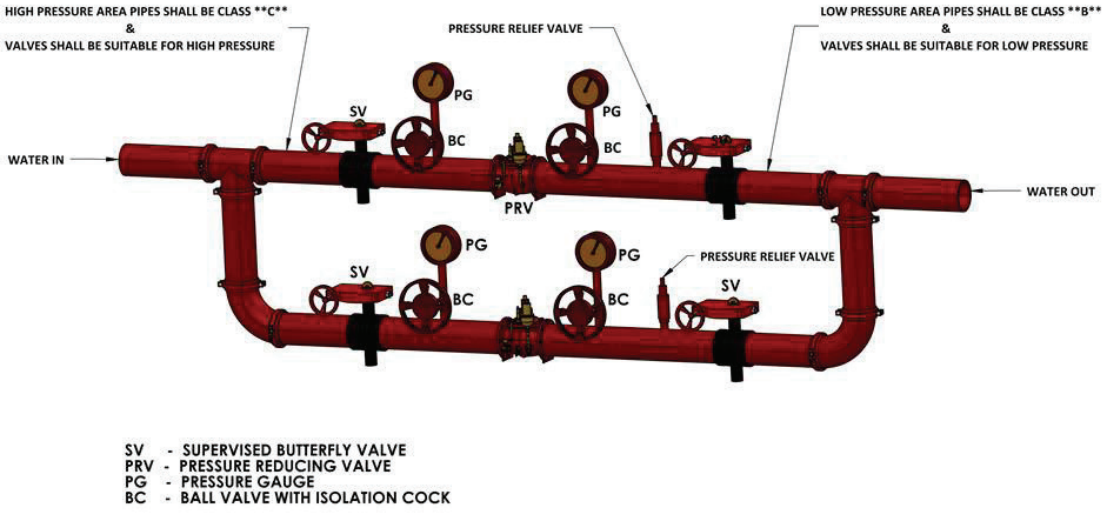


Figure:- D.05-F8.: Pressure Reducing Station

Table:- D.05-T4: Automatic Sprinkler System Design Requirements

ITEMS	REQUIREMENTS
12. SECTION OR FLOOR ZONE CONTROL VALVE (ZCV)	i. A sectional or floor zone control valve (ZCV) assembly shall be installed where the tapping is taken from the sprinkler riser for each floor in multi-story buildings. ii. All Highrise buildings shall be provided with a motorized Zone Control Valve, supervised by a zone control valve control panel for annunciation and manual operation by General Directorate of Civil Defence - Kingdom of Bahrain, to control, activate or de-activate the desired floor sprinkler. The zone control valve control panel shall be located at the Fire Command Center next to the main Fire detection and Alarm control panel or at the fire pump room. iii. ZCV shall have supervised Butterfly valve, fitted with an indicator showing "OPEN" and "CLOSE" positions, and complete with padlocked securing straps. The valve shall be mounted on the upstream side of the flow switch. iv. ZCV shall have a water flow alarm switch having paddle type water flow detector suitable for the size of the pipe in which it is installed shall be fixed after the butterfly valve, on the main supply pipe and before any sprinkler connection is taken off. v. ZCV shall have an inspector test and drain connections having not less than 25 mm diameter shall be installed on downstream side of flow switch. vi. ZCV shall have dial pressure gauges suitable for the water pressures that shall be fitted so that they can be easily removed for testing and checking without shutting down the water supply. Pressure gauge shall be installed between the butterfly valve and the water flow switch. vii. The minimum distance between the water flow switch and the butterfly valve and the test & drain valve shall be not less than 600 mm. viii. The water flow switch shall be mounted on the top of the pipe or as recommended by the original equipment manufactures data sheet. ix. All the equipment of ZCV assembly shall be rated for the system working pressure and water temperature service and permitted by the General Directorate of Civil Defence as per **Sub Section 10.0** x. The ZCV assembly shall be installed in an easily accessible & visible locations, preferably inside the star enclosure above the required headroom height. xi. ZCV assembly shall be provided with an identification sign board in a visible location in both Arabic & English languages. xii. ZCV must be permitted by General Directorate of Civil defense – Kingdom of Bahrain. xiii. Where the ZCV assembly is located in a closed room or shaft, the access door or panel shall be provided with an identification sign board in visible location in both Arabic & English.

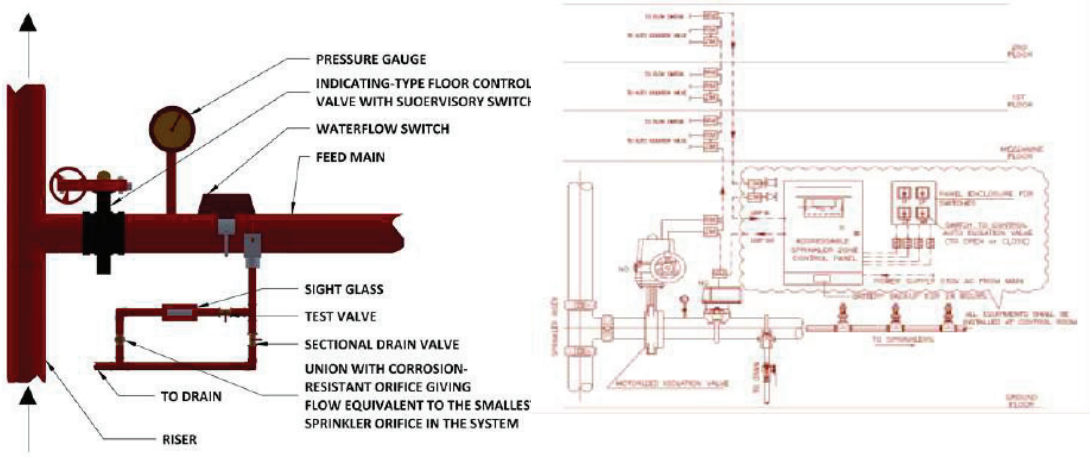


Figure:- D.05-F9.: Zone Control Valve

Table:- D.05-T4: Automatic Sprinkler System Design Requirements

ITEMS	REQUIREMENTS
13. HYDRAULIC CALCULATIONS	i. The sprinkler design with Computerized Hydraulic calculations shall be provided to determine the fire water demand, pressure and pipe sizes required for a sprinkler system. ii. The hydraulic calculation shall be performed using the General Directorate of Civil Defence - Kingdom of Bahrain listed and permitted software. The following criteria shall be used for Hydraulic calculations. iii. Hydraulics bases shall be an occupancy hazard that is located to the farthest point or the top most of the source of fire water supply system within the occupancy or density of discharge required according to the preset values as per occupancy classification.

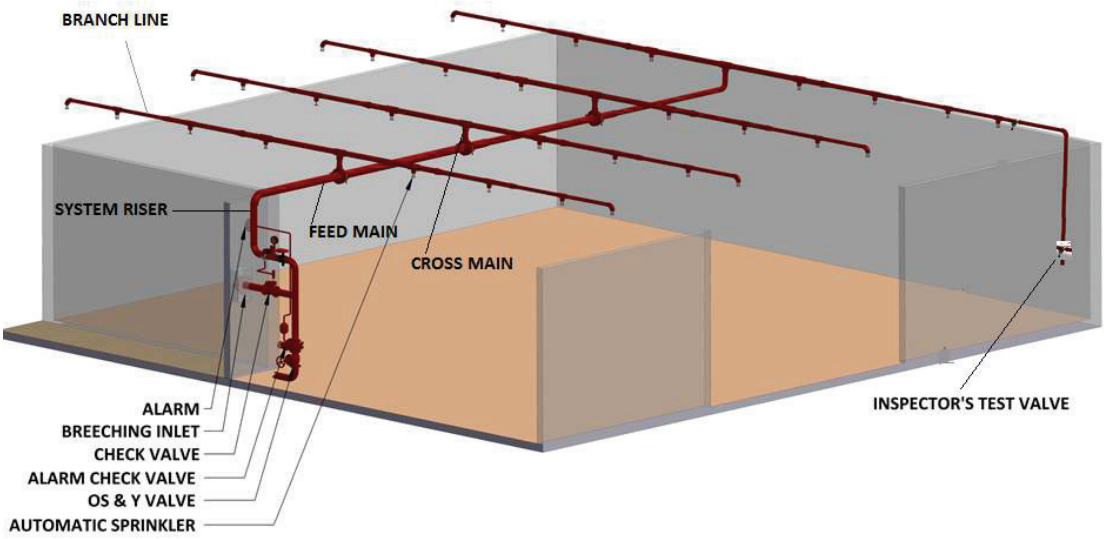


Figure:-D.05-F10.: Typical Standard Sprinkler System Network

Table:- D.05-T4: Automatic Sprinkler System Design Requirements

ITEMS	REQUIREMENTS
14. SPRINKLER ZONING AND AREA LIMITATIONS	i. The maximum floor area on any one floor to be protected by sprinklers supplied by any one sprinkler system riser or combined system riser shall be 4831 m^2 for Light and Ordinary Hazard. Separate Alarm Check Valve (ACV) shall be used for each 4831 m^2 sprinkler zones in light and ordinary hazards.. ii. The maximum floor area on any one floor to be protected by sprinklers supplied by any one sprinkler system riser or combined system riser shall be 3720 m^2 for Extra Hazard and Storage occupancies. Separate Alarm Check Valve (ACV) shall be used for each 3720 m^2 sprinkler zones in extra hazards.. iii. The floor area occupied by mezzanines shall not be included in the area limits.
15. PROTECTION AREA PER SPRINKLER	i. The protection area of coverage per sprinkler (A_s) shall be determined as S X L, $A_s = S \times L$. a. Where S is along the branch line, the distance between sprinklers (or to wall or obstruction in the case of the end sprinkler on the branch line) upstream and downstream. Choose the larger of either twice the distance to the wall or the distance to the next sprinkler on the same branch. b. Where L is between the branch lines, perpendicular distance to the sprinkler on the adjacent branch line (or to a wall or obstruction in the case of the last branch line) on each side of the branch line on which the subject sprinkler is positioned. Choose the larger of either twice the distance to the wall or obstruction or the distance to the next sprinkler on the adjacent branch.

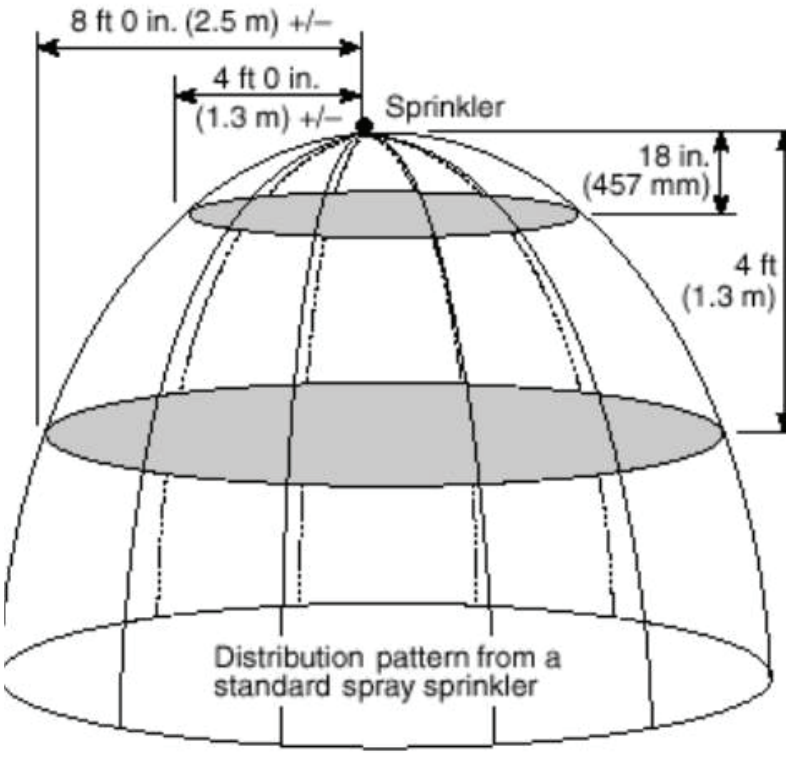


Figure:-D.05-F11 : Protection Area per Sprinkler Head, $A_s = SxL$.

5.0. Installation Requirements

5.1. The General requirements for Automatic Sprinkler System design and installation shall be as per **Table:- D.05-T5.**

Table:- D.05-T5: Automatic Sprinkler System Installation Requirements

ITEMS	REQUIREMENTS
1. PROTECTION AREA AND SPACING	i. The protection areas and the maximum spacing of various sprinkler heads, with a lenient consideration, shall comply with **Table:-D.05-T6.A.** unless the hazard demands a reduction in these figures. ii. The distance from sprinklers to walls shall not exceed one-half of the allowable distance between sprinklers. iii. Under curved surfaces, the horizontal distance shall be measured at the floor level from the wall, or at the intersection of the curved surface and the floor to the nearest sprinkler shall not be greater than one-half the allowable distance between sprinklers. iv. The distance between sprinklers shall not be less than 1.8 m on center.
2. STANDARD PENDENT AND UPRIGHT SPRINKLERS	i. The upright sprinkler heads shall be installed in such a way that their deflector is facing an upright position only with the frame arms parallel to the branch line to minimize the obstruction of its discharge pattern. ii. Upright sprinklers shall be installed where there is no false ceiling, such as car park, stores, plant rooms and concealed spaces above false ceiling areas etc. iii. Pendent Sprinklers shall be installed as Recessed or concealed sprinklers where there is a false ceiling. iv. Pendent sprinklers installed as recessed or concealed sprinklers shall be permitted to be used with, General Directorate of Civil Defence - Kingdom of Bahrain permitted and listed flexible pipes. v. The distance between the sprinkler deflector to the ceiling shall be not less than 25mm and shall be not more than 300 mm. vi. Where the situation does not permits to locate the sprinkler head within 300mm from the ceiling and exceeds 300mm, it shall be fitted with a deflector plate made of stainless steel having a diameter not less than 200 mm and shall be attached to the deflector. vii. Sprinkler protective caps and straps shall be removed immediately after the commissioning of the sprinkler system. viii. Sprinklers shall be fitted with a protective guard where there is possibilities for accidental damage of sprinkler bulbs. ix. The minimum distance between the sprinkler to the adjacent sprinkler shall be not less than 1.8 meters. x. The maximum distance between the standard sprinkler and the adjacent standard sprinkler shall be not more than 4.5 meters. Where the extended coverage upright sprinklers are used, the maximum distance between sprinkler and sprinkler shall be not more than their permit listing as per the original equipment manufacturers technical data sheet. xi. The minimum distance between a sprinkler and a wall shall be not less than 100 mm. xii. The maximum distance between a standard sprinkler and a wall shall be not more than 2.25 meters or ½ of the spacing between the sprinkler. xiii. There should not be any continuous or non-continuous obstructions such as columns, beams, truss webs and chords, pipes, ducts, and other fixtures that could prevent a discharge pattern below the sprinkler head for less than or equal to 500 mm. xiv. Sprinklers shall be installed under fixed obstructions over 800 mm wide such as ducts, cable trays, decks, open grate floorings etc.

Table:- D.05-T5: Automatic Sprinkler System Installation Requirements

ITEMS	REQUIREMENTS
2. STANDARD PENDENT AND UPRIGHT SPRINKLERS	xv. The minimum clearance between the top of storage and the sprinkler head shall be not less than 500 mm and shall be 1000 mm in special situations for special sprinklers such as ESFR & ELO sprinklers. xvi. Sprinklers under glass or plastic skylights exposed to the direct rays of the sun shall be of the intermediate-temperature classification. xvii Where there is a vertical change in the ceiling elevation within the area of coverage of the sprinkler creating a distance of more than 900 mm between the upper ceiling and the sprinkler deflector, a vertical plane extending down from the ceiling at the change in elevation shall be considered a wall for the purpose of sprinkler spacing. xviii. Where the distance between the upper ceiling and the sprinkler deflector is less than or equal to 900 mm, the sprinklers shall be permitted to be spaced as though the ceiling was flat, provided the obstruction rules and ceiling pocket rules are observed. xix. Under an obstructed construction, the sprinkler shall be installed in each bay of such construction with the sprinkler deflector located not less than 25 mm to not more than 300mm from the ceiling. xx. Sprinklers shall be located so as to minimize obstructions to discharge or additional sprinklers shall be provided to ensure an adequate coverage of the hazard. xxi. Sprinklers shall be permitted to be spaced on the opposite sides of obstructions not exceeding 1.2 m in width, provided the distance from the center line of the obstruction to the sprinklers does not exceed one-half the allowable distance permitted between sprinklers. xxii. Obstructions located against the wall and that are not over 762 mm in width shall be permitted to be protected.

Table:- D.05-T5: Automatic Sprinkler System Installation Requirements

ITEMS	REQUIREMENTS
4. SIDEWALL SPRINKLERS	i. Sidewall sprinkler heads shall be installed along a wall side, a side of a beam or beneath the flat smooth ceiling where upright or pendent sprinklers with open piping may not be desirable due to aesthetics issues. ii. Sidewall sprinklers shall be installed such that their deflectors are aligned parallel to the ceiling or roof. iii. Sidewall sprinkler shall be installed on the ramps, for the protection of any office or room where there is no false ceiling and open piping is not desirable due to aesthetic issues. iv. Quick / fast response type sprinklers shall be installed in the light hazard areas. v. The recessed / concealed pendent sprinklers shall be installed as per the installation guidelines recommended by the original equipment manufacturer. vi. Sidewall sprinkler protective caps and straps shall be removed immediately after the commissioning of the sprinkler system. vii. Sidewall sprinklers shall be fitted with a protective guard where there are possibilities for accidental damage of sprinkler bulbs. viii. The distance between a side wall sprinkler deflector and the ceiling shall be not less than 100 mm and shall be not more than 150 mm. However in noncombustible ceiling areas the distance between the side wall sprinkler deflector and the ceiling shall be permitted to be 150mm to 300mm and 300mm to 450 mm if the sprinklers are listed for such use as per original equipment manufacturers technical data sheets. ix. Where soffits used for the installation of sidewall sprinklers exceed 203 mm in width or projection from the wall, additional sprinklers shall be installed below the soffit. x. The minimum distance between the sprinkler and the adjacent sprinkler shall be not less than 1.8 m. xi. In light hazard occupancies, the maximum distance between the standard sidewall sprinkler and the adjacent standard sprinkler shall be not more than 4.25 m. and the room width shall be not more than 3.6 m. Where the extended coverage upright sprinklers are used, the maximum spacing between sprinklers along the wall and room width shall be not more than its permit listing as per the original equipment manufacturers technical data sheet. xii. In ordinary hazard occupancies, the maximum distance between the standard sidewall sprinklers to the adjacent standard sprinkler shall be not more than 3 m. and the room width shall be not more than 3 m. Where the extended coverage upright sprinklers are used, the maximum spacing between sprinklers along the wall and room width shall be not more than its permit listing as per the Original equipment manufacturers technical data sheet. xiii. The minimum distance between a sidewall sprinkler to a wall shall be not less than 100mm. xiv. The maximum distance between a standard sidewall sprinkler and a wall shall be not more than 2.125 m. in light hazard and shall be not more than 1.5 m. in ordinary hazard or ½ of the spacing between the sprinkler. xv. There should not be any continuous or non-continuous obstructions such as columns, beams, truss webs and chords, pipes, ducts and other fixtures that could prevent discharge pattern below the sprinkler head which is less than or equal to 500 mm.

Table:- D.05-T5: Automatic Sprinkler System Installation Requirements

ITEMS	REQUIREMENTS
5. SIDEWALL SPRINKLERS	xvi. Sprinklers shall be installed under fixed obstructions over 1.2 m wide such as ducts, cable trays, decks, open grate floorings etc. xvii. The minimum clearance between the top of storage and the sidewall sprinkler head shall be not less than 500mm. xviii. Sidewall sprinklers under glass or plastic skylights exposed to the direct rays of the sun shall be of the intermediate-temperature classification. xix. Sidewall sprinklers shall be located so as to minimize obstructions to discharge or additional sprinklers shall be provided to ensure an adequate coverage of the hazard. xx. Sidewall sprinklers shall be installed no closer than 1.2 m. from light fixtures or similar obstructions.
6. OBSTRUCTIONS	i. The position of various types of sprinklers to avoid obstructions of discharge patterns shall be as per **Table:- D.05-T5.A.**

Table:- D.05-T5.A: Maximum allowable distance of deflector above the obstruction base

DISTANCE FROM SPRINKLERS TO OBSTRUCTIONS (A)	STANDARD SPRINKLERS (B)	SIDEWALL SPRINKLERS (B)	EXTENDED COVERAGE SPRINKLERS (B)	ESFR SPRINKLERS (B)
1. Less than 300 mm	0 mm	25 mm	0 mm	0 mm
2. 300 mm to less than 450 mm	65 mm	75 mm	0 mm	35 mm
3. 450 mm to less than 600 mm	90 mm	115 mm	25 mm	75 mm
4. 600 mm to less than 750 mm	140 mm	145 mm	25 mm	140 mm
5. 750 mm to less than 900 mm	190 mm	175 mm	25 mm	200 mm
6. 900 mm to less than 1050 mm	240 mm	200 mm	75 mm	250 mm
7. 1050 mm to less than 1200 mm	305 mm	230 mm	75 mm	300 mm
8. 1200 mm to less than 1350 mm	355 mm	250 mm	125 mm	375 mm
9. 1350 mm to less than 1500 mm	420 mm	290 mm	175 mm	450 mm
10. 1500 mm to less than 1700 mm	457 mm	325 mm	175 mm	550 mm
11. 1700 mm to less than 1800 mm	508 mm	350 mm	175 mm	650 mm
12. 1800 mm to less than 2000 mm	600 mm	380 mm	225 mm	775 mm
13. 2000 mm to less than 2100 mm	750 mm	410 mm	275 mm	
14. 2100 mm to less than 2300 mm	875 mm	440 mm	350 mm	
15. 2300 mm to less than 2400 mm			350 mm	
16. 2400 mm to less than 2600 mm			375 mm	
17. 2600 mm to less than 2700 mm			425 mm	
18. 2700 mm to less than 2900 mm			475 mm	
19. 2900 mm to less than 3000 mm			525 mm	

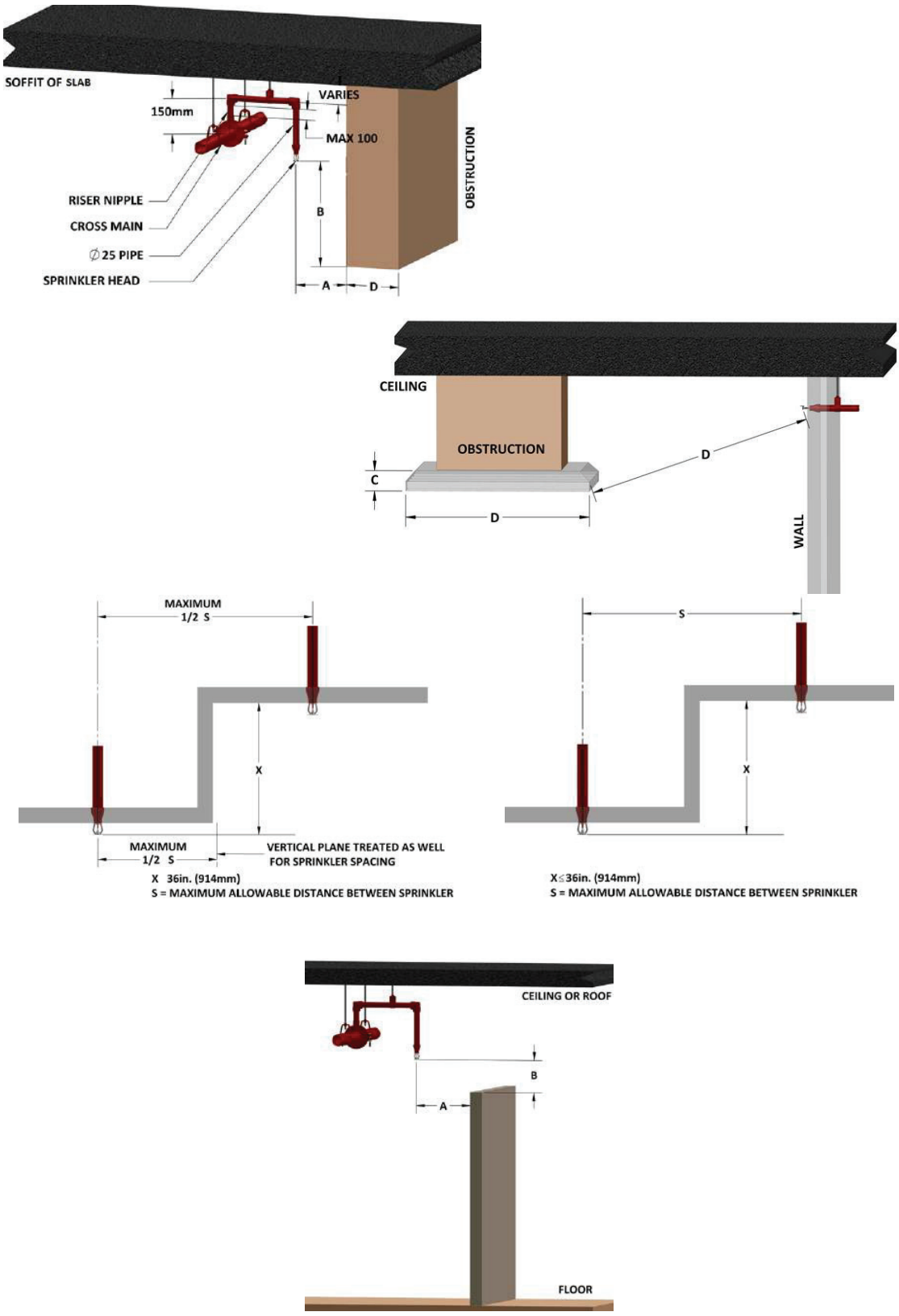


Figure:- D.05-F12.: Positioning of Sprinkler Deflectors from Obstructions

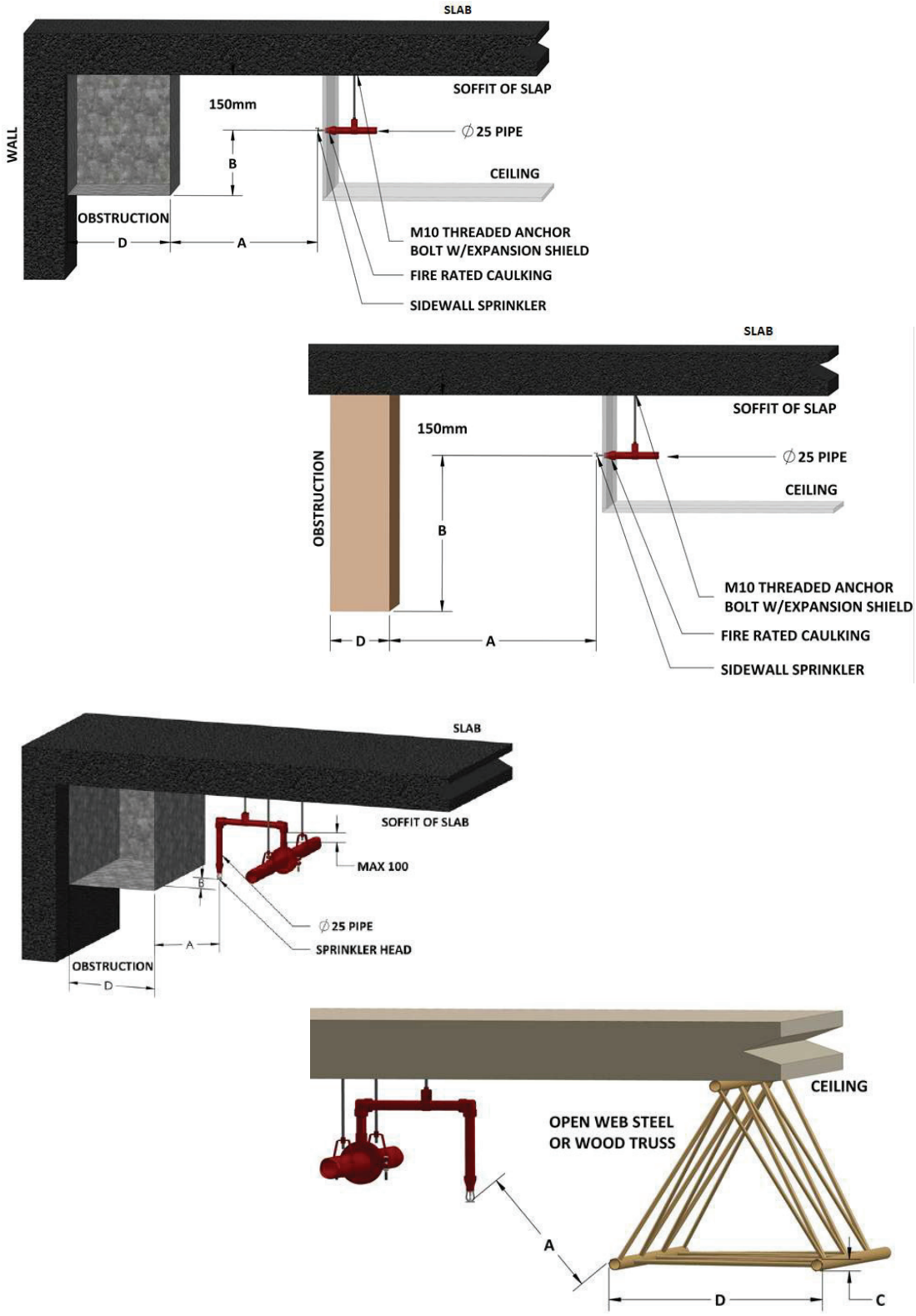


Figure:-D.05-F12.: Positioning of Sprinkler Deflectors from Obstructions

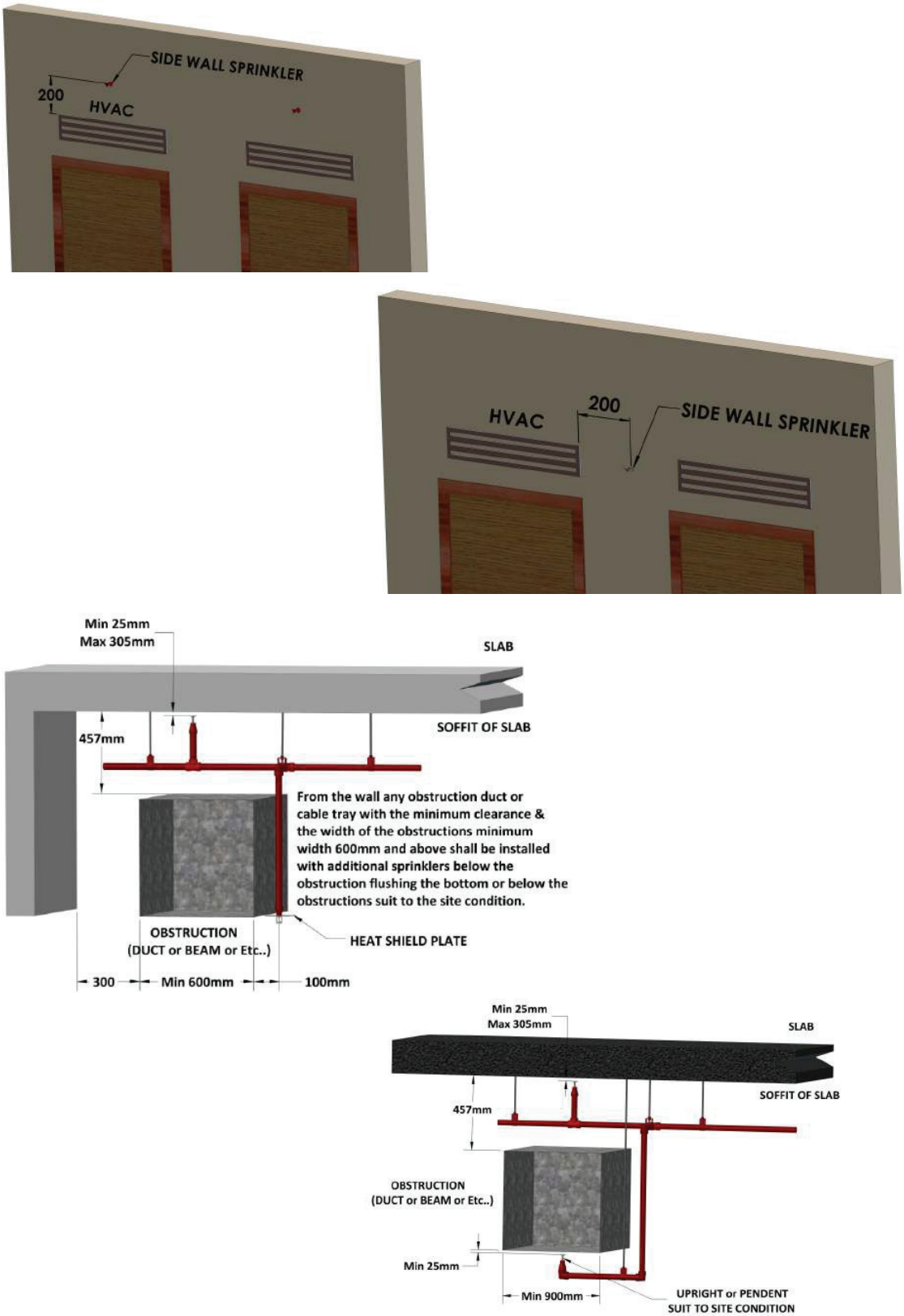


Figure:- D.05-F12.: Positioning of Sprinkler Deflectors from Obstructions

Table:- D.05-T5: Automatic Sprinkler System Installation Requirements

ITEMS	REQUIREMENTS
7. HANGERS AND BRACES	i. Hangers shall be designed to support five times the weight of the water-filled pipe plus 250 lb (115 kg) at each point of piping support. ii. The minimum distance between hangar supports, size of hangar rods, fasteners, bolts, clamps etc. shall be designed & selected and installed to withstand the load 5 times the weight of water filled pipe, plus 115 kg load. iii. These points of support shall be adequate to support the system. iv. Hanger components shall be ferrous, listed and permitted by General Directorate of Civil Defence - Kingdom of Bahrain as per **Sub Section 10.0.** v. All the supports provided for the sprinkler system piping shall allow the free movement for expansion or contraction of pipe work and shall be located by ensuring that the branch lines or fittings are not affected by the supports during expansion or contraction of the pipe installation. vi. Sprinkler system main risers shall be supported by riser clamps or by hangers located on the horizontal connections within 600 mm of the center line of the riser. Riser clamps supporting risers by means of set screws and riser clamps anchored to walls using hanger rods in the horizontal position shall not be permitted to vertically support risers. vii. Vertical risers supported at the bottom of the riser at the lowest level, at each level, above & below the offsets and top of the risers. The maximum distance between each riser support shall not exceed 3 m. viii. An anchor support shall be provided at the base (bottom) of each vertical riser pipes to withstand the total weight of the pipe with water and to prevent the movement by an upward thrust in the sprinkler system. ix. The sizes of hanger rods, U-hooks and eye rods shall not be less than that of **Table:- D.05-T5.E** x. However, the hangars spacing and hangar rod size supporting the horizontal pipes shall be not less than the distance specified in **Table:- D.05-T5.E**

Table:- D.05-T5.B: Hanger Rods, U-Hooks, Eye Rod Sizes

PIPE SIZES	HANGER ROD SIZES	U-HOOK SIZES	EYE ROD SIZES	BOLT OR ROD SIZES	HANGER SPACING
Up to 50 mm		8 mm			2 meters
65 mm to 100 mm					2.5 meters
65 mm to 150 mm		8 mm			
Up to 100 mm	10 mm		10 mm	10 mm	
125 mm	12 mm		12 mm	12 mm	
150 mm	12 mm		12 mm	12 mm	
200 mm	12 mm	12 mm	12 mm	12 mm	3 meters
250 mm	16 mm			16 mm	3 meters
300 mm	16 mm			20 mm	3 meters



6.0. Design Criteria

Table:- D.05-T6: Automatic Sprinkler System Design Requirements

ITEMS	REQUIREMENTS
1. A. DESIGN CRITERIA BASED ON HAZARDS	i. All the design criteria for Automatic Sprinkler Systems provided in this code are based on Single Point Design Density Selections. ii. The automatic Sprinkler Design criteria based on the hazard category shall be as per **Table:- D.05-T6.A.**

Table:- D.05-T6.A .:Automatic Sprinkler Design Criteria based on Hazard Categories

CRITERIA	1. LIGHT HAZARD	2. ORDINARY HAZARD GROUP 1	3. ORDINARY HAZARD GROUP 2	4. EXTRA HAZARD GROUP 1	5. EXTRA HAZARD GROUP 2
Design Density (mm/min) gpm/ft²	(4.1) 0.10	(6.1) 0.15	(8.1) 0.20	(12.2) 0.30	(16.3) 0.40
Area of Operation (m²) Ft²	(140) 1500	(140) 1500	(140) 1500	(230) 2500	(230) 2500
Hose Stream Allowance, gpm	50 gpm	50 gpm	50 gpm	50 gpm	50 gpm
Total Water Demand, Gal.	250 Gal.	300 gpm	350 gpm	800 gpm	1050 gpm
Pump Capacity, without yard hydrant gpm	250 gpm	300 gpm	350 gpm	750 gpm	1000 gpm
Pump Capacity, with yard hydrant gpm	750 gpm	750 gpm	750 gpm	1250 gpm	1500 gpm
Standard Sprinkler Maximum Coverage Area	20.9 m²	12.1 m²	12.1 m²	9.3 m²	9.3 m²
Standard Sprinkler Maximum Spacing	4.6 m	4.6 m	4.6 m	3.7 m	3.7 m
Extended Coverage Standard Sprinkler Maximum Coverage Area	37 m²	30 m²	30 m²	18.2 m²	13.4 m²
Extended Coverage Standard Sprinkler Maximum Spacing	6.1 m	5.5 m	5.5 m	4.3 m	4.6 m
Sidewall Standard Sprinkler Maximum Coverage Area	18.2 m²	9.3 m²	9.3 m²	Not allowed	Not allowed
Sidewall Standard Sprinkler Maximum distance along wall (S)	4.3 m	3 m	3 m	-	-
Sidewall Standard Sprinkler Maximum Room width (L)	11.1 m	9.3 m	9.3 m	-	-
Extended Coverage Sidewall Sprinkler Maximum Coverage Area	37 m²	37 m²	37 m²	Not allowed	Not allowed
Extended Coverage Sidewall Sprinkler Maximum Spacing	8.5 m	7.3 m	7.3 m		
ESFR (Early Suppression Fast Response) For ceiling height up to 9 m Maximum Coverage Area	9.3 m²	9.3 m²	9.3 m²	9.3 m²	9.3 m²
ESFR (Early Suppression Fast Response) For ceiling height up to 9 m Maximum Spacing	3.7 m	3.7 m	3.7 m	3.7 m	3.7 m
ESFR (Early Suppression Fast Response) For ceiling height more than 9 m Maximum Coverage Area	9.3 m²	9.3 m²	9.3 m²	9.3 m²	9.3 m²
ESFR (Early Suppression Fast Response) For ceiling height more than 9 m Maximum Spacing	3 m	3 m	3 m	3 m	3 m

Table:- D.05-T6.B : Hose Stream Allowance and Water Supply Duration

Commodity	Sprinkler Type	Sprinkler Spacing Type	Number of Ceiling Sprinklers in Design Area [a]	Size of Design Area at ceiling	Hose Stream Allowance		Water Supply Duration (minutes)
					Gpm	L/min	
Class I – IV commodities, Group A plastics, idle wood pallets and idle plastic pallets.	Commodity Mode density / area (CMDA)	Standard and Extended coverage	NA	Up to 1200 ft^2 (112 m^2)	250	950	60
				Over 1200 ft^2 (112 m^2) Up to 1500 ft^2 (140 m^2)	500	1900	90
				Over 1500 ft^2 (140 m^2) Up to 2600 ft^2 (240 m^2)	500	1900	120
				Over 2600 ft^2 (240 m^2)	500	1900	150
	Commodity Mode Specific application / area (CMSA)	Standard	Upto 12	NA	250	950	60
			Over 12 to 15	NA	500	1900	90
			Over 15 to 25	NA	500	1900	120
			Over 25	NA	500	1900	150
		Extended Coverage	Upto 6	NA	250	950	60
			Upto 8[b]	NA	250	950	60
			Over 6 to 8	NA	500	1900	90
			Over 8 to 12	NA	500	1900	120
			Over 12	NA	500	1900	150
	Early Suppression fast response (ESFR)	Standard	Upto 12	NA	250	950	60
			Over 12 to 15	NA	500	1900	90
			Over 15 to 25	NA	500	1900	120
			Over 25	NA	500	1900	150
On-floor rubber tier storage upto 5 ft (1.5m) in height	CMDA & CMSA	Standard and Extended Coverage	Any	Any	250	950	120
Rubber tier storage	CMDA	Standard and Extended Coverage	NA	Upto 5000 ft^2 (465 m^2)	750	2850	180
	CMSA	Standard	Upto 15	NA	500	1900	180
	ESFR	Standard	Upto 12	NA	250	950	60
			Over 12 to 20	NA	500	1900	120[c]
Roll Paper	CMDA	Standard	NA	Upto 4000 ft^2 (370 m^2)	500	1900	120
	CMSA	Standard	Upto 25	NA	500	1900	120
	ESFR	Standard	Upto 12	NA	250	950	60
Alternative Protection in accordance with Section 25.6	NA	NA	NA	NA	250	950	60

- NA: Not applicable.
- [a] For CMSA and ESFR sprinklers, the additional sprinklers included in the design area for obstructions do not need to be considered in determining the total number of sprinklers in this column.
- [b] Limited to a maximum of 144 ft2 (1 3 m2) per sprinkler.
- [c]For storage on-tread, on-side, and laced tires in open portable steel racks or palletized portable racks, with pile height up to 25 ft (7.6 m) and building height up to 30 ft (9.1 m) with K-14.0 (K-200) or K-16.8 (K-240) ESFR sprinklers, the water supply duration is 180 minutes.

Table:- D.05-T6: Automatic Sprinkler System Design Requirements

ITEMS	REQUIREMENTS
1.B. DESIGN CRITERIA BASED ON CHARTS	**1. GENERAL NOTES FOR SPRINKLER DESIGN REQUIREMENTS** i. Sprinkler design for various storage materials and storage arrangement shall be as per the **Table:- D.05-T6.C through Table:- D.05-T6.W** ii. Pump capacities based on the storage materials, storage height and storage arrangement shall be as per **Table:- D.05-T6.C through Table:- D.05-T6.W** iii. The pump capacity indicated in these tables is the duty point (primary rating point) of the pump. The fire pump design point and the head shall be selected based on the hydraulic calculation and fire pump characteristic curve inline with NFPA 20. iv. All sprinkler design densities are single point design criteria taken from NFPA 13 tables. v. The proposed pump capacities in these tables are rounded to the average and nearest capacities that are commercially available, listed and internationally listed and permitted. vi. Water Tank capacities shall be as per **Section D, Chapter 11**. vii. The number of design sprinklers considered for ESFR type sprinkler protection shall be 12. viii. The ceiling sprinkler design density for an aisle width between 1.2 m. and 2.4 m. shall be respectively determined by the linear interpolation of their densities. ix. The in-Rack Sprinkler demand shall be calculated for the 8 remotest sprinkler. The in-rack Sprinkler minimum K factor shall be 5.6 and minimum in-rack sprinkler pressure shall be 1 Bar.

Table:- D.05-T6: Automatic Sprinkler System Design Requirements

ITEMS	REQUIREMENTS
2. DESIGN CRITERIA FOR IDLE PALLETS	i. The automatic Control Mode (Design/Area) Sprinkler Design criteria for idle wooden pallets stored indoors shall be as per **Table:- D.05-T6.C.** ii. The automatic special application Sprinkler Design criteria for wooden pallets stored indoors shall be as per (K11.2), **Table:- D.05-T6.D.** iii. The automatic Specific Application Sprinkler Design criteria for idle wooden pallets stored indoors on floor shall be as per (K16.8), **Table:- D.05-T6.E.** iv. The automatic Specific Application Sprinkler Design criteria for idle wooden pallets stored indoors on floor shall be as per (K19.6), **Table:- D.05-T6.F.**

Table:- D.05-T6.C. : Control Mode (Design/Area) for Idle Wooden Pallets Stored Indoors

INDOOR STORAGE ARRANGE-MENT	K-FACTOR	MAXIMUM STORAGE HEIGHT	MAXI-MUM CEILING HEIGHT	REQUIRED DESIGN DENSITY Gpm (LPM)	AREA OF SPRINKLER OPERATION FT² (m²)		PUMP CAPACITY	PUMP CAPACITY WITH HOSE ALLOWANCE
					HIGH TEMP SPRINKLER	ORDINARY TEMP SPRINKLER		
ON FLOOR	8 (115)	≤ 1.8 m	6.1 m	0.20 (8.2)	2000 (185)		750 gpm	1000 gpm
	8 (115) or Larger	≤ 1.8 m	6.1 m	0.20 (8.2)		3000 (280)	750 gpm	1250 gpm
	11.2 (160) or larger	≤ 2.4 m	9.1 m	0.45 (18.3)	2500 (230)	-	1250 gpm	2000 gpm
	16.8 (240)	≤ 6.1	9.1 m	0.60 (24.5)	2000 (185)	-	1250 gpm	2000 gpm
ON FLOOR OR RACK WITHOUT SOLID SHELVES	11.2 (160) or larger	>2.4 m - 3.7m	9.1 m	0.60 (24.5)	3500 (325)	-	2500 gpm	2500 gpm
		>3.7 m - 6.1m	9.1 m	0.60 (24.5)	4500(420)	-	3000 gpm	3000 gpm

Table:- D.05-T6.D: Specific Application (K-factor 11.2) for Idle Wooden Pallets Stored Indoors On Floor

TYPE OF SYSTEM	K-FACTOR / ORIENTATION	MAXIMUM STORAGE HEIGHT	MAXI-MUM CEILING HEIGHT	NUMBER OF DESIGN SPRINKLERS BY MINIMUM PRESSURE			PUMP CAPACITY	PUMP CAPACITY WITH HOSE ALLOWANCE
				25 psi	50 psi			
WET	11.2 (160) Upright	≤ 6.1 m	9.1 m	15	-	-	1000 gpm	1250 gpm
DRY	11.2 (160) Upright	≤ 6.1 m	9.1 m	25	-	-	1500 gpm	2000 gpm

Table:- D.05-T6.E: Specific Application (K-factor 16.8) for Idle wooden Pallets Stored Indoors On Floor

TYPE OF SYSTEM	K-FACTOR / ORIENTATION	MAXIMUM STORAGE HEIGHT	MAXIMUM CEILING HEIGHT	NUMBER OF DESIGN SPRINKLERS	MINIMUM OPERAING PRESSURE	PUMP CAPACITY	PUMP CAPACITY WITH HOSE ALLOWANCE
WET	16.8 (240) Upright	6.1 m	9.1 m	15	15 psi	1000 gpm	1250 gpm
DRY	16.8 (240) Upright	6.1 m	9.1 m	25	15 psi	2000 gpm	2000 gpm

Table:- D.05-T6.F: Specific Application (K-factor 19.6) for Idle wooden Pallets Stored Indoors On Floor

TYPE OF SYS-TEM	K-FACTOR/ ORIENTATION	MAXIMUM STORAGE HEIGHT	MAXIMUM CEILING HEIGHT	NUMBER OF DESIGN SPRIN-KLERS	MINIMUM OPERAT-ING PRESSURE (PSI)	PUMP CAPACITY	PUMP CAPACITY WITH HOSE ALLOWANCE
WET	19.6 (280) Pendent	6.1 m	9.1 m	15	16psi	1250 gpm	1500 gpm
WET	19.6 (280) Pendent	6.1 m	10.7 m	15	25psi	1500 gpm	2000 gpm
WET	19.6 (280) Pendent	6.1 m	12.2 m	15	30psi	2000 gpm	2000 gpm

Table:- D.05-T6: Automatic Sprinkler System Design Requirements

ITEMS	REQUIREMENTS
3. DESIGN CRITERIA FOR CMDA WITH CEILING CLEARANCE	i. For CMDA criteria where the clearance to ceiling exceeds those identified in **Table:- D.05-T6.G**, the requirements of **Table:- D.05-T6.G.1** and **Table:- D.05-T6.G.2** shall apply. ii. Protection of Class I through IV commodities using CMDA criteria that exceeds the maximum allowable clearance in **Table:- D.05-T6.G** shall be in accordance with **Table:- D.05-T6.G.1.** iii. Protection of plastic and rubber commodities with CMDA criteria having clearance exceeding the allowable limit of **Table:- D.05-T6.G.1** shall be in accordance with **Table:- D.05-T6.G.2.**

Table:- D.05-T6.G: Maximum Clearance from Top of storage to Ceiling for CMDA Protection Criteria

Commodity	Class I to IV	Group A Plastic
Palletized, solid-piled, bin box, shelf or back – to - back shelf storage	20 ft (6.1 m)	20 ft (6.1 m)
Rack Storage upto 25 ft (7.6m)	20 ft (6.1 m)	10 ft (3.0 m)
Rack Storage Over 25 ft (7.6 m)	10 ft (3.0 m)	10 ft (3.0 m)

Table:- D.05-T6.G.1 : Class I through Class IV Commodities

Storage Configuration	Where the clearance to Ceiling exceeds	Protection is based upon the storage height that would result in a clearance to ceiling of..	In-rack Sprinklers*
Palletized, solid-piled, bin box, shelf or back – to-back shelf storage	20 ft (6.1 m)	20 ft (6.1 m)	N/A
Rack Storage upto and including 25 ft (7.6m)	20 ft (6.1 m)	20 ft (6.1 m)	Permitted as alternative to presumed clearance of 20 ft (6.1 m)
Rack Storage Over 25 ft (7.6 m)	10 ft (3.0 m)	10 ft (3.0 m)	Permitted as alternative to presumed clearance of 10 ft (3.0 m)
*When applying the supplemental in-rack sprinkler option, the ceiling density is based upon the given storage height with an assumed acceptable clearance to ceiling. Provide one level of supplemental, quick response in- rack sprinklers located directly below the top tier of storage and at every flue space intersection.			

Table:- D.05-T6.G.2 : Plastic and Rubber Commodities

Storage Configuration	Where the clearance to Ceiling exceeds	Protection is based upon the storage height that would result in a clearance to ceiling of...	In-rack Sprinklers*
Palletized, solid-piled, bin box, shelf or back – to-back shelf storage	20 ft (6.1 m)	20 ft (6.1 m)	N/A
Rack Storage upto and including 25 ft (7.6m)	10 ft (3.0 m)	10 ft (3.0 m)	Permitted as alternative to presumed clearance of 10 ft (3.0 m)
Rack Storage Over 25 ft (7.6 m)	10 ft (3.0 m)	N/A	Required
*If in-rack sprinklers are required for the actual storage height with an acceptable clearance to ceiling, in-rack sprinklers are installed as indicated by that criteria. Provide one level of supplemental, quick response in-rack sprinklers located directly below the top tier of storage and at every flue space intersection.			

Table:- D.05-T6: Automatic Sprinkler System Requirements

ITEMS	REQUIREMENTS
4. DESIGN CRITERIA (ESFR) FOR IDLE PALLETS	i. The automatic ESFR Sprinkler Design criteria for idle wooden pallets stored indoors shall be as per **Table:- D.05-T6.H.** ii. The automatic ESFR Sprinkler Design criteria for idle plastic pallets stored indoors shall be as per **Table:- D.05-T6.I.** iii. Minimum of 12 nos Sprinklers to considered to achieve the pump capacity.

Table:- D.05-T6.H : ESFR Sprinkler Protection for Indoor Storage of Idle Wood Pallets

Type of Sprinkler	Location of Storage	Nominal K Factor	Maximum Storage height		Maximum Ceiling / Roof Height		Maximum Operating Pressure		Pump Capacity (gpm)	Pump Capacity with Hose Allowance (gpm)
			ft	m	ft	m	Psi	bar		
ESFR (Pendent)	On Floor or Rack without solid shelves	14.0 (200)	25	7.6	30	9.1	50	3.4	1250	1500
			25	7.6	32	9.8	60	4.1	1500	2000
		16.8 (240)	25	7.6	30	9.1	35	2.4	1250	1500
			25	7.6	32	9.8	42	2.9	1500	2000
			35	10.7	40	12.2	52	3.6	1500	2000
		22.4 (320)	25	7.6	30	9.1	25	1.7	1500	2000
			30	9.1	35	10.7	35	2.4	2000	2000
			35	10.7	40	12.2	40	2.8	2000	2000
		25.2 (360)	25	7.6	30	9.1	15	1.0	1250	1500
			30	9.1	35	10.7	20	1.4	1500	2000
			35	10.7	40	12.2	25	1.7	1250	1500
ESFR (Upright)	On Floor	14.0 (200)	20	6.1	30	9.1	50	3.4	1250	1500
			20	6.1	35	10.7	75	5.2	1500	2000
		16.8 (240)	20	6.1	30	9.1	35	2.4	1250	1500
			20	6.1	35	10.7	52	3.6	1500	2000

Table:- D.05-T6.I : ESFR Pendent Sprinkler Protection for Indoor Storage of Idle Plastic Pallets on Floor or Open Frame Racks

Maximum Ceiling height		K Factor	Minimum Operating Pressure [psi (bar)]	Pump Capacity (gpm)	Pump Capacity with Hose Allowance (gpm)
ft	m				
30	9.1	K14 (200)	50 (3.4)	1250	1500
		K16.8 (240)	35 (2.4)	1250	1500
		K22.4 (320)	35 (2.4)	2000	2000
		K25.2 (360)	35 (2.4)	2000	2500
40	12.2	K14 (200)	Racked option available, but in-rack sprinklers required*		
		K16.8 (240)			
		K22.4 (320)	Racked option available, but in-rack sprinklers required*		
		K25.2 (360)			
> 40	> 12.2	K14 (200)	Racked option available, but in-rack sprinklers required*		
		K16.8 (240)			
		K22.4 (320)	Racked option available, but in-rack sprinklers required*		
		K25.2 (360)			
***Refer NFPA 13, Chapter 25 for exposed non expanded Group A plastic commodities**					

Table:- D.05-T6 : Automatic Sprinkler System Requirements

ITEMS	REQUIREMENTS
5.1 DESIGN CRITERIA FOR CLASS I TO IV STORED PALLETIZED TO A STORAGE HEIGHT OF UPTO 3.7M	i. The automatic Sprinkler Design criteria for Class I to Class IV stored palletized, solid piled or on shelf with storage height up to 3.7 m shall be as per **Table :- D.05-T6.J.a**

Table:- D.05-T6.J.a : Class I to Class IV stored palletized, solid piled or on shelves with storage height up to 3.7

Storage Arrangement	Commodity Class	Maximum Storage Height	Maximum Ceiling Height (m)	Required Design density Gpm (Lpm)	Area Of Sprinkler Operation Ft ² (M²)	Pump Capacity	Pump Capacity With Hose Allowance
SOLID PILED, PALLETIZE, BIN BOX, SHELF, SINGLE, DOUBLE OR MULTIPLE ROW RACK AND BACK TO BACK SHELF STORAGE,	I	≤ 3.7 m		0.15 (6.1)	1500 (140)	300 gpm	750 gpm
	II	≤ 3 m		0.15 (6.1)	1500 (140)	300 gpm	750 gpm
		≥3 m to ≤ 3.7 m		0.20 (8.1)	1500 (140)	350 gpm	750 gpm
	III	≤ 3.7 m		0.20 (8.1)	1500 (140)	350 gpm	750 gpm
	IV	≤ 3 m		0.20 (8.1)	1500 (140)	350 gpm	750 gpm
*PALLETIZED, BIN BOX, SHELF AND SOLID PILED	IV	≥3 m to ≤ 3.7 m	9.8	0.20 (8.1)	1500 (140)	350 gpm	750 gpm
*SINGLE, DOUBLE OR MULTIPLE ROW RACK AND BACK TO BACK SHELF STORAGE	IV	≥3 m to ≤ 3.7 m	9.8	0.30 (12.2)	2500 (230)	750 gpm	1250 gpm
*SINGLE, DOUBLE OR MULTIPLE ROW RACK	IV	≥3 m to ≤ 3.7 m	9.8	See NFPA 13, Chapter 25			

ITEMS	REQUIREMENTS
5.2. DESIGN CRITERIA GROUP A PLASTIC STORED PALLETIZED, BIN BOX, SHELF OR RACKS WITH STORAGE HEIGHT UP TO 3.7 M.	i. The automatic Sprinkler Design criteria for Group A plastic stored palletized, bin box, shelf or racks with storage height of up to 3.7 m shall be as per **Table :- D.05-T6.J.b.**

Table :- D.05-T6.J.b.: Group A Plastic stored up to 3.7 m

COMMODITY CLASS		STORAGE ARRANGEMENT	MAXIMUM STORAGE HEIGHT	MAXIMUM CEILING HEIGHT	REQUIRED DESIGN DENSITY Gpm (LPM)	AREA OF SPRINKLER OPERATION FT² (m²)	IN RACK SPRINKLER	PUMP CAPACITY	PUMP CAPACITY WITH HOSE ALLOWANCE
GROUP A PLASTIC CARTONED NON-EXPANDED AND EXPANDED		SOLID PILED, PALLETIZED, BIN BOX, SHELF, SINGLE, DOUBLE AND MULTIPLE ROW RACK AND BACK TO BACK SHELF STORAGE	≤ 1.5 m	-	0.20 (8.1)	1500 (140)	No need	300 gpm	750 gpm
			≥1.5 m to ≤ 3 m	4.6 m	0.30 (12.2)	2500 (232)	No need	750 gpm	1250 gpm
			≥1.5 m to ≤ 3 m	6 .1 m	0.40 (16.3)	2500 (232)	No need	1000 gpm	1500 gpm
			≥3 m to ≤ 3.7 m	5.2 m	0.40 (16.3)	2500 (232)	No need	1000 gpm	1500 gpm
		SOLID PILED, PALLETIZED, BIN BOX, SHELF AND BACK TO BACK SHELF STORAGE	≥3 m to ≤ 3.7 m	9.8 m	0.40 (16.3)	2500 (232)	No need	1000 gpm	1500 gpm
		SINGLE, DOUBLE AND MULTIPLE ROW RACK	≥3 m to ≤ 3.7 m	9.8 m	See NFPA 13, Chapter 25.				
GROUP A PLASTIC EXPOSED	NON-EXPANDED AND EXPANDED	SOLID PILED, PALLETIZED, BIN BOX, SHELF, SINGLE, DOUBLE AND MULTIPLE ROW RACK AND BACK TO BACK SHELF STORAGE	≤ 1.5 m	-	0.20 (8.1)	1500 (140)	No need	350 gpm	750 gpm
			≥ 1.5 m to ≤ 3 m	4.6 m	0.40 (16.3)	2500 (232)	No need	1000 gpm	1500 gpm
		SOLID PILED, PALLETIZED, BIN BOX, SHELF AND BACK TO BACK SHELF STORAGE	≥ 1.5m to ≤2.4m	8.5 m	0.40 (16.3)	2500 (232)	No need	1000 gpm	1500 gpm
			≥ 3 m to ≤3.7 m	5.2 m	0.40 (16.3)	2500 (232)	No need	1000 gpm	1500 gpm
		SINGLE, DOUBLE AND MULTIPLE ROW RACK	≥ 3 m to ≤3.7 m	5.2 m	0.40 (16.3)	2500 (232)	No need	1000 gpm	1500 gpm
			≥ 3 m to ≤ 3.7 m	9.8 m	See NFPA 13, Chapter 25.				
	NON-EXPANDED	SOLID PILED, PALLETIZED, BIN BOX, SHELF, SINGLE, DOUBLE AND MULTIPLE ROW RACK	≥ 1.5 m to ≤ 3 m	6.1 m	0.40 (16.3)	2500 (232)	No need	1000 gpm	1500 gpm
	EXPANDED	SINGLE, DOUBLE AND MULTIPLE ROW RACK	≥ 1.5 m to ≤ 3 m	6.1 m	See NFPA 13, Chapter 25.				

Table:- D.05-T6 : Automatic Sprinkler System Requirements

ITEMS	REQUIREMENTS
5.3. DESIGN CRITERIA FOR TIRES STORED SOLID PILED, ON SHELF OR IN RACKS UP TO 3.7 M	**i.** The automatic Sprinkler Design criteria for Tires stored solid piled, on shelf or in racks with storage height of up to 3.7 m shall be as per **Table :- D.05-T6.J.c**

Table :- D.05-T6.J.c : Tires stored up to height of 3.7 m

COM-MODITY CLASS	STORAGE ARRANGEMENT	MAXIMUM STORAGE HEIGHT	MAXI-MUM CEILING HEIGHT	REQUIRED DESIGN DENSITY Gpm (LPM)	AREA OF SPRINKLER OPERATION FT² (m²)	IN RACK SPRINKLER	PUMP CAPACITY	PUMP CAPACITY WITH HOSE ALLOWANCE
TIRES	ON FLOOR, ON SIDE	≥ 1.5 m to ≤3.7 m	9.8 m	0.30 (12.2)	2500 (232)	No need	750 gpm	1250 gpm
	ON FLOOR, ON TREAD OR ON SIDE	≤1.5 m	-	0.20 (8.1)	1500 (140)	No need	350 gpm	750 gpm
	SINGLE DOUBLE OR MULTIPLE- ROW ON RACKS ON TREAD OR ON SIDE	≤1.5 m	-	0.20 (8.1)	1500 (140)	No need	350 gpm	750 gpm
	SINGLE-ROW RACK, PORTABLE, ON TREAD OR ON SIDE	≥1.5 m to ≤ 3.7 m	9.8 m	0.30 (12.2)	2500 (232)	No need	750 gpm	1250 gpm
	SINGLE-ROW RACK, FIXED, ON TREAD OR ON SIDE	≥1.5 m to ≤ 3.7 m	9.8 m	0.30 (12.2)	2500 (232)	No need	750 gpm	1250 gpm
		≥1.5 m to ≤3.7 m	9.8 m	See NFPA 13, Chapter25				



Figure:- D.05-F13.: Tire Storage arrangement for illustration

Table:- D.05-T6 : Automatic Sprinkler System Requirements

ITEMS	REQUIREMENTS
5.4. DESIGN CRITERIA FOR ROLLED PAPER STORED UP TO 3.7 M	**i.** The automatic Sprinkler Design criteria for Rolled Paper with storage height of up to 3.7 m shall be as per **Table :- D.05-T6.J.d**

Table :- D.05-T6.J.d.: Rolled Paper stored up to height of 3.7 m

COMMODITY CLASS	STORAGE ARRANGE-MENT	MAXIMUM STORAGE HEIGHT (Meters)	MAXIMUM CEILING HEIGHT (Meters)	REQUIRED DESIGN DENSITY Gpm (LPM)	AREA OF SPRINKLER OPERATION FT² (m²)	IN RACK SPRINKLER	PUMP CAPACITY WITH HOSE DEMAND	PUMP CAPACITY WITH YDRANTS
ROLLED PAPER HEAVY AND MEDIUM WEIGHT	ON END	≤ 3 m	9.1 m	0.20 (8.1)	1500 (140)	No need	350 gpm	750 gpm
ROLLED PAPER, TISSUE AND LIGHT WEIGHT	ON END	≤ 3 m	9.1 m	0.30 (12.2)	2500 (232)	No need	750 gpm	1250 gpm





Figure:- D.05-F14.: Paper Roll warehouse for illustration

Table:- D.05-T6 : Automatic Sprinkler System Requirements

ITEMS	REQUIREMENTS
6. DESIGN CRITERIA FOR SOLID PILED, BIN BOX, SHELF OR BACK TO BACK SHELF STORAGE THROUGH CLASS I TO CLASS IV HEIGHT 3.7M TO 9.1M	i. The automatic Sprinkler Design criteria for back to back shelf storage with storage height greater than 3.7m upto 4.6m shall be as per **Table :- D.05-T6.K.** ii. For storage greater than 5.5m and upto 6.1m using ordinary temperature sprinkler from **Table :- D.05-T6.K.** iiii. Design Densities shall be selected from **Table :- D.05-T6.K** with a design area of 2000 ft2 (185 m2)

Table:- D.05-T6.K : Sprinkler System Design Density, Storage 12 ft to 30 ft (3.7 m to 9.1 m) High [gpm/ft^2 (mm/min)]

Storage height		Commodity Class	High Temperature Rated Sprinkler	Ordinary Temperature Rated Sprinkler
ft	m			
12 to 15	3.7 to 4.6	I	0.15 (6.1)	0.15 (6.1)
		II	0.15 (6.1)	0.16 (6.5)
		III	0.20 (8.2)	0.20 (8.2)
		IV	0.21 (8.6)	0.27 (11.0)
> 15 to 18	> 4.6 to 5.5	I	0.15 (6.1)	0.19 (7.7)
		II	0.15 (6.1)	0.21 (8.6)
		III	0.20 (8.2)	0.26 (10.6)
		IV	0.27 (11.0)	0.35 (14.3)
> 18 to 20	> 5.5 to 6.1	I	0.15 (6.1)	0.21 (8.6)
		II	0.17 (6.9)	0.23 (9.4)
		III	0.21 (8.6)	0.29 (11.8)
		IV	0.30 (12.2)	0.39 (15.9)
> 20 to 22	> 6.1 to 6.7	I	0.17 (6.9)	0.23 (9.4)
		II	0.19 (7.7)	0.25 (10.2)
		III	0.23 (9.4)	0.32 (13.0)
		IV	0.33 (13.4)	0.43 (17.5)
> 22 to 25	> 6.7 to 7.6	I	0.20 (8.2)	0.28 (11.4)
		II	0.23 (9.4)	0.31 (12.6)
		III	0.28 (11.4)	0.39 (15.9)
		IV	0.41 (16.7)	0.53 (21.6)
> 25 to 28	> 7.6 to 8.5	I	0.25 (10.2)	0.35 (14.3)
		II	0.28 (11.4)	0.38 (15.5)
		III	0.35 (14.3)	0.48 (19.6)
		IV	0.50 (20.4)	0.64 (26.1)
> 28 to 30	> 8.5 to 9.1	I	0.29 (11.8)	0.40 (16.3)
		II	0.32 (13.0)	0.44 (17.9)
		III	0.40 (16.3)	0.55 (22.4)
		IV	0.57 (23.2)	0.74 (30.2)

Table:- D.05-T6.L : Automatic Sprinkler System Requirements

ITEMS	REQUIREMENTS
6. DESIGN CRITERIA FOR CLASS I TO IV STORED IN SINGLE OR DOUBLE ROW RACKS WITH STORAGE HEIGHT OF OVER 3.7 M TO 6.1 M (WITHOUT SOLID SHELVES)	i. The automatic Sprinkler Design Criteria for Class I to IV stored in Single or Double row racks with storage height of above 3.7 m to 6.1 m (Without Solid Shelves), shall be as per **Table:- D.05-T6.L.a, Table:- D.05-T6.L.b and Table:- D.05-T6.L.c** ii. The area of sprinkler operation shall be 186 m^2 except for below. a. The area of sprinkler operation shall be 215 m^2 for design density 0.55 (22.4), AMAO- (Assumed Maximum Area of Operation) for high temperature sprinklers. b. The area of sprinkler operation shall be 370 m^2 for design density 0.55 (22.4), ordinary temperature iii. Unless otherwise indicated in **Table:- D.05-T6.L.a, Table:- D.05-T6.L.b and Table:- D.05-T6.L.c** the minimum design area shall be 2000 ft^2 (185 m^2). iv. Pump capacity indicated in the **Table:- D.05-T6.L.a, Table:- D.05-T6.L.b and Table:- D.05-T6.L.c** considering the maximum design density (ordinary temperature sprinkler).

Table:- D.05-T6.L.a : Single- or Double-Row Racks – Storage Height Over 3.7m Up to and Including 15 ft (4.6 m) [gpm/ft^2 (mm/min)]

Commodity Class	Encapsulated	In- Rack Sprinklers Mandatory	Aisles ft (m) width	Density - High-Temperature-Rated Sprinkler (LPM/ m^2)	Density - Ordinary-Temperature rated Sprinkler (LPM/ m^2)	Design Area ft2 (m2)	Pump Capacity (gpm)	Pump Capacity with Hose Allowance (gpm)
I	No	No	4 (1.2)	0.19 (7.7)	0.22 (9.0)	2000 (185)	750	1000
			8 (2.4)	0.17 (6.9)	0.20 (8.1)	2000 (185)	750	1000
	Yes	No	4 (1.2)	0.33 (13.4)[a]	0.33 (13.4)[b]	4000 (370)	1500	2000
			8 (2.4)	0.28 (11.4)	0.32 (13.0)	2000 (185)	750	1250
II	No	No	4 (1.2)	0.23 (9.4)	0.26 (10.6)	2000 (185)	750	1250
			8 (2.4)	0.20 (8.2)	0.22 (9.0)	2000 (185)	750	1000
	Yes	No	4 (1.2)	0.33 (13.4)[a]	0.33 (13.4)[b]	4000 (370)	1500	2000
			8 (2.4)	0.28 (11.4)	0.32 (13.0)	2000 (185)	750	1250
III	No	No	4 (1.2)	0.26 (10.6)	0.29 (11.8)	2000 (185)	750	1000
			8 (2.4)	0.22 (9.0)	0.25 (10.2)	2000 (185)	750	1000
	Yes	Yes	4 (1.2)	See NFPA 13, Chapter 25				
			8 (2.4)					
IV	No	No	4 (1.2)	0.35 (14.3)	0.36 (14.7)[c]	3000 (280)	1250	1500
			8 (2.4)	0.30 (12.2)	0.34 (13.9)	2000 (185)	750	1000
	Yes	Yes	4 (1.2)	See NFPA 13, Chapter 25				
			8 (2.4)					

[a] Design area is 2400 ft^2 (220 m^2)

[b] Design area is 4000 ft^2 (370 m^2)

[c] Design area is 3000 ft^2 (280 m^2)

Table:- D.05-T6.L.b : Single- or Double-Row Racks – Storage Height Greater than 15 ft (4.6 m) Up to and Including 18 ft (5.5 m) [gpm/ft² (mm/min)]

Commodity Class	Encapsulated	In- Rack Sprinklers Mandatory	Aisles ft (m)	High-Temperature-Rated Sprinkler	Ordinary Temperature rated Sprinkler	Design Area ft2 (m2)	Pump Capacity (gpm)	Pump Capacity with Hose Allowance (gpm)
I	No	No	4 (1.2)	0.27 (11.0)	0.31 (12.6)	2000 (185)	750	1000
			8 (2.4)	0.25 (10.2)	0.28 (11.4)	2000 (185)	750	1000
	Yes	No	4 (1.2)	0.47 (19.2)[a]	0.47 (19.2)[b]	4000 (370)	2000	2500
			8 (2.4)	0.40 (16.3)	0.46 (18.7)	2000 (185)	1000	1250
II	No	No	4 (1.2)	0.32 (13.0)	0.37 (15.1)	2000 (185)	750	1000
			8 (2.4)	0.28 (11.4)	0.31 (12.6)	2000 (185)	750	1000
	Yes	No	4 (1.2)	0.47 (19.2)[a]	0.47 (19.2)[b]	4000 (370)	2000	2500
			8 (2.4)	0.40 (16.3)	0.46 (18.7)	2000 (185)	1000	1250
III	No	No	4 (1.2)	0.37 (15.1)	0.42 (17.1)	2000 (185)	1000	1250
			8 (2.4)	0.31 (12.6)	0.36 (14.7)	2000 (185)	750	1000
	Yes	Yes	4 (1.2)	See NFPA 13, Chapter 25				
			8 (2.4)					
IV	No	No	4 (1.2)	0.49 (20.0)	0.51 (20.8)[c]	3000 (280)	2000	2000
			8 (2.4)	0.42 (17.1)	0.48 (19.6)	2000 (185)	1000	1250
	Yes	Yes	4 (1.2)	See NFPA 13, Chapter 25				
			8 (2.4)					

[a] Design area is 2400 ft² (220 m²)
[b] Design area is 4000 ft² (370 m²)
[c] Design area is 3000 ft² (280 m²)

Table:- D.05-T6.L.c : Single- or Double-Row Racks – Storage Height Greater than 18 ft (5.5 m) Up to and Including 20 ft (6.1 m) [gpm/ft² (mm/min)]

Commodity Class	Encapsulated	In- Rack Sprinklers Mandatory	Aisles ft (m)	High-Temperature-Rated Sprinkler	Ordinary-Temperature – rated Sprinkler	Design Area ft2 (m2)	Pump Capacity (gpm)	Pump Capacity with Hose Allowance (gpm)
I	No	No	4 (1.2)	0.32 (13.0)	0.37 (15.1)	2000 (185)	750	1000
			8 (2.4)	0.29 (11.8)	0.33 (13.4)	2000 (185)	750	1000
	Yes	No	4 (1.2)	0.55 (22.4)[a]	0.55 (22.4)[b]	4000 (370)	2500	2500
			8 (2.4)	0.47 (19.1)	0.54 (21.9)	2000 (185)	1250	1500
II	No	No	4 (1.2)	0.38 (15.5)	0.44 (17.9)	2000 (185)	1000	1250
			8 (2.4)	0.33 (13.5)	0.37 (15.1)	2000 (185)	750	1000
	Yes	No	4 (1.2)	0.55 (22.4)[a]	0.55 (22.4)[b]	4000 (370)	2500	2500
			8 (2.4)	0.47 (19.1)	0.54 (21.9)	2000 (185)	1250	1500
III	No	No	4 (1.2)	0.43 (17.5)	0.49 (19.9)	2000 (185)	1000	1250
			8 (2.4)	0.37 (15.1)	0.42 (17.1)	2000 (185)	1000	1250
	Yes	Yes	4 (1.2)	See NFPA 13, Chapter 25				
			8 (2.4)					
IV	No	No	4 (1.2)	0.58 (23.7)	0.60 (24.5)[c]	3000 (280)	2000	2500
			8 (2.4)	0.50 (20.4)	0.57 (23.2)	2000 (185)	1250	1500
	Yes	Yes	4 (1.2)	See NFPA 13, Chapter 25				
			8 (2.4)					

[a] Design area is 2400 ft² (220 m²)
[b] Design area is 4000 ft² (370 m²)
[c] Design area is 3000 ft² (280 m²)

Table:- D.05-T6 : Automatic Sprinkler System Requirements

ITEMS	REQUIREMENTS
7. DESIGN CRITERIA FOR CLASS I TO IV STORED IN SINGLE OR DOUBLE ROW RACKS WITH STORAGE HEIGHT OF ABOVE 6.1 M TO AND 7.6 M. (WITHOUT SOLID SHELVES)	i. The automatic Sprinkler Design criteria for Class I to Class IV stored on single or double row racks with storage height 6.1 m to 6.7 m (without solid shelves) shall be as per **Table:- D.05-T6.M.** ii. The automatic Sprinkler Design criteria for Class I to Class IV stored on single or double row racks with storage height 6.7 m to 7.6 m (without solid shelves) shall be as per **Table:- D.05-T6.N,** iii. Area of sprinkler operation of not less than 2000 ft^2 (185m^2) for Wet system and 2600 ft^2 (240 m^2) for Dry system.

Table:- D.05-T6.M : Single- or Double-Row Racks – Storage Height Greater than 20 ft (6.1 m) Up to and Including 22 ft (6.7 m) [gpm/ft^2 (mm/min)]

Commodity Class	Encapsulated	In- Rack Sprinklers Mandatory	Aisles ft (m)	High-Temperature-Rated Sprinkler	Ordinary Temperature rated Sprinkler	Pump Capacity (gpm) (Wet)	Pump Capacity with Hose Allowance (gpm) (Wet)
I	No	No	4 (1.2)	0.42 (17.1)	0.48 (19.6)	1000	1250
			8 (2.4)	0.38 (15.5)	0.43 (17.5)	1000	1250
	Yes	Yes	4 (1.2)	See NFPA 13, Chapter 25			
			8 (2.4)				
II	No	No	4 (1.2)	0.49 (20.0)	0.57 (23.2)	1250	1500
			8 (2.4)	0.43 (17.5)	0.48 (19.6)	1000	1250
	Yes	Yes	4 (1.2)	See NFPA 13, Chapter 25			
			8 (2.4)				
III	No	No	4 (1.2)	0.56 (22.8)	0.64 (26.1)	1500	2000
			8 (2.4)	0.48 (19.6)	0.48 (19.6)	1000	1250
	Yes	Yes	4 (1.2)	See NFPA 13, Chapter 25			
			8 (2.4)				
IV	No	No	4 (1.2)	0.75 (30.5)	0.78 (31.7)*	2500	3000
			8 (2.4)	0.65 (26.5)	0.74 (30.1)	1500	2000
	Yes	Yes	4 (1.2)	See NFPA 13, Chapter 25			
			8 (2.4)				
* Design area is 3000 ft^2 (280 m^2)							

Table:- D.05-T6.N : Single- or Double-Row Racks – Storage Height Greater than 22 ft (6.7 m) Up to and Including 25 ft (7.6 m) [gpm/ft^2 (mm/min)]

Commodity Class	Encapsulated	In- Rack Sprinklers Mandatory	Aisles ft (m)	High-Temperature-Rated Sprinkler	Ordinary- Temperature –rated Sprinkler	Pump Capacity (gpm)	Pump Capacity with Hose Allowance (gpm)
I	No	No	4 (1.2)	0.56 (22.8)	0.65 (26.9)	1500	2000
			8 (2.4)	0.51 (20.8)	0.58 (23.6)	1250	1500
	Yes	Yes	4 (1.2)	See NFPA 13, Chapter 25			
			8 (2.4)				
II	No	No	4 (1.2)	0.67 (27.3)	0.77 (31.3)	2000	2000
			8 (2.4)	0.58 (23.7)	0.65 (26.5)	1500	2000
	Yes	Yes	4 (1.2)	See NFPA 13, Chapter 25			
			8 (2.4)				
III	No	No	4 (1.2)	0.75 (30.5)	0.86 (34.9)	2000	2000
			8 (2.4)	0.65 (26.5)	0.74 (30.1)	1500	2000
	Yes	Yes	4 (1.2)	See NFPA 13, Chapter 25			
			8 (2.4)				
IV	No	No	4 (1.2)	See NFPA 13, Chapter 25			
			8 (2.4)				
	Yes	Yes	4 (1.2)				
			8 (2.4)				

Table:- D.05-T6 : Automatic Sprinkler System Requirements

ITEMS	REQUIREMENTS
8. DESIGN CRITERIA FOR CLASS I TO IV STORED IN MULTIPLE ROW RACKS OF 4.9 M DEPTH AND AISLES 2.4 M OR WIDER WITH STORAGE HEIGHT OF OVER 3.7 M TO 7.6 M.	i. The automatic Sprinkler Design Criteria for Class I to IV stored in Multiple row racks of 4.9 m depth and aisles 2.4 m or wider with storage height of over 3.7 m to 6.1 m shall be as per **Table:- D.05-T6.O.a, Table:- D.05-T6.O.b , Table:- D.05-T6.O.c, Table:- D.05-T6.O.d, Table:- D.05-T6.O.e, with Area of sprinkler operation of not less than 2000 ft² (185m²) for Wet system and 2600 ft² (240 m²) for Dry system.** iii. Area of sprinkler operation of not less than 2000 ft² (185m²) for Wet system and 2600 ft² (240 m²) for Dry system.

Table:- D.05-T6.O.a : Multiple-Row Racks – Rack Depth up to and including 16 ft (4.9 m), Aisles 8 ft (2.4 m) or wider, Storage Height up to and including 15 ft (4.6 m) [gpm/ft² (mm/min)]

Commodity Class	Encapsulated	In- Rack Sprinklers Mandatory	High Temperature Rated Sprinkler	Ordinary Temperature rated Sprinkler	Pump Capacity (gpm) (Wet)	Pump Capacity with Hose Allowance (gpm) (Wet)
I	No	No	0.22 (9.0)	0.25 (10.2)	750	1000
	Yes	No	0.28 (11.4)	0.31 (12.6)	750	1000
II	No	No	0.25 (10.2)	0.28 (11.4)	750	1000
	Yes	No	0.32 (13.0)	0.35 (14.3)	750	1000
III	No	No	0.28 (11.4)	0.31 (12.6)	750	1000
	Yes	Yes	See NFPA 13, Chapter 25			
IV	No	Yes	See NFPA 13, Chapter 25			
	Yes	Yes	See NFPA 13, Chapter 25			

Table:- D.05-T6.O.b : Multiple-Row Racks – Rack Depth up to and including 16 ft (4.9 m), Aisles 8 ft (2.4 m) or wider, Storage Height above 15 ft (4.6 m) up to and including 18 ft (5.5 m) [gpm/ft² (mm/min)]

Commodity Class	Encapsulated	In- Rack Sprinklers Mandatory	High-Temperature-Rated Sprinkler	Ordinary-Temperature –rated Sprinkler	Pump Capacity (gpm) (Wet)	Pump Capacity with Hose Allowance (gpm) (Wet)
I	No	No	0.31 (12.6)	0.35 (14.3)	750	1000
	Yes	No	0.39 (15.9)	0.44 (17.9)	1000	1250
II	No	No	0.36 (14.7)	0.40 (16.3)	1000	1250
	Yes	No	0.45 (18.3)	0.50 (20.4)	1000	1250
III	No	No	0.40 (16.3)	0.44 (17.9)	1000	1250
	Yes	Yes	See NFPA 13, Chapter 25			
IV	No	Yes	See NFPA 13, Chapter 25			
	Yes	Yes	See NFPA 13, Chapter 25			

Table:- D.05-T6.O.c : Multiple-Row Racks – Rack Depth up to and including 16 ft (4.9 m), Aisles 8 ft (2.4 m) or wider, Storage Height above 18 ft (5.5 m) up to and including 20 ft (6.1 m) [gpm/ft² (mm/min)]

Commodity Class	Encapsulated	In- Rack Sprinklers Mandatory	High-Temperature-Rated Sprinkler	Ordinary-Temperature –rated Sprinkler	Pump Capacity (gpm) (Wet)	Pump Capacity with Hose Allowance (gpm) (Wet)
I	No	No	0.37 (15.1)	0.41 (16.7)	1000	1250
	Yes	No	0.46 (18.7)	0.51 (20.8)	1250	1500
II	No	No	0.42 (17.1)	0.47 (19.2)	1000	1250
	Yes	No	0.53 (21.6)	0.59 (24.0)	1250	1500
III	No	No	0.47 (19.1)	0.52 (21.2)	1250	1500
	Yes	Yes	See NFPA 13, Chapter 25			
IV	No	Yes	See NFPA 13, Chapter 25			
	Yes	Yes	See NFPA 13, Chapter 25			

Table:- D.05-T6.O.d : Multiple-Row Racks – Rack Depth up to and including 16 ft (4.9 m), Aisles 8 ft (2.4 m) or wider, Storage Height above 20 ft (6.1 m) up to and including 22 ft (6.7 m) [gpm/ft² (mm/min)]

Commodity Class	Encapsulated	In- Rack Sprinklers Mandatory	High-Temperature-Rated Sprinkler	Ordinary- Temperature –rated Sprinkler	Pump Capacity (gpm) (Wet)	Pump Capacity with Hose Allowance (gpm) (Wet)
I	No	No	0.48 (19.6)	0.53 (21.6)	1250	1500
	Yes	Yes	See NFPA 13, Chapter 25			
II	No	Yes	See NFPA 13, Chapter 25			
	Yes	Yes	See NFPA 13, Chapter 25			
III	No	Yes	See NFPA 13, Chapter 25			
	Yes	Yes	See NFPA 13, Chapter 25			
IV	No	Yes	See NFPA 13, Chapter 25			
	Yes	Yes	See NFPA 13, Chapter 25			

Table:- D.05-T6.O.e : Multiple-Row Racks – Rack Depth up to and including 16 ft (4.9 m), Aisles 8 ft (2.4 m) or wider, Storage Height above 22 ft (6.7 m) up to and including 25 ft (7.6 m) [gpm/ft² (mm/min)]

Commodity Class	Encapsulated	In- Rack Sprinklers Mandatory	High-Temperature-Rated Sprinkler	Ordinary- Temperature –rated Sprinkler	Pump Capacity (gpm) (Wet)	Pump Capacity with Hose Allowance (gpm) (Wet)
I	No	No	0.65 (26.5)	0.72 (29.3)	1500	2000
	Yes	Yes	See NFPA 13, Chapter 25			
II	No	Yes	See NFPA 13, Chapter 25			
	Yes	Yes	See NFPA 13, Chapter 25			
III	No	Yes	See NFPA 13, Chapter 25			
	Yes	Yes	See NFPA 13, Chapter 25			
IV	No	Yes	See NFPA 13, Chapter 25			
	Yes	Yes	See NFPA 13, Chapter 25			

Table:- D.05-T6: Automatic Sprinkler System Requirements

ITEMS	REQUIREMENTS
9. DESIGN CRITERIA FOR CLASS I TO IV STORED IN MULTIPLE ROW RACKS OF OVER 4.9 M DEPTH OR AISLES NARROWER THAN 2.4 M, WITH STORAGE HEIGHT OF OVER 3.7 M UP TO 4.6M.	i. The automatic Sprinkler Design Criteria for Class I to IV stored in Multiple row racks of over 4.9 m depth or aisles narrower than 2.4 m, with storage height of over 3.7 m up to 4.6 m shall be as per **Table:- D.05-T6.P with Area of sprinkler operation of not less than 2000 ft² (185m²) for Wet system and 2600 ft² (240 m²) for Dry system.**

Table:- D.05-T6.P : Multiple-Row Racks – Rack Depth over 16 ft (4.9 m) or Aisles Narrower than 8 ft (2.4 m) , Storage Height up to and including 15 ft (4.6 m) [gpm/ft² (mm/min)]

Commodity Class	Encapsulated	In- Rack Sprinklers Mandatory	High-Temperature-Rated Sprinkler	Ordinary- Temperature – rated Sprinkler	Pump Capacity (gpm) (Wet)	Pump Capacity with Hose Allowance (gpm) (Wet)
I	No	No	0.22 (9.0)	0.25 (10.2)	750	1000
	Yes	No	0.28 (11.4)	0.31 (12.6)	750	1000
II	No	No	0.25 (10.2)	0.28 (11.4)	750	1000
	Yes	No	0.32 (13.0)	0.35 (14.3)	750	1000
III	No	No	0.28 (11.4)	0.31 (12.6)	750	1000
	Yes	Yes	See NFPA 13, Chapter 25			
IV	No	Yes	See NFPA 13, Chapter 25			
	Yes	Yes	See NFPA 13, Chapter 25			

10. EVALUATION OR MODIFICATION OF EXISTING SYSTEMS SINGLE OR DOUBLE ROW–RACK STORAGE HEIGHT OVER 3.7M UPTO AND INCLUDING 7.6M	i. The automatic Sprinkler Design criteria for Class I to Class IV stored on single or double row racks with storage height over 3.7 m up to and including 7.6 m for Evaluation or Modification of Existing system shall be as per **NFPA 13, 2022 Edition, Chapter 21.4.1.2.2 and Table :- 21.4.1.2.2.1**
11. EVALUATION OR MODIFICATION OF EXISTING SYSTEMS MULTIPLE ROW–RACK DEPTH UPTO AND INCLUDING 4.9M, AISLES 2.4M OR WIDER, STORAGE HEIGHT OVER 3.7M UPTO AND INCLUDING 7.6M	i. The automatic Sprinkler Design Criteria for Class I to IV stored in Multiple row racks of upto 4.9 m depth, aisles 2.4 m or wider, with storage height of over 3.7 m up to 4.6 m for Evaluation or Modification of Existing system shall be as per **NFPA 13, 2022 Edition, Chapter 21.4.1.3.2 and Table :- 21.4.1.3.2.1.**
12. EVALUATION OR MODIFICATION OF EXISTING SYSTEMS MULTIPLE ROW–RACK DEPTH OVER 4.9M OR AISLES MORE NARROWER THAN 2.4M, STORAGE HEIGHT OVER 3.7M UPTO AND INCLUDING 7.6M	i. The automatic Sprinkler Design Criteria for Class I to IV stored in Multiple row racks of over 4.9 m depth or aisles more narrower than 2.4 m, with storage height of over 3.7 m up to 4.6 m for Evaluation or Modification of Existing system shall be as per **NFPA 13, 2022 Edition, Chapter 21.4.1.5 and Table :- 21.4.1.5.1.**

Table:- D.05-T6 : Automatic Sprinkler System Requirements

ITEMS	REQUIREMENTS
13. DESIGN CRITERIA OF CMSA (CONTROL MODE SPECIFIC APPLICATION) AND NOMINAL K-FACTOR FOR PALLETIZED, SOLID PILED STORAGE OF FOR CLASS I TO IV COMMODITIES	i. The automatic Sprinkler Design criteria of CMSA and Nominal K-factor for Class I to Class IV palletized, solid piled Storage shall be as per **Table:- D.05-T6.Q.**

Table:- D.05-T6.Q : CMSA Sprinkler Design Criteria for Palletized and Solid-Piled storage of Class I through Class IV Commodities (Encapsulated and Non-encapsulated)

Configuration	Commodity Class	Maximum Storage Height		Maximum Ceiling / Roof Height		K-Factor / Orientation	Type of System	Number of Design Sprinklers	Minimum Operating Pressure		Pump Capacity (gpm) (Wet)	Pump Capacity with Hose Allowance (gpm) (Wet)
		ft	m	ft	M				psi	bar		
Palletized	Class I or II	25	7.6	30	9.1	11.2 (160) Upright	Wet	15	25	1.7	1000	1250
							Dry	25	25	1.7	1500	2000
						16.8 (240) Upright	Wet	15	10	0.7	1000	1250
							Dry	25	15	1.0	2000	2000
						19.6 (280) Pendent	Wet	15	16	1.1	1250	1500
						25.2 (360) Pendent	Wet	15	10	0.7	1250	1500
				35	10.7	11.2 (160) Upright	Wet	15	25	1.7	1000	1250
							Dry	25	25	1.7	1500	2000
						16.8 (240) Upright	Wet	15	15	1.0	1000	1250
							Dry	25	15	1.0	2000	2000
				40	12.2	25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
		30	9.1	35	10.7	19.6 (280) Pendent	Wet	15	25	1.7	1500	2000
				40	12.2	25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
		35	10.7	40	12.2	19.6 (280) Pendent	Wet	15	30	2.1	2000	2000
						25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
	Class III	25	7.6	30	9.1	11.2 (160) Upright	Wet	15	25	1.7	1000	1250
							Dry	25	25	1.7	1500	2000
						16.8 (240) Upright	Wet	15	15	1.0	1000	1250
							Dry	25	15	1.0	2000	2000
						19.6 (280) Pendent	Wet	15	16	1.1	1250	1500
						25.2 (360) Pendent	Wet	15	10	0.7	1250	1500
				35	10.7	11.2 (160) Upright	Wet	15	25	1.7	1000	1250
							Dry	25	25	1.7	1500	2000
						16.8 (240) Upright	Wet	15	15	1.0	1000	1250
							Dry	25	15	1.0	2000	2000
				40	12.2	25.2 (360) Pendent	Wet	15	23	1.6	2000	2500

Table:- D.05-T6.Q : CMSA Sprinkler Design Criteria for Palletized and Solid-Piled storage of Class I through Class IV Commodities (Encapsulated and Non-encapsulated)

Configuration	Commodity Class	Maximum Storage Height		Maximum Ceiling / Roof Height		K-Factor / Orientation	Type of System	Number of Design Sprinklers	Minimum Operating Pressure		Pump Capacity (gpm) (Wet)	Pump Capacity with Hose Allowance (gpm) (Wet)
		ft	m	ft	M				psi	bar		
Palletized	Class III	30	9.1	35	10.7	19.6 (280) Pendent	Wet	15	25	1.7	1500	2000
				40	12.2	25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
		35	10.7	40	12.2	19.6 (280) Pendent	Wet	15	30	2.1	2000	2000
						25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
	Class IV	20	6.1	30	9.1	11.2 (160) Upright	Wet	20	25	1.7	1250	1500
							Dry	15	50	3.4	1250	1500
						16.8 (240) Upright	Wet	20	15	1.0	1500	2000
							Dry	15	15	1.0	1000	1250
						19.6 (280) Pendent	Wet	15	16	1.1	1250	1500
						25.2 (360) Pendent	Wet	15	10	0.7	1250	1500
				40	12.2	25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
		25	7.6	30	9.1	16.8 (240) Upright	Wet	15	22	1.5	1250	1500
						19.6 (280) Pendent	Wet	15	16	1.1	1250	1500
						25.2 (360) Pendent	Wet	15	10	0.7	1250	1500
				40	12.2	25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
		30	9.1	35	10.7	19.6 (280) Pendent	Wet	15	25	1.7	1500	2000
				40	12.2	25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
		35	10.7	40	12.2	19.6 (280) Pendent	Wet	15	30	2.1	2000	2000
						25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
Solid Piled	Class I or II	20	6.1	30	9.1	11.2 (160) Upright	Wet	15	25	1.7	1000	1250
							Dry	25	25	1.7	1500	2000
						16.8 (240) Upright	Wet	15	10	0.7	1000	1250
							Dry	25	15	1.0	2000	2000
						19.6 (280) Pendent	Wet	15	16	1.1	1250	1500
						25.2 (360) Pendent	Wet	15	10	0.7	1250	1500
				40	12.2	25.2 (360) Pendent	Wet	15	23	1.6	2000	2500

Table:- D.05-T6.Q : CMSA Sprinkler Design Criteria for Palletized and Solid-Piled storage of Class I through Class IV Commodities (Encapsulated and Non-encapsulated)

Configuration	Commodity Class	Maximum Storage Height		Maximum Ceiling / Roof Height		K-Factor / Orientation	Type of System	Number of Design Sprinklers	Minimum Operating Pressure		Pump Capacity (gpm) (Wet)	Pump Capacity with Hose Allowance (gpm) (Wet)
		ft	m	ft	M				psi	bar		
Solid Piled	Class I or II	25	7.6	30	9.1	16.8 (240) Upright	Wet	15	10	0.7	1000	1250
						19.6 (280) Pendent	Wet	15	16	1.1	1250	1500
						25.2 (360) Pendent	Wet	15	10	0.7	1250	1500
				40	12.2	25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
		30	9.1	35	10.7	19.6 (280) Pendent	Wet	15	25	1.7	1500	2000
				40	12.2	25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
		30	10.7	40	12.2	19.6 (280) Pendent	Wet	15	30	2.1	2000	2000
						25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
	Class III	20	6.1	30	9.1	11.2 (160) Upright	Wet	15	25	1.7	1000	1250
							Dry	25	25	1.7	1500	2000
						16.8 (240) Upright	Wet	15	15	1.0	1000	1250
							Dry	25	15	1.0	2000	2000
						19.6 (280) Pendent	Wet	15	16	1.1	1250	1500
						25.2 (360) Pendent	Wet	15	10	0.7	1250	1500
				40	12.2	25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
		25	7.6	30	9.1	16.8 (240) Upright	Wet	15	22	1.5	1250	1500
						19.6 (280) Pendent	Wet	15	16	1.1	1250	1500
						25.2 (360) Pendent	Wet	15	10	0.7	1250	1500
				40	12.2	25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
		30	9.1	35	10.7	19.6 (280) Pendent	Wet	15	25	1.7	1500	2000
				40	12.2	25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
		35	10.7	40	12.2	19.6 (280) Pendent	Wet	15	30	2.1	2000	2000
						25.2 (360) Pendent	Wet	15	23	1.6	2000	2500

Table:- D.05-T6.Q : CMSA Sprinkler Design Criteria for Palletized and Solid-Piled storage of Class I through Class IV Commodities (Encapsulated and Non-encapsulated)

Configuration	Commodity Class	Maximum Storage Height		Maximum Ceiling / Roof Height		K-Factor / Orientation	Type of System	Number of Design Sprinklers	Minimum Operating Pressure		Pump Capacity (gpm) (Wet)	Pump Capacity with Hose Allowance (gpm) (Wet)
		ft	m	ft	M				psi	bar		
Solid Piled	Class IV	20	6.1	30	9.1	11.2 (160) Upright	Wet	15	50	3.4	1250	1500
						16.8 (240) Upright	Wet	15	22	1.5	1250	1500
						19.6 (280) Pendent	Wet	15	16	1.1	1250	1500
						25.2 (360) Pendent	Wet	15	10	0.7	1250	1500
				40	12.2	25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
		25	7.6	30	9.1	16.8 (240) Upright	Wet	15	22	1.5	1250	1500
						19.6 (280) Pendent	Wet	15	16	1.1	1250	1500
						25.2 (360) Pendent	Wet	15	10	0.7	1250	1500
				40	12.2	25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
		30	9.1	35	10.7	19.6 (280) Pendent	Wet	15	25	1.7	1500	2000
				40	12.2	25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
		35	10.7	40	12.2	19.6 (280) Pendent	Wet	15	30	2.1	2000	2000
						25.2 (360) Pendent	Wet	15	23	1.6	2000	2500

Table:- D.05-T6 : Automatic Sprinkler System Requirements

ITEMS	REQUIREMENTS
14. DESIGN CRITERIA OF CMSA (CONTROL MODE SPECIFIC APPLICATION) AND NOMINAL K-FACTOR FOR PALLETIZED AND SOLID STORAGE OF GROUP A PLASTIC COMMODITIES.	i. The automatic Sprinkler Design criteria of CMSA and Nominal K-factor for Group A Plastic stored palletized, solid piled shall be as per **Table:- D.05-T6.R.**

Table:- D.05-T6.R : CMSA Sprinkler Design Criteria for Palletized and Solid-Piled storage of Group A Plastic Commodities

Storage Arrangement	Commodity Class	Maximum Storage Height		Maximum Ceiling / Roof Height		K-Factor / Orientation	Type of System	Number of Design Sprinklers	Minimum Operating Pressure		Pump Capacity (gpm) (Wet)	Pump Capacity with Hose Allowance (gpm) (Wet)
		ft	m	ft	M				psi	bar		
Palletized	Cartoned non expanded plastics	20	6.1	30	9.1	11.2 (160) Upright	Wet	25	25	1.7	1500	2000
						16.8 (240) Upright	Wet	15	22	1.5	1250	1500
						19.6 (280) Pendent	Wet	15	16	1.1	1250	1500
						25.2 (360) Pendent	Wet	15	10	0.7	1250	1500
				40	12.2	25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
		25	7.6	30	9.1	16.8 (240) Upright	Wet	15	22	1.5	1250	1500
						19.6 (280) Pendent	Wet	15	16	1.1	1250	1500
						25.2 (360) Pendent	Wet	15	10	0.7	1250	1500
				40	12.2	25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
		30	9.1	35	10.7	19.6 (280) Pendent	Wet	15	25	1.7	1500	2000
				40	12.2	25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
		35	10.7	40	12.2	19.6 (280) Pendent	Wet	15	30	2.1	2000	2000
						25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
Solid Piled	Cartoned non expanded plastics	20	6.1	30	9.1	11.2 (160) Upright	Wet	15	50	3.4	1250	1500
						16.8 (240) Upright	Wet	15	22	1.5	1250	1500
						19.6 (280) Pendent	Wet	15	16	1.1	1250	1500
						25.2 (360) Pendent	Wet	15	10	0.7	1250	1500
				40	12.2	25.2 (360) Pendent	Wet	15	23	1.6	2000	2500

Table:- D.05-T6.R : CMSA Sprinkler Design Criteria for Palletized and Solid-Piled storage of Group A Plastic Commodities

Storage Arrangement	Commodity Class	Maximum Storage Height		Maximum Ceiling / Roof Height		K-Factor / Orientation	Type of System	Number of Design Sprinklers	Minimum Operating Pressure		Pump Capacity (gpm) (Wet)	Pump Capacity with Hose Allowance (gpm) (Wet)
		ft	m	ft	M				psi	bar		
Solid Piled	Cartoned non expanded plastics	25	7.6	30	9.1	16.8 (240) Upright	Wet	15	22	1.5	1250	1500
						19.6 (280) Pendent	Wet	15	16	1.1	1250	1500
						25.2 (360) Pendent	Wet	15	10	0.7	1250	1500
				40	12.2	25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
		30	9.1	35	10.7	19.6 (280) Pendent	Wet	15	25	1.7	1500	2000
				40	12.2	25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
		35	10.7	40	12.2	19.6 (280) Pendent	Wet	15	30	2.1	2000	2000
						25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
Palletized	Exposed non expanded plastics	20	6.1	30	9.1	11.2 (160) Upright	Wet	25	25	1.7	1500	2000
						16.8 (240) Upright	Wet	15	22	1.5	1250	1500
		25	7.6	30	9.1	16.8 (240) Upright	Wet	15	22	1.5	1250	1500
	Cartooned or exposed expanded plastics	18	5.5	26	7.9	11.2 (160) Upright	Wet	15	50	3.4	1250	1500
						16.8 (240) Upright	Wet	15	22	1.5	1250	1500
Solid Piled	Cartooned or exposed non expanded plastics	20	6.1	30	9.1	11.2 (160) Upright	Wet	15	50	3.4	1250	1500
		25	7.6	30	9.1	16.8 (240) Upright	Wet	15	22	1.5	1250	1500

Table:- D.05-T6 : Automatic Sprinkler System Requirements

ITEMS	REQUIREMENTS
15. DESIGN CRITERIA OF CMSA (CONTROL MODE SPECIFIC APPLICATION) AND NOMINAL K-FACTOR FOR RACK STORAGE OF CLASS I THROUGH CLASS IV COMMODITIES.	i. The automatic Sprinkler Design criteria of CMSA and Nominal K-factor for Class I to IV rack storage shall be as per **Table:- D.05-T6.S.**

Table:- D.05-T6.S : CMSA Sprinkler Design Criteria for Rack storage of Class I through Class IV Commodities (Encapsulated and Non-encapsulated)

Storage Arrangement	Commodity Class	Maximum Storage Height		Maximum Ceiling / Roof Height		K-Factor / Orientation	Type of System	Number of Design Sprinklers	Minimum Operating Pressure		Pump Capacity (gpm) (Wet)	Pump Capacity with Hose Allowance (gpm) (Wet)
		ft	m	ft	M				psi	bar		
Single, double and multiple-row racks	Class I or II	20	6.1	30	9.1	11.2 (160) Upright	Wet	15	25	1.7	1000	1250
							Dry	25	25	1.7	1500	2000
						16.8 (240) Upright	Wet	15	10	0.7	1000	1250
							Dry	25	15	1.0	2000	2000
						19.6 (280) Pendent	Wet	15	16	1.1	1250	1500
						25.2 (360) Pendent	Wet	15	10	0.7	1250	1500
				40	12.2	25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
		25	7.6	30	9.1	11.2 (160) Upright	Wet	20	25	1.7	1250	1500
							Dry	30	15	1.0	1500	2000
						16.8 (240) Upright	Wet	15	10	0.7	1000	1250
							Dry	30	15	1.0	2000	2500
						19.6 (280) Pendent	Wet	15	16	1.1	1250	1500
						25.2 (360) Pendent	Wet	15	10	0.7	1250	1500
				40	12.2	25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
		30	9.1	35	10.7	11.2 (160) Upright	Wet	In rack sprinkler required as per NFPA 13, Chapter 25				
							Dry					
							Dry *	36	55	3.8	3000	3500
						16.8 (240) Upright	Wet	In rack sprinkler required as per NFPA 13, Chapter 25				
							Dry					
							Dry *	36	22	1.5	3000	3500
						19.6 (280) Pendent	Wet	15	25	1.7	1500	2000
	Class III	35	10.7	40	12.2	11.2 (160) Upright	Dry *	36	55	3.8	3000	3500
						16.8 (240) Upright	Dry *	36	22	1.5	3000	3500
						19.6 (280) Pendent	Wet	15	30	2.1	2000	2000
						25.2 (360) Pendent	Wet	15	23	1.6	2000	2500

Table:- D.05-T6.S : CMSA Sprinkler Design Criteria for Rack storage of Class I through Class IV Commodities (Encapsulated and Non-encapsulated)

Storage Arrangement	Commodity Class	Maximum Storage Height		Maximum Ceiling / Roof Height		K-Factor / Orientation	Type of System	Number of Design Sprinklers	Minimum Operating Pressure		Pump Capacity (gpm) (Wet)	Pump Capacity with Hose Allowance (gpm) (Wet)
		ft	m	ft	M				psi	bar		
Single, double and multiple-row racks	Class III	20	6.1	30	9.1	11.2 (160) Upright	Wet	15	25	1.7	1000	1250
							Dry	25	25	1.7	1500	2000
						16.8 (240) Upright	Wet	15	15	1.0	1000	1250
							Dry	25	15	1.0	2000	2000
						19.6 (280) Pendent	Wet	15	16	1.1	1250	1500
						25.2 (360) Pendent	Wet	15	10	0.7	1250	1500
				40	12.2	25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
		25	7.6	30	9.1	11.2 (160) Upright	Wet	In rack sprinkler required as per NFPA 13, Chapter 25				
							Dry					
						16.8 (240) Upright	Wet	15	22	1.5	1250	1500
							Dry	In rack sprinkler required as per NFPA 13, Chapter 25				
						19.6 (280) Pendent	Wet	15	16	1.1	1250	1500
						25.2 (360) Pendent	Wet	15	10	0.7	1250	1500
				35	10.7	11.2 (160) Upright	Wet	In rack sprinkler required as per NFPA 13, Chapter 25				
							Dry					
						16.8 (240) Upright	Wet	In rack sprinkler required as per NFPA 13, Chapter 25				
							Dry					
						19.6 (280) Pendent	Wet	15	25	1.7	1500	2000
				40	12.2	19.6 (280) Pendent	Wet	15	30	2.1	2000	2000
						25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
		30	9.1	35	10.7	19.6 (280) Pendent	Wet	15	25	1.7	1500	2000
		35	10.7	40	12.2	19.6 (280) Pendent	Wet	15	30	2.1	2000	2000
						25.2 (360) Pendent	Wet	15	23	1.6	2000	2500

Table:- D.05-T6.S : CMSA Sprinkler Design Criteria for Rack storage of Class I through Class IV Commodities (Encapsulated and Non-encapsulated)

Storage Arrangement	Commodity Class	Maximum Storage Height		Maximum Ceiling / Roof Height		K-Factor / Orientation	Type of System	Number of Design Sprinklers	Minimum Operating Pressure		Pump Capacity (gpm) (Wet)	Pump Capacity with Hose Allowance (gpm) (Wet)
		ft	m	ft	M				psi	bar		
Single, double and multiple-row racks	Class IV	20	6.1	25	7.6	11.2 (160) Upright	Wet	15	50	3.4	1250	1500
						16.8 (240) Upright	Wet	15	22	1.5	1250	1500
						19.6 (280) Pendent	Wet	15	16	1.1	1250	1500
				30	9.1	11.2 (160) Upright	Wet	20	50	3.4	2000	2000
								15	75	5.2	1500	2000
						16.8 (240) Upright	Wet	15	22	1.5	1250	1500
						19.6 (280) Pendent	Wet	15	16	1.1	1250	1500
						25.2 (360) Pendent	Wet	15	10	0.7	1250	1500
				40	12.2	25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
		25	7.6	30	9.1	11.2 (160) Upright	Wet	In rack sprinkler required as per NFPA 13, Chapter 25				
						16.8 (240) Upright	Wet	15	22	1.5	1250	1500
						19.6 (280) Pendent	Wet	15	16	1.1	1250	1500
						25.2 (360) Pendent	Wet	15	10	0.7	1250	1500
				35	10.7	11.2 (160) Upright	Wet	In rack sprinkler required as per NFPA 13, Chapter 25				
						16.8 (240) Upright	Wet	In rack sprinkler required as per NFPA 13, Chapter 25				
						19.6 (280) Pendent	Wet	15	25	1.7	1500	2000
				40	12.2	19.6 (280) Pendent	Wet	15	30	2.1	2000	2000
						25.2 (360) Pendent	Wet	15	23	1.6	2000	2500
		30	9.1	35	10.7	19.6 (280) Pendent	Wet	15	25	1.7	1500	2000
		35	10.7	40	12.2	19.6 (280) Pendent	Wet	15	30	2.1	2000	2000
						25.2 (360) Pendent	Wet	15	23	1.6	2000	2500

*High temperature-rated sprinklers are used. Dry system water delivery is required in accordance with NFPA 13,2022 edition, Clause 8.2.3.6 with a maximum time of water delivery of 30 seconds with four sprinklers initially open

Table:- D.05-T6 : Automatic Sprinkler System Requirements

ITEMS	REQUIREMENTS
16. DESIGN CRITERIA OF CMSA (CONTROL MODE SPECIFIC APPLICATION) AND NOMINAL K-FACTOR FOR RACK STORAGE OF GROUP A PLASTIC COMMODITIES STORED UP TO AND INCLUDING 10.7M HEIGHT.	i. The automatic Sprinkler Design criteria of CMSA and Nominal K-factor for Group A Plastic commodities rack storage shall be as per **Table:- D.05-T6.T.**

Storage Arrangement	Commodity Class	Maximum Storage Height		Maximum Ceiling / Roof Height		K-Factor / Orientation	Type of System	Number of Design Sprinklers	Minimum Operating Pressure		Pump Capacity (gpm) (Wet)	Pump Capacity with Hose Allowance (gpm) (Wet)
		ft	m	ft	M				psi	bar		
Single, double and multiple-row racks	Cartoned non expanded plastics	20	6.1	25	7.6	11.2 (160) Upright	Wet	15	50	3.4	1250	1500
						16.8 (240) Upright	Wet	15	22	1.5	1250	1500
						19.6 (280) Pendent	Wet	15	16	1.1	1250	1500
				30	9.1	11.2 (160) Upright	Wet	30	50	3.4	2500	3000
								20	75	5.2	2000	2500
						16.8 (240) Upright	Wet	15*	22	1.5	1250	1500
						19.6 (280) Pendent	Wet	15	16	1.1	1250	1500
		25	7.6	30	9.1	11.2 (160) Upright	Wet	In rack sprinkler required as per NFPA 13, Chapter 25				
						16.8 (240) Upright	Wet	15*	22	1.5	1250	1500
						19.6 (280) Pendent	Wet	15	16	1.1	1250	1500
						25.2 (360) Pendent	Wet	15	10	0.7	1250	1500
				35	10.7	11.2 (160) Upright	Wet	In rack sprinkler required as per NFPA 13, Chapter 25				
						16.8 (240) Upright	Wet	In rack sprinkler required as per NFPA 13, Chapter 25				
						19.6 (280) Pendent	Wet	15	25	1.7	1500	2000
		30	9.1	35	10.7	19.6 (280) Pendent	Wet	15	25	1.7	1500	2000
		35	10.7	40	12.2	19.6 (280) Pendent	Wet	15	30	2.1	2000	2500
						25.2 (360) Pendent	Wet	15	23	1.6	2000	2500

Table:- D.05-T6.T : CMSA Sprinkler Design Criteria for Rack storage of Group A Plastic Commodities stored upto and including 10.7m Height

Storage Arrangement	Commodity Class	Maximum Storage Height		Maximum Ceiling / Roof Height		K-Factor / Orientation	Type of System	Number of Design Sprinklers	Minimum Operating Pressure		Pump Capacity (gpm) (Wet)	Pump Capacity with Hose Allowance (gpm) (Wet)
		ft	m	ft	M				psi	bar		
Single, double and multiple-row racks	Exposed non expanded plastics	20	6.1	25	7.6	11.2 (160) Upright	Wet	15	50	3.4	1250	1500
						16.8 (240) Upright	Wet	15	22	1.5	1250	1500
				30	9.1	11.2 (160) Upright	Wet	30	50	3.4	2500	3000
								20	75	5.2	2000	2500
						16.8 (240) Upright	Wet	15*	22	1.5	1250	1500
		25	7.6	30	9.1	11.2 (160) Upright	Wet	In rack sprinkler required as per NFPA 13, Chapter 25				
						16.8 (240) Upright	Wet	15*	22	1.5	1250	1500
				35	10.7	11.2 (160) Upright	Wet	In rack sprinkler required as per NFPA 13, Chapter 25				
						16.8 (240) Upright	Wet	In rack sprinkler required as per NFPA 13, Chapter 25				
*Limited to single and double row racks with minimum 8 ft (2.4 m) aisles.												

Table:- D.05-T6 : Automatic Sprinkler System Requirements

ITEMS	REQUIREMENTS
17. DESIGN CRITERIA OF CMSA (CONTROL MODE SPECIFIC APPLICATION) AND NOMINAL K-FACTOR FOR RUBBER TIRES	i. The automatic Sprinkler Design criteria of CMSA and Nominal K-factor for Rubber tires shall be as per **NFPA 13, 2022 Edition, Table 22.6.**
18. DESIGN CRITERIA OF CMSA (CONTROL MODE SPECIFIC APPLICATION) AND NOMINAL K-FACTOR FOR ROLL PAPER STORAGE	i. The automatic Sprinkler Design criteria of CMSA and Nominal K-factor for Roll paper storage shall be as per **NFPA 13, 2022 Edition, Table 22.7.**

Table:- D.05-T6.: Automatic Sprinkler System Requirements

ITEMS	REQUIREMENTS
17. DESIGN CRITERIA OF ESFR FOR CLASS I TO IV, STORED PALLETIZED, SOLID PILED AND SINGLE, DOUBLE AND MULTIPLE ROW RACK	i. The automatic Sprinkler Design criteria of ESFR for Class I to Class IV, stored palletized, solid piled or on shelf and Single, Double and Multiple row rack shall be as per **Table:- D.05-T6.U** for a minimum of 12 sprinkler heads. ii. Minimum 900 mm clearance to be maintained between sprinkler and top of storage

Table:- D.05-T6.U : ESFR Sprinkler Ceiling- Only Option for Solid Pile; Palletized and single, Double and Multiple-Row Rack Storage

Commodity	ESFR Sprinkler – Upright / Pendent Orientation K- Factor	Maximum Ceiling / Roof Height ft	Maximum Ceiling / Roof Height m	Minimum Operating Pressure psi (bar)	Pump Capacity (gpm) (Wet)	Pump Capacity with Hose Allowance (gpm) (Wet)
Class I through Class IV and cartoned non expanded Group A plastics	K14 (200) (Pendent & Upright)	25	7.6	50 (3.4)	1250	1500
		30	9.1	50 (3.4)	1250	1500
		35	10.7	75 (5.2)	1500	2000
	K16.8 (240) (Pendent and Upright)	25	7.6	35 (2.4)	1250	1500
		30	9.1	35 (2.4)	1250	1500
		35	10.7	52 (3.6)	1500	2000
	K16.8 (240) (Pendent)	40	12.2	52 (3.6)	1500	2000
	K22.4 (320) (Pendent)	25	7.6	25 (1.7)	1500	2000
		30	9.1	25 (1.7)	1500	2000
		35	10.7	35 (2.4)	2000	2000
		45	13.7	40 (2.8)	2000	2000
	K25.2(360) (Pendent)	25	7.6	15 (1.0)	1250	1500
		30	9.1	15 (1.0)	1250	1500
		35	10.7	20 (1.4)	1500	2000
		40	12.2	25 (1.7)	1500	2000
		45	13.7	40 (2.8)	2000	2500
Cartoned expanded Group A Plastics	K14 (200) Pendent and Upright)	25	7.6	50 (3.4)	1250	1500
		30	9.1	50 (3.4)	1250	1500
	K16.8 (240) Pendent and Upright	25	7.6	35 (2.4)	1250	1500
		30	9.1	35 (2.4)	1250	1500
Exposed non expanded Group A plastics	14 (200) Pendent	25	7.6	50 (3.4)	1250	1500
		30	9.1	50 (3.4)	1250	1500
		45	13.7	See NFPA 13, Chapter 25		
	16.8 (240) Pendent	25	7.6	35 (2.4)	1250	1500
		30	9.1	35 (2.4)	1250	1500
	22.4 (320) (Pendent)	40	12.2	75 (5.2)	2500	3000
	25.2(360) (Pendent)	40	12.2	60 (4.1)	2500	3000
		45	13.7	See NFPA 13, Chapter 25		
Exposed expanded Group A plastics	25.2(360) (Pendent)	30	9.1	30 (2.0)[b]	2000	2000
		40	12.2	60 (4.1)[b,c]	2500	3000

[a] See NFPA 13, Chapter 20.3 for information on lower hazard commodities with higher hazard commodities.
[b] These options apply when all requirements in Section 27.4 are applied including vertical barriers.
[c] This option applies to palletized and solid pile storage in a closed array.

Table:- D.05-T6: Automatic Sprinkler System Requirements

ITEMS	REQUIREMENTS
18. DESIGN CRITERIA OF ESFR SPRINKLERS FOR RUBBER TIRES PROTECTION.	i. The automatic ESFR Sprinkler Design criteria for Rubber tire storage shall be as per **Table:- D.05-T6.V, for a minimum of 12 sprinkler head operation.** ii. Table is applicable to Wet system only.

Table:- D.05-T6.V. : ESFR Sprinklers for Protection of Rubber Tires

Piling Method	Pile Height	Maximum Building Height		Nominal K-Factor	Orientation	Number of sprinklers	Minimum Operating Pressure		Pump Capacity (gpm) (Wet)	Pump Capacity with Hose Allowance (gpm) (Wet)
		ft	m				psi	bar		
Rubber tire storage, on-side or on-tread portable racks, open portable racks, or fixe racks without solid shelves	Up to 25 ft (7.6m)	30	9.1	14.0 (200)	Upright/ Pendent	12[a]	50	3.4	1250	1500
				16.8 (240)	Upright/ Pendent	12[a]	35	2.4	1250	1500
				22.4 (320)	Pendent	12[a]	25	1.7	1500	2000
				25.2 (360)	Pendent	12[a]	15	1.0	1250	1500
Rubber tire storage, on-side, in palletized portable racks, open portable racks, or fixed racks without solid shelves	Up to 25 ft (7.6m)	35	10.7	14.0 (200)	Upright/ Pendent	12[a]	75	5.2	1500	2000
				16.8 (240)	Pendent	12[a]	52	3.6	1500	2000
				22.4 (320)	Pendent	12[a]	35	2.4	2000	2000
				25.2 (360)	Pendent	12[a]	25	1.7	1500	2000
On-tread, on-side, and laced tires in open portable steel racks or palletized portable racks	Up to 25 ft (7.6m)	30	9.1	14.0 (200)	Pendent	20[b,c]	75	5.2	2500	3000
				16.8 (240)	Pendent	20[b,c]	52	3.6	2500	3000
Rubber tire storage, on-side, in palletized portable racks	Up to 25 ft (7.6m)	40	12.2	16.8 (240)	Pendent	12[a]	52	3.6	1500	2000
Rubber tire storage, on-tread or laced in open portable steel racks	Up to 25 ft (7.6m)	40	12.2	25.2 (360)	Pendent	12[a]	40	2.8	2000	2500
On-tread, on-side and laced tires in open portable steel racks or palletized portable racks	Up to 30 ft (9.1m)	40	12.2	25.2 (360)	Pendent	12[a]	75	5.2	3000	3000

a The shape of the design area is in accordance with NFPA 13, 2022 Edition, Chapter 23. (23.2.2)

b Where used in this application, ESFR protection is expected to control rather than suppress the fire.

c The design area consist of the most hydraulically demanding 20 sprinklers, with five sprinklers on each of four branch lines. The design includes a minimum operating area of 1600 ft2(150 m2)

Table:- D.05-T6: Automatic Sprinkler System Requirements

ITEMS	REQUIREMENTS
19. DESIGN CRITERIA OF ESFR SPRINKLERS FOR ROLL PAPER STORAGE PROTECTION.	i. The automatic ESFR Sprinkler Design criteria for Roll Paper storage protection shall be as per **Table:- D.05-T6.W, for a minimum of 12 sprinkler head operation.**

Table:- D.05-T6.W : ESFR Sprinkler for Protection of Roll Paper storage (Maximum Height of Storage Permitted) Heavy Weight

ESFR K-Factor	Orientation	System Type	Pressure		Building Height		Heavy Weight						Tissue All Arrays	Pump Capacity (gpm)	Pump Capacity with Hose Allowance (gpm)
							Closed		Standard		Open				
			psi	bar	ft	m	ft	m	ft	m	ft	m			
14.0 (200)	Upright/ Pendent	Wet	50	3.4	30	9.1	25	7.6	25	7.6	25	7.6	NA	1250	1500
16.8 (240)	Upright/ Pendent	Wet	35	2.4										1250	1500
22.4 (320)	Pendent	Wet	25	1.7										1500	2000
25.2 (360)	Pendent	Wet	15	1.0										1250	1500
14.0 (200)	Upright/ Pendent	Wet	75	5.2	35	10.7	30	9.1	30	9.1	30	9.1	NA	1500	2000
16.8 (240)	Upright/ Pendent	Wet	52	3.6										1500	2000
16.8 (240)	Pendent	Wet	52	3.6	40	12.2	30	9.1	30	9.1	30	9.1	NA	1500	2000
22.4 (320)	Pendent	Wet	40	2.7										2000	2000
25.2 (360)	Pendent	Wet	25	1.7										1500	2000
22.4 (320)	Pendent	Wet	50	3.4	45	13.7	30	9.1	30	9.1	30	9.1	NA	2000	2500
25.2 (360)	Pendent	Wet	50	3.4										2500	2500

Table:- D.05-T6.W : ESFR Sprinkler for Protection of Roll Paper storage (Maximum Height of Storage Permitted) Medium Weight

ESFR K-Factor	Orientation	System Type	Pressure		Building Height		Medium Weight						Tissue All Arrays	Pump Capacity (gpm)	Pump Capacity with Hose Allowance (gpm)
							Closed		Standard		Open				
			psi	bar	ft	m	ft	m	ft	m	ft	m			
14.0 (200)	Upright/ Pendent	Wet	50	3.4	30	9.1	25	7.6	25	7.6	25	7.6	NA	1250	1500
16.8 (240)	Upright/ Pendent	Wet	35	2.4										1250	1500
22.4 (320)	Pendent	Wet	25	1.7										1500	2000
25.2 (360)	Pendent	Wet	15	1.0										1250	1500
14.0 (200)	Upright/ Pendent	Wet	75	5.2	35	10.7	NA						NA	1500	2000
16.8 (240)	Upright/ Pendent	Wet	52	3.6										1500	2000
16.8 (240)	Pendent	Wet	52	3.6	40	12.2	NA						NA	1500	2000
22.4 (320)	Pendent	Wet	40	2.7										2000	2000
25.2 (360)	Pendent	Wet	25	1.7										1500	2000
22.4 (320)	Pendent	Wet	50	3.4	45	13.7	NA						NA	2000	2500
25.2 (360)	Pendent	Wet	50	3.4										2500	2500

Table:- D.05-T6: Automatic Sprinkler System Requirements

ITEMS	REQUIREMENTS
20. IN-RACK SPRINKLER PROTECTION OPTIONS INDEPENDENT OF CEILING-LEVEL SPRINKLERS.	i. The In-Rack Sprinkler Design criteria, Protection options independent of ceiling level sprinklers. shall be as per **Table:- D.05-T6.Y**. ii. In-rack sprinkler characteristics, Maximum Vertical and Maximum Horizontal spacing shall be as per **Table:- D.05-T6.X, Table:- D.05-T6.X.a , Table:- D.05-T6.X.b and Figure:- D.05-F15.a, Figure:- D.05-F15.b, Figure:- D.05-F15.c, Figure:- D.05-F15.d, Figure:- D.05-F15.e and Figure:- D.05-F15.f** iii. Protection of closed-top Class I through Class N and Group A plastic commodities (i.e., no open-top containers) stored on single-, double-, or multiple-row racks shall be permitted to be protected in accordance with this section. iv. Where the storage rack will not be solely dedicated to storage requiring in-rack sprinkler protection in accordance with this section, either of the following shall apply: (1) Extend the in-rack sprinkler protection horizontally one pallet load beyond the commodities requiring protection in accordance with this section. (2) Install a vertical barrier to segregate the commodities requiring protection in accordance with this section from any adjacent commodities. v. Commodities that can be protected by the ceiling level sprinkler system shall be permitted to be stored vertically above and horizontally adjacent to the portions of the storage rack equipped as prescribed by this section. vi. In-rack sprinkler systems shall be wet-pipe only. vii. In-rack sprinklers shall be located within the foot-print of the rack structure. viii. Pump capacities for In-rack sprinklers shall be in accordance with In-Rack and Ceiling Sprinkler requirements in chapter 20,21,22 and 23 from NFPA 13, Greater demand to be selected. **<u>Ceiling Level Sprinkler System Requirements.</u>** i. Where in-rack sprinklers are in accordance with **Sub Section 6.20.,** the top level of in-rack sprinklers shall be considered a floor for design purposes of the ceiling sprinkler system. ii. The ceiling-level sprinkler system shall be in accordance with the guidelines outlined in **NFPA 13, Chapters 20, 21, 22, or 23**, depending on the commodity hazard and the ceiling-level sprinkler, except as modified in **NFPA 13, Chapter 25.6.** **<u>Water Supply Requirements.</u>** i. The minimum water supply requirements for a hydraulically designed in-rack sprinkler system shall be determined by adding the hose stream allowance from **Table:- D.05-T6.B** to the water demand for in-rack sprinklers. ii. The water supply requirements shall be available for a minimum duration as required in **Table:- D.05-T6.B** iii. The water supply for the in-rack sprinkler system shall be capable of providing the required in-rack sprinkler system design obtained from **Sub Section 6.20,** independent of the design requirements of the ceiling sprinkler system protecting this same area. iv. The water supply for the ceiling-level sprinkler system shall be capable of providing the required ceiling-level sprinkler system design obtained from **NFPA 13, Chapters 21, 22, or 23,** independent of the design requirements of the in-rack sprinkler system obtained from **NFPA 13, Chapter 25.6.**

Table:- D.05-T6.X : In- Rack Sprinkler Characteristics

Sprinkler Type	K – Factor	Coverage Type	Orientation	RTI rating	Temperature Rating
CMDA (Option 1)	Minimum K-8.0 (115)	Standard Coverage	Pendent or Upright	Quick-response	Ordinary temperature
ESFR (Option 2a)	Minimum K-14.0 (200)	Standard Coverage	Pendent	Fast-response	Ordinary Temperature
ESFR (Option 2b)	Minimum K-22.4 (320)	Standard Coverage	Pendent	Fast-response	Ordinary Temperature
CMDA (Option 3)	K-25.2 (360)	Extended Coverage	Pendent	Fast-response	Intermediate Temperature

Table:- D.05-T6.X.a : Maximum Horizontal Spacing of In- Rack Sprinkler

Rack Type	Option 1	Option 2a and 2b	Option 3
Single-row Racks	5 ft (1.5 m) ***(See Figure; D.05-F15.a)***	4.5 ft (1.4 m) ***(See Figure; D.05-F15.b, Figure; D.05-F15.c and Figure; D.05-F15.d)***	10 ft (3.0 m) ***(See Figure; D.05-F15.e and Figure; D.05-F15.f)***
Double-row Racks	5 ft (1.5 m) at each rack face 10 ft (3.0 m) within the longitudinal flue space ***(See Figure; D.05-F15.a)***	4.5 ft (1.4 m) at each rack face* 4.5 ft (1.4 m) within the longitudinal flue space ***(See Figure; D.05-F15.b, Figure; D.05-F15.c and Figure; D.05-F15.d)***	Not required at the rack face 10 ft (3.0 m) within the longitudinal flue space ***(See Figure; D.05-F15.e and Figure; D.05-F15.f)***
Multiple-row Racks	5 ft (1.5 m) at each rack face and at each alternating rack bay 10 ft (3.0 m) between in-rack sprinkler at every other rack bay ***(See Figure; D.05-F15.a)***	8 ft 6 in. (2.6 m) at each rack face 4.5 ft (1.4 m) in-between rack faces ***(See Figure; D.05-F15.b, Figure; D.05-F15.c and Figure; D.05-F15.d)***	10 ft (3.0 m) at each rack face 10 ft (3.0 m) in-between rack faces ***(See Figure; D.05-F15.e and Figure; D.05-F15.f)***

Note: Option 1 , Option 2a, Option 2b, and Option 3 are in reference to those listed in Table:- D.05-T6.X.a

*The Maximum Horizontal distance between in-rack sprinklers is permitted to be increased to 8.5 ft (2.6 m) when the maximum distance between transverse flue spaces does not exceed 4.25 ft (1.3 m).

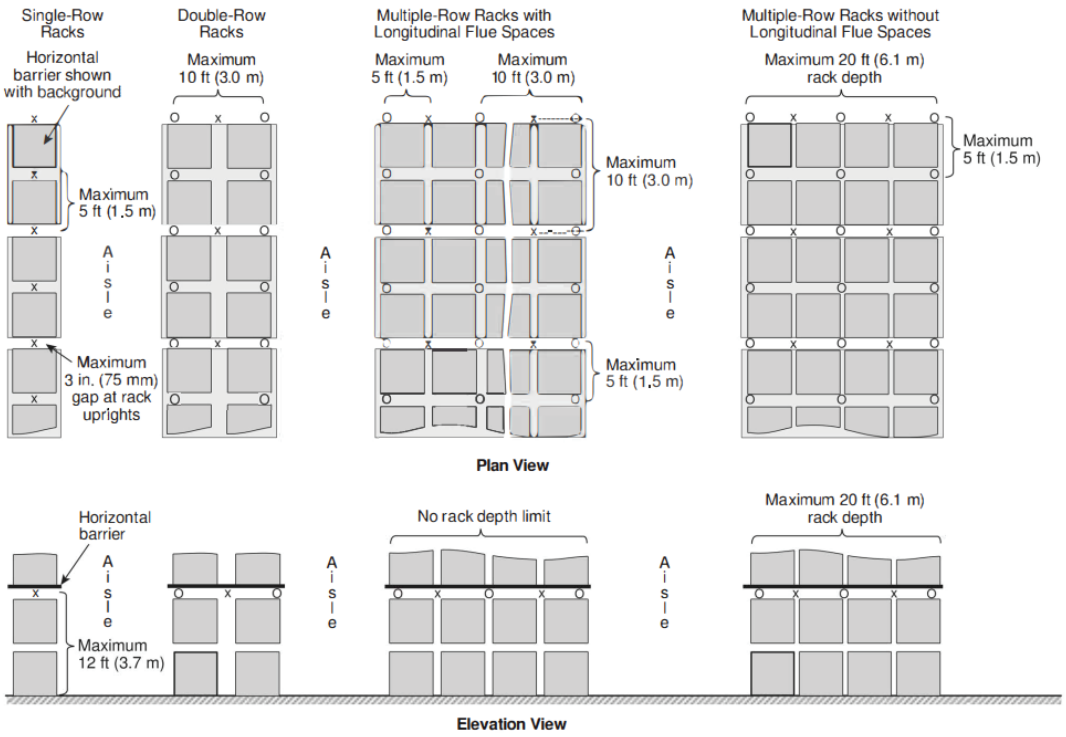
Table:- D.05-T6.X.b: Maximum Vertical Spacing of In- Rack Sprinkler

Commodity Classification	Maximum Vertical Spacing of In-Rack Sprinkler Levels			
	Option 1	Option 2a	Option 2b	Option 3
Class I through Class IV	12 ft (3.7 m) with horizontal barriers	30 ft (9.1m)	40 ft (12.2m)	30 ft (9.1m) with horizontal barriers
Cartoned – Non expanded Group A plastics	12 ft (3.7 m) with horizontal barriers	30 ft (9.1m)	40 ft (12.2m)	30 ft (9.1m) with horizontal barriers
Cartoned – Expanded Group A plastics	12 ft (3.7 m) with horizontal barriers	30 ft (9.1m)	30 ft (9.1m)	30 ft (9.1m) with horizontal barriers
Exposed non expanded and exposed expanded Group A Plastic	12 ft (3.7 m) with horizontal barriers	Not Permitted	30 ft (9.1m)	20 ft (6.1m) with horizontal barriers

Table:- D.05-T6.Y. : In- Rack Sprinkler System Design for Option 1, 2a,2b and 3

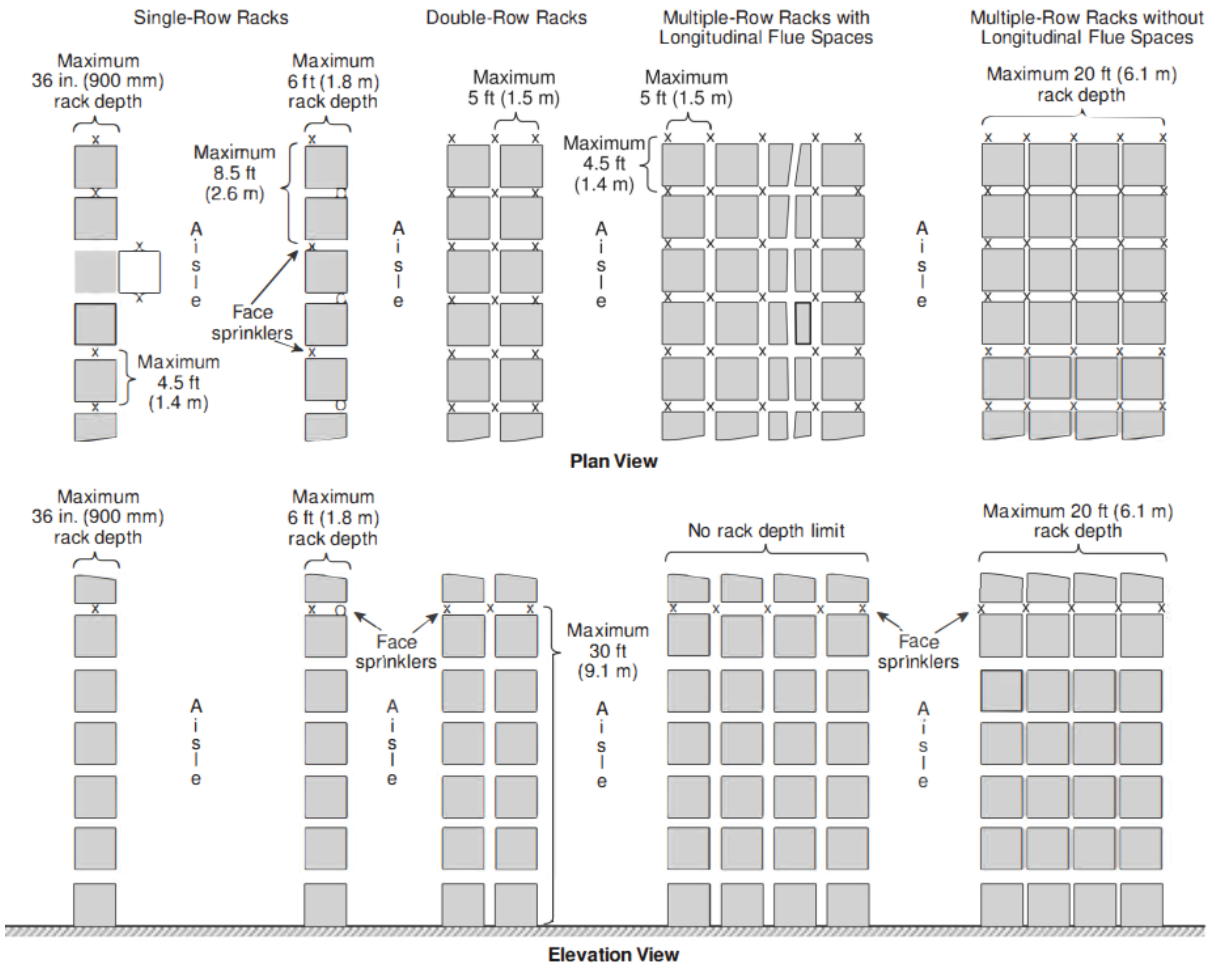
IRAS Option	Commodity Hazard	Maximum In-Rack Sprinkler Vertical Interval ft (m)	In-Rack Sprinkler K-factor	In-Rack Sprinkler System Design, No. of IRAS @ Minimum flow, gpm (L/min)			
				Single Row Racks upto 3 ft (0.9m) Deep	Single Row Racks over 3 ft (0.9m) and upto 6 ft (1.8m) Deep	Double Row Racks	Multiple-Row Racks [a]
1	Class I-IV and Group A plastic (Cartoned and exposed) commodities	12 (3.7)	Minimum K-8.0 (K-115)	6 @ 60 (227)	6 @ 60 (227)	8 @ 60 (227)	8 @ 60 (227)
2a	Class I-IV and Cartoned and non expanded Group A plastic	30 (9.1)	Minimum K-14.0 (K-200) Pendent ESFR	4 @ 65 (250)	5 @ 65 (227)	6 @ 65 (250)	6 @ 65 (250)
2a	Cartoned expanded Group A plastics (Also Class I-IV and cartoned non expanded Group A plastics)	30 (9.1)	Minimum K-14.0 (K-200) Pendent ESFR	4 @ 100 (380)	5 @ 100 (380)	6 @ 100 (380)	6 @ 100 (380)
2b	Exposed group A plastic commodities (Also, Class I-IV and cartoned Group A plastics)	30 (9.1)	Minimum K-22.4 (K-320) Pendent ESFR	4 @ 120 (455)	5 @ 120 (455)	5 and 5[b] @ 120 (455)	5 and 5[b] @ 120 (455)
2b	Class I-IV and cartoned non expanded Group A plastics	40 (12.2)	Minimum K-22.4 (K-320) Pendent ESFR	4 @ 120 (455)	5 @ 120 (455)	6 @ 120 (455)	6 @ 120 (455)
3	Class I-IV and cartoned (Non expanded and expanded) Group A plastic commodities.	30 (9.1)	K25.2 (K360) Pendent extended coverage	4 @ 138 (520)	4 @ 138 (520)	4 @ 138 (520)	8[c] @ 138 (520)
3	Exposed Group A plastic commodities (Also, Class I-IV and cartoned Group A plastics)	20 (6.1)	K25.2 (K360) Pendent extended coverage	4 @ 138 (520)	4 @ 138 (520)	4 @ 138 (520)	8[c] @ 138 (520)

Notes: Option 1, Option 2a, Option 2b, and Option 3 are m reference to those listed in Table:- Table:- D.05-T6.X
a For maximum rack depths of 16 ft (4.9 m) for Option 2 and Option 3.
b This represents five sprinklers in the most remote rack as well as five sprinklers in the nearest adjacent rack.
c This represents three sprinklers at each rack face and the two sprinklers in-between them.



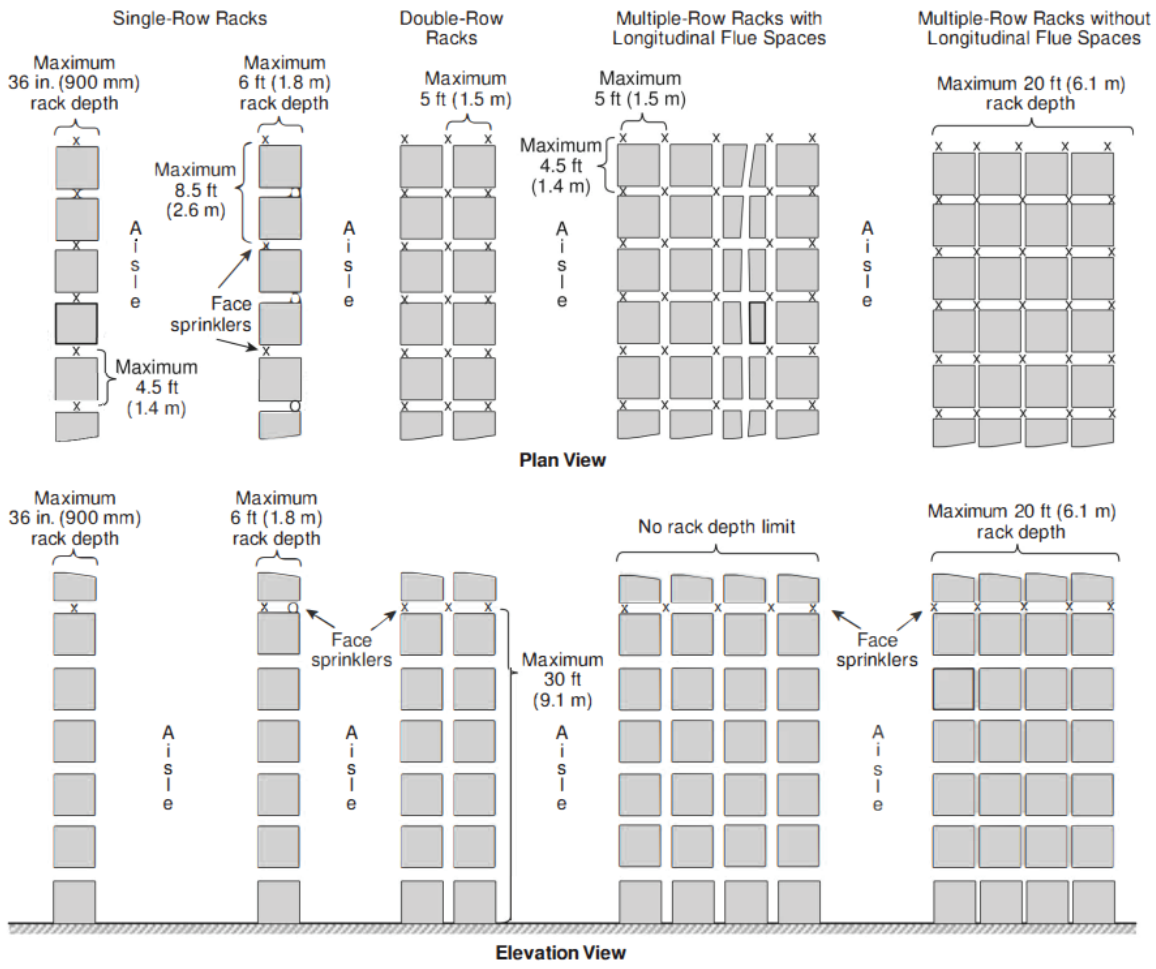
Notes:
(1) In-rack sprinklers are ordinary-temperature-rated, quick-response, pendent or upright, and minimum K-8.0 (K-115). The in-rack sprinkler system is to be designed for a minimum of six in-rack sprinklers operating at 60 gpm (230 L/min) for single-row racks or a minimum of eight in-rack sprinklers operating at 60 gpm (230 L/min) for double- or multiple-row racks.
(2) The symbols X and O represent in-rack sprinklers.
(3) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Figure:- D.05-F15.a : In-Rack Sprinkler Arrangements for Class I through Class IV and Group A Plastic Commodities.



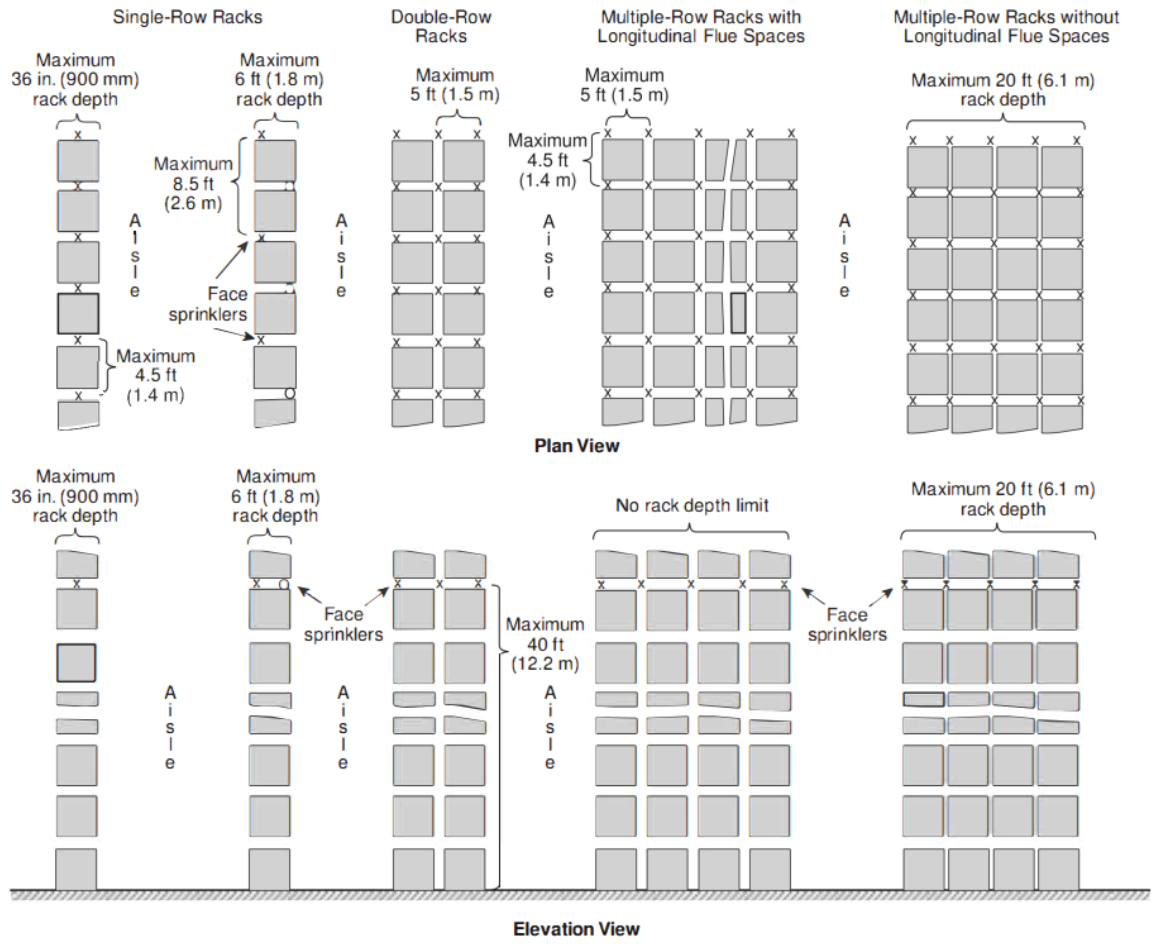
Notes:
(1) In-rack sprinklers are ordinary-temperature-rated, fast-response, pendent, and minimum K-14.0 (K-200) ESFR sprinklers.
(2) Where Class I through Class IV and cartoned nonexpanded Group A plastic commodities are maintained in single-row racks having a maximum rack depth of 36 in. (900 mm), the in-rack sprinkler system is to be designed for a minimum of four in-rack sprinklers operating at 65 gpm (250 L/min).
(3) Where Class I through Class IV and cartoned (expanded and nonexpanded) Group A plastic commodities are maintained in single-row racks having a maximum rack depth of 36 in. (900 mm), the in-rack sprinkler system is to be designed for a minimum of four in-rack sprinklers operating at 100 gpm (380 L/min).
(4) Where Class I through Class IV and cartoned nonexpanded Group A plastic commodities are maintained in single-row racks having a maximum rack depth over 36 in. (900 mm) and up to and including 6 ft (1.8 m), the in-rack sprinkler system is to be designed for a minimum of five in-rack sprinklers operating at 65 gpm (250 L/min).
(5) Where Class I through Class IV and cartoned (expanded and nonexpanded) Group A plastic commodities are maintained in single-row racks having a maximum rack depth over 36 in. (900 mm) and up to and including 6 ft (1.8 m), the in-rack sprinkler system is to be designed for a minimum of five in-rack sprinklers operating at 100 gpm (380 L/min).
(6) Where Class I through Class IV and cartoned nonexpanded Group A plastic commodities are maintained in double- or multiple-row racks, the in-rack sprinkler system is to be designed for a minimum of six in-rack sprinklers operating at 65 gpm (250 L/min).
(7) Where Class I through Class IV and cartoned (expanded and nonexpanded) Group A plastic commodities are maintained in double- or multiple-row racks, the in-rack sprinkler system is to be designed for a minimum of six in-rack sprinklers operating at 100 gpm (380 L/min).
(8) The symbols X and O represent in-rack sprinklers.
(9) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as three loads or as many as 20 loads between in-rack sprinklers that are spaced 30 ft (9.1 m) apart vertically.

Figure:- D.05-F15.b : In-Rack Sprinkler Arrangements for Class I through Class IV and Cartoned Group A Plastic Commodities,



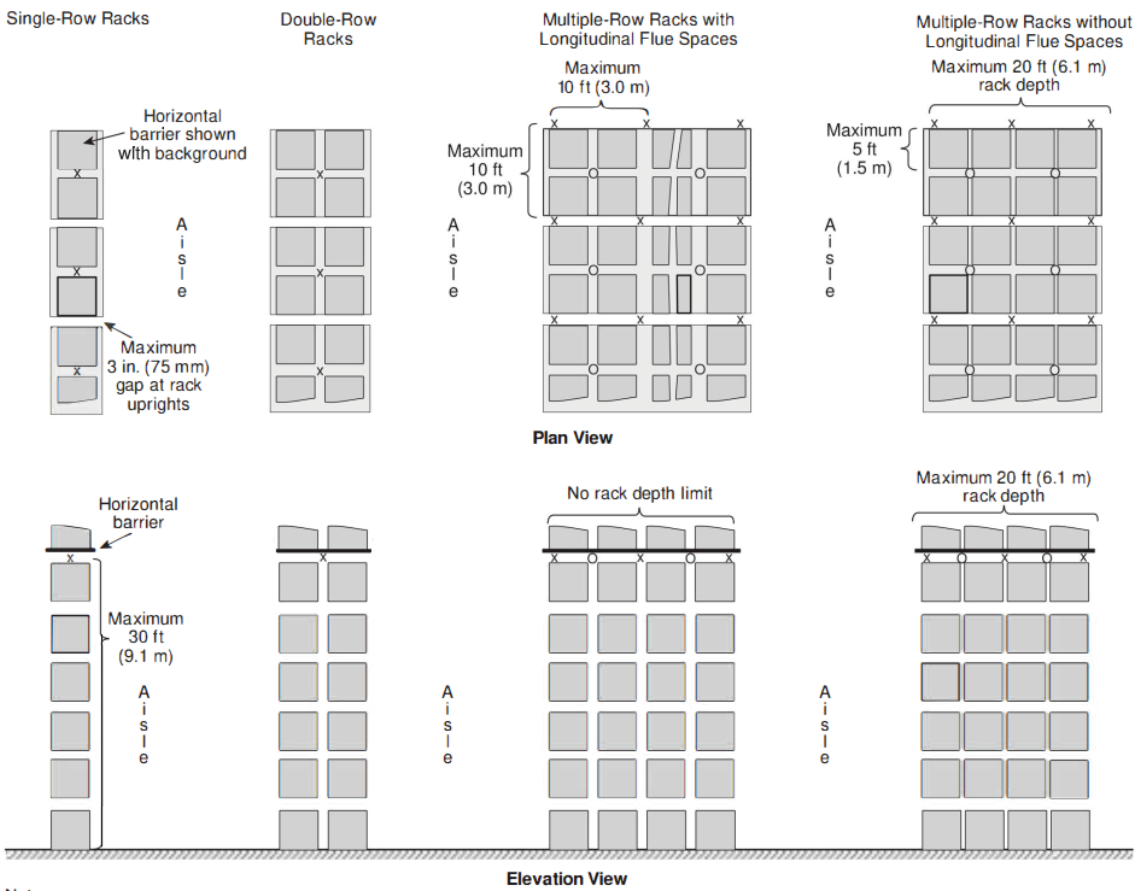
Notes:
(1) In-rack sprinklers are ordinary-temperature-rated, fast-response, pendent, and minimum K-22.4 (K-320) ESFR sprinklers.
(2) Where Class I through Class IV and cartoned and exposed Group A plastic commodities are maintained in single-row racks having a maximum rack depth of 36 in. (900 mm), the in-rack sprinkler system is to be designed for a minimum of four in-rack sprinklers operating at 120 gpm (455 L/min).
(3) Where Class I through Class IV and cartoned and exposed Group A plastic commodities are maintained in single-row racks having a maximum rack depth over 3 ft (0.9 m) and up to and including 6 ft (1.8 m), the in-rack sprinkler system is to be designed for a minimum of five in-rack sprinklers operating at 120 gpm (455 L/min).
(4) Where Class I through Class IV and cartoned and exposed Group A plastic commodities are maintained in double- or multiple-row racks, the in-rack sprinkler system is to be designed for a minimum of 10 in-rack sprinklers (five in-rack sprinklers on the top level of the most remote rack as well as five in-rack sprinklers on the top level of the nearest adjacent storage rack) operating at 120 gpm (455 L/min).
(5) The symbols X and O represent in-rack sprinklers.
(6) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as three loads or as many as 20 loads between in-rack sprinklers that are spaced 30 ft (9.1 m) apart vertically.

Figure:- D.05-F15.c : In-Rack Sprinkler Arrangements for Class I through Class IV and Group A Plastic Commodities, Maximum 30 ft (9.1 m) Vertical Increments. Maximum 30 ft (9.1 m) Vertical Increments.



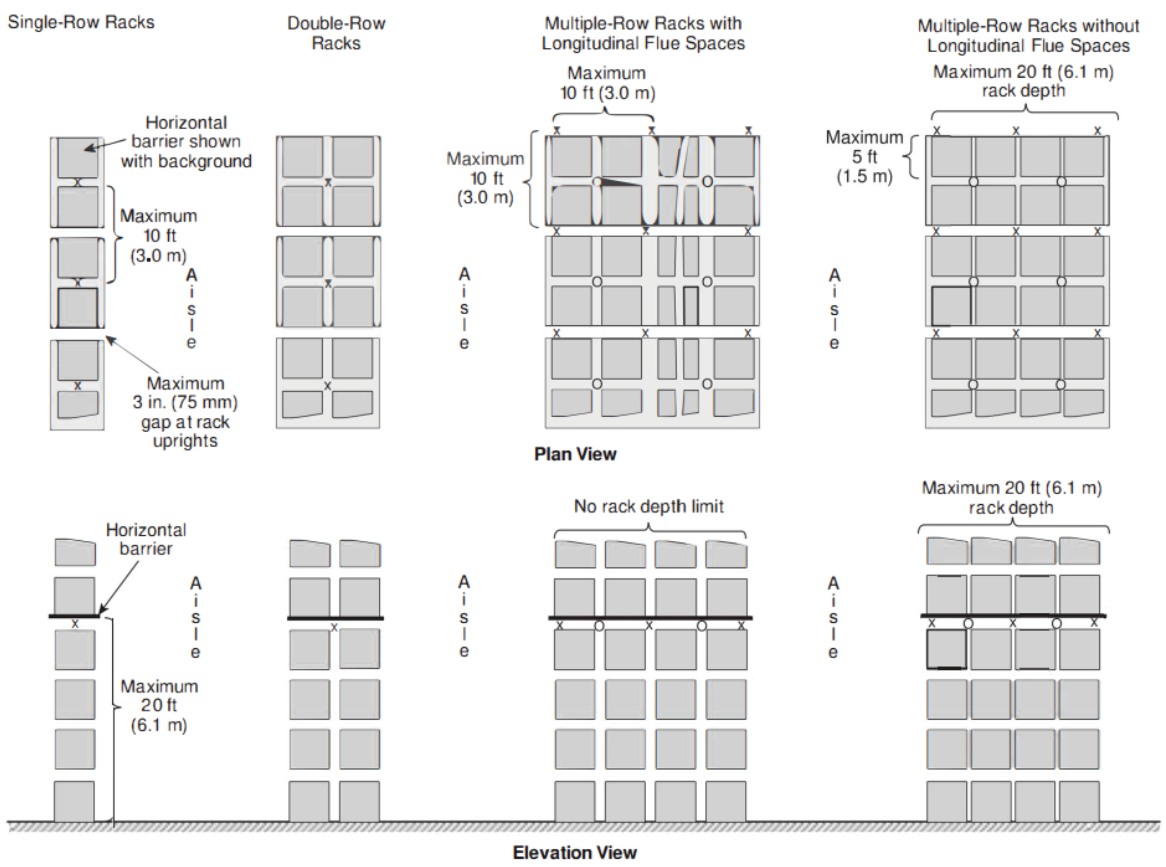
Notes:
(1) In-rack sprinklers are ordinary-temperature-rated, fast-response, pendent, and minimum K-22.4 (K-320) ESFR sprinklers.
(2) Where Class I through Class IV and cartoned expanded Group A plastic commodities are maintained in single-row racks having a maximum rack depth of 36 in. (900 mm), the in-rack sprinkler system is to be designed for a minimum of four in-rack sprinklers operating at 120 gpm (455 L/min).
(3) Where Class I through Class IV and cartoned nonexpanded Group A plastic commodities are maintained in single-row racks having a maximum rack depth over 36 in. (900 mm) and up to and including 6 ft (1.8 m), the in-rack sprinkler system is to be designed for a minimum of five in-rack sprinklers operating at 120 gpm (455 L/min).
(4) Where Class I through Class IV and cartoned nonexpanded Group A plastic commodities are maintained in double- or multiple-row racks, the in-rack sprinkler system is to be designed for a minimum of six in-rack sprinklers operating at 120 gpm (455 L/min).
(5) The symbols X and O represent in-rack sprinklers.
(6) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as four loads or as many as 26 loads between in-rack sprinklers that are spaced 40 ft (12.2 m) apart vertically.

Figure:- D.05-F15.d : In-Rack Sprinkler Arrangements for Class I through Class IV and Cartoned Group A Plastic Commodities, Maximum 40 ft (12.2 m) Vertical Increments.



Notes:
(1) In-rack sprinklers are intermediate-temperature-rated, fast-response, pendent, and minimum K-25.2 (K-360) extended-coverage CMDA sprinklers.
(2) Where Class I through Class IV and cartoned Group A plastic commodities are maintained in single- or double-row racks, the in-rack sprinkler system is to be designed for a minimum of four in-rack sprinklers operating at 138 gpm (520 L/min).
(3) Where Class I through Class IV and cartoned Group A plastic commodities are maintained in multiple-row racks, the in-rack sprinkler system is to be designed for a minimum of eight in-rack sprinklers (three at each face and two in between) operating at 138 gpm (520 L/min).
(4) The symbol X represents in-rack sprinklers.
(5) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as three loads or as many as 20 loads between in-rack sprinklers that are spaced 30 ft (9.1 m) apart vertically.

Figure:- D.05-F15.e : In-Rack Sprinkler Arrangements for Class I through Class IV and Cartoned Group A Plastic Commodities, Maximum 30 ft (9.1 m) Vertical Increments.



Notes:
(1) In-rack sprinklers are intermediate-temperature-rated, fast-response, pendent, and minimum K-25.2 (K-360) extended-coverage CMDA sprinklers.
(2) Where Class I through Class IV and cartoned and exposed Group A plastic commodities are maintained in single- or double-row racks, the in-rack sprinkler system is to be designed for a mimimum of four in-rack sprinklers operating at 138 gpm (520 L/min).
(3) Where Class I through Class IV and cartoned and exposed Group A plastic commodities are maintained in multiple-row racks, the in-rack sprinkler system is to be designed for a minimum of eight in-rack sprinklers (three at each face and two in between) operating at 138 gpm (520 L/min).
(4) The symbol X represents in-rack sprinklers.
(5) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as two loads or as many as 13 loads between in-rack sprinklers that are spaced 20 ft (6.1 m) apart vertically.

Figure:- D.05-F15.f : In-Rack Sprinkler Arrangements for Class I through Class IV and Group A Plastic Commodities, Maximum 20 ft (6.1 m) Vertical Increments.

7.0 Automatic Dry Sprinkler Systems

7.1. The requirements for Automatic Dry Sprinkler System material, design, installation shall be as per **Table:- D.05-T7.,** Applicable Sprinkler requirements of **Table:- D.05-T6.** and the General Requirements of **Table D.11-T1.**

Table:- D.05-T7 : Automatic Dry Sprinkler System Requirements

ITEMS	REQUIREMENTS
1. DEFINITION	i. A sprinkler system employing automatic sprinklers that are attached to a piping system containing air or nitrogen under pressure, the release of which (as from the opening of a sprinkler) permits the water pressure to open a valve known as a dry pipe valve, and the water then flows into the piping system and out the opened sprinklers. ii. Freezers and Refrigerated spaces having an ambient temperature less than 4°C shall be provided with Dry Sprinkler Systems.
2. COMPONENTS	i. Fire Pumps, Controller, Fire Water Tank, Pipes, Fittings, Nitrogen/Air Supply , Sprinkler Heads, Isolation valves, Alarm Check valves (ACV), Floor Zone Control Valve (ZCV), Pressure gauge, Flow Switch, Test connection, Drains, Breeching inlet and Signs.
3. FIRE PUMP CAPACITY	i. The fire pump set shall consist of 1 Electric driven pump, 1 diesel driven pump and 1 electric Jockey pump, complete with controllers. ii. The pump capacity shall be as per **Section D, Chapter 02.**
4. PIPES	i. Where the sprinkler pipe passes through a wall or floor into the refrigerated space, a section of pipe arranged for removal shall be provided immediately inside the space. The removable length of the required pipe shall be a minimum of 762mm. ii. The connection pipe from the air supply to the dry pipe valve shall not be less than 15 mm in diameter and shall enter the system above the priming water level of the dry pipe valve. iii. The air supply piping shall be equipped with two easily removable supply lines at least 1.9 m long and at least 25.4 mm in diameter.
5. PRESSURE GAUGES	i. The permitted and General Directorate of Civil Defence - Kingdom of Bahrain listed Pressure gauges shall be installed a. On the water side and air side of the dry pipe valve. b. At the air receiver where one is provided. c. In each independent pipe from air supply to dry pipe system. d. At quick-opening devices
6. SPRINKLERS	i. Sprinklers shall be either listed dry type sprinklers or Upright Sprinklers. Standard or pendent sprinklers shall not be installed in Dry Systems.
7. DESIGN AREA AND DESIGN DENSITY.	**i.** The dry Sprinkler System Design area and the design densities shall be as per **Table:- D.05-T7.A.**

Table D.05-T7.A.: Design Area and Design Densities for Dry Sprinklers based on Occupancy Hazard

HAZARD	DESIGN DENSITY (mm/min) gpm/ft²	AREA OF OPERATION (m²) Ft²	WATER DEMAND ONLY FOR SPRINKLERS gpm
1. Light Hazard	(4.1) 0.10	(181) 1950	195
2. Ordinary 1 Hazard	(6.1) 0.15	(181) 1950	290
3. Ordinary 2 Hazard	(8.1.1) 0.20	(181) 1950	390
4. Extra Hazard Group 1	(12.2) 0.30	(300) 3250	975
5. Extra Hazard Group 2	(16.3) 0.40	(300) 3250	1300

Table D.05-T7.A.: Automatic Dry Sprinkler System Requirements

ITEMS	REQUIREMENTS
8. SIZE OF THE DRY SPRINKLER SYSTEM	i. The system size shall be such that the initial water is discharged from the system test connection in not more than 60 seconds, starting at the normal air pressure on the system and at the time of the fully opened inspection test connection.
9. GRIDDED SYSTEM	i. The dry pipe sprinkler system shall not be Gridded.
10. LOCATION OF DRY PIPE VALVE	i. The dry Sprinkler Valve shall not be located inside area where the temperature is below 4°C. ii. An indicating-type control valve for the operational testing of the system shall be provided on each sprinkler riser outside of the refrigerated space
11. AIR	i. Each dry pipe system shall have a dedicated and automatic air maintenance device. ii. Air or nitrogen or other permitted gas pressure shall be maintained on dry pipe systems throughout the year. iii. The compressed air supply shall be from a source available at all times. iv. Air or nitrogen supply for systems shall be one of the following. a. Air from the room with lowest temperature to reduce the moisture content. b. Air compressor/dryer package listed for the application utilizing an ambient air. c. Compressed nitrogen gas from cylinders used in lieu of compressed air v. The air supply shall have a capacity capable of restoring normal air pressure in the system within 60 minutes. vi. Each supply line shall be equipped with control valves located in the warm area. vii. A check valve shall be installed in the air filling connection, and a listed or approved shutoff valve of either the renewable disc or ball valve type shall be installed on the supply side of this check valve and shall remain closed unless filling the system. viii. An permitted relief valve shall be provided between the air supply and the shutoff valve and shall be set to relieve pressure no less than 10 psi (0.7 bar) in excess of system air pressure and shall not exceed the manufacturer's limitations. ix. The system air pressure shall be maintained in accordance with the instruction sheet furnished with the dry pipe valve, or shall be 20 psi (1.4 bar) in excess of the calculated trip pressure of the dry pipe valve, based on the highest normal water pressure of the system supply. x. A check valve or other positive backflow prevention device shall be installed in the air supply to each system to prevent airflow or waterflow from one system to another. xi. A low air pressure alarm to a constantly attended location shall be in stalled.
12. WATER DELIVERY	i. Calculations for the dry pipe system water delivery shall be based on the hazard and shall comply with **Table 9.8.B.**

Table D.05-T7.B.: Dry Pipe System Water Delivery

HAZARD	NUMBER OF MOST REMOTE SPRINKLERS OPEN INITIALLY	MAXIMUM TIME OF WATER DELIVERY
1. Light Hazard	1	60 Seconds
2. Ordinary 1 Hazard	2	50 Seconds
3. Ordinary 2 Hazard	2	50 Seconds
4. Extra Hazard Group 1	4	45 Seconds
5. Extra Hazard Group 2	4	40 Seconds

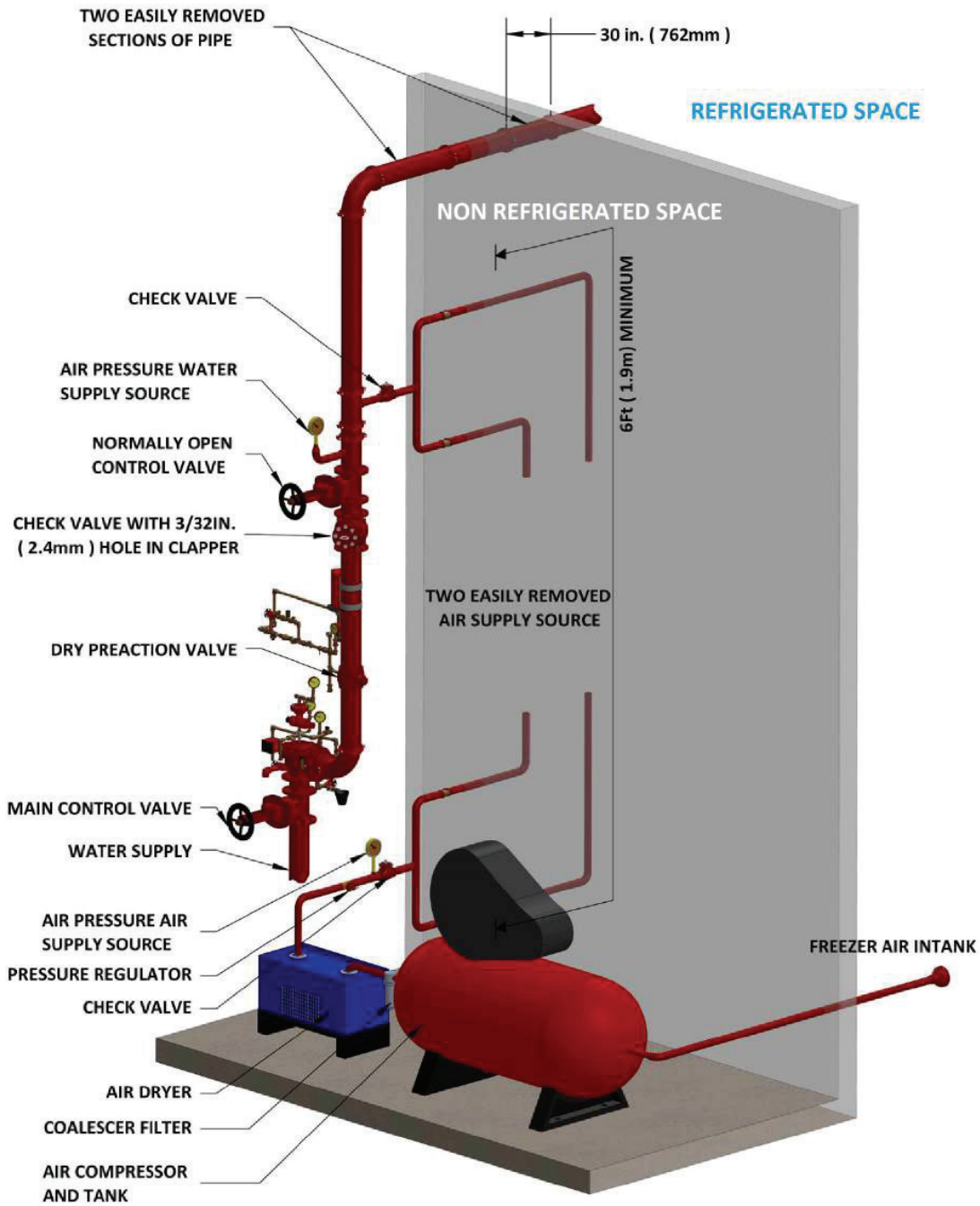


Figure:- D.05-F15: Typical Arrangement of Dry Sprinkler System for Refrigerated areas

8.0 Automatic Pre-action System Sprinkler Systems

8.1. The requirements for Pre-action Automatic Sprinkler System material, design, installation shall be as per **Table:- D.05-T8.,** Applicable Sprinkler requirements of **Table:- D.05-T6.** and the General Requirements of **Table:- D.11-T1.**

Table:- D.05-T8: Automatic Pre-action Sprinkler System Requirements

ITEMS	REQUIREMENTS
1. DEFINITION	i. A Pre-action System is a system which employs automatic and closed-type sprinkler heads connected to a piping system that contains air (either pressurized or non-pressurized), with a supplemental system of detection serving the same area as the sprinklers. ii. These systems are typically used in applications where the accidental discharge of water would be catastrophic to the usage occupancy (for example; Museum, Art galleries, computer servers, lift machine rooms, telecommunications equipment, and high voltage electrical components). iii. Pre-action systems shall be any of the following types. a. A single interlock system, which admits water to a sprinkler piping upon operation of detection devices. b. A double interlock system, which admits water to a sprinkler piping upon operation of both detection devices and automatic sprinklers.
2. COMPONENTS	i. Fire Pumps, Fire Water Tank, Pipes, Fittings, Nitrogen/Air Supply , Sprinkler Heads, Isolation valves, Pre-action Valve, Pressure gauge, Flow Switch, Test connection, Drains, Breeching inlet, Signs. ii. All components of pneumatic, hydraulic, or electrical systems shall be compatible.
3. FIRE PUMP CAPACITY	i. The fire pump set shall consist of 1 Electric driven pump, 1 diesel driven pump and 1 electric Jockey pump, complete with controllers. ii. The pump capacity shall be as per **Section D, Chapter 02.**
4. PIPES	i. Where the sprinkler pipe passes through a wall or floor into the refrigerated space, a section of the pipe arranged for the removal shall be provided immediately inside the space. The removable length of the required pipe shall be a minimum of 762 mm. ii.The connection pipe from the air supply to the dry pipe valve shall not be less than 15 mm in diameter and shall enter the system above the priming water level of the dry pipe valve. iii. The air supply piping shall be equipped with two easily removable supply lines at least 1.9 m long and at least 25.4 mm in diameter.
5. VALVES	i. The automatic water control valve shall be provided with hydraulic, pneumatic, or mechanical manual means for an operation that is independent of the detection devices and of the sprinklers.
6. PRESSURE GAUGES	i. The permitted and General Directorate of Civil Defence - Kingdom of Bahrain listed Pressure gauges shall be installed a. Above and below the pre-action valve. b. On air supply to the pre-action valve.
7. SPRINKLERS	i. Sprinklers shall be either listed dry type sprinklers or Upright Sprinklers and Horizontal sprinklers.
8. SIZE OF THE SYSTEM	i. Not more than 1000 automatic sprinklers shall be controlled by one Single interlocked pre-action valve. ii. Double interlocked System size shall be designed to deliver water to test the connection in no more than 60 seconds.

Table:- D.05-T8 : Automatic Pre-action Sprinkler System Requirements

ITEMS	REQUIREMENTS
9. GRIDDED SYSTEM	i. The pre-action pipe sprinkler system shall not be Gridded.
10. LOCATION OF PRE-ACTION SYSTEM VALVE	i. The pre-action Sprinkler Valve shall not be located inside area where temperature is below 4°C. ii. An indicating-type control valve for operational testing of the system shall be provided on each sprinkler riser outside of the refrigerated space, when refrigerated spaces are protected.
11. FIRE DETECTION SYSTEM	**i.** The fire detection and alarm system for the pre-action system shall comply with **Section C, Chapter 01. Fire Detection and Alarm Systems.** ii. Detectors shall be of electric or pneumatic fixed temperature type with temperature ratings less than those of the sprinklers. iii. Detection devices shall not be rate-of-rise type.
12. AIR	i. Each Pre-action system shall have a dedicated and automatic air maintenance device. ii. Air, nitrogen or other permitted gas pressure shall be maintained on dry pipe systems throughout the year. iii. The compressed air supply shall be from a source available at all times. iv. Air or nitrogen supply for systems shall be one of the following. a. Air from the room with the lowest temperature to reduce the moisture content. b. Air compressor/dryer package listed for the application utilizing ambient air. c. Compressed nitrogen gas from cylinders used in lieu of compressed air v. The air supply shall have a capacity capable of restoring normal air pressure in the system within 60 minutes. vi. Each supply line shall be equipped with control valves located in the warm area. vii. A check valve shall be installed in the air filling connection, and a listed or permitted shutoff valve of either the renewable disc or ball valve type shall be installed on the supply side of this check valve and shall remain closed unless filling the system. viii. An permitted relief valve shall be provided between the air supply and the shutoff valve and shall be set to relieve pressure no less than 10 psi (0.7 bar) in excess of system air pressure and shall not exceed the manufacturer's limitations. ix. All pre-action system shall maintain a minimum supervising air or nitrogen pressure of 7 psi (0.5 bar). x. A check valve or other positive backflow prevention device shall be installed in the air supply to each system to prevent airflow or water flow from one system to another. xi. A low air pressure alarm to a constantly attended location shall be installed.

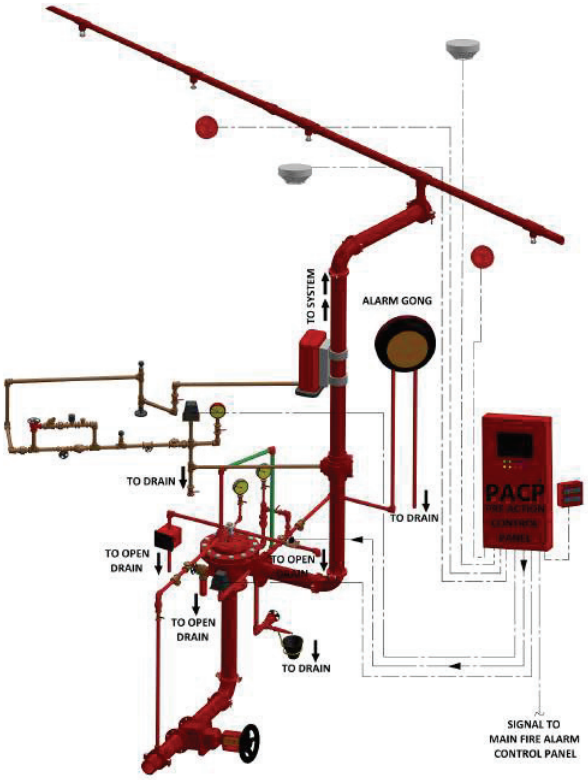


Figure:- D.05-F16: Typical Arrangement of Single Inter locked Pre-action System

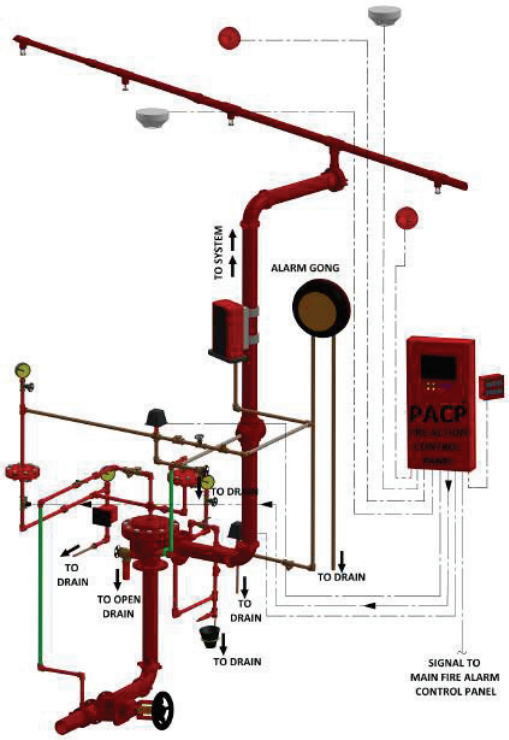


Figure:- D.05-F17: Typical Arrangement of Double Inter locked Pre-action System

9.0 Acceptance test and maintenance

9.1. Automatic Sprinkler and Deluge Systems shall be inspected and maintained as per minimum guidelines in accordance with **Table:- D.05-T9.** However, detailed acceptance, inspection tests and maintenance shall be as per **NFPA 13, NFPA 15 and NFPA 25.**

Table:- D.05-T9.: Sprinkler and Deluge Testing, Inspection and Maintenance

ITEMS	REQUIREMENTS
1. ACCEPTANCE TEST	**1. FLUSHING** i. The underground Piping shall be flushed. ii. The piping between the Breeching inlet and the check valve in the inlet pipe shall be flushed with a sufficient volume of water in order to remove any construction debris and trash accumulated in the piping prior to the completion of the system and prior to the installation of the General Directorate of Civil Defence - Kingdom of Bahrain. iii. The minimum flow rate shall not be less than the hydraulically calculated water demand flow rate of the system plus hose demands. **2. HYDROSTATIC TEST** i. The piping network shall be tested hydrostatically at not less than 13.8 bar (200 psi) of pressure for 2 hours, or at 3.5 bar (50 psi) in excess of the maximum pressure where the maximum pressure is in excess of 10.3 bar (150 psi). The pressure shall be maintained for 2 hours. ii. When deluge systems are being hydrostatically tested, plugs shall be installed in fittings and replaced with open sprinklers after the test is completed, or the operating elements of automatic sprinklers shall be removed after the test is completed. iii. For pre-action systems, in addition to the standard hydrostatic test, an air pressure leakage test at 40 psi (2.7 bar) shall be conducted for 24 hours. Any leakage that results in a loss of pressure in excess of 1½ psi (0.1 bar) for the 24 hours shall be corrected. iv. The piping, joints and discharge devices shall show no leakage. v. Any leakage that results in a loss of pressure in excess of 0.1 bar (1½ psi) during a continuous 24-hour period shall be corrected. vi. The installing contractor shall furnish a certificate for flushing and hydrostatic test prior to the start of the fire pump and field acceptance test. vii. Hose connections and General Directorate of Civil Defence - Kingdom of Bahrain breeching inlet connections shall be tested for compatibility. (All General Directorate of Civil Defence - Kingdom of Bahrain Breeching inlets are instantaneous coupling type). viii. The piping between the breeching inlet connection and the check valve in the inlet pipe shall be tested hydrostatically in the same manner. **3. FIELD ACCEPTANCE TEST** i. The water flow detecting devices including the associated alarm circuits shall be flow tested through the inspector's test connection and shall result in an audible alarm on the premises within 5 minutes after such flow begins and until such flow stops. ii. Testing shall be conducted while fire pumps are running for wet riser systems. iii. At least one remote sprinkler head shall be burst open with a heating device and associated system functions such as the alarm gong operation, fire pump operation, flow switch operation etc. shall be tested and verified. iv. The automatic operation of a deluge or pre-action valve shall be tested in accordance with the manufacturer's instructions. v. Each pressure-regulating device shall be tested to verify that the installation is correct, that the device is operating properly, and that the inlet and outlet pressures at the device are in accordance with the design. vi. All control valves shall be fully closed and opened under system water pressure to ensure proper operation. vii. Signs, both in English and Arabic shall be verified on site. viii. The consultant shall hand over one set of stamped record drawings and one copy of the completed test report to the building owner.

Table:- D.05-T9.: Sprinkler and Deluge Testing, Inspection and Maintenance

ITEMS	REQUIREMENTS
2. QUARTERLY INSPECTION	i. Sprinklers shall not show signs of leakage. They shall be free of corrosion, foreign materials, paint, and physical damage and shall be installed in the correct orientation (e.g., upright, pendent, or sidewall). ii. Escutcheons and cover plates for recessed, flush, and concealed sprinklers shall be replaced if found missing during the inspection. iii. A minimum clearance from a sprinkler deflector and the top of storage shall be more than 1 m. iv. Availability of correct type of spare sprinklers shall be verified. v. Pressure and flow gauges shall be free of damage and in good working condition. vi. Water flow alarm and supervisory signal initiating devices shall be inspected quarterly to verify that they are free of physical damages. vii. The hydraulic design information sign shall be inspected quarterly to verify that it is provided, attached securely to the sprinkler riser, and is legible.
3. QUARTERLY TEST	i. Systems shall be tested quarterly as per FIELD ACCEPTANCE TEST as required by **Table:- D.05-T9.1.,** by the General Directorate of Civil Defence - Kingdom of Bahrain permitted maintenance contractor.
4. MAINTENANCE	i. Valves shall be lubricated to ensure smooth operation. ii. Pressure, flow gauges, supervisory signal devices and water flow devices shall be verified for good working condition. iii. Detection system for deluge and pre-action systems shall be verified for good working condition. iv. Leaking, damaged and corroded parts shall be replaced. v. Pumps and controllers of the system shall be tested, maintained as per **Table:- D.02-T2.**

10.0 Material Test Standards, Permits and registration.

10.1. Acceptable Test Standards and criteria

10.1.1. All the Valves, Pumps, Piping, Hose, Nozzles, Devices, Sprinklers, Motors, Materials, Systems, Assemblies, equipment, Products and Accessories, referred to in this chapter with respect to Life Safety, Fire Safety and Emergency Services shall be Listed Permitted and registered by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain.

10.1.2. There is no year of edition mentioned against any test standards. It is the intent of General Directorate of Civil Defence - Kingdom of Bahrain to invite the customers seeking laboratory tests and the test laboratories to follow the "LATEST EDITION OF THE TEST STANDARD, AS AND WHEN THEY ARE UPGRADED/REVISED/AMENDED, TO THE DATE"

10.1.3. Sprinkler

i. UL 199, Standard for Automatic Sprinklers for Fire Protection Service.
ii. UL 199J, Standard for Automatic Window Sprinklers for Fire Protection Service.
iii. UL 1626, Standard for Residential Sprinklers for Fire Protection Service.
iv. UL 1767, Standard for (ESFR) Early-Suppression Fast-Response Sprinklers.
v. UL 1767B, Standard for Specific application (ESFR) Pendent Sprinklers.
vi. FM 2000, Automatic Control Mode Sprinklers for fire protection.
vii. FM 2030, Residential Automatic Sprinklers for fire protection.
viii. FM 2008, Suppression Mode ESFR Automatic Sprinklers
ix. FM 1632, Telescoping Sprinkler Assemblies for Use in Fire Protection Systems for Anechoic Chambers
x. EN 12259-1, Fixed firefighting systems. Components for sprinkler and water spray systems. Sprinklers
xi. EN 12259-14, Fixed firefighting systems. Components for sprinkler and water spray systems. Sprinklers- Part 14. Sprinklers for residential applications
xii. LPS 1038, Requirements & Testing Methods for EPEC Sprinklers
xiii. LPS 1039, Requirements & Testing Methods for Automatic Sprinklers (inc TS1 Automatic Sprinklers commercial and domestic & residential, TS 4 Multiple Jet Controls, TS 8 Electrically Operated Sprinkler Heads, TS 9 Dual Sensing Sprinkler Heads)
xiv. LPS 1258, Requirements & Testing Methods for tight operating tolerance glass sprinkler bulbs
xv. LPS 1267, Requirements & Testing Methods for ESFR Sprinkler Heads
xvi. LPS 2072, Requirements & Testing Methods for K160 ELO Sprinkler Heads
xvii. BS 9252, Components for residential sprinkler systems. Specification and test methods for residential sprinklers.
xvii. UL 2167 Water Mist Nozzles for Fire-Protection Service nozzles for Fire-Protection Service
xix. UL 2351, Water Spray Nozzles

10.1.4. Underground Pipes and Fittings

i. FM 1613, Permitted Standard for Polyethylene (PE) Pipe and Fittings for underground fire protection service, in accordance with NFPA 24 and AWWA C906, minimum DR-9 with temperature and pressure rating not less than the system working pressure.
ii. FM 1614, Permitted Standard for Fiber Reinforced Composite (FRC) Pipes and Fittings for underground fire protection service.
iii. FM 1620, Permit Standard for Pipe joints and anchor fittings for underground fire protection service.
iv. UL 1285 Pipe and Couplings, Polyvinyl Chloride (PVC), and Oriented Polyvinyl Chloride (PVCO) for Underground Fire Service
v. UL 1713 Pressure Pipe and Couplings, Glass Fiber-Reinforced, for Underground Fire Service
vi. UL 194 Gasketed Joints for Ductile-Iron Pipe and Fittings for Fire Protection Service

10.1.5. Aboveground Pipes and Fittings

i. FM 1920, Permit Standard for Pipe coupling and fittings for aboveground fire protection service.
ii. ANSI/UL 852, Metallic Sprinkler Pipe for Fire Protection Service
iii. ANSI/UL 1821, Thermoplastic Sprinkler Pipe and Fittings for Fire Protection Service
iv. FM 1637, Flexible Sprinkler Hose with Fittings
v. FM 1630, Steel Pipe for Automatic Fire Sprinkler Systems
vi. UL 852, Metallic Sprinkler Pipe for Fire Protection Service
vii. UL 1821, Thermoplastic Sprinkler Pipe and Fittings for Fire Protection Service
viii. ASTM A53, Galvanized Steel ERW Pipe, sch 40.
ix. ASTM A53, Galvanized Steel Seamless Pipe, sch 40.

10.1.6. Valves

i. FM 1041, Permitted Standard for Alarm Check Valve
ii. FM 1021, Dry Pipe Valves
iii. FM 1020, Automatic Water Control Valves
iv. FM 1120, 1130, Fire Service Water Control Valves (OS & Y and NRS Type Gate Valves)
v. FM 1210, Swing Check Valves
vi. FM 1362, Pressure Reducing Valves
vii. FM 1031, Quick Opening Devices (Accelerators and Exhausters) for Dry Pipe Valves
viii. FM 1042, Waterflow Alarm Indicators (Vane Type)
ix. FM 1045, Waterflow Detector Check Valves
x. FM 1140, Quick Opening Valves 1⁄4 Inch Through 2 Inch Nominal Size
xi. FM 1111, Permitted Standard for Post Indicator Valve assembly
xii. FM 1112, Indicating Valves (Butterfly or Ball Type)
xiii. ANSI/UL 193, Alarm Valves for Fire Protection Service
xiv. ANSI/UL 260, Dry Pipe and Deluge Valves for Fire Protection Service
xv. UL 1478, Fire Pump Relief Valves
xvi. UL 1726, Automatic Drain Valves for Standpipe Systems
xvii. UL 2573, Air release valve
xviii. UL 258, Shutoff Valves for Trim and Drain Purposes

xix. UL 668, Hose Valves for Fire Protection Service
xx. UL 1486, quick Opening Devices for Dry Pipe Valves for Fire Protection Service
xxi. UL 1468, Pressure Reducing Valve
xxii. UL 1726, Automatic Drain Valves for Standpipe Systems
xxiii. UL 258, Shutoff Valves for Trim and Drain Purposes
xxiv. UL 262, Gate Valves for Fire Protection Service
xxv. ANSI/UL 312, Check Valves for Fire Protection Service
xxvi. UL 1091, Butterfly Valves for Fire Protection Service
xxvii. ANSI/UL 1468, Direct Acting Pressure Reducing, Restricting Valves
xxviii. ANSI/UL 1739, Pilot-Operated Pressure-Control Valves
xxix. EN 12259-2, Fixed firefighting systems. Components for sprinkler and water spray systems. Wet alarm assemblies.
xxx. EN 12259-3, Fixed firefighting systems. Components for sprinkler and water spray systems. Dry alarm valve assemblies.
xxxi. BS 5041-1, Fire hydrant systems equipment. Specification for landing valves for wet risers.
xxxii. BS 5041-2, Fire hydrant systems equipment. Specification for landing valves for dry risers.
xxxiii. BS 5041-4, Fire hydrant systems equipment. Specification for boxes for landing valves for dry risers.
xxxiv. BS 12094-13, Fixed firefighting systems. Components for gas extinguishing systems. Requirements and test methods for check valves and non-return valves.
xxxv. BS 5041-3, Fire hydrant systems equipment. Specification for inlet breeching s for dry riser inlets.
xxxvi. BS 5041-5, Fire hydrant systems equipment. Specification for boxes for foam inlets and dry riser inlets.
xxxvii. BS 5154, Gate Valve.
xxxvii. BS EN 593, Industrial vales. Metallic butterfly valves
xxxviii. LPS 1040, Requirements and Testing Methods for Wet Alarm Valve Sets
xxxix. LPS 1041, Requirements and Testing Procedures for the LPCB Permitted and Listing of Dry Pipe Valve Sets
xxxx. LPS 1185, Requirements for Testing Gear Operated Butterfly Valves
xxxxi. LPS 1186, Requirements and Testing Methods for Check Valves
xxxxii. EN 12259-2, Fixed firefighting systems. Components for sprinkler and water spray systems. Wet alarm valve assemblies
xxxxiii. EN 1074-1, Valves for fire water
xxxxiv. EN 1074-2, Valves for fire water
xxxxv. EN 12259-3, Fixed firefighting systems. Components for sprinkler and water spray systems. Dry alarm valve assemblies
xxxxvi. LPS TS3, Requirements and Testing for Deluge Valves and Actuators
xxxxvii. LPS 2071,Requirements for LPCB Permitted Pre-Action Systems for use in sprinkler systems
xxxxviii. prEN 12259-9. Fixed firefighting systems. Components for sprinkler and water spray systems. Part 9. Deluge alarm valves
xxxxix. UL 789. Indicator Posts for Fire-Protection Service

10.1.7. Hangers

i. ANSI/UL 203, Pipe Hanger Equipment for Fire Protection Service
ii. FM 1951, 1952, 1953, Pipe Hanger Components for Automatic Sprinkler Systems
iii. FM 1950, Seismic Sway Brace Components for Automatic Sprinkler Systems
iv. LPS 1194, Requirements & Test Methods for Pipe Hangers

10.1.8. Fittings

i. Fittings ANSI/UL 213, Rubber Gasketed Fittings for Fire Protection Service
ii. FM 1920, Pipe Couplings and Fittings for Fire Protection Systems
iii. UL 1474, Adjustable Drop Nipples for Sprinkler Systems
iv. FM 1631, Adjustable and Fixed Sprinkler Fittings ½ Inch through 1 Inch Nominal Size
v. ANSI/UL 2443, Flexible Sprinkler Hose with Fittings for Fire Protection Service
vi. LPS 1219, Requirements and testing procedures for the LPCB permitted and listing of pipe couplings
vii. LPS 1261, Requirements for Testing Flexible Hoses for Sprinkler Systems

10.1.9. Water Motor Gong

i. FM 1055, Permitted Standard for Water Motor Gong.
ii. BS EN 12259-4, Fixed firefighting systems. Components for sprinkler and water spray systems. Water motor alarms.
iii. UL 346, Waterflow Indicators for Fire Protective Signaling Systems

10.1.10. Deluge/Pre-action System

i. FM 1011/1012/1013, Deluge and Pre-action Sprinkler Systems.
ii. UL 260/262/260 - Pre-action Systems



Chapter 6

Deluge Water Spray System

Chapter 6

Deluge Water Spray System



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1.0 Scope

1.1. This chapter provides minimum requirements for the design, installation, inspection and acceptance testing of water spray fixed system for fire protection service and the minimum requirements for the periodic testing and maintenance of water spray fixed system.

1.2. Specifically designed to provide effective fire control, extinguishment, prevention or exposure protection.

2.0 Definitions

2.1. General

2.1.1. Shall

It is a mandatory requirement by General Directorate of Civil Defence - Kingdom of Bahrain.

2.1.2. Should

It is a recommendation but it is not mandatory by General Directorate of Civil Defence - Kingdom of Bahrain.

2.1.3. Listed

Permitted and registered by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain.

2.1.4. Bar

Unit of measurement for pressure. Though it is not a SI unit, it is a common practice to use this unit of measurement in fire protection.

2.1.5. Unit of Measurement

The Unit of Measurement in this code are international system of units. (SI).

- 1 gal = 3.785 L
- 1 gpm/ft2 = (40.746 L/min)/ m2
- 1 gal = 3.785 dm^3
- 1 psi = 6894.757 Pa
- 1 psi = 0.0689 bar
- 1 bar = 10^5 Pa

2.1.6. GPM (Gallons per Minute)

Unit of measurement for flow. Though it is not a SI unit, it is widely a practice to use this unit of measurement for water flow per square feet in fire protection.

2.1.7. Water Spray

Water in a form having a predetermined pattern, particle size, velocity, and density discharge from specially designed nozzles or devices.

2.1.8. Automatic Water Spray Nozzle

A nozzle intended to open automatically by the operation of a heat responsive element that maintains the discharge orifice closed by means such as the exertion of force on a cap (button or disc), that when discharging water under pressure, will distribute the water in a specific and, directional pattern.

2.1.9. Open Water Spray Nozzle

An open water discharge device that, when discharging water under pressure, will distribute the water in a specific, directional pattern.

2.1.10. Deluge Valve

A type of system actuation valve that is opened by the operation of a discharging device installed in the same areas as the spray nozzles or by remote manual operation supplying water to all spray nozzles.

2.1.11. System Actuation Valve

The main valve that controls the flow of water into the water spray system.

2.1.12. Density

The unit rate of water application to an area or surface expressed in gpm/ft^2 or ($L/min/m^2$).

2.1.13. Exposure Protection

Absorption of heat through application of water spray to structures or equipment exposed to a fire, to limit surface temperature to a level that will minimize damage and prevent failure.

2.1.14. Electrical Clearance

The air distance between the water spray equipment, including piping and nozzles, and unenclosed or uninsulated live electrical components at other than ground potential.

2.1.15. Pilot Sprinkler

An automatic sprinkler or thermostatic fixed temperature release device used as a detector to pneumatically or hydraulically release the system actuation valve.

2.1.16. Area Application

The application of ultra high-speed water spray over a specific floor area or over the surface area of a specific object.

2.1.17. Local Application

The application of ultra high-speed water spray on a specific point or points of ignition, such as cutting, mixing or grinding operations.

2.1.18. Fire Area

An area that is physically separated from other areas by space, barriers, walls, or other means in order to contain fire within that area.

2.1.19. Impingement

The striking of a protected surface by water droplets issuing directly from a water spray nozzle.

3.0. Deluge Water Spray Systems

3.1. General Requirements

3.1.1 The requirements for Deluge Water Spray System material, shall be as per **Table:- D.06-T1.,**

Table:- D.06-T1 : Automatic Deluge Water Spray System Requirements

ITEMS	REQUIREMENTS
1. DEFINITION	i. A water spray system is a special fixed pipe system connected to a reliable supply of fire protection water and equipped with water spray nozzles for specific water discharge and distribution over the surface or area to be protected. The piping system is connected to a water supply through a deluge valve that can be actuated both automatically and manually to initiate the flow of water. Automatic system actuation valves for spray systems can be actuated electrically by the operation of automatic detection equipment, such as heat detectors, relay circuits, and gas detectors, or mechanically by hydraulic or pneumatic systems, depending on the operating mode of the individual valves. ii. The Deluge System application could be to extinguish fires, control burning, fire exposure protection (Cooling) or prevention of fire. The pattern of the water spray discharged from spray nozzles onto a surface may be elliptical or Circular, and the cross section of the projected discharge is conical. The water spray is forcefully directed onto the object or surface being protected. The pattern of spray nozzle discharge must carry water spray over the distance between the nozzle and the target, compensate for wind and draft conditions, and effectively hit the surface to be protected. The required discharge density in gpm/ft^2 (L/min/m^2) and complete coverage of the area to be protected are also essential elements. iii. LPG Tanks, Flammable Gas/Liquid Tanks, Electrical Hazards such as transformers, Oil switches, motors, cable trays/ Trenches, Service Tunnels, Transport Tunnels and other such hazards shall be provided with Deluge Water Spray System.
2. COMPONENTS	i. Fire Pumps, Controller, Fire Water Tank, Pipes, Fittings, Nitrogen/Air Supply , Spray Nozzles, Isolation valves, Deluge Valve, Pressure gauge, Flow Switch, Test connection, Drains, Breeching inlet and Signs. ii. All components of pneumatic, hydraulic, or electrical systems shall be compatible, listed and permitted by General Directorate of Civil Defence. iii. System components shall be rated for the maximum working pressure to which they are exposed, but not less than 12.1 bar (175 psi).
3. FIRE PUMPS	i. The fire pump set shall consist of 1 Electric driven pump, 1 diesel driven pump and 1 electric Jockey pump, complete with controllers. ii. The pump capacity shall be as per **Section D, Chapter 02.**
4. WATER SPRAY NOZZLES	i. Nozzles shall be open, listed and permitted by General Directorate of Civil Defence. ii. Selection of nozzles shall be based on discharge characteristics, hazard evaluation, ambient conditions and manufacturer's instructions regarding positioning and coverage.
5. DELUGE VALVE	i. The deluge System actuation valve shall be located as close to hazard protected as possible upon evaluation of hazard factors such as radiant heat flux, potential explosions, accessibility, discharge time and, drainage arrangement such as dikes, bund walls, trenches etc.

Table:- D.06-T1 : Automatic Deluge Water Spray System	
ITEMS	**REQUIREMENTS**
6. ELECTRICAL CLEARANCE	i. All system components shall be positioned to maintain the minimum electrical clearances from live parts. The clearance distance shall comply with **Table:- D.06-T1.a**

Table:- D.06-T1.a : Clearance from Water Spray Equipment to Live Uninsulated Electrical Component

NOMINAL SYSTEM VOLTAGE (kV)	MAXIMUM SYSTEM VOLTAGE (kV)	DESIGN BASIC IMPULSE LEVEL (BIL) (kV)	MNIMUM CLEARANCE OF WATER SPRAY EQUIPMENT (mm)
1. Up to 13.8	14.5	110	178
2. 23	24.3	150	254
3. 34.5	36.5	200	330
4. 46	48.3	250	432
5. 69	72.5	350	635
6. 115	121	550	1067
7.138	145	650	1270
8. 161	169	750	1473
9. 230	242	900/ 1050	1930/ 2134
10. 345	362	1050/ 1300	2134/ 2642
11. 500	550	1500/1800	3150/ 3658
12. 765	800	2050	4242



WATER SPRAY PROTECTION FOR TRANSFORMER FOR ILLUSTRATION



FUEL TANK EXPOSURE PROTECTION FOR ILLUSTRATION

Table:- D.06-T1 : Automatic Deluge Water Spray System	
ITEMS	**REQUIREMENTS**
7. PIPING SUPPORT	i. The system piping shall be supported to maintain its integrity under fire conditions. ii. The piping shall be supported from steel or concrete structural members or pipe stands. iii. Pipe stands used to support piping shall be in accordance with **Table:- D.06-T1.b** to determine maximum heights for pipe stands supporting various diameters of looped piping. iv. The distance between stands shall be as per **Table:- D.06-T1.c.** v. Pipe stands shall be constructed of Schedule 40 threaded pipe, malleable iron flange base, and shall have a threaded cap top. vi. Pipe stands shall be anchored to a concrete pier or footing with either drop-in anchors, quick bolts, or cast-in-place J hooks. vii. The piping shall be attached to the pipe stand with U-bolts or equivalent attachment. viii. The piping shall be supported and braced to restrict movement due to nozzle reaction and water surges so that system performance and integrity is maintained. ix. Hangers shall comply with **Table:-D.11-T1.**

Table:- D.06-T1.b .: Maximum Pipe Stand Heights

DIAMETER OF PIPE	PIPE STAND DIAMETER 40 mm	PIPE STAND DIAMETER 50 mm	PIPE STAND DI-AMETER 65 mm	PIPE STAND DIAMETER 80 mm	PIPE STAND DIAMETER 100 mm
1. 40 mm	3048 mm	4267 mm	5486 mm	8534 mm	9144 mm
2. 50 mm	2438 mm	3658 mm	4876 mm	7925 mm	9144 mm
3. 65 mm	1829 mm	3048 mm	4267 mm	7315 mm	9144 mm
4. 80 mm		2438 mm	3658 mm	6705 mm	9144 mm
5. 100 mm					3048 mm

Table:- D.06-T1.c.: Pipe Stand Distance

LOOP SIZE	DISTANCE BETWEEN PIPE STANDS
1. 25 mm	3048 mm
2. 40 mm	3658 mm
3. 50 mm	4267 mm
4. 65 mm	4572 mm

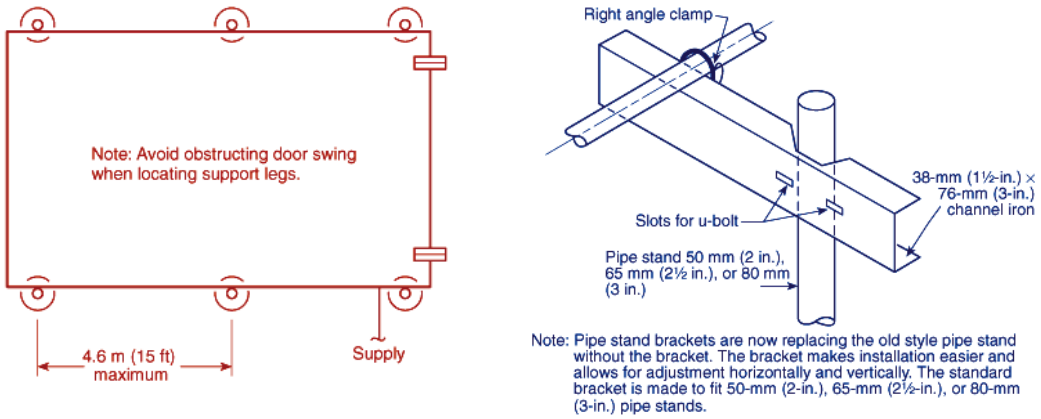


Figure:- D.06-F1: Typical Arrangement of Support legs for Pipe Stands

Table:- D.06-T1 : Automatic Deluge Water Spray System Requirements	
ITEMS	**REQUIREMENTS**
8. DRAINAGE	i. All water spray system pipes and fittings shall be installed so that the system can be drained. ii. Drains shall discharge to a safe location, and drain valves, where provided, shall be accessible. iii. Drains shall not be directly interconnected with any sewer systems.
9. FIRE DETECTION AND ALARM SYSTEM	i. The selection, location, and spacing of automatic fire detectors for the actuation of fixed water spray systems shall comply with **Section C, Chapter 01. Fire Detection and Alarm Systems.** ii. The detection equipment requiring protection from the weather shall be provided with a canopy, hood, or other suitable protection. iii. Detectors shall be located so that no portion of the hazard being protected extends beyond the perimeter line of detectors. iv. When located out of doors or in the open, the spacing of fixed temperature or rate-of-rise detectors shall be reduced by at least 50 percent from the listed spacing under smooth ceilings. v. Any flow from a single automatic nozzle of the smallest orifice size installed on the system or flow from any group of non-automatic nozzles, shall result in an audible alarm on the premises within 90 seconds after flow begins. vi. Where a separate detection system is used to activate the water spray system. The alarm shall be actuated independently of the system water flow to indicate the operation of the detection system. vii. The flammable gas detectors and radiant energy sensing fire detectors shall be installed as per their listing specifications.
10. PILOT SPRINKLERS	i. Where pilot sprinklers are used for fire detection in indoor locations, the maximum horizontal spacing shall not exceed 3.7 m. ii. Pilot sprinklers located outdoors, such as in open process structures, shall be spaced such that the elevation of a single level of pilot sprinklers and between additional levels of pilot sprinklers shall not exceed 5.2 m. iii. The horizontal distance between pilot sprinklers installed outdoors shall not exceed 2.5 m. iv. Pilot sprinklers shall be installed as per their listing specifications in special situations. v. Applicable Sprinkler requirements in **Section D, Chapter 05. Automatic Sprinkler system.**
11. REMOTE MANUAL ACTIVATION	i. At least one manual actuation device independent of the manual actuation device at the system actuation valve shall be installed for all automatic systems installed in occupied areas.
12. BREECHING INLET	i. Breeching inlet connections shall be provided for all water spray systems, except for ultra high-speed water spray systems.
13. GAUGES	i. Pressure gauges shall be installed below and above the Deluge Valve, below the system actuation valve and on air or water supply to pilot lines.
14. STRAINERS	i. Strainers shall be provided for all water spray systems so as to be accessible for cleaning and flushing.
15. PIPES	i. Pipes shall comply to **Table:- D.11-T1**
16. FITTINGS	i. Fittings shall comply to **Table:- D.11-T1**

3.2. Design Requirements

3.2.1. The design requirements for Deluge Water Spray System shall be as per **Table:- D.06-T2.**

Table:-D.06-T2 : Automatic Deluge Water Spray System Requirements

ITEMS	REQUIREMENTS
1. DESIGN	i. The system and water supplies shall be designed to admit water into the piping and to discharge effective water spray from all open nozzles without delay. ii. Tapping from wet risers to feed deluge system shall not be permitted. iii. Manual operation shall be permitted where automatic operation of the system presents a hazard to personnel and trained personnel are available to operate such manual systems. iv. Nozzle spacing (vertically or horizontally) shall not exceed 3 m. v. A single system shall not protect more than one fire area. vi. The hydraulically designed discharge rate for a single system or multiple systems designed to operate simultaneously shall not exceed the available water supply. vii. Extinguishment of fires by water spray shall be accomplished by one or a combination of the following methods: a. Surface cooling b. Smothering by produced steam c. Emulsification d. Dilution e. Other factors viii. Design Densities for various hazards, when demanded by other sections of this code or by General Directorate of Civil Defence hazard evaluation shall be as per **Table:- D.06-T2.A.** The duration of Discharge shall not be less than 60 minutes. ix. All Deluge Water Spray Systems shall be hydraulically designed along with the manufacturer's instructions.

Table:- D.06-T2.A.: Water Spray Design Densities and Criteria

HAZARD,	REQUIRED DESIGN DENSITY	OTHER REQUIREMENTS
1. Cable - Spread/ Trenches/ Trays/Cable runs	12.2 lpm (0.30 gpm)	Air Sampling Type smoke detection for smoldering fire sensing shall be provided.
2. Belt Conveyors	10.2 lpm (0.25 gpm)	Interlocks shall be provided between the detection system and the machinery to shut down belt conveyor operation, including upstream feed.
3. Conveyor Belt	10.2 lpm (0.25 gpm)	The water spray system shall be installed to automatically wet the top belt, its contents, and the bottom return belt.
4. Pumps, Compressors handling Flammable Liquids		See **Chapter 13. Flammable Liquids**
5. Flammable Liquid pool fires		See **Chapter 13. Flammable Liquids**
6. Vessels Exposure protection (LPG/ Flammable Liquid/ Gas Tanks,	10.2 lpm (0.25 gpm)	Water spray shall be applied to top and bottom surfaces of vertical vessels. See also **Chapter 13. Flammable Liquids**
7. Structural Steel Exposure protection	4.1 lpm (0.10 gpm)	Horizontal, stressed (primary) structural steel members shall be protected.
8. Vertical Structural Steel Exposure protection	10.2 lpm (0.25 gpm)	A vertical structural steel that has been encased in fire-resistant insulating material to provide a desired level of fire resistance, does not need not be protected with a water spray system.
9. Transformers	10.2 lpm (0.25 gpm) or 6.1 lpm(0.15 gpm)	The water shall be applied to a projected area of rectangular prism envelope or non-absorbing surface exposure for the transformer and its appurtenances. See **NFPA 15,Chapter 7.4.4.3.1**

Table:-D.06-T2 : Automatic Deluge Water Spray System Requirements

ITEMS	REQUIREMENTS
10. WATER DEMAND	i. The water supply must be adequate to supply the operating water spray system(s) with the required gpm (L/min) at effective pressure. Water spray systems adjacent to the hazard initially protected may require additional water. ii. The water supply should be able to supply hose streams simultaneously. The total required water supply pressure and flow rates should be considered when the system is designed. iii. The duration of the required discharge varies according to the nature of the hazard, the purpose for which the system is designed, and other factors that can be evaluated only for each installation.

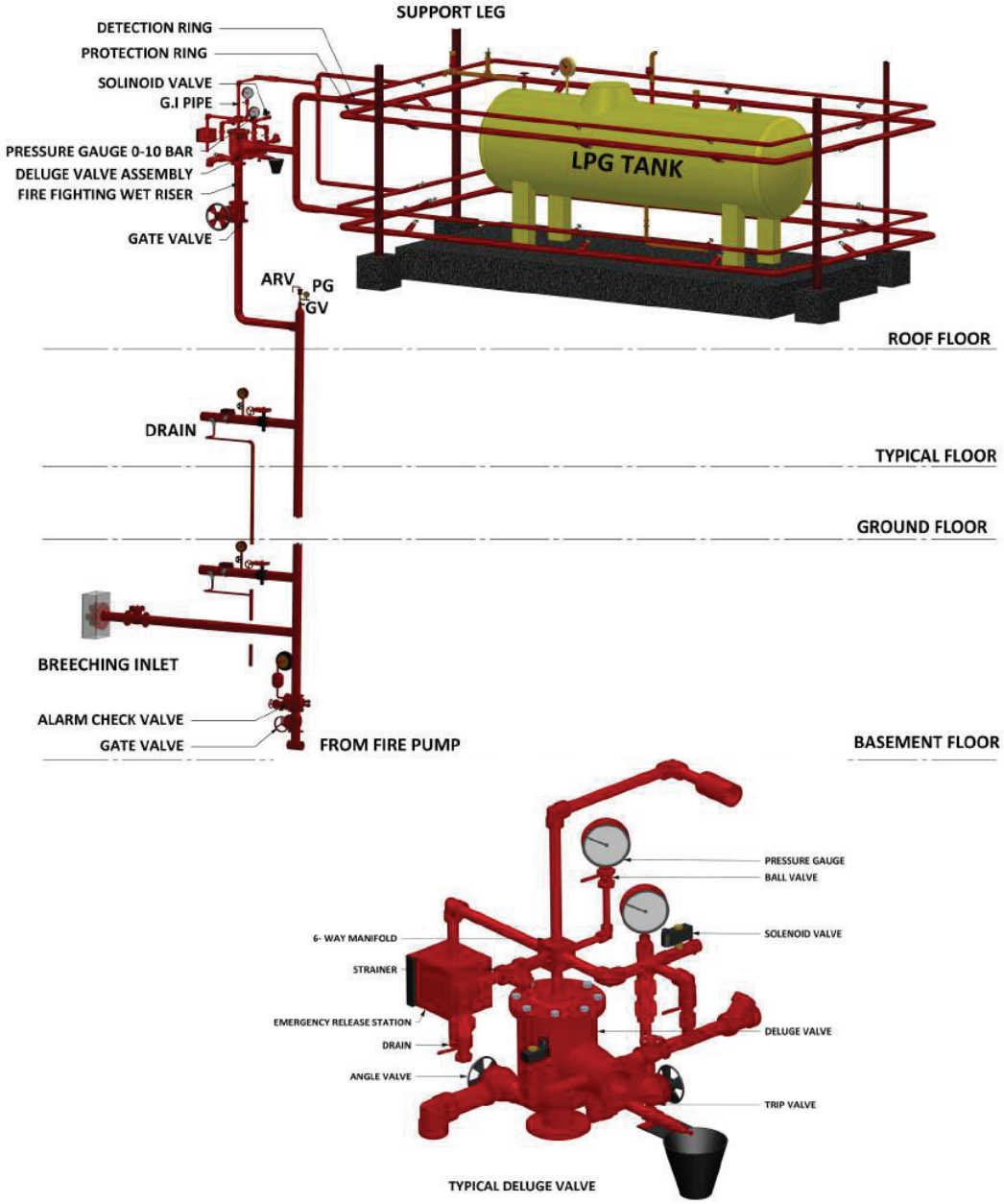


Figure:- D.06-F2.: Typical Deluge Water Spray System Application for LPG Tank.

5.0. Acceptance test and maintenance

5.1. Automatic Deluge Water spray Systems shall be inspected and maintained as per minimum guidelines in accordance with **Table:- D.06-T3.** However, detailed acceptance, inspection tests and maintenance shall be as per **NFPA 15 and NFPA 25.**

Table:- D.06-T3.: Deluge Water Spray Testing, Inspection and Maintenance

ITEMS	REQUIREMENTS
1. ACCEPTANCE TEST	**1. FLUSHING** i. The underground piping shall be flushed. ii. The piping between the fire department connection and the check valve in the inlet pipe shall be flushed with a sufficient volume of water in order to remove any construction debris and trash accumulated in the piping prior to the completion of the system and prior to the installation of the General Directorate of Civil Defence connection. iii. The minimum flow rate shall not be less than the hydraulically calculated water demand flow rate of the system plus hose demands. **2. HYDROSTATIC TEST** i. The piping network shall be tested hydrostatically at not less than 13.8 bar (200 psi) of pressure for 2 hours, or at 3.5 bar (50 psi) in excess of the maximum pressure where the maximum pressure is in excess of 10.3 bar (150 psi). The pressure shall be maintained for 2 hours. ii. When deluge systems are being hydrostatically tested, plugs shall be installed in fittings and replaced with open sprinklers after the test is completed, or the operating elements of automatic sprinklers shall be removed after the test is completed. iii. The piping, joints and discharge devices shall show no leakage. iv. Any leakage that results in a loss of pressure in excess of 0.1 bar (1½ psi) during a continuous 24-hour period shall be corrected. v. The installing contractor shall furnish a certificate for flushing and hydrostatic test prior to the start of the fire pump and field acceptance test. vi. Hose connections and General Directorate of Civil Defence breeching inlet connections shall be tested for compatibility. (General Directorate of Civil Defence – Kingdom of Bahrain connections are instantaneous coupling type). vii. The piping between the breeching inlet connection and the check valve in the inlet pipe shall be tested hydrostatically in the same manner.

Table:- D.06-T3.: Deluge Water Spray Testing, Inspection and Maintenance	
ITEMS	**REQUIREMENTS**
ACCEPTANCE TEST	**3. FIELD ACCEPTANCE TEST** i. The waterflow detecting devices including the associated alarm circuits shall be flow tested through the inspector's test connection and shall result in an audible alarm on the premises within 5 minutes after such flow begins and until such flow stops. ii. At least one remote sprinkler head shall be burst open with a heating device and associated system functions such as the alarm gong operation, fire pump operation, flow switch operation etc. shall be tested and verified. iii. The automatic operation of a deluge valve shall be tested in accordance with the manufacturer's instructions. iv. All control valves shall be fully closed and opened under system water pressure to ensure proper operation. v. Signs, both in English and Arabic shall be verified on site. vi. The consultant shall hand over one set of stamped record drawings and one copy of the completed test report to the building owner.
2. QUARTERLY INSPECTION	i. Sprinklers shall not show signs of leakage. They shall be free of corrosion, foreign materials, paint, and physical damage and shall be installed in the correct orientation (e.g., upright, pendent, or sidewall). ii. A minimum clearance from a sprinkler deflector and the top of storage shall be more than 1 m. iii. Availability of correct type of spare sprinklers shall be verified. iv. Pressure and flow gauges shall be free of damage and in good working condition. v. Water flow alarm and supervisory signal initiating devices shall be inspected quarterly to verify that they are free of physical damages. vi. The hydraulic design information sign shall be inspected quarterly to verify that it is provided, attached securely to the sprinkler riser, and is legible.
3. QUARTERLY TEST	i. Systems shall be tested quarterly as per FIELD ACCEPTANCE TEST as required by **Table:- D.06-T3.1.**, by the General Directorate of Civil Defence permitted
4. MAINTENANCE	i. Valves shall be lubricated to ensure smooth operation. ii. Pressure, flow gauges, supervisory signal devices and water flow devices shall be verified for good working condition. iii. Detection system for deluge systems shall be verified for good working condition. iv. Leaking, damaged and corroded parts shall be replaced. v. Pumps and controllers of the system shall be tested, maintained as per **Section D, Chapter 02.**

6.0 Material Test Standards, Permits and registration.

6.1. Acceptable Test Standards and criteria

6.1.1. All the Valves, Pumps, Piping, Nozzles, Devices, Sprinklers, Materials, Systems, Assemblies, equipment, Products and Accessories, referred to in this chapter with respect to Life Safety, Fire Safety and Emergency Services shall be Listed, Permitted and Registered by the Civil Defence.

6.1.2. There is no year of edition mentioned against any test standards. It is the intent of General Directorate of Civil Defence to invite the customers seeking laboratory tests and the test laboratories to follow the "LATEST EDITION OF THE TEST STANDARD, AS AND WHEN THEY ARE UPGRADED/REVISED/AMENDED, TO THE DATE"

6.1.3. Sprinkler

- **i.** UL 199, Standard for Automatic Sprinklers for Fire Protection Service.
- **ii.** UL 199J, Standard for Automatic Window Sprinklers for Fire Protection Service.
- **iii.** UL 1626, Standard for Residential Sprinklers for Fire Protection Service.
- **iv.** EN 12259-1, Fixed firefighting systems. Components for sprinkler and water spray systems. Sprinklers
- **v.** prEN 12259-14, Fixed firefighting systems. Components for sprinkler and water spray systems. Sprinklers- Part 14. Sprinklers for residential applications
- **vi.** LPS 1039, Requirements & Testing Methods for Automatic Sprinklers (inc TS1 Automatic Sprinklers commercial and domestic & residential, TS 4 Multiple Jet Controls, TS 8 Electrically Operated Sprinkler Heads, TS 9 Dual Sensing Sprinkler Heads)
- **vii.** LPS 1258, Requirements & Testing Methods for tight operating tolerance glass sprinkler bulbs
- **viii.** BS 9252, Components for residential sprinkler systems. Specification and test methods for residential sprinklers.
- **ix.** UL 2351, Water Spray Nozzles.

6.1.4. Underground Pipes and Fittings

- **i.** FM 1613, Permitted Standard for Polyethylene (PE) Pipe and Fittings for underground fire protection service, in accordance with NFPA 24 and AWWA C906, minimum DR-9 or SDR-9 with temperature and pressure rating not less than the system working pressure.
- **ii.** FM 1614, Permitted Standard for Fiber Reinforced Composite (FRC) Pipes and Fittings for underground fire protection service.
- **iii.** FM 1620, Permitted l Standard for Pipe joints and anchor fittings for under-ground fire protection service.
- **iv.** UL 1285 Pipe and Couplings, Polyvinyl Chloride (PVC), and Oriented Polyvinyl Chloride (PVCO) for Underground Fire Service
- **v.** UL 1713 Pressure Pipe and Couplings, Glass Fiber-Reinforced, for Underground Fire Service
- **vi.** UL 194 Gasketed Joints for Ductile-Iron Pipe and Fittings for Fire Protection Service

6.1.5. Aboveground Pipes and Fittings

i. FM 1920, Permitted Standard for Pipe coupling and fittings for aboveground fire protection service.
ii. ANSI/UL 852, Metallic Sprinkler Pipe for Fire Protection Service
iii. ANSI/UL 1821, Thermoplastic Sprinkler Pipe and Fittings for Fire Protection Service
iv. FM 1630, Steel Pipe for Automatic Fire Sprinkler Systems
v. UL 852, Metallic Sprinkler Pipe for Fire Protection Service
vi. UL 1821, Thermoplastic Sprinkler Pipe and Fittings for Fire Protection Service
vii. ASTM A53, Galvanized Steel ERW Pipe, sch 40.
viii. ASTM A53, Galvanized Steel Seamless Pipe, sch 40.

6.1.6. Valves

i. FM 1020, Automatic Water Control Valves
ii. FM 1120, 1130, Fire Service Water Control Valves (OS & Y and NRS Type Gate Valves)
iii. FM 1210, Swing Check Valves
iv. FM 1112, Indicating Valves (Butterfly or Ball Type)
v. UL 1091, Butterfly Valves for Fire Protection Service
vi. UL 1726, Automatic Drain Valves for Standpipe Systems
vii. UL 2573, Air release valve
viii. UL 258, Shutoff Valves for Trim and Drain Purposes
ix. UL 668, Hose Valves for Fire Protection Service
x. UL 1486, Quick Opening Devices for Dry Pipe Valves for Fire Protection Service
xi. UL 1468, Pressure Reducing Valve
xii. UL 1726, Automatic Drain Valves for Standpipe Systems
xiii. UL 258, Shutoff Valves for Trim and Drain Purposes
xiv. UL 262, Gate Valves for Fire Protection Service
xv. ANSI/UL 312, Check Valves for Fire Protection Service
xvi. ANSI/UL 1468, Direct Acting Pressure Reducing, Restricting Valves
xvii. ANSI/UL 1739, Pilot-Operated Pressure-Control Valves
xviii. EN 12259-2, Fixed firefighting systems. Components for sprinkler and water spray systems. Wet alarm assemblies.
xix. EN 12259-3, Fixed firefighting systems. Components for sprinkler and water spray systems. Dry alarm valve assemblies.
xx. EN 12259-3, Fixed firefighting systems. Components for sprinkler and water spray systems. Dry alarm valve assemblies
xxi. LPS TS3, Requirements and Testing for Deluge Valves and Actuators
xxii. LPS 2071,Requirements for LPCB Permitted Pre-Action Systems for use in sprinkler systems
xxiii. prEN 12259-9. Fixed firefighting systems. Components for sprinkler and water spray systems.

6.1.16. Hangers

i. ANSI/UL 203, Pipe Hanger Equipment for Fire Protection Service
ii. FM 1951, 1952, 1953, Pipe Hanger Components for Automatic Sprinkler Systems
iii. FM 1950, Seismic Sway Brace Components for Automatic Sprinkler Systems
iv. LPS 1194, Requirements & Test Methods for Pipe Hangers

6.1.17. Fittings

i. Fittings ANSI/UL 213, Rubber Gasketed Fittings for Fire Protection Service
ii. FM 1920, Pipe Couplings and Fittings for Fire Protection Systems
iii. UL 1474, Adjustable Drop Nipples for Sprinkler Systems
iv. FM 1631, Adjustable and Fixed Sprinkler Fittings ½ Inch through 1 Inch Nominal Size
v. ANSI/UL 2443, Flexible Sprinkler Hose with Fittings for Fire Protection Service
vi. LPS 1219, Requirements and testing procedures for the LPCB Permitted and listing of pipe couplings
vii. LPS 1261, Requirements for Testing Flexible Hoses for Sprinkler Systems

6.1.30. Breeching inlet

i. UL 405, Fire Department connections.
ii. BS 5041, Part -3 , Fire Hydrant system equipment



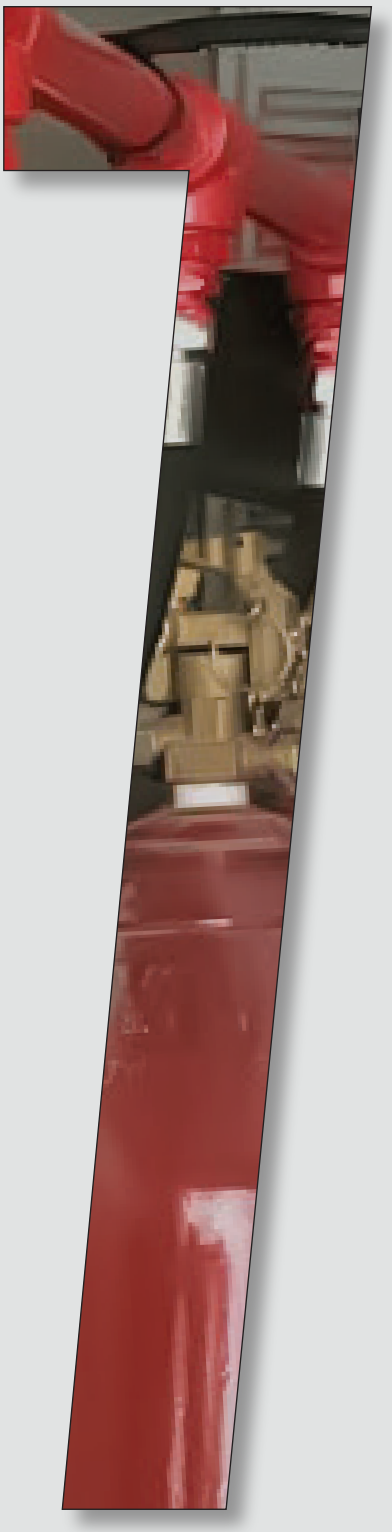
Chapter 7

Water Mist



Chapter 7

Water Mist



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1.0 Scope

1.1 This code provides general information on design, installation, permits, listing, inspection and maintenance of Water mist Fire Protection system.

1.2 To provide protection for life and property from fire through standardization of design, installation, maintenance and testing requirements for water based fire suppression system that use a specific spray (mist) that absorbs heat, displaces oxygen or block the radiant heat to control, suppress or extinguish fires.

2.0. Definitions

2.1. General

2.1.1. Shall

It is a mandatory requirement by General Directorate of Civil Defence – Kingdom of Bahrain.

2.1.2. Should

It is a recommendation but it is not mandatory by General Directorate of Civil Defence - Kingdom of Bahrain.

2.1.3. Listed

Permitted and registered by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain.

2.1.4. Bar (bar)

Unit of measurement for pressure. Though it is not a SI unit, it is a common practice to use this unit of measurement in fire protection.

2.1.5. Unit of Measurement

The Unit of Measurement in this code are international system of units. (SI).

- 1 in. = 25.4 mm
- 1 ft^2 = 0.0929 m^2
- 1 gal = 3.785 dm^3
- 1 gal = 3.785 L
- 1 gpm/ft^2 = (40.746 L/min)/ m^2
- 1 ft^3 = 0.028317 m^3
- 1 lb = 0.4536 Kg
- 1 lb/ ft^3 = 16.0183 Kg/m^3
- 1 psi = 6894.757 Pa
- 1 psi = 0.0689 bar
- 1 bar = 10^5 Pa
- 1 mm = 1000 µ

2.1.6. GPM (Gallons per minute)

Unit of measurement for flow. Though it is not a SI unit, it is widely a practice to use this unit of measurement for water flow per square feet in fire protection.

1 GPM (gpm/minute) = 3.78 Liter/minute (LPM)

2.1.7. Fire Suppression

Sharply reducing the heat release rate of a fire and preventing its regrowth by means of direct and sufficient application of extinguishing agents such as water or gas or chemicals through the fire plume to the burning fuel surface.

2.1.8. Water based Fire Protection Systems

Water is the most widely used and available fire-extinguishing agent. Water is effective in fire suppression. The techniques and mechanisms using water and its heat absorbing, cooling and fire extinguishing properties to fight and extinguish fires are Water Based Fire Protection Systems such as Water Mist Systems.

2.1.9. Water Mist

A water spray for which the $Dv_{0.99}$, (Dv_f-A drop diameter such that the cumulative volume, from zero diameter to this respective diameter, is the fraction, *f*, of the corresponding sum of the total distribution) for the flow-weighted cumulative volumetric distribution of water droplets is less than 1000 µm within the nozzle operating pressure range.

2.1.10. Water Mist System

A distribution system connected to a water supply or water and atomizing media supply that is equipped with one or more nozzles capable of delivering water mist intended to control, suppress, or extinguish fires and that has been demonstrated to meet the performance requirements of its listing and this standard.

2.1.11. Water Mist Atomizing Media

Compressed air or other gases that produce water mist by mechanical mixing with water.

2.1.12. Water Mist Nozzle

A special purpose device, containing one or more orifices, designed to produce and deliver a water spray meeting either the definition of 'water mist' or meeting the specific requirements of an permitted water mist fire test protocol.

2.1.13. Additive

Any chemical or mixture of chemicals intentionally introduced into the system.

2.1.14. High Pressure System

A water mist system where the distribution system piping is exposed to pressures of 34.5 bar (500 psi) or greater.

2.1.15. Intermediate Pressure System

A water mist system where the distribution system piping is exposed to pressures greater than 12.1 bar (175 psi) but less than 34.5 bar (500 psi).

2.1.16. Low Pressure System

A water mist system where the distribution piping is exposed to pressures of 12.1 bar (175 psi) or less.

2.1.17. Propellant

Compressed gas used as a prime mover to push water out of storage vessels, through pipe networks, or through distribution components.

2.1.18. Single Fuel System

A water mist system utilizing a single piping system to supply each nozzle

.

2.1.19. Twin Fuel System

A water mist system in which water and an atomizing medium are supplied to the water mist nozzle utilizing a separate piping system for each medium or a single piping system for both.

2.1.20. Deluge Water Mist System

A water mist system utilizing non automatic mist nozzles (open) attached to a piping network connected to the fluid supply(ies) through a valve controlled by an independent detection system installed in the same area as the mist nozzles.

2.1.21. Dry Pipe Water Mist System

A water mist system using automatic nozzles attached to a piping system containing air, nitrogen, or inert gas under pressure, the release of which (as from an opening of an automatic nozzle) allows the water pressure to open a dry pipe valve. The water then flows into the piping system and out through any open nozzles.

2.1.22. Engineered Water Mist System

Those systems that need individual calculation and design to determine the flow rates, nozzle pressures, pipe size, area, or volume protected by each nozzle, discharge density of water mist, the number and types of nozzles, and the nozzle placement in a specific system.

2.1.23. Local Application Water Mist System

A water mist system arranged to discharge directly on an object or hazard in an enclosed, unenclosed, or open outdoor condition.

2.1.24. Pre-action Water Mist System

A water mist system using automatic nozzles attached to a piping system that contains air that might or might not be under pressure, with a supplemental detection system installed in the same areas as the mist nozzles. The actuation of the detection system opens a valve that allows water to flow into the piping system and discharges through all opened nozzles in the system.

2.1.25. Wet Pipe Water Mist System

A water mist system using automatic nozzles attached to a piping system containing water and connected to a water supply so that water discharges immediately from nozzles operated by the heat from a fire.

2.1.26. The requirements for Water Mist System material, design, installation shall be as per **Table:- D.07-T2.,** and the Applicable General Requirements of **Table:- D.11-T1.**

3.0 Water Mist System

3.1. General Requirements

3.1.1. The General requirements for Water Mist System material and components shall **Table:- D.07-T1.**

Table:- D.07-T1: Water Mist System Requirements

ITEMS	REQUIREMENTS
1. DEFINITION	i. A distribution system connected to a water supply or water and atomizing media supplies that is equipped with one or more nozzles capable of delivering water mist intended to control, suppress, or extinguish fires ii. Water mist shall be as per the manufacturer's specifications with requirements of its listing based on its demonstration to meet the performance requirements for specific applications such as Road Tunnels, Service Tunnels, Cable spread areas, Machinery rooms, Marine service rooms, Combustion turbines, wet benches and such processing equipment, Local application to equipment, Industrial oil cookers, computer room raised floors, Chemical fume hoods and continuous wood board presses. iii. A Water Mist System without detailed design, equipment selection, installation and maintenance manual, listed and recognized by international testing and certification bodies shall not be acceptable. iv. Water mist can be discharged through various arrangement of Systems such as Water Mist deluge Systems, Pre-action Systems, Dry Pipe Systems etc. See **Sub Section 2.0.** for definitions.
2. APPLICATION	i. The characteristics of the specific application (compartment variables and hazard classification) shall be consistent with the listing of the system. ii. Pre-engineered water mist systems for compartment enclosures shall not be extrapolated beyond the volume, ceiling height, ventilation rate, and number of nozzles tested, unless the dimensions of the enclosure are such that additional nozzles are required to maintain nozzle spacing. iii. The system design and installation manual evaluated by the listing tests shall identify the working limits and parameters of the system, the fire hazards, and the range of compartment variables for which the listing is applicable. iv. The parameters of ventilation, either natural or forced shall be addressed in the design and installation manual.
3. COMPONENTS	i. Fire Pumps, Control System, Additives, Fire Water Tank, Gas and water containers/cylinders, Pipes, Tubes, Fittings, Spray Nozzles, pressure gauges, Isolation valves, Solenoid Valves, Strainers/Filters, Fire Detection and Alarm Systems and Signs. ii. All the components of the water mist systems shall be listed and permitted by General Directorate of Civil Defence. iii. The system components shall be rated for the maximum working pressure to which they are exposed, but not less than 12.1 bar (175 psi).
4. FIRE PUMPS	i. Fire Pump set shall consist of 1 Electric driven pump, 1 diesel driven pump and 1 electric Jockey pump, complete with controllers. ii. Electrical or diesel-driven pumps supplying water mist systems shall be of sufficient capacity to exceed both the system flow rate and pressure demands as determined by hydraulic calculations, by a minimum of 10 percent for both flow and pressure. iii. The discharge piping for water mist pumps and pump assemblies for high pressure or intermediate pressure water mist systems shall be equipped with a valve test connection for the purpose of connecting a flow metering device to permit accurate measurement of the pump performance during the acceptance test and during annual testing.
5. WET RISERS AND HOSE SYSTEMS	i. Where wet risers and hose systems are required by this code, a separate systems complete with Pumps, pipes and fittings shall be provided as per other sections of this chapter.

Table:- D.07-T1: Water Mist System Requirements

ITEMS	REQUIREMENTS
6. BREECHING INLET	i. A breeching inlet for General Directorate of Civil Defence shall be provided for all water mist systems except where a. The water mist is protecting an area less than 200 m^2 . b. The water mist system pressure exceeds 12 bar and is supplied by storage cylinders. c. Water mist systems where the atomizing medium is essential for fire suppression. ii. For water mist systems with system design pressures less than or equal to 12 bar (175 psi), the connection of the Breeching inlet to the system shall be made on the upstream (supply) side of the system strainer or filter. iii. For water mist systems with system design pressures in excess of 12 bar (175 psi), the connection of the fire department connection to the system shall be made on the suction side of the pressure source components.
7. ADDITIVES	i. All the components in the water mist systems and the additive injection system shall be of corrosion resistant material.
8. GAS AND WATER CONTAINERS	i. Gas and water containers subject to pressurization shall be made, tested, permitted, equipped and marked in accordance with the current specifications of the ASME Boiler and Pressure Vessel Code, Section VIII, or other permitted international standards. ii. Each pressurized container shall be provided with a safety device to release excess pressure. iii. Each water and gas container shall have a permanent nameplate or other permanent marking specifying the liquid/gas held in the container (including additives) and the nominal water volume and pressurization level (where applicable) of the container. iv. All containers supplying the same manifold outlet shall be interchangeable and of the same size and charge.
9. FIRE DETECTION AND ALARM SYSTEM	i. Fire Detection, control system, design and installation shall be as per **Section C, Chapter 01. Fire Detection and Alarm Systems.**
10. NOZZLES	i. Nozzles shall be installed in accordance with the manufacturer's listing. ii. The minimum and maximum height and nozzle pressure limitations shall be in accordance with the manufacturer's listing. iii. The minimum and maximum distances between nozzles, distance from walls, obstructions to nozzles, distance below ceilings etc. shall be in accordance with the manufacturer's listing. iv. Temperature rating, Classifications and color coding of thermally activated nozzles shall be as per **Table:- D.07-T1.A.**

Table:- D.07-T1.A: Nozzle Operating Temperature and Color Classification

MAXIMUM CEILING TEMPERATURE	TEMPERATURE RATING OF SPRINKLER HEAD	TEMPERATURE CLASSIFICATION	COLOR CODE	GLASS BULB COLORS
1. 38°C	**57°C—77°C**	Ordinary	Uncolored or Black	Orange or Red
2. 66°C	**79°C—107°C**	Intermediate	White	Yellow or Green
3. 107°C	**121°C—149°C**	High	Blue	Blue
4. 149°C	**163°C—191°C**	Extra High	Red	Purple
5. 191°C	**204°C—246°C**	Very Extra High	Green	Black
6. 246°C	**260°C—302°C**	Ultra High	Orange	Black
7. 329°C	**343°C**	Ultra High	Orange	Black

Table:- D.07-T1: Water Mist System Requirements

ITEMS	REQUIREMENTS
11. SYSTEM PROTECTION AREA LIMITATIONS	i. The maximum area on any floor to be protected by water mist supplied by any one water mist system riser or a combined system riser shall be 4831 m^2 for Light Hazard and Ordinary Hazard.
12. PRESSURE GAUGES	i. Pressure gauges shall be installed in the following locations. a. On both sides of a pressure regulating valve b. On the pressurized side of all supply connections c. On the pressurized side of all system control valves d. On all pressurized storage containers e. On all air supplies for dry pipe and pre-action systems
13. STRAINERS AND FILTERS	i. All installed water mist systems must have a suitable and permitted water basket inline water filter and a suitably permitted Y-strainer to capture any dirt from entering the pumps and causing nozzle blockages. ii. Every water mist nozzle shall have a suitable inbuilt stainless steel sieve to prevent dirt from entering the nozzle and causing blockages.
14. VALVES	i. All valves in the system shall be listed and installed as per their listing. ii. Valves on connections to water supplies, sectional control and isolation valves, and other valves in supply pipes to nozzles. iii. Water mist system Control and activation valves shall operate by an permitted mechanical, electrical, or pneumatic means.
15. PRV'S	i. Compressed gas pressure reducing valves shall be installed as per their listing, where the supply pressure is higher than the system design pressure. ii. Pressure set, point-adjusting mechanisms on the PRVs shall be tamper resistant, and the adjustment shall be indicated by a permanent marking.
16. DRAIN AND TEST CONNECTIONS	i. Each water mist system shall have a drain on the system side of the control valve. ii. The inspector's test connections shall contain an orifice equal to or smaller than the smallest nozzle installed in the system.
17. HANGERS AND SUPPORTS	i. Hangers and supports shall be located in accordance with the requirements contained within the system's design manual. ii. The length of an unsupported arm over to a nozzle shall not exceed 0.6 m (2 ft.) for steel pipe or 0.3 m (1 ft.) for steel tubing. iii. Hangers used on low pressure water mist systems shall be permitted to be designed and installed in accordance with **Table:- D.05-T5.7.** iv. The tube Hanger Maximum spacing shall be as per **Table:- D.07-T1.B.**

Table:- D.07-T1.B: Water Mist Tube Hanger Spacing

TUBE O.D (Outer Diameter)	MAXIMUM SPACING BETWEEN HANGERS
1. 6– 14 mm	1.21 m
2. 15– 22 mm	1.52 m
3. 23-28 mm	1.82 m
4. 30-38 mm	2.12 m
5. 40-49 mm	2.42 m
6. 50– 59 mm	3 m
7. 60– 70 mm	3.33 m
8. 71-89 mm	3.64 m
9. 90-108 mm	3.94 m

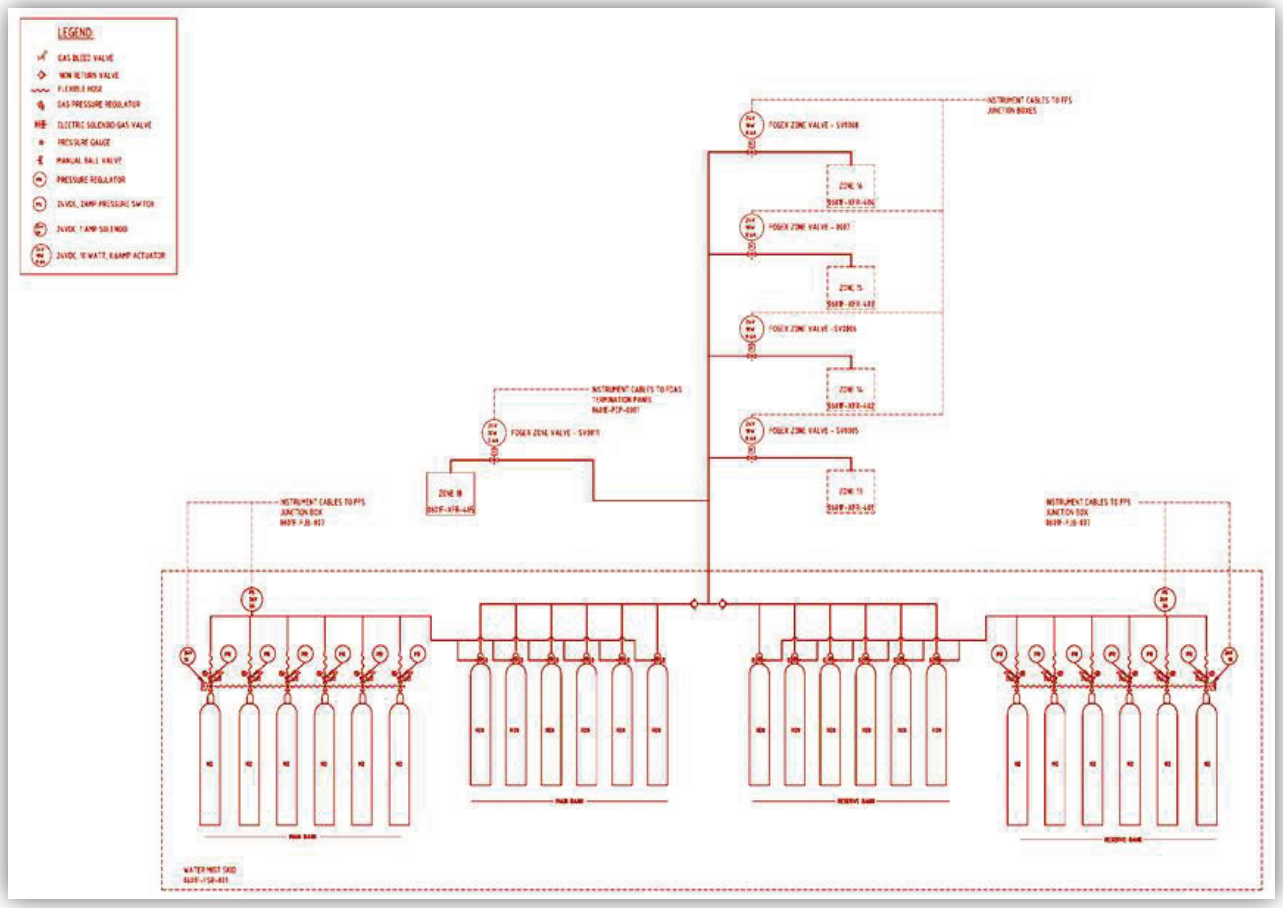




Figure:- D.07-F1 :Typical Water Mist System

4.0. Inspection and maintenance

4.1. Water Mist Systems shall be inspected and maintained as per minimum guidelines in accordance with **Table:- D.07-T3.** However, detailed acceptance, inspection tests and maintenance shall be as per **NFPA 750 and NFPA 25.**

Table:- D.07-T3.: Water Mist System Testing, Inspection and Maintenance

ITEMS	REQUIREMENTS
1. ACCEPTANCE TEST	**1. FLUSHING** i. The underground Piping shall be flushed. ii. The piping between the Breeching inlet and the check valve in the inlet pipe shall be flushed with a sufficient volume of water in order to remove any construction debris and trash accumulated in the piping prior to the completion of the system and prior to the installation of the General Directorate Civil Defence connection. iii. The minimum flow rate shall not be less than the hydraulically calculated water demand flow rate of the system plus hose demands. **2. HYDROSTATIC TEST** i. All new systems, including the yard piping and fire department connections, shall be tested hydrostatically at not less than 13.8 bar (200 psi) of pressure for 2 hours, or at 3.5 bar (50 psi) in excess of the maximum pressure where the maximum pressure is in excess of 10.3 bar (150 psi). Pressure shall be maintained for 2 hours. ii. The inside standpipe system piping shall show no leakage. iii. Any leakage that results in a loss of pressure in excess of 0.1 bar (1½ psi) during a continuous 24-hour period shall be corrected. iv. The installing contractor shall furnish a certificate for flushing and hydrostatic test prior to the start of the fire pump and field acceptance test. v. Hose connections and General Directorate of Civil Defence breeching inlet connections shall be tested for compatibility. (All General Directorate of Civil Defence connections are instantaneous coupling type). vi. The piping between the Breeching inlet and the check valve in the inlet pipe shall be tested hydrostatically in the same manner. vii. During the hydrostatic test, the pressure gauge at the top of each riser shall be observed and the pressure recorded. **3. FIELD ACCEPTANCE TEST** i. Testing shall be conducted while fire pumps are running for water mist systems. ii. The water supply shall be tested to verify compliance with the design. This test shall be conducted by flowing water from the hydraulically most remote hose connections. iii. A flow test shall be conducted at each roof outlet to verify that the required pressure is available at the required flow. iv. The maximum flow to be demonstrated from a single hose connection shall be 946 L/min (250 gpm) for a 65-mm (2½-in.) connection and (379 L/min) 100 gpm for a 40-mm (1½-in.) connection and 50 gpm for a 25 mm connection. v. The filling arrangement for suction tanks shall be verified by shutting down all supplies to the tank, draining the tank to below the designated low water level, and then opening the supply valve to ensure operation of its automatic features. vi. Each pressure-regulating device shall be tested to verify that the installation is correct, that the device is operating properly, and that the inlet and outlet pressures at the device are in accordance with the design. vii. Signs, both in English and Arabic shall be verified on site. viii. The consultant shall hand over one set of stamped record drawings and one copy of the completed test report to the building owner.

Table:- D.07-T3.: Water Mist System Testing, Inspection and Maintenance

ITEM	REQUIREMENTS
2. WEEKLY INSPECTION	**VISUAL OBSERVATION** i. The piping is free of leakage. ii. Pressure gauges are in good condition and reading are satisfactory. iii. The hose cabinet is in good condition and contains equipment, nozzle, hose and hose outlets as per design (Class I, II or III). iv. The landing valve and Hose outlets' caps are in good condition and in place. v. There are no obstructions to the Fire Hose Cabinet. vi. Control valves, Valve handles and supervisory devices are not damaged and in good condition.
3. MAINTENANCE	i. Water Mist system installed shall be inspected and maintained in accordance with instruction provided by the installer or manufacturer operation and maintenance instruction. ii. It is preferable to have a permanent maintenance contract for the system by a specialized contractor licensed by the General Administration of Civil Defense.

5.0. Material Test Standards and Permits.

5.1. Acceptable Test Standards and criteria

5.1.1. All the Valves, Pumps, Piping, Hose, Nozzles, Devices, Sprinklers, Motors, Materials, Systems, Assemblies, equipment, Products and Accessories, referred to in this chapter with respect to Life Safety, Fire Safety and Emergency Services shall be Listed, Permitted and registered by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain.

5.1.2. **There is no year of edition mentioned against any test standards. It is the intent of General Directorate Civil Defence to invite the customers seeking laboratory tests and the test laboratories to follow the "LATEST EDITION OF THE TEST STANDARD, AS AND WHEN THEY ARE UPGRADED/REVISED/AMENDED, TO THE DATE"**

5.1.3. **Fire Pump., Tested successfully at 150% of the rated flow.**

- **i.** UL 448, Standard for Centrifugal Stationary Pumps for Fire-Protection Service.
- **ii.** UL 448B, Standard for residential Fire Pumps intended for one and two family dwellings and manufactured homes.
- **iii.** UL 448C, Standard for Stationary, Rotary type, positive displacement pumps for Fire Protection Service.
- **iv.** FM 1319, Permitted Standard for Centrifugal Fire Pumps (Horizontal, End Suction Type)
- **v.** FM 1370, Permitted Standard for Centrifugal Fire Pumps (Vertical Shaft, Turbine Type, Barrel).
- **vi.** FM 1313, Permitted Standard for Positive Displacement Fire Pumps (Rotary Gear Type)
- **vii.** FM 1312, Permitted Standard for Centrifugal Fire Pumps (Vertical Shaft, Turbine Type).
- **viii.** UL 162A, Fixed water motor coupled pumps for foam concentrate proportioning.
- **ix.** LPS 1131, Requirements and testing methods for pumps for automatic sprinkler installation pump sets.
- **x.** EN 12259-12, Fixed firefighting systems — Components for sprinkler and water spray systems — Part 12: Pumps
- **xi.** LPS 1240, Requirements for LPCB permitted fire sprinkler pump sets used in automatic sprinkler installations

5.1.4. **Fire Pump Motor**

- **i.** UL 1004-5, Standard for Fire Pump Motor.

5.1.5. **Diesel Engine**

- **i.** UL 1247, Standard for Diesel Engines for Driving Stationary Fire Pumps.
- **ii.** FM 1333, Diesel Engine Fire Pump Drivers
- **iii.** LPS 1239, Requirements and testing procedures for the LPCB Permitted and listing of diesel engines for sprinkler pump sets

5.1.6. Fire Pump Controller.

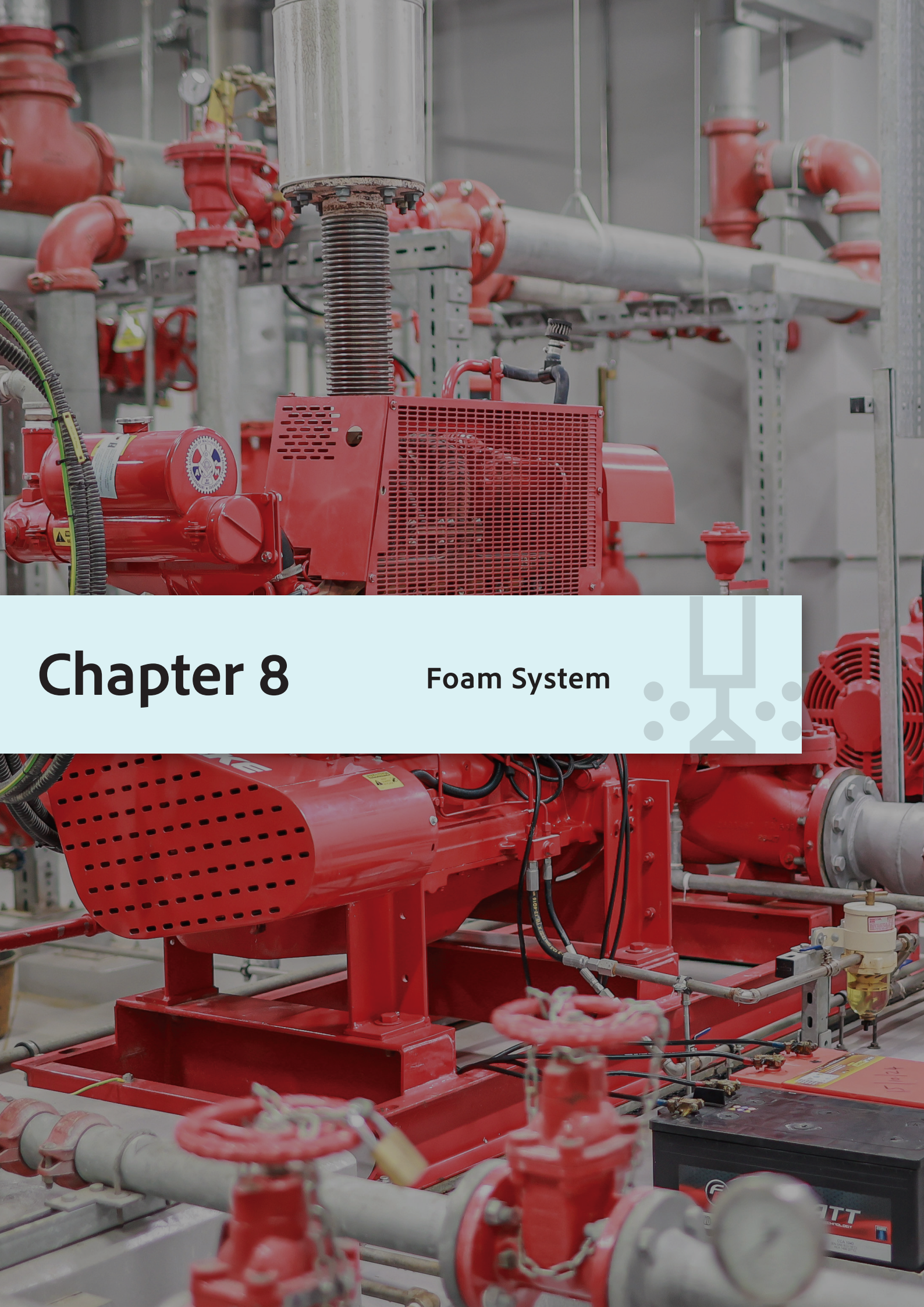
i. UL 218, Standard for Fire Pump Controller.
ii. FM 1321/1323, Standard for Fire Pump Controller for Electric Motor and Diesel Engine Driven Fire Pumps.
iii. LPS 1236, Requirements for control panels for diesel engine driven pumps used in automatic sprinkler installations.
iv. LPS 1237, Requirements for control panels for electric motor driven pumps used in automatic sprinkler installations

5.1.7. Sprinkler

i. UL 199, Standard for Automatic Sprinklers for Fire Protection Service.
ii. UL 199J, Standard for Automatic Window Sprinklers for Fire Protection Service.
iii. UL 1626, Standard for Residential Sprinklers for Fire Protection Service.
iv. UL 1767, Standard for (ESFR) Early-Suppression Fast-Response Sprinklers.
v. UL 1767B, Standard for Specific application (ESFR) Pendent Sprinklers.
vi. FM 2000, Automatic Control Mode Sprinklers for fire protection.
vii. FM 2030, Residential Automatic Sprinklers for fire protection.
viii. FM 2008, Suppression Mode ESFR Automatic Sprinklers
ix. FM 1632, Telescoping Sprinkler Assemblies for Use in Fire Protection Systems for Anechoic Chambers
x. EN 12259-1, Fixed firefighting systems. Components for sprinkler and water spray systems. Sprinklers
xi. EN 12259-14, Fixed firefighting systems. Components for sprinkler and water spray systems. Sprinklers- Part 14. Sprinklers for residential applications
xii. LPS 1038, Requirements & Testing Methods for EPEC Sprinklers
xiii. LPS 1039, Requirements & Testing Methods for Automatic Sprinklers (inc TS1 Automatic Sprinklers commercial and domestic & residential, TS 4 Multiple Jet Controls, TS 8 Electrically Operated Sprinkler Heads, TS 9 Dual Sensing Sprinkler Heads)
xiv. LPS 1258, Requirements & Testing Methods for tight operating tolerance glass sprinkler bulbs
xv. LPS 1267, Requirements & Testing Methods for ESFR Sprinkler Heads
xvi. LPS 2072, Requirements & Testing Methods for K160 ELO Sprinkler Heads
xvii. BS 9252, Components for residential sprinkler systems. Specification and test methods for residential sprinklers.
xvii. UL 2167 Water Mist Nozzles for Fire-Protection Service nozzles for Fire-Protection Service
xix. UL 2351, Water Spray Nozzles

5.1.8. Water Mist Systems

i. FM 5560, Water Mist Systems.
ii. LPS 1283, Requirements and test methods for the permit of water mist systems for use in commercial low hazard occupancies.



Chapter 8

Foam System

Section D

Chapter 8

Foam System



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1.0 Scope

1.1 The purpose of this section is to provide a reasonable degree of protection for life and property from fire through installation requirements for foam-water sprinkler and spray systems based on sound engineering principles, test data, and field experience.

1.2 This section contains minimum requirements for the design, installation, and maintenance of foam-water sprinkler and spray systems.

1.3 These systems shall be designed with the required density for either foam or water application as the controlling factor, depending on the design purpose of the system.

1.4 It is not the intent of this standard to specify where foam-water sprinkler and spray protection is required.

1.5 The determination of where foam-water sprinkler and spray systems are required shall be made in accordance with such applicable building and fire codes or standards such as NFPA 30 or NFPA 409.

2.0 Definitions

2.1. General

2.1.1. Shall

It is a mandatory requirement by General Directorate of Civil Defence – Kingdom of Bahrain.

2.1.2. Should

It is a recommendation but it is not mandatory by General Directorate of Civil Defence - Kingdom of Bahrain.

2.1.3. Listed

Permitted and registered by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain.

2.1.4. Bar (bar)

Unit of measurement for pressure. Though it is not a SI unit, it is a common practice to use this unit of measurement in fire protection.

2.1.5. Unit of Measurement

1 in. = 25.4 mm
1 ft = 0.3048 m
1 ft2 = 0.0929 m2
1 ft3 = 0.02832 m3
1 gpm = 3.7848 L/min
1 psi = 0.0689 bar
1 gpm/ft2 =40.746 (L/min)/m2
1 lb = 0.4536 kg
°F = 9/5 × °C + 32
°C = 5/9(°F − 32)
1 Gal. = 3.785 L (Liters)
1 L = 0.264 Gal.
1 Cubic Meter = 1000 L
1 Cubic Meter = 264.17 Gal.

2.1.6. US Gallons (Gal.)

Unit of measurement for volume. Though it is not a SI unit, it is a common practice to use this unit of measurement for water volume in fire protection.

2.1.7. GPM (Gallons per minute)

Unit of measurement for flow. Though it is not a SI unit, it is widely a practice to use this unit of measurement for water flow per square feet in fire protection.
1 GPM (gpm/minute) = 3.78 Liter/minute (LPM)

2.1.8. Breeching inlet

A connection through which the General Directorate of Civil Defence – Kingdom of Bahrain fire department can pump supplemental water into the sprinkler system, standpipe, or other system, furnishing water for fire extinguishment or to supplement existing water supplies.

2.1.9. Fire Vehicle (Fire Fighting Apparatus)

Fire Vehicle or Fire Fighting Apparatus is designed for fire fighters and is used by General Directorate of Civil Defence Kingdom of Bahrain trained fire fighters to carry water and equipment to fight fires. These Vehicles are equipped with Water, pumps, extinguishing agents, extinguishers, Rescue and smoke venting tools and equipment. Please refer **Section A. Chapter 1.**

2.1.10. Fire Suppression

Sharply reducing the heat release rate of a fire and preventing its regrowth by means of direct and sufficient application of extinguishing agents such as water or gas or chemicals through the fire plume to the burning fuel surface.

2.1.11. Water based Fire Protection Systems

Water is the most widely used and available fire-extinguishing agent. Water is effective in fire suppression. The techniques and mechanisms using water and its heat absorbing, cooling and fire extinguishing properties to fight and extinguish fires are Water Based Fire Protection Systems such as Standpipe System, Automatic Sprinkler Systems, Water Spray Systems, Water Mist Systems, Fire Hydrant Systems, and Foam Systems etc.

2.1.12. High-Challenge Fire Hazard

A fire hazard typical of that produced by fires in combustible high-piled storage.

2.1.13. Foam

Foam is a stable aggregation of small gas filled bubbles of lower density than oil or water, formed from aqueous solutions of specially formulated concentrated liquid foaming agents that exhibits a tenacity for covering horizontal surfaces, producing an air excluding, cooling continuous layer of vapour-sealing, water-bearing material that prevents combustion.

2.1.14. Foam Concentrate

Foam concentrate is a concentrated liquid foaming agent as received from the manufacturer.

2.1.15. Foam Solution

A homogeneous mixture of water and foam concentrate in the proper proportions. For the purpose of this document, “foam solution” and “solution” are used inter-changeably.

2.1.16. Foam Proportioning

Proportioning is the continuous introduction of foam concentrate at the recommended ratio into the water stream to form foam solution.

2.1.17. Foam-Water Sprinkler System

A special system that is pipe-connected to a source of foam concentrate and to a water supply. The system is equipped with appropriate discharge devices for extinguishing agent discharge and for distribution over the area to be protected. The piping system is connected to the water supply through a control valve that usually is actuated by the operation of automatic detection equipment that is installed in the same areas as the sprinklers. When this valve opens, water flows into the piping system, foam concentrate is injected into the water, and the resulting foam solution discharging through the discharge devices generates and distributes foam. Upon exhaustion of the foam concentrate supply, water discharge follows and continues until shut off manually. Systems can be used for discharge of water first, followed by a discharge of foam for a specified period, and then followed by water until they manually shut off. Existing deluge sprinkler systems that have been converted to the use of aqueous film-forming foam or film-forming fluoroprotein foam are classified as foam-water sprinkler systems.

2.1.18. Foam-Water Deluge System

A foam-water sprinkler system employing open discharge devices, which are attached to a piping system that is connected to a water supply through a valve that is opened by the operation of a detection system, which is installed in the same areas as the discharge devices. When this valve opens, water flows into the piping system and discharges from all discharge devices attached thereto.

2.1.19. Foam Discharge Duration

Systems shall deliver foam to the hazards they protect for a specified period at given densities, either prior to water discharge or following water discharge, depending upon system design purpose.

2.1.20. Aqueous Film Forming Foam (AFFF) Concentrate

This concentrate is based on fluorinated surfactants plus foam stabilizers and usually diluted with water to a 1 percent, 3 percent, or 6 percent solution. The foam formed acts as a barrier both to exclude air or oxygen and to develop an aqueous film on the fuel surface capable of suppressing the evolution of fuel vapors. The foam produced with AFFF concentrate is dry chemical compatible and thus is suitable for combined use with dry chemicals.

2.1.21. Film Forming Flouroprotein Foam (FFFP) Concentrate

This concentrate uses fluorinated surfactants to produce a fluid aqueous film for suppressing hydrocarbon fuel vapors. This type of foam utilizes a protein base plus stabilizing additives and inhibitors to protect against freezing, corrosion, and bacterial decomposition, and it also resists fuel pickup. The foam is usually diluted with water to a 3 percent or 6 percent solution and is dry chemical compatible.

2.1.22. Alcohol Resistant Foam Concentrate

This concentrate is used for fighting fires on water-soluble materials and other fuels destructive to regular, AFFF, or FFFP foams, as well as for fires involving hydrocarbons. There are three general types. One is based on water-soluble natural polymers, such as protein or fluoroprotein concentrates, and also contains alcohol-insoluble materials that precipitate as an insoluble barrier in the bubble structure. The second type is based on synthetic concentrates and contains a gelling agent that surrounds the foam bubbles and forms a protective raft on the surface of water-soluble fuels; these foams can also have film-forming characteristics on hydrocarbon fuels. The third type is based on both water-soluble natural polymers, such as fluoroprotein, and contains a gelling agent that protects the foam from

water soluble fuels. This foam can also have film-forming and fluoroprotein characteristics on hydrocarbon fuels. Alcohol-resistant foam concentrates are generally used in concentrations of 3 percent to 10 percent solutions, depending on the nature of the hazard to be protected and the type of concentrate.

2.1.23. Medium and High Expansion Foam Concentrate
This concentrate, which is usually derived from hydrocarbon surfactants, is used in specially designed equipment to produce foams having foam-to-solution volume ratios of 20:1 to approximately 1000:1. This equipment can be air-aspirating or blower-fan type.

2.1.24. Air Aspirating Discharging Devices
Devices specially designed to aspirate and mix air into the foam solution to generate foam, followed by foam discharge in a specific design pattern.

2.1.25. Non-Air Aspirating Discharging Devices
Devices designed to provide a specific water discharge pattern.

2.1.26. Fixed Foam Discharge Outlet.
A device permanently attached to a tank, dike, or other containment structure, designed to introduce foam.

2.1.27. Type I Discharge Outlet.
An permitted discharge outlet that conducts and delivers foam gently onto the liquid surface without submergence of the foam or agitation of the surface.

2.1.28. Type II Discharge Outlet.
An permitted discharge outlet that does not deliver foam gently onto the liquid surface but is designed to lessen submergence of the foam and agitation of the surface.

2.1.29. Expansion
The ratio of the final foam volume to the original foam solution volume.

2.1.30. Semi subsurface Foam Injection
Discharge of foam at the liquid surface within a storage tank from a floating hose that rises from a piped container near the tank bottom.

2.1.31. Subsurface Foam Injection
Discharge of foam into a storage tank from an outlet near the tank bottom.

2.1.32. Fixed System
A complete installation in which foam is piped from a central foam station, discharging through fixed delivery outlets to the hazard to be protected with permanently installed pumps where required.

2.1.33. Mobile System
Any type of foam-producing unit that is mounted on wheels and that is self-propelled or towed by a vehicle and can be connected to a water supply or can utilize a premixed foam solution.

2.1.34. Fixed Monitor (Cannon)
A device that delivers a large foam stream and is mounted on a stationary support that either is elevated or is at grade.

2.1.35. Portable Monitor (Cannon)

A device that delivers a foam monitor stream and is mounted on a movable support or wheels so it can be transported to the fire scene.

2.1.36. Balanced Pressure Bladder Tank

A foam concentrate tank fitted with an internal bladder which uses water flow through a modified venturi type proportioner to control the foam concentrate injection rate by displacing the foam concentrate within the bladder with water outside the bladder.

2.1.37. Flash Point (FP).

The minimum temperature of a liquid at which sufficient vapor is given off to form an ignitable mixture with the air, near the surface of the liquid or within the vessel used

2.1.38. Fire Point.

The lowest temperature at which a liquid will ignite and achieve sustained burning when exposed to a test flame

2.1.39. Boiling Point (BP).

The temperature at which the vapor pressure of a liquid equals the surrounding atmospheric pressure.

3.0 Classification of Liquids

3.1. Class I Liquids.

A liquid with a closed-cup flash point below 100°F (37.8°C) shall be designated as a Class I liquid (i.e., flammable liquid) a Reid vapor pressure that does not exceed an absolute pressure of 40 psi (276 kPa) at 100°F (37.8°C)

Class I liquids shall be further subclassified in accordance with the following

3.1.1. Class IA Liquid.

A liquid that has a flash point below 73°F (22.8°C) and a boiling point below 100°F (37.8°C).

3.1.2. Class IB Liquid.

A liquid that has a flash point below 73°F(22.8°C) and a boiling point at or above 100°F (37.8°C).

3.1.3. Class IC Liquid.

A liquid that has a flash point at or above 73°F (22.8°C), but below 100°F (37.8°C).

3.2. Class II Liquids.

A liquid with a closed-cup flash point at or above 100°F (37.8°C) but below 140°F (60°C) shall be designated as a Class II liquid (i.e., combustible liquid).

3.3. Class III Liquids

A liquid with a closed-cup flash point at or above 140°F (60°C) shall be designated as a Class III liquid (i.e., combustible liquid).
Class III liquids shall be further subclassified in accordance with the following:

3.3.1. Class IIIA Liquid.

A liquid that has a flash point at or above 140°F (60°C), but below 200°F (93°C).

3.3.2 Class IIIB Liquid.

A liquid that has a flash point at or above 200°F (93°C).

4.0 Foam Sprinkler/Deluge/Discharge Systems

The requirements for Foam Sprinkler/ Deluge/ Discharge System material, design, installation shall be as per **Table:- D.08-T1.,** Applicable Sprinkler requirements and the General Requirements shall be as per **Section D ,Chapter-05 & Chapter-11.**

Table:- D.08-T1: Foam Sprinkler/ Deluge System Requirements

ITEMS	REQUIREMENTS
1. DEFINITION	i. Foam is produced by mixing a foam concentrate with water at the appropriate concentration, and then aerating and agitating the solution to form the bubble structure. Some foams are thick and viscous and form tough and, heat-resistant blankets over burning liquid surfaces and vertical areas. Other foams are thinner and spread more rapidly. Some foams are capable of producing a vapor sealing film of surface active water solution on a liquid surface. Some, such as medium- or high-expansion foam, are meant to be used as large volumes of wet gas cells for inundating surfaces and filling cavities. ii. The process of producing and applying fire-fighting air-foams to hazards requires three separate operations, each of which consumes energy. a. The proportioning process b. The foam generation phase c. The distribution method. iii. Foam agent can be discharged through various arrangement of Systems such as Foam-water Sprinkler Systems, Foam-water Deluge Spray Systems, Foam monitor Systems etc. See **Sub Section 2.0** for definitions.
2. COMPONENTS	i. Fire Pumps, Controller, Foam concentrate pumps, Fire Water Tank, Foam concentrate Bladder Tank, Foam proportioning System, Pipes, Fittings, Sprinklers/ Spray Nozzles, Isolation valves, Deluge Valve, Pressure gauge, Flow Switch, Test connection, Drains, Breeching inlet and Signs. ii. All the components of Foam Systems including the used water shall be compatible with the foam concentrate and foam solution and listed and permitted by General Directorate of Civil Defence – Kingdom of Bahrain. iii. All foam solutions and type of systems applied to hazard shall be as per the manufacturer's specifications and Material Safety Data Sheet. iv. The System components shall be rated for the maximum working pressure to which they are exposed, but not less than 12.1 bar (175 psi).
3. FIRE PUMPS	i. The fire Pump set shall consist of 1 Electric driven pump, 1 diesel driven pump and 1 electric Jockey pump, complete with controllers. ii. The pump capacity shall be as per **Section D,Chapter-11– Application of Fire Protection System**
4. FOAM CONCENTRATE	i. Foam concentrates shall be from single manufacturer and single composition. Foam concentrates from different manufacturers, or different brands of the same manufacturer shall not be mixed. ii. Storage tanks material, methods, storage temperature and other specifications shall be as per the manufacturer's instructions. iii. Water-soluble and certain flammable and combustible liquids and polar solvents that are destructive to nonalcohol-resistant foams shall require the use of alcohol-resistant foams.
5. FOAM SYSTEM LOCATION	i. Foam equipment, proportioner, pumps, control valves shall be as close to hazard they are protecting as possible, without compromising the safety of the equipment and of the personnel operating such systems.
6. FOAM STRAINERS	i. General Directorate of Civil Defence –Kingdom of Bahrain listed strainers, having perforations not larger than the smallest spray orifice and not less than 3.2 mm shall be installed , so as to be accessible for cleaning and flushing while maintaining the system discharge during activation.

Table:- D.08-T1: Foam Sprinkler/ Deluge System Requirements	
ITEMS	**REQUIREMENTS**
7. TEST CONNECTIONS	i. System test connections shall be sized to accommodate both the low flow of the proportioner and the maximum anticipated flow through the proportioner.
8. LOW EXPANSION FOAM ALSO SEE Table:- D.08-T1 DESIGN CRITERIA	i. Design criteria for above the surface application with fixed foam discharge outlet for Fixed-Roof Storage tanks containing Hydrocarbons shall comply with **Table:- D.08-T1.A** and **Table:- D.08-T1.F.**
9. FOAM WATER SPRINKLER	i. Design densities, design area and duration of foam water sprinkler and foam water spray applications for indoor storage of water miscible liquids with concentration > 50% and Immiscible Liquids in metal container, shall be as per **Table:- D.08-T1.B.** ii. If liquid concentration ≤ 50 % and > 20 % .Shall be Protect using design criteria for a Class III commodity as described in NFPA 13. iii. For in-rack sprinkler layout and schemes in **Table:- D.08-T1.B** refer to **Table:- D.08-T1.AC.** iv. Design criteria for Foam water sprinkler system for processes and activities handling flammable and combustible liquids shall comply with **Table:- D.08-T1.C.**
10. FOAM HANDLINE AND MONITOR PROTECTION	i. Design criteria for Foam Handline and Monitor protection for Fixed-Roof Storage tanks containing Hydrocarbons shall comply with **Table:- D.08-T1.F.** ii. Foam Monitor nozzles shall not be considered as the primary means of protection for fixed-roof tanks over 18 m (60 ft.) in diameter. iii. Foam handlines shall not be permitted to be used as the primary means of protection for fixed-roof tanks over 9 m (30 ft.) in diameter or those over 6 m (20 ft.) in height. iv. The design Criteria of Foam Monitor System for Loading Racks (Truck or Rail cars at loading and unloading) shall comply with **Table:- D.08-T1.H.**

Table:- D.08-T1.A.: Discharge Time and Application Rate for Type II Fixed Foam Discharge Outlet of Outdoor Aboveground Storage Tank Containing Hydrocarbon

HAZARD	REQUIRED DESIGN DENSITY	DESIGN AREA m^2	ADDITIONAL FOAM FOR HYDRAULIC IMBALANCE	FOAM CAPACITY DURATION
1. Fixed roof storage tank containing hydrocarbon with flash point below 38°C or liquids heated above their flash point.	4.1 lpm/m2 (0.10 gpm/ft2)	Entire tank surface	10%	55 minutes
2. Fixed roof storage tank containing hydrocarbon with flash point between 38°C and 60°C (100°F and 140°F).	4.1 lpm/m2 (0.10 gpm/ft2)	Entire tank surface	10%	30 minutes
3. Fixed roof storage tank containing crude petroleum.	4.1 lpm/m2 (0.10 gpm/ft2)	Entire tank surface	10%	55 minutes
4. Floating roof storage tank containing hydrocarbon.	Follow NFPA 11	Follow NFPA 11	Follow NFPA 11	Follow NFPA 11

Table:- D.08-T1.B.: Design Criteria for Foam-Water Sprinkler Protection of Single- or Double-Row Rack Storage of Ignitable (Flammable or Combustible) Liquids in Metal Containers, Portable Tanks, and IBCs

Container Style and Capacity (gal)	Liquid class	Storage Height (m)	Ceiling Height (m)	Design criteria for sprinkler				Notes	Pump capacity	
				Ceiling sprinkler	Density (lpm/m^2)	Area (m^2)	In-rack Layout		Without hydrant	With hydrant
NONRELIEVING-STYLE CONTAINERS										
[FP < 200°F (93°C) AND BP ≥ 100°F (37.8°C)]										
≤ 5	IB IC II IIIA	7.6	9.1	K≥8.0 SR or QR(HT)	12.2	180	L-3	1,2, 3,4	1250	1500
>5 and ≤60	IB IC II IIIA	7.6	9.1	K≥8.0 SR(HT)	12.2	270	L-3	1,3, 4,5	1500	2000
[FP ≥ 200°F (93°C)]										
≤60	IIIB	12.2	15.2	K≥8.0 SR(HT)	12.2	180	L-4	1,5	1250	1500
RELIEVING-STYLE CONTAINERS										
[FP < 200°F (93°C) AND BP ≥ 100°F (37.8°C)]										
≤ 5	IB IC II IIIA	7.6	9.1	K≥8.0 SR or QR(HT)	12.2	180	L-4	1,2, 3,4	1250	1500
>5 and ≤60, portable tanks and IBCs	IB IC II IIIA	7.6	9.1	K≥8.0 SR(HT)	12.2	270	L-4	1,3, 4,5	1500	2000
[FP ≥ 200°F (93°C)]										
≤60	IIIB	12.2	15.2	K≥8.0 SR(HT)	12.2	180	L-4	1,5	1250	1500

Note:

1. The in-rack sprinkler design shall be based on the 6 most remote sprinklers for one level of in-rack sprinklers or 12 most remote sprinklers for top 2 levels if two levels of in-rack sprinklers. or 18 most remote sprinklers for top 3 levels if three or more level of in-rack sprinklers.
2. Design area can be reduced to 1500 ft^2 (135 m^2) when using a preprimed foam-water system installed in accordance with NFPA 16 and maintained according to NFPA 25.
3. Design area can be reduced to 2000 ft^2 (180 m^2)when using a preprimed foam-water system installed in accordance with NFPA 16 and maintained according to NFPA 25.
4. In-rack sprinkler hydraulic design can be reduced to three sprinklers operating per level, with three levels operating simultaneously, when using a preprimed foam-water sprinkler system designed in accordance with NFPA 16 and maintained in accordance with NFPA 25.
5. The minimum in-rack sprinkler discharge pressure shall not be less than a gauge pressure of 10 psi (0.7 bar).
6. The in-rack sprinkler shall be K 5.6 quick response (or) Standard response (ordinary temperature type.)
7. The demand per in-rack sprinkler shall be 30 gpm.
8. For in-rack sprinkler layouts Refer **Sub section 4.1**

Illustrative Images of Rack arrangement



Illustrative Images of Palletized Stacked arrangement



Table:- D.08-T1.C.: Design Criteria for Foam-Water Sprinkler Protection of Palletized and Stacked Storage of Ignitable (Flammable or Combustible) Liquids in Metal Containers, Portable Tanks, and IBCs

Container Style and Capacity (gal)	Liquid class	Storage Height (m)	Ceiling Height (m)	Design criteria for sprinkler				Pump capacity	
				Ceiling sprinkler	Density (lpm/m$^{2)}$	Area (m^2)	Notes	Without hydrant	With hydrant
NONRELIEVING-STYLE CONTAINERS									
[FP < 200°F (93°C) AND BP ≥ 100°F (37.8°C)]									
≤ 5 Cartoned	IB IC II IIIA	3.4	9.1	K≥11.2 SR or QR(HT)	16.3	270	1	1250	1500
≤ 5 Un Cartoned	IB IC II IIIA	3.7	9.1	K≥8.0 SR or QR(HT)	12.2	270	1	1000	1250
>5 and ≤60	IB IC II IIIA	1.5 (1 high)	9.1	K≥8.0 SR(HT)	12.2	270	1	1000	1250
RELIEVING-STYLE CONTAINERS									
[FP < 200°F (93°C) AND BP ≥ 100°F (37.8°C)]									
>5 and ≤60	IB IC II IIIA	2.0 (2 high)	9.1	K≥8.0 SR(HT)	12.2	270	2,3	1000	1250
		3.0 (3 high)	10	K≥11.2 SR(HT)	18.3	270	2,3	1500	2000
		4.2 (4 high)	10	K≥11.2 SR(HT)	24.5	270	2,3	2000	2000
Portable tanks and IBCs	IB IC II IIIA	1 or 2 high	9.1	K≥8.0 SR(HT)	12.2	270	-	1000	1250

Note:

1. Design area can be reduced to 2000 ft^2 when using a pre primed foam-water system installed in accordance with NFPA 16 and maintained according to NFPA 25.
2. Both 3⁄4 in. (20 mm) and 2 in. (50 mm) listed pressure-relieving mechanisms are required on containers greater than 6 gal (23 L) capacity.
3. Drums placed on open slatted pallet, not nested, to allow pressure relief from drums on lower levels.

Illustrative Images of Flammable or Combustible Liquids stored in Metal Containers, Portable Tanks, and Intermediate Bulk Containers (IBC)


PORTABLE TANKS FOR ILLUSTRATION




INTERMEDIATE BULK CONTAINERS FOR ILLUSTRATION




BULK STORAGE TANKS FOR ILLUSTRATION

4.1. In-Rack Sprinkler Design Layouts 1 to 4.

For the purposes of this sub section the following shall apply to the in-rack sprinkler design layouts specified in **Table:- D.08-T1.B & Table:- D.08-T1.L.**

4.1.1. Layout 1

As referenced in **Table:- D.08-T1.B & Table:- D.08-T1.L,** shall mean one line of in-rack sprinklers 8 ft (2.4 m) above the floor in the longitudinal flue space, with sprinklers spaced not more than 10 ft (3 m) on center.

4.1.2. Layout 2

As referenced in **Table:- D.08-T1.B & Table:- D.08-T1.L,** shall mean one line of in-rack sprinklers 6 ft (1.8 m) above the floor and one line of in-rack sprinklers 12 ft (3.6 m) above the floor in the longitudinal flue space, with sprinklers spaced not more than 10 ft (3 m) on center. Sprinklers shall be staggered vertically.

4.1.3. Layout 3

As referenced in **Table:- D.08-T1.B & Table:- D.08-T1.L,** shall mean one line of in-rack sprinklers in the longitudinal flue space at every storage level above the floor except above the top tier, with sprinklers spaced not more than 10 ft (3 m) on center. Sprinklers shall be staggered vertically, where more than one level of in-rack sprinklers is installed.

4.1.4. Layout 4

As referenced in **Table:- D.08-T1.B & Table:- D.08-T1.L,** shall mean one line of in-rack sprinklers in the longitudinal flue space at every other storage level except above the top tier, beginning above the first storage level, with sprinklers spaced not more than 10 ft (3 m) on center. Sprinklers shall be staggered vertically, where more than one level of in-rack sprinklers is installed.

4.1.5. Layout 5

As referenced in **Table:- D.08-T1.B & Table:- D.08-T1.L,** shall mean one line of in-rack sprinklers in the longitudinal flue space at every storage level above the floor except above the top tier and face sprinklers at the first storage level at each rack upright. In-rack sprinklers shall be spaced not more than 9 ft (2.7 m) on center and shall be staggered vertically, where more than one level of in-rack sprinklers is installed.

4.1.6. Layout 6

As referenced in **Table:- D.08-T1.B & Table:- D.08-T1.L,** shall mean one line of in-rack sprinklers in the longitudinal flue space at every other storage level above the first storage level except the top tier and face sprinklers at the first storage level at each rack upright. In-rack sprinklers shall be spaced not more than 10 ft (3 m) on center and shall be staggered vertically, where more than one level of in-rack sprinklers is installed.

Table:- D.08-T1.E.: Design Criteria for Foam Water Sprinkler for processes and activities handling flammable and combustible Liquids					
HAZARD	**REQUIRED DESIGN DENSITY**	**DESIGN AREA m^2**	**FOAM CONCEN-TRATE DURATION**	**PUMP CAPACITY WITHOUT HYDRANT gpm**	**PUMP CAPACITY WITH HYDRANT gpm**
1. LOADING AND UNLOADING AREA	6.5 lpm/m^2 (0.16 gpm/ft^2)	465 m^2	15 Minutes	1000	1250
2. INDOOR STORAGE OF LIQUIDS IN ATMOSPHERIC STORAGE TANKS	12.2 lpm/m^2 (0.30 gpm/ft^2)	465 m^2	15 Minutes	1500	2000
3. SPRAY APPLICATION USING FLAMMABLE COMBUSTIBLE LIQUIDS	6.5 lpm/m^2 (0.16 gpm/ft^2)	465 m^2	15 Minutes	1000	1250
4. POWDER COATING APPLICATION	6.5 lpm/m^2 (0.16 gpm/ft^2)	465 m^2	15 Minutes	1000	1250
5. AIRCRAFT HANGER	REFER TO NFPA 409				

	Table:- D.08-T1: Foam Sprinkler/ Deluge System Requirements
ITEMS	**REQUIREMENTS**
11. DRAINAGE	i. Facilities shall be provided for the safe removal or retention of the largest anticipated flammable liquid spill plus the free water reaching the floor from the fixed fire protection system, as well as the discharge from hose streams.
12. PRECAUTION	i. Application of foam through solid streams that plunge into the flammable liquid could result as the source of ignition of the ensuing fire. The ignitions could be because of static discharges resulting from splashing and turbulence. Therefore, any application of foam to an unignited flammable liquid should be as gentle as possible. Correct application methods include a spray pattern or banking the foam stream off a backboard so that the foam flows gently onto the liquid surface. ii. Foam solutions are conductive and therefore not recommended for use on electrical fires. If foam is used, a spray is less conductive than a straight stream. However, because foam is cohesive and contains materials that allow water to conduct electricity, foam spray is more conductive than water spray.
13. FOAM WATER SPRINKLER, PRE-ACTION, DRY PIPE SYSTEM	i. The system piping shall be hydraulically designed to obtain reasonably uniform foam and water distribution and to allow for loss of head in system piping. ii. Sprinkler spacing shall not exceed 9.3 m^2 per sprinkler. iii. The spacing between the branch line shall not exceed 3.7 m^2. iv. The temperature rating of the sprinklers shall be within the range of 121°C to 149°C (250°F to 300°F) where they are located at the roof or ceiling. v. Where sprinklers are located at an intermediate level, the temperature rating shall be within the range of 57°C to 77°C (135°F to 170°F), unless ambient conditions require a higher rating. vi. A minimum of 3% foam-water solution shall be discharged. vii. The foam sprinkler system shall also comply with **Section D. Chapter 10. Wet Sprinkler System.** viii. The foam pre-action sprinkler System shall also comply with **Section D. Chapter 05. Pre-action sprinkler system.** ix. The foam dry sprinkler system shall also comply with **Section D. Chapter 10. Dry Sprinkler System.** x. The foam system shall have a provision for manual operation.

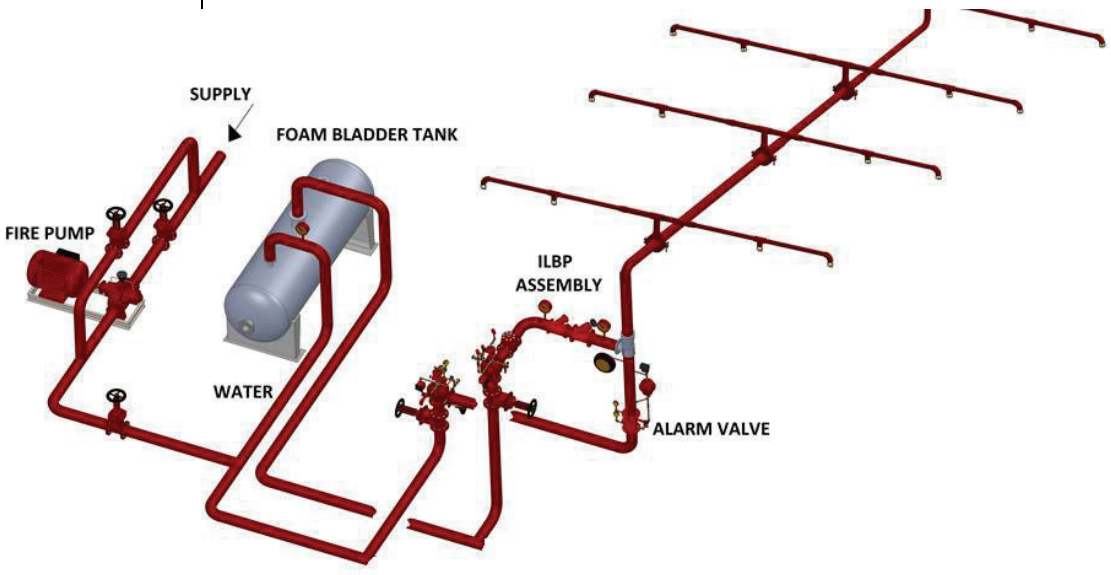


Figure :- D.08.F1.: Typical Foam Water Sprinkler System for Diesel Generator Room

Table:- D.08-T1: Foam Sprinkler/ Deluge System Requirements	
ITEMS	**REQUIR MENTS**
14. FOAM WATER DELUGE SYSTEM	i. The foam Water Deluge System shall comply with **Section D, Chapter-06 Deluge Water Spray System.** ii. The system piping shall be hydraulically designed to obtain a reasonably uniform foam and water distribution and to allow for the loss of head in water supply piping. iii. an automatic Fire detection in compliance with **Chapter 8. Fire Detection and Alarm System** shall be used for fixed systems except for certain outdoor situations where manually triggered systems can be acceptable based on hazard evaluation. iv. A minimum of 3% foam-water solution shall be discharged. v. A piping carrying foam solution shall be sized as if carrying plain water. vi. The foam Water Deluge System shall have provision for manual operation.

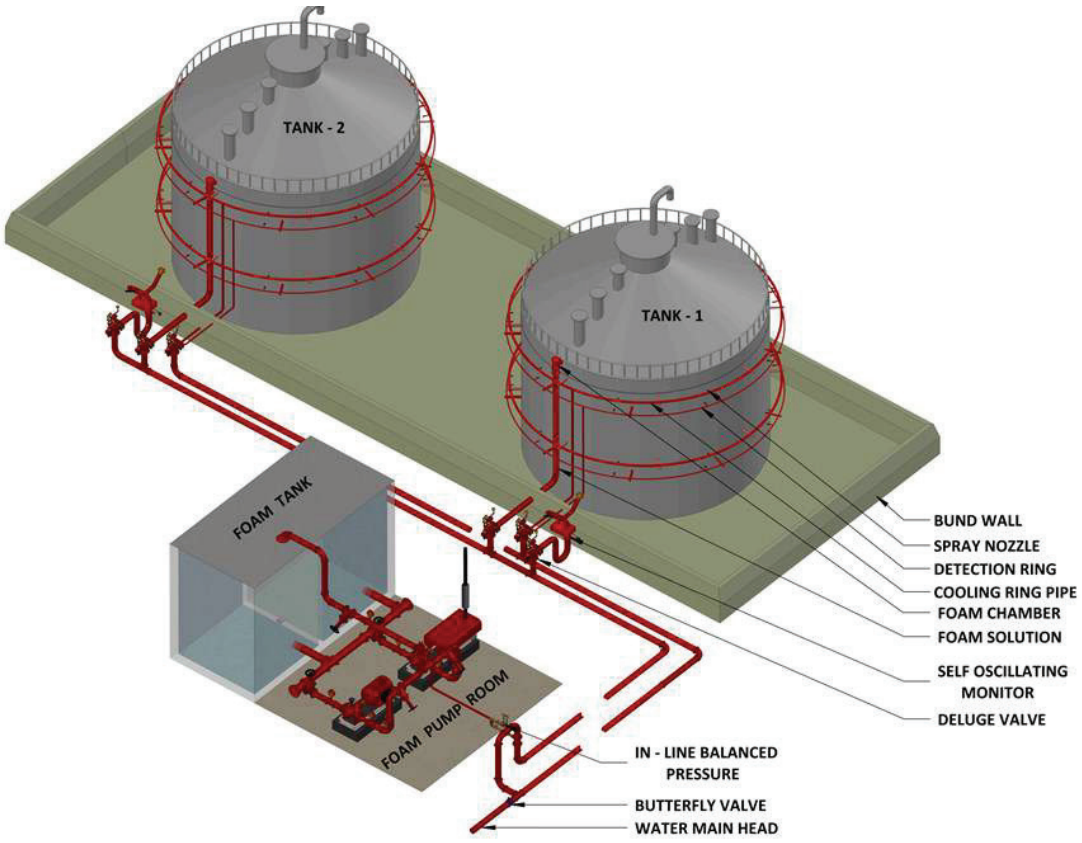


Figure :- D.08-F2 .: Typical Foam Water Deluge System for Flammable Liquid Storage

Table:- D.08-T1: Foam Sprinkler/ Deluge System Requirements	
ITEMS	REQUIREMENTS
15. DESIGN CRITERIA FOR LOW – EXPANSION FOAM SYSTEM	i. Design Criteria for above the surface application with fixed foam discharge outlet for Fixed-Roof Storage tanks containing Hydrocarbons shall comply with **Table:- D.08-T1.A** and **Table:- D.08-T1.F.** ii. Low-expansion foam shall be provided to protect outdoor storage tanks, interior flammable liquid hazards, loading racks, diked areas and non-diked spill areas. iii. Foam Monitor nozzles shall not be considered as the primary means of protection for fixed-roof tanks over 18 m (60 ft.) in diameter. iv. Foam handlines shall not be permitted to be used as the primary means of protection for fixed-roof tanks over 9 m (30 ft.) in diameter or those over 6 m (20 ft.) in height. v. Fixed foam outlets shall not be used to protect horizontal or pressure tanks. vi. For the protection of a flammable liquid contained in a vertical fixed-roof (cone) atmospheric storage tank, discharge outlets shall be attached to the tank. vii. Where two or more discharge outlets are required, the outlets shall be spaced equally around the periphery of the tank, individually piped and separately valved for isolation outside the dike area. viii. Fixed foam discharge outlets shall be attached at the top of the shell and shall be located or connected to preclude the possibility of the tank contents overflowing into the foam lines. ix. Fixed foam discharge outlets shall be provided with a seal, frangible under low pressure, to prevent entrance of vapors into foam outlets and pipelines. x. Fixed foam discharge outlets shall be provided with inspection means to allow maintenance and for inspection and replacement of vapor seals.

Table:- D.08-T1.E.: Foam Handline and Monitor Protection for Fixed-Roof Storage Tanks Containing Hydrocarbons Tanks

HAZARD	REQUIRED DESIGN DENSITY (MINIMUM APPLICATION RATE)	FOAM ADDITION FOR HYDRAULIC IMBALANCE	DURATION
1. Flash point between 100 °F and 140 °F (38 °C and 60°C)	6.5 lpm/m² (0.16 gpm/ ft²)	10%	50 Minutes
2. Flash point below 100 °F (38 °C) or liquids heated above their flash points	6.5 lpm/m² (0.16 gpm/ ft²)	10%	65 Minutes
3. Crude petroleum	6.5 lpm/m² (0.16 gpm/ ft²)	10%	65 Minutes

Table:- D.08-T1.F Number of Fixed Foam Discharge Outlets for Fixed-Roof Tanks Containing Hydrocarbons or Flammable and Combustible Liquids Requiring Alcohol-Resistant Foams

TANK DIAMETER OR EQUIVALENT AREA	Minimum number of discharge outlet
1. Up to 24 m	1
2. Over 24 m - 37 m	2
3. Over 37 m - 43 m	3
4. Over 43 m - 49 m	4
5. Over 49 m - 55 m	5
6. Over 55 m - 61 m	6
7. Over 61 m	6, Plus 1 outlet for each additional 465 m² area

	Table:- D.08-T1: Foam Sprinkler/ Deluge System Requirements
ITEMS	**REQUIREMENTS**
DESIGN CRITERIA FOR LOW – EXPANSION FOAM SYSTEM	xi. Design Criteria of Subsurface application of Foam protection for Fixed-Roof Storage tanks containing Hydrocarbons shall comply with **Table:- D.08-T1.G.** xii. Subsurface injection systems shall not be used for protection of Class IA hydrocarbon liquids or for the protection of alcohols, esters, ketones, aldehydes, anhydrides, or other products requiring the use of alcohol-resistant foams. xiii. Foam concentrates and equipment for subsurface injection shall be listed. xiv. Fluoroprotein foam, AFFF, and FFFP for subsurface injection shall have expansion ratios between 2:1 and 4:1. xv. The foam velocity at the point of discharge into the tank contents shall not exceed 3 m/sec (10 ft./sec) for Class IB liquids or 6 m/sec (20 ft./sec) for other classes of liquids unless actual tests prove that higher velocities are satisfactory. xvi. Where two or more outlets are required, they shall be located so that the foam travel on the surface cannot exceed 30 m (100 ft.). xvii. The number of subsurface foam discharge outlets for fixed-roof storage tanks containing Hydrocarbons shall comply with **Table:- D.08-T1.G.** xviii. A highly viscous liquid heated above 93°C lower initial application rated may be required to prevent frothover. Good judgment should be used in applying foam in tank containing hot oil, burning asphalt or burning liquid heated over 100°C. xix. If due to type and quantity of discharge outlet the discharge rate is highly proportionate, the reduction in the discharge period is permitted but shall be not less than 70%. xx. The foam discharge outlet shall be elevated at least 0.3m above the highest water level at the bottom. xxi. The size and length of the pipe upstream of the foam maker shall be designed to limit the back pressure within the design condition of the equipment.

Table:- D.08-T1.G.: Subsurface Foam Discharge Density, Number of Outlets for Fixed Roof Hydrocarbon Tanks

TANK DIAMTER	CLASS II LIQUID	CLASS I AND LIQUID HEATED ABOVE THEIR FLASH POINTS	CRUDE PETROLEUM
1. Up to 24 m	4.1 lpm/m^2 (0.10 gpm/ft^2) 1 Outlet 30 minutes	4.1 lpm/m2 (0.10 gpm/ ft2) 1 Outlet 55 minutes	4.1 lpm/m2 (0.10 gpm/ ft2) 1 Outlet 55 minutes
2. Over 24 m—37 m	4.1 lpm/m^2 (0.10 gpm / ft^2)1 Outlet 30 minutes	4.1 lpm/m2 (0.10 gpm/ ft2) 2 Outlet 55 minutes	4.1 lpm/m2 (0.10 gpm/ ft2) 2 Outlet 55 minutes
3. Over 37 m—43 m	4.1 lpm/m^2 (0.10 gpm/ ft2) 2 Outlet 30 minutes	4.1 lpm/m2 (0.10 gpm/ ft2) 3 Outlet 55 minutes	4.1 lpm/m2 (0.10 gpm/ ft2) 3 Outlet 55 minutes
4. Over 43 m—49 m	4.1 lpm/m^2 (0.10 gpm/ ft2) 2 Outlet 30 minutes	4.1 lpm/m2 (0.10 gpm/ ft2) 4 Outlet 55 minutes	4.1 lpm/m2 (0.10 gpm/ ft2) 4 Outlet 55 minutes
5. Over 49 m—55 m	4.1 lpm/m^2 (0.10 gpm/ ft2) 2 Outlet 30 minutes	4.1 lpm/m2 (0.10 gpm/ ft2) 5 Outlet 55 minutes	4.1 lpm/m2 (0.10 gpm/ ft2) 5 Outlet 55 minutes
6. Over 55 m—61 m	4.1 lpm/m^2 (0.10 gpm/ ft2) 3 Outlet 30 minutes	4.1 lpm/m2 (0.10 gpm/ ft2) 6 Outlet 55 minutes	4.1 lpm/m2 (0.10 gpm/ ft2) 6 Outlet 55 minutes
7. Over 61 m	4.1 lpm/m^2 (0.10 gpm/ ft2) 3 Outlet, and additional 1 outlet for every 700 m^2 30 minutes	4.1 lpm/m2 (0.10 gpm/ ft2) 6 Outlet, and additional 1 outlet for every 465 m^2 55 minutes	4.1 lpm/m2 (0.10 gpm/ ft2) 6 Outlet, and additional 1 outlet for every 465 m^2 55 minutes

Table:- D.08-T1: Foam Sprinkler/ Deluge System Requirements	
ITEMS	**REQUIREMENTS**
DESIGN CRITERIA FOR LOW – EXPANSION FOAM SYSTEM	xxii. The design Criteria of Foam Monitor System for Loading Racks (Truck or Rail cars at loading and unloading) shall comply with **Table:- D.08-T1.H.** xxiii. The design Criteria of Foam Monitor System for Loading Diked and non-diked areas shall comply with **Table:- D.08-T1.I.** xxiv. Fixed foam outlets shall not be used to protect horizontal or pressure tanks.

Table:- D.08-T1.H.: Design Criteria for Foam Monitors System for Loading

HAZARD	FOAM TYPE	REQUIRED DESIGN DENSITY (MINIMUM APPLICATION RATE)	FOAM ADDITION FOR HYDRAULIC IMBALANCE	DURATION
1. HYDROCARBONS	Protein and Flouroprotein	6.5 lpm/m^2 (0.16 gpm/ ft^2)	10%	15 minutes
2. HYDROCARBONS	AFFF, FFFP, Alcohol Resistant AFFF and FFFP	4.1 lpm/m^2 (0.10 gpm/ ft^2)	10%	15 minutes
3. FLAMMABLE AND COM-BUSTIBLE LIQUIDS REQUIRING ALCOHOL RESISTANT FOAMS	Alcohol Resistant Foams	4.1 lpm/m^2 (0.10 gpm/ ft^2) or Manufacturer's specifications, whichever is higher	10%	15 minutes

Table:- D.08-T1.I.: Design Criteria for Fixed Foam Application on Diked Areas Involving Hydrocarbon Liquids Areas

TYPE OF FOAM DISCHARGE OUTLETS	REQUIRED DESIGN DENSITY (MINIMUM APPLICATION RATE)	DURATION CLASS I HYDROCARBON	DURATION CLASS II HYDROCARBONS
1. LOW LEVEL FOAM DISCHARGE OUTLET	4.1 lpm/m^2 (0.10 gpm/ ft^2)	30 minutes	20 minutes
2. FOAM MONITORS	6.5 lpm/m^2 (0.16 gpm/ ft^2)	30 minutes	20 minutes
3. FOAM USING COMPRESSED AIR TECHNOLOGY	Consult manufacturer for listed minimum application rate	30 minutes	20 minutes

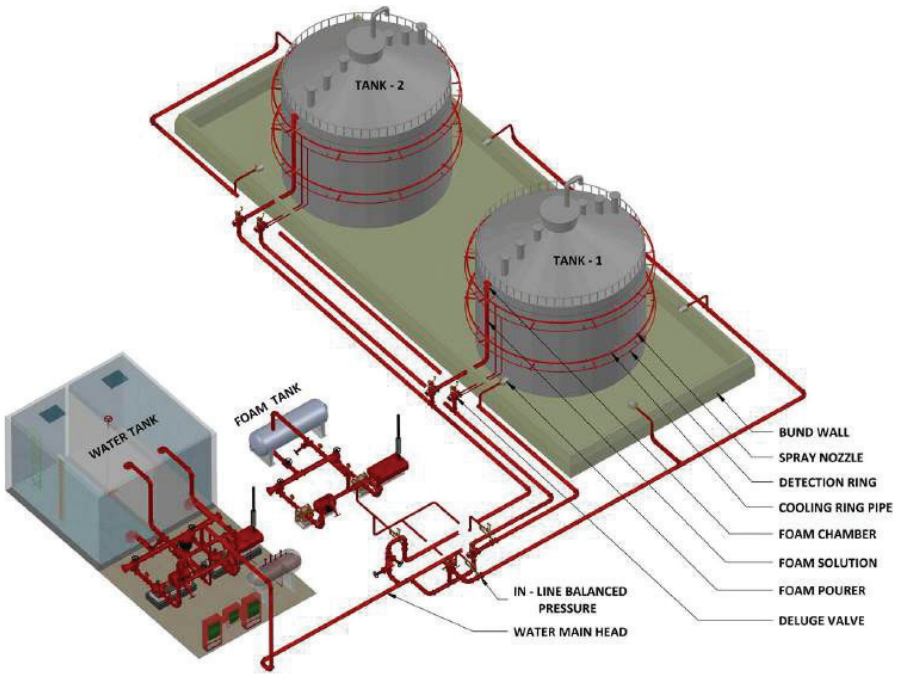


Figure :-D.08-F3: Typical Fixed Foam Discharge and Water spray cooling System outlet System for Hydrocarbon tanks

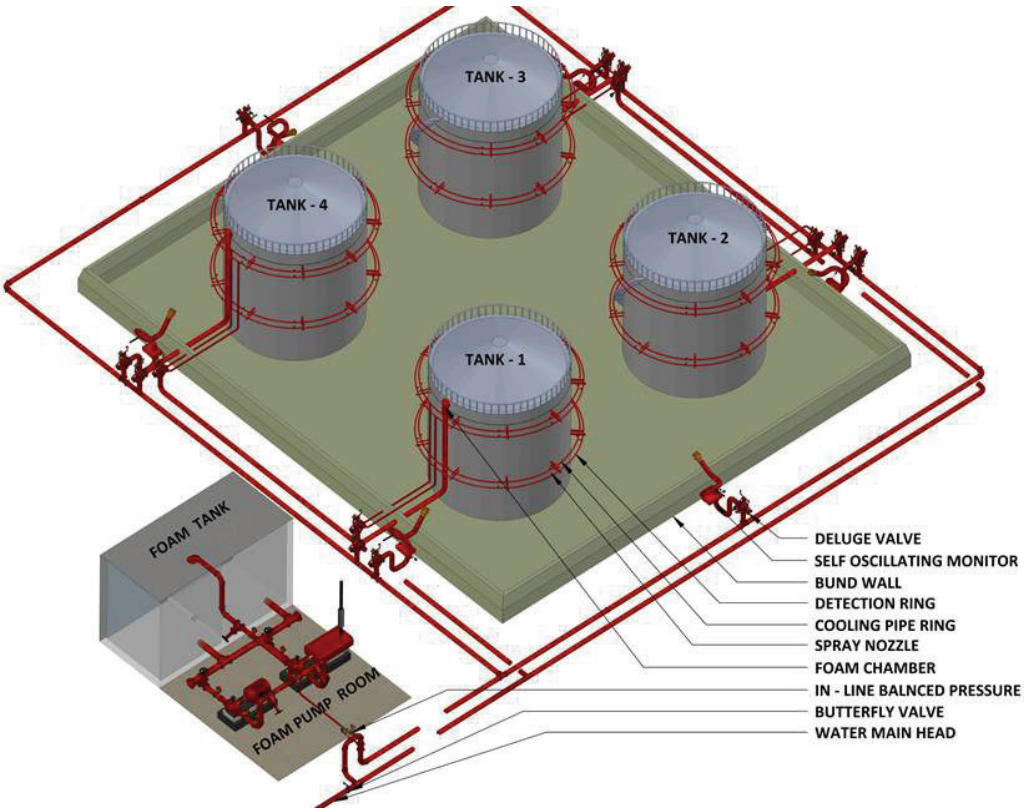


Figure :- D.08-F4: Typical Fixed Foam Monitor System for Diked Area

	Table:- D.08-T1: Foam Sprinkler/ Deluge System Requirements
ITEMS	**REQUIREMENTS**
16. MEDIUM AND HIGH – EXPANSION FOAM SYSTEM	i. Medium- and high-expansion foams shall be specifically evaluated to verify the applicability of medium- or high-expansion foam as a fire control agent for the type of hazard being considered for the application of foam. ii. Medium and high-expansion Foam Systems shall be provided where required by other sections of the code to protect hazards such as Ordinary combustibles, Flammable Liquids etc. iii. Liquefied Natural Gas (LPG) shall be protected only with High Expansion Foam Systems. iv. Medium and high-expansion Foam Systems shall not be used on fires containing Cellulose Nitrate, energized unenclosed electrical equipment and Water reactive metals such as Sodium, Potassium, Sodium-Potassium Alloys (NaK), Triethyl-aluminium, Phosphorus pentoxide, Liquefied Flammable Gas. v. Protection with Foam and Personnel Safety shall be as per material MSDS and foam manufacturers specifications. vi. Medium and high-expansion Foam Systems can be used in total flooding systems, Local application systems or portable foam generating Systems. vii. Medium and high-expansion Foam Systems shall maintain an electrical clearance from live insulated electrical equipment as per **Table:- D.08-T1.J.** viii. Automatic Detection in accordance with **Section C, Chapter 01. Fire Detection and Alarm Systems** shall be used for fixed High expansion Foam Systems. ix. Where hazard evaluation demands, detectors shall be General Directorate of Civil Defence listed and permitted. The same applies to flame, combustibles, vapor, gas detectors, inter- faced to control systems as per **Section C, Chapter 01.Fire Detection and Alarm Systems.** x. The foam-generating apparatus shall be located and arranged so that inspection, testing, recharging, and other maintenance operations are facilitated and the interruption of protection is held to a minimum. xi. The foam-generating equipment shall be located as close as possible to the hazard(s) it protects, but not where it will be unduly exposed to a fire or explosion. xii. The system Design, Application and installation shall be as per manufacturer's specifications.

Table:- D.08-T1.J.: Clearance from Medium and High Expansion Foam Equipment to Live Uninsulated Electrical Component

NOMINAL LINE VOLTAGE kV	NOMINAL VOLTAGE TO GROUND	DESIGN BASIC INSULATION LEVEL (BIL)	MNIMUM CLEARANCE
1. Up to 15	Up to 9	110	178 mm
2. 23	13	150	254 mm
3. 34.5	20	200	330 mm
4. 46	27	250	432 mm
5. 69	40	350	635 mm
6. 115	66	550	940 mm
7.138	80	650	1118 mm
8. 161	93	750	1321 mm
9. 196– 230	114-132	900/ 1050/ 1175/ 1300	1600 mm/ 1930 mm/ 2210 mm/ 2489 mm
10. 287-380	166-220	1425/ 1550	2769 mm/ 3048 mm
11. 500	290	1675/ 1800/ 1925	3327 mm/3607 mm/ 3886 mm
12. 500-700	290-400	2100/ 2300	4267 mm/ 4674 mm

Table:- D.08-T1: Foam Sprinkler/ Deluge System Requirements	
ITEMS	**REQUIREMENTS**
16. MEDIUM AND HIGH – EXPANSION FOAM SYSTEM	xiii. The maximum submergence time for high-expansion Foam Systems measured from the start of the foam discharge shall not be more than the duration mentioned as per **Table:- D-08-T1.K.**

Table:- D.08-T1.K.: Maximum Submergence Time for High Expansion Foam Measured from Start of Foam Discharge in Minutes

HAZARD	CONSTRUCTION TYPE			
	Type II (000), Type III (200), Type V (000)		Type I (all), Type II (222, 111), Type IV (2HH), Type V (111)	
	SPRINKLERED	NON-SPRINKLERED	SPRINKLERED	NON-SPRINKLERED
1. FLAMMABLE LIQUIDS *FLASH POINTS BELOW 38°C (100°F)+ HAVING A VAPOR PRESSURE NOT EXCEEDING 276 kPa (40 psia)	3 minutes	2 minutes	5 minutes	3 minutes
2. COMBUSTIBLE LIQUIDS *FLASH POINTS OF 38°C (100°F) AND ABOVE+	4 minutes	3 minutes	5 minutes	3 minutes
3. LOW-DENSITY COMBUSTIBLES (I.E. FOAM RUBBER, FOAM PLASTICS, ROLLED TISSUE, OR CREPE PAPER)	4 minutes	3 minutes	6 minutes	4 minutes
4. HIGH-DENSITY COMBUSTIBLES (I.E. ROLLED PAPER KRAFT OR COATED BANDED)	7 minutes	5 minutes	8 minutes	6 minutes
5. HIGH-DENSITY COM-BUSTIBLES (I.E. ROLLED PAPER KRAFT OR COAT-ED UNBANDED)	5 minutes	4 minutes	6 minutes	5 minutes
6. RUBBER TIRES	7 minutes	5 minutes	8 minutes	6 minutes
7. COMBUSTIBLES IN CARTONS, BAGS, OR FIBER DRUMS	7 minutes	5 minutes	8 minutes	6 minutes

	Table:- D.08-T1: Foam Sprinkler/ Deluge System Requirements
ITEMS	**REQUIREMENTS**
17. DESIGN CRITERIA FOR INDOOR STORAGE OF FLAMMABLE AND COMBUSTIBLE LIQUIDS IN METAL CONTAINERS	i. Flammable and combustible liquids stored in metal containers shall be protected by a fire water sprinkler system as per **Table:- D.08-T1.L. through Table:- D.08-T1.Q.** ii. The in-rack sprinkler design shall be based on the 6 most remote sprinklers if there is one level of in-rack sprinklers or 12 most remote sprinklers for 2 levels of in-rack sprinklers or 18 most remotes sprinklers for top 3 levels, if there are three or more levels of in-rack sprinklers. iii. Water demand per in-rack sprinkler shall be 30 GPM. iv. In-rack sprinkler shall be K5.6 ordinary temperature quick response type. v. Refer to **Table: - D.08-T1.AC.** For Sprinkler layouts and Schemes.

Table:- D.08-T1.L.: Design Criteria for Sprinkler Protection of Single- or Double-Row Rack Storage of Ignitable (Flammable or Combustible) Liquids in Metal Containers, Portable Tanks, and IBCs

Container Style and Capacity (gal)	Liquid class	Storage Height (m)	Ceiling Height (m)	Design criteria for sprinkler				Notes	Pump capacity	
				Ceiling Sprinkler	Density (lpm/m^2)	Area (m^2)	In-rack Layout		Without hydrant	With hydrant
NONRELIEVING-STYLE CONTAINERS										
[FP < 200°F (93°C) AND BP ≥ 100°F (37.8°C)]										
≤ 1	IB IC II IIIA	4.9	9.1	K ≥11.2 QR(HT)	24.5	180	L-1	1,2,7	2000	2000
		6.1	9.1	K ≥11.2 SR or QR(HT)	24.5	180	L-2	1,2,7	2000	2000
≤ 5	IB IC II IIIA	7.6	9.1	K ≥8.0 SR or QR(HT)	12.2	270	L-3	1,7	1500	2000
>5 and ≤60	IB IC II IIIA	7.6	9.1	K ≥11.2 SR(HT)	16.3	270	L-5	1,7	2000	2000
[FP ≥ 200°F (93°C)]										
≤ 5	IIIB	12.2	15.2	K ≥8.0 SR or QR(HT)	12.2	180	L-4	1,3,7	1250	1500
>5 and ≤60		12.2	15.2	K ≥8.0 SR(HT)	12.2	270	L-4	1,3,7	1500	2000
RELIEVING-STYLE CONTAINERS										
[FP < 200°F (93°C) AND BP ≥ 100°F (37.8°C)]										
≤ 5	IB IC II IIIA	4.3	5.5	K ≥11.2/ QR(HT) (Pendent only)	26.5	180	-	4	2000	2500
		7.6	9.1	K ≥8.0 SR or QR(HT)	12.2	270	L-4	1,5,7	1500	2000
>5 and ≤60, portable tanks and IBCs	IB IC II IIIA	7.6	9.1	K ≥11.2 SR(HT)	24.5	270	L-6	1,7	2500	2500
		7.6	9.1	K ≥11.2 SR(HT)	24.5	270	L-5	1,7	2500	2500
[FP ≥ 200°F (93°C)]										
≤ 5	IIIB	12.2	15.2	K ≥8.0 SR or QR(HT)	12.2	180	L-4	1,7	1250	1500

>5 and ≤60, portable tanks and IBCs	IIIB	12.2	15.2	K ≥8.0 SR(HT)	12.2	270	L-4	1,3,7 & 1,6,7 (for portable tank and IBCs)	1500	2000

Note:-

1. The in-rack sprinkler design shall be based on the 8 most remote sprinklers for one level of in-rack sprinklers or 12 most remote sprinklers for top 2 levels if two levels of in-rack sprinklers or 18 most remote sprinklers for top 3 levels if three or more level of in-rack sprinklers.
2. Protection for uncartoned or case-cut nonsolid shelf display up to 6.5 ft (2 m) and storage above on pallets in racking and stored on shelf materials, including open wire mesh, or 2 in. × 6 in. (50 mm × 150 mm) wooden slats, spaced a minimum of 2 in. (50 mm) apart.
3. Increase ceiling density to 0.60 if more than one level of storage exists above the top level of in-rack sprinklers.
4. Double-row racks limited to maximum 6 ft (1.8 m) depth
5. For K=8.0 and larger ceiling sprinklers, increase ceiling density to 0.60 (24.5 Lpm/ m^2) over 2000 ft^2 (180 m^2) if more than one level of storage exists above the top level of in-rack sprinklers.
6. Reduce in-rack sprinkler spacing to maximum 9 ft (2.7 m) centers.
7. The minimum in-rack discharge pressure shall not be less than 10 psi (0.7 Bar).
8. The in-rack sprinkler shall be K 5.6 quick response (or) Standard response (ordinary temperature type.)
9. The demand per in-rack sprinkler shall be 30 gpm.
10. For in-rack sprinkler layouts Refer Sub section 4.1
11. For in-rack sprinkler schemes refer to the Table:- D.08-T1.AB..

Table:- D.08-T1.M.: Design Criteria for Sprinkler Protection of Palletized and Stacked Storage of Ignitable (Flammable or Combustible) Liquids in Metal Containers, Portable Tanks, and IBCs

Container Style and Capacity (gal)	Liquid class	Storage Height (m)	Ceiling Height (m)	Design criteria for sprinkler			Notes	Pump capacity	
				Ceiling Sprinkler	Density (lpm/$m^{2)}$	Area (m^2)		Without hydrant	With hydrant
NONRELIEVING-STYLE CONTAINERS									
[FP < 200°F (93°C) AND BP ≥ 100°F (37.8°C)]									
≤ 5	IB IC II IIIA	1.2	5.5	K ≥8.0 SR or QR(HT)	8.6	140	1	500	750
		1.5	5.5	K ≥8.0 SR or QR(HT)	12.2	270	-	1000	1250
		2	9.1	K ≥11.2 QR(HT)	18.3	270	-	1500	2000
>5 and ≤60	IB IC II IIIA	1.5	5.5	K ≥11.2 SR(HT)	16.3	270	-	1250	1500
[FP ≥ 200°F (93°C)]									
≤ 5	IIIB	5.5	9.1	K ≥8.0/QR/ SR or QR(HT)	10.2	270	-	750	1000
>5 and ≤60	IIIB	3.1	6.1	K ≥8.0 SR(HT)	10.2	270	-	750	1000
		5.5	9.1	K ≥8.0 SR(HT)	14.3	270	-	1250	1500
RELIEVING-STYLE CONTAINERS									
[FP < 200°F (93°C) AND BP ≥ 100°F (37.8°C)]									
≤ 5	IB IC II IIIA	3.7	9.1	K ≥11.2 QR(HT) Pendent only	24.5	270	2	2000	2000
>5 and ≤60	IB	1.5	9.1	K ≥11.2 SR(HT)	16.3	270	-	1250	1500

	IC II IIIA	2	9.1	K ≥11.2 SR(HT)	24.5	270	3	2000	2000
Portable tanks and IBCs	IB IC II IIIA	1 High	9.1	K ≥8.0 SR(HT)	12.2	270	-	1000	1250
		2 High	9.1	K ≥11.2 SR(HT)	24.5	270	-	2000	2000
[FP ≥ 200°F (93°C)]									
≤ 5	IIIB	5.5	9.1	K ≥8.0 SR or QR(HT)	10.2	270	-	750	1000
>5 and ≤60	IIIB	3.1	6.1	K ≥8.0 SR(HT)	10.2	270	-	750	1000
		5.5	9.1	K ≥8.0 SR(HT)	14.3	270	-	1250	1500
Portable tanks and IBCs	IIIB	1 High	9.1	K ≥8.0 SR(HT)	10.2	270	-	750	1000
		2 High	9.1	K ≥11.2 SR(HT)	20.4	270	-	1500	2000

Note:-

1. Minimum hose stream demand can be reduced to 250 gpm for 2 hours.
2. Sprinklers must also be hydraulically calculated to provide a density of 0.80 gpm/ft^2 (32.6 lpm/m^2 over 1000 ft^2 (90m^2).
3. Drums must be placed on open slatted pallet, not nested, to allow pressure relief from drums on lower levels.

Table:- D.08-T1.N.: Design Criteria for Sprinkler Protection of Palletized and Stacked Storage of Unsaturated Polyester Resins in Metal Containers

Container Style and Capacity (gal)	Liquid class	Storage Height (m)	Ceiling Height (m)	Design criteria for sprinkler			Notes	Pump capacity	
				Ceiling Sprinkler	Density (lpm/m^2)	Area (m^2)		Without hydrant	With hydrant
NONRELIEVING-STYLE CONTAINERS									
>5 and <60	All	3.1	10.1	K ≥11.2 SR (HT or OT)	18.3	270	1,2,3	1500	2000

Note:-

1. Drums placed on open, slatted pallet, not nested, to allow pressure relief from drums on lower levels.
2. Storage areas containing unsaturated polyester resin (UPR) should not be located in the same spill containment area or drainage path of other Class I or Class II liquids [FP < 140°F (60°C)], unless protected as required for such other liquids.
3. Both 3⁄4 in. (20 mm) and 2 in. (50 mm) listed and labeled pressure-relieving devices are required on containers that exceed 6 gal (23 L) capacity.

Table:- D.08-T1.O.: Design Criteria for Sprinkler Protection of Shelf Storage of Ignitable (Flammable or Combustible) Liquids in Metal Containers.

Container Style and Capacity (gal)	Liquid class	Storage Height (m)	Ceiling Height (m)	Design criteria for sprinkler			Notes	Pump capacity	
				Ceiling Sprinkler	Density (lpm/m^2)	Area (m^2)		Without hydrant	With hydrant
NONRELIEVING-STYLE CONTAINERS									

Table:- D.08-T1.O.: Design Criteria for Sprinkler Protection of Shelf Storage of Ignitable (Flammable or Combustible) Liquids in Metal Containers.

Container Style and Capacity (gal)	Liquid class	Storage Height (m)	Ceiling Height (m)	Design criteria for sprinkler			Notes	Pump capacity	
				Ceiling Sprinkler	Density (lpm/m$^{2)}$	Area (m^2)		Without hydrant	With hydrant
≤ 1	All	1.8	5.5	K ≥5.6 SR or QR(HT)	7.7	140	1,2,3	500	750

Note:-

1. Protection limited to mercantile shelving that is 2 ft (600 mm) or less in depth per side, with backing between each side.
2. Minimum hose stream demand can be reduced to 250 gpm for 2 hours.
3. The minimum aisle width shall not be less than 5 ft (1.5 m).

Table:- D.08-T1.P.: Design Criteria for Sprinkler Protection of Single , Double and Row-Rack Storage of Ignitable (Flammable or Combustible) Liquids in Relieving style Metal Containers.

Container Style and Capacity (gal)	Liquid class	Storage Height (m)	Ceiling Height (m)	Design criteria ceiling sprinkler			In-rack sprinkler design				Pump capacity	
				Ceiling sprinkler	No of sprinkler	Stated pressure	Inrack Sprinkler	Flow (GPM)	Lay out	Notes	With out hydrant	With hydrant
[FP< 200°F (93°C) AND BP≥ 100°F (37.8°C)]												
RACK STORAGE WITH MAXIMUM 6 ft (1.8 m) RACK DEPTH AND MINIMUM 7.5 ft (2.3 m) AISLE WIDTH												
≤ 5 CARTONED OR UNCARTONED	**1B 1C II IIIA IIIB**	4.3	7.3	Pendent ESFR K ≥ 14.0 (OT)	12	50 psi	K 11.2 QR(OT)	36	L-7	1,2,3, 4,5,6,7	2000	2000
	1B 1C II IIIA IIIB	4.3	7.3	Pendent ESFR K ≥ 25.0 (OT)	12	25 psi	-	-	-	2,3, 4,5,6	1500	2000
RACK STORAGE WITH MAXIMUM 9 ft (2.7 m) RACK DEPTH AND 8 ft (2.4 m) MINIMUM AISLE WIDTH												
≤ 1 CARTONED Only	**1B 1C II IIIA IIIB**	6.1	9.1	Pendent ESFR K ≥ 14.0 (OT)	12	75 psi	-	-	-	-	1500	2000
	1B 1C II IIIA IIIB	7.6	9.1	Pendent ESFR K ≥ 14.0 (OT)	12	50 psi	K 8.0 QR(OT)	31	L-8	1,2,5,7	2000	2000
≤ 5 CARTONED OR UNCARTONED	**1B 1C II IIIA IIIB**	7.6	9.1	Pendent ESFR K ≥ 14.0 (OT)	12	75 psi	K 8.0 QR(OT)	44	L-9	1,2,5,7	2500	2500

Table:- D.08-T1.P.: Design Criteria for Sprinkler Protection of Single , Double and Row-Rack Storage of Ignitable (Flammable or Combustible) Liquids in Relieving style Metal Containers.

Container Style and Capacity (gal)	Liquid class	Storage Height (m)	Ceiling Height (m)	Design criteria ceiling sprinkler			In-rack sprinkler design				Pump capacity	
				Ceiling sprinkler	No of sprinkler	Stated pressure	Inrack Sprinkler	Flow (GPM)	Lay out	Notes	With out hydrant	With hydrant

Note:-

1. The in-rack sprinkler design shall be based on the 7 most remote sprinklers for one level of in-rack sprinklers or 14 most remote sprinklers for top 2 levels if more than one levels of in-rack sprinklers .
2. The in-rack sprinkler water demand should be balanced with the ceiling sprinkler water demand at their point of connection.
3. One-gallon and 1-quart containers are not required to be relieving style.
4. Provide minimum 3 in. transverse flue at rack uprights.
5. For Class IIIB liquids [FP ≥ 200°F (93°C)], see also **Table:- D.08-T1.M**
6. Racks can have open-mesh wire intermediate shelving on lower levels.
7. The minimum in-rack sprinkler discharge pressure shall not be less than a gauge pressure of 10 psi (0.7 bar)
8. For in-rack sprinkler Layouts refer to the **Table:- D.08-T1.AC.**

Table:- D.08-T1.Q.: Design Criteria for Sprinkler Protection of Palletized Storage of Ignitable (Flammable or Combustible) Liquids in Relieving style Metal Containers.

Container Style and Capacity (gal)	Liquid class	Storage Height (m)	Ceiling Height (m)	Design criteria for sprinkler				Pump capacity	
				Ceiling sprinkler	No of sprinkler	Stated pressure	In-rack Layout	Without hydrant	With hydrant
[FP< 200°F (93°C) AND BP≥ 100°F (37.8°C)]									
STORAGE WITH MINIMUM 7.5 ft (2.3 m) AISLE WIDTH									
≤ 1 CARTONED	**1B 1C II IIIA IIIB**	2.4	9.1	Pendent ESFR K ≥ 14.0 (OT)	12	50 psi	-	1250	1500
≤ 5 CARTONED OR UNCARTONED	**1B 1C II IIIA IIIB**	3.7	9.1	Pendent ESFR K ≥ 14.0 (OT)	12	75 psi	-	1500	2000

	Table:- D.08-T1: Foam Sprinkler/ Deluge System Requirements
ITEMS	**REQUIREMENTS**
18. DESIGN CRITERIA FOR INDOOR STORAGE OF FLAMMABLE AND COMBUSTIBLE LIQUIDS IN NON-METAL CONTAINERS	i. Water miscible flammable and combustible liquids with concentration less than 20% and stored in non-metal container shall be protected as Class I commodity. ii. Water miscible flammable and combustible liquids with concentration 20% to 50% and stored in non-metal container shall be protected as Class III commodity. iii. All other flammable and combustible liquids stored in non-metallic containers shall be protected as per **Table:- D.08-T1.R.** through **Table:- D.08-T1.AB.** iv. The in-rack sprinkler design shall be based on the 6 most remote sprinklers for one level of in-rack sprinkler or 4 most remote sprinklers for top 2 levels if there are two levels or more levels of in-rack sprinklers. Demand per in-rack sprinkler shall be 57 gpm for Scheme S - A & S - B and 30 gpm for Scheme S – C, S – D & S - F. v. In-rack sprinkler shall be Ordinary temperature quick response type. vi. Ceiling sprinkler shall be standard response type. vii. Plastic container shall not be permitted if protection criteria are not available as per **Table:- D.08-T1.R.** through **Table:- D.08-T1.AB.**, unless full scale fire test is carried out by listing body for protection criteria and permitted by General Directorate of Civil Defence Kingdom of Bahrain. viii. Refer to **Table:- D.08-T1.AC.** For Sprinkler layouts and Schemes.

Table:- D.08-T1.R.: Design Criteria for Sprinkler Protection of Single , Double and Row-Rack Storage of Ignitable (Flammable or Combustible) Liquids in Nonmetallic Containers.

Container Style and Capacity (gal)	Liquid class	Storage Height (m)	Ceiling Height (m)	Design criteria for sprinkler				Pump capacity	
				In-rack sprinkler	Density (lpm/m^2)	Area (m^2)	In-rack Scheme	Without hydrant	With hydrant
[FP ≥ 200°F (93°C)]									
MINIMUM 4 ft (1.2 m) AISLE WIDTH									
PLASTIC CONTAINERS, CARTONED OR UNCARTONED									
≤ 5	**IIIB**	All	All	≥K8.0 OT(QR)	8	270	S - A	1250	2000
FP ≥ 375°F (190°C)]									
MINIMUM 8 ft (2.4 m) AISLE WIDTH									
FLEXIBLE PLASTIC LINER WITHIN A COMPOSITE CORRUGATED PAPERBOARD BOX									
≤ 6	**IIIB**	All	All	≥K8.0 OT(QR)	8	270	S – C	1000	1500
FLEXIBLE PLASTIC LINER WITHIN A COMPOSITE CONTINUOUSLY WOUND CORRUGATED PAPERBOARD INTERMEDIATE BULK CONTAINER									
≤ 275	**IIIB**	8.5	9.1	≥K8.0 OT(QR)	8	270	S – C	1000	1500

Note:-

1. Refer **Table:- D.08-T1.AC.** for ceiling sprinkler design and in-rack sprinkler schemes.

Table:- D.08-T1.S.: Design Criteria for Sprinkler Protection of Single , Double and Row-Rack Storage of Water-Miscible Ignitable (Flammable or Combustible) Liquids in Glass or Plastic Containers.

Container Style and Capacity (gal)	Liquid class	Storage Height (m)	Ceiling Height (m)	Design criteria for sprinkler				Pump capacity	
				In-rack sprinkler	Density (lpm/m$^{2)}$	Area (m^2)	In-rack Layout	Without hydrant	With hydrant
RACK STORAGE WITH MAXIMUM 9 ft (2.7 m) RACK DEPTH AND MINIMUM 8 ft (2.4 m) AISLE WIDTH									
CARTONED									
16 oz	-	All	All	≥K8.0 OT(QR)	8	270	S - A	1250	2000
≤ 1	-	All	All	≥K8.0 OT(QR)	8	270	S – B	1250	2000
CARTONED OR UNCARTONED									
≤ 60	-	7.6	9.1	≥K8.0 OT(QR)	8	270	S – C	1000	1500

Note:-

1. Refer **Table:- D.08-T1.AC.** for ceiling sprinkler design and in-rack sprinkler schemes.

Table:- D.08-T1.T.: Design Criteria for Sprinkler Protection of Palletized Storage in Listed and Labeled Rigid Nonmetallic IBCs.

Container Style and Capacity (gal)	Liquid class	Storage Height (m)	Ceiling Height (m)	Design criteria for sprinkler				Pump capacity	
				Ceiling sprinkler	Density Lpm/m^2	Area m^2	Notes	Without hydrant	With hydrant
[FP< 200°F (93°C) AND BP≥ 100°F (37.8°C)]									
STORAGE WITH MINIMUM 7.5 ft (2.3 m) AISLE WIDTH									
793	**II & III**	1 High	9.1	K ≥ 11.2 SR (HT)	18.3	270	1,2,3	1500	2000
		2 High	9.1	K ≥ 11.2 SR (HT)	24.5	270	1,2,3	2000	2000

Note:-

1. Foam-water sprinkler protection shall be permitted to be substituted for water sprinkler protection, provided the same design criteria are used.
2. Rigid nonmetallic intermediate bulk containers shall be listed and labeled in accordance with UL 2368.
3. The sprinkler operating gauge pressure shall be a minimum 30 psi (2.1 Bar).

Table:- D.08-T1.U.: Design Criteria for Sprinkler Protection of Single- and Double-Row Rack Storage of in Listed and Labeled Rigid Nonmetallic IBCs.

Container Style and Capacity (gal)	Liquid class	Storage Height (m)	Ceiling Height (m)	Design criteria for sprinkler				Notes	Pump capacity	
				In-rack sprinkler	Density Lpm/m²	Area m²	In-rack Scheme		Without hydrant	With hydrant
[FP< 200°F (93°C) AND BP≥ 100°F (37.8°C)]										
RACK STORAGE WITH MAXIMUM 9 ft (2.7 m) RACK DEPTH AND MINIMUM 8 ft (2.4 m) AISLE WIDTH										
793	II & III	7.6	9.1	K ≥ 8.0 SR (OT)	8	270	S-B	1	1250	2000

Note:-

1. Rigid nonmetallic intermediate bulk containers are listed and labeled in accordance with UL 2368
2. For in-rack sprinkler schemes refer to the **Table:- D.08-T1.AC.**

Table:- D.08-T1.V.: Design Criteria for Sprinkler Protection of Palletized and stacked Storage of Miscible (Flammable or Combustible) Liquids in Glass or plastic container.

Container Style and Capacity (gal)	Liquid class	Storage Height (m)	Ceiling Height (m)	Design criteria for sprinkler				Pump capacity	
				Ceiling sprinkler	Density Lpm/m²	Area m²	In-rack Layout	Without hydrant	With hydrant
≤ 8 oz	-	1.5	11.6	K ≥ 11.2 QR (OT)	19.15	180	-	1000	1250

Table:- D.08-T1.W.: Design Criteria for Sprinkler Protection or Foam-Water Sprinkler Protection of Single- and Double-Row Rack Storage of Liquids in Metal Containers

Container Style and Capacity (gal)	Liquid class	Storage Height (m)	Ceiling Height (m)	Design criteria for sprinkler				Pump capacity	
				In-rack sprinkler	Density Lpm/m²	Area m²	In-rack Scheme	Without hydrant	With hydrant
[FP ≥ 100°F (37.8°C)]									
RACK STORAGE WITH MAXIMUM 6 ft (1.8 m) RACK DEPTH AND MINIMUM 9 ft (2.7 m) AISLE WIDTH									
≥ 5 and ≤ 60	II & III	10.4	14.6	Pendent (IT) K ≥ 25.2 CMDA(EX)	8	270	S-E	2000	2500

Note:-

1. Refer **Table:- D.08-T1.AC.** for ceiling sprinkler design and in-rack sprinkler schemes.

Table:- D.08-T1.X.: Design Criteria for Sprinkler Protection of Ignitable (Flammable or Combustible) Liquids

Container Style and Capacity (gal)	Liquid class	Storage Height (m)	Ceiling Height (m)	Design criteria for sprinkler				Pump capacity	
				In-rack sprinkler	Density Lpm/m²	Area m²	In-rack Scheme	Without hydrant	With hydrant
Flash Points Below 200°F (93°C)									
MINIMUM 4 ft (1.2 m) AISLE WIDTH, Any Rack width									
< 2 oz (< 60ml) Cartoned	-	All	All	K ≥ 8.0 QR (OT)	8	270	S-A	1250	2000

Note:-

1. Refer **Table:- D.08-T1.AC.** for ceiling sprinkler design and in-rack sprinkler schemes.

Table:- D.08-T1.Y.: Water Sprinkler Protection for Single- or Double-Row Rack Storage of Liquids with a in Plastic Containers.

Container Style and Capacity (gal)	Liquid class	Storage Height (m)	Ceiling Height (m)	Design criteria for sprinkler					Pump capacity	
				In-rack sprinkler	Celling sprinkler	Density Lpm/m² (or) Number of sprinkler	Area m² (or) Pressure	In-rack Layout	Without hydrant	With hydrant
FP ≥ 450°F (230°C)										
RACK STORAGE WITH MAXIMUM 9 ft (2.7 m) RACK DEPTH AND MINIMUM 8 ft (2.4 m) AISLE WIDTH										
≤ 5 gal Cartoned	-	7.6	9.1	K ≥ 8.0 QR (OT)	S-A/S-D				1250	2000
	-	7.6	9.1	-	Pendent K14 ESFR (OT)	12 Nos.	75 psi	-	1500	2000
	-	4.6	9.1	-	Pendent K14 ESFR (OT)	12 Nos.	50 psi	-	1250	1500
≤ 5 gal Uncartoned or Mixed cartoned and uncartoned	-	7.6	9.1	K ≥ 8.0 QR (OT)	S-A/S-D				1250	2000
RACK STORAGE WITH MAXIMUM 9 ft (2.7 m) RACK DEPTH AND MINIMUM 4 ft (1.2 m) AISLE WIDTH										
(≤ 48 oz ≤1.4 L) Cartoned	-	10.7	12.1		Pendent K-25.2 ESFR (OT)	S-D [only 1 level of in-rack sprinklers at approximately (4.6 m) level].			1250	2000

Note:-

1. Refer **Table:- D.08-T1.AC.** for ceiling sprinkler design and in-rack sprinkler schemes.

Table:- D.08-T1.Z.: Design Criteria for Sprinkler Protection of Single or Double Row Rack Storage of 100 Percent or Less Ethanol/Propanol/Methanol In Plastic or Glass Containers

Container Style and Capacity (gal)	Storage Height (m)	Ceiling Height (m)	Design criteria for sprinkler						Pump capacity	
			In-rack sprinkler	Celling sprinkler	Density Lpm/m^2 (or) Number of sprinkler	Area m^2 (or) Pressure	In-rack Layout	Flow (GPM)	Without hydrant	With hydrant
MINIMUM 8 ft (2.4 m) AISLE WIDTH										
≤6 oz (≤180 ml) Cartoned	7.6	As per Manufacturer	-	Pendent K 14.0 QR (OT)	12	50 psi	-		1250	1500
	7.6	As per Manufacturer	-	Pendent K 16.8 QR (OT)	12	35 psi	-		1250	1500
	7.6	As per Manufacturer	-	Pendent K 22.4 QR (OT)	12	25 psi	-		1500	2000
	7.6	As per Manufacturer	-	Pendent K 25.2 QR (OT)	12	20 psi	-		1500	2000
	7.6	As per Manufacturer	K ≥ 8.0 QR (OT)	K 11.2 SR (OT)	20	29 psi	Layout-9	45	2000	2500
	7.6	As per Manufacturer	K ≥ 8.0 QR (OT)	≥ K 11.2 SR (OT)	20	7 psi	Layout-8	45	1250	1500
	10.6	12.2	-	Pendent K 14.0 QR (OT)	12	75 psi	-		1500	2000
	10.6	12.2	-	Pendent K 16.8 QR (OT)	12	52 psi	-		1500	2000
	10.6	12.2	-	Pendent K 22.4 QR (OT)	12	45 psi	-		2000	2000
	10.6	12.2	-	Pendent K 25.2 QR (OT)	12	40 psi	-		2000	2500

Note:-

1. The in-rack sprinkler design shall be based on the 8 most remote sprinklers for one level of in-rack sprinklers or 14 most remote sprinklers for top 2 levels if two levels of in-rack sprinklers are installed.
2. Refer **Table:- D.08-T1.AC.** for ceiling sprinkler design and in-rack sprinkler schemes and layouts.

Table:- D.08-T1.AA.: Design Criteria for Sprinkler Protection of Single, Double or Multi Row Rack Storage of 50 Percent/50 Percent Mixture of Ethanol/Propanol/Methanol/Water in Plastic or Glass Containers

Container Style and Capacity (gal)	Storage Height (m)	Ceiling Height (m)	Design criteria for sprinkler						Pump capacity	
			In-rack sprinkler	Celling sprinkler	Number of sprinkler	Pressure	In-rack Layout	Flow (GPM)	Without hydrant	With hydrant
MINIMUM 8 ft (2.4 m) AISLE WIDTH (Double Row Rack)										
≤1 (≤ 4 L) Cartoned	7.6	9.1	-	Pendent ≥K 14.0 QR(OT)	12	75 psi	-		1500	2000
	7.6	9.1	K ≥ 8.0 QR (OT)	K 11.2 SR (OT)	20	29 psi	Layout-9	45	2000	2500
	7.6	9.1	K ≥ 8.0 QR (OT)	K 14.0 SR (OT)	20	18 psi	Layout-9	45	2000	2500
	7.6	9.1	K ≥ 8.0 QR (OT)	K 16.8 SR (OT)	20	13 psi	Layout-9	45	2000	2500
	7.6	9.1	K ≥ 8.0 QR (OT)	K 25.2 SR (OT)	20	7 psi	Layout-9	45	2000	2500
MINIMUM 4 ft (1.2 m) AISLE WIDTH (Any type of rack)										
<59 oz (< 1.75 L) Cartoned	All	All	K 8.0 (or) K 11.2 QR (OT)	≥K 11.2 SR (OT)	20	7 psi	S-F (<1.5 m) storage above top level of in-rack sprinklers		1250	2000
				≥K 11.2 SR (OT)	20	29 psi	S-F (<3 m) storage above top level of in-rack sprinklers		2000	2500

Note:-

1. Refer **Table:- D.08-T1.AC.** for ceiling sprinkler design and in-rack sprinkler schemes and layouts.

Table:- D.08-T1.AB.: Design Criteria for Sprinkler Protection of Palletized Storage of 50 Percent/50 Percent Mixture of Ethanol/Propanol/Methanol/Water in Plastic or Glass Containers

Container Style and Capacity (gal)	Storage Height (m)	Ceiling Height (m)	Design criteria for sprinkler					Pump capacity	
			In-rack sprinkler	Celling sprinkler	Density Lpm/m² (or) Number of sprinkler	Area m² (or) Pressure	In-rack Layout	Without hydrant	With hydrant
MINIMUM 8 ft (2.4 m) AISLE WIDTH (Double Row Rack)									
<59 oz (< 1.75 L) Cartoned	5.2	9	-	K 14.0 QR (OT)	12 Nos.	50 psi.	-	1250	1500
	1.5	9	-	K 14.0 QR (OT)	20 Nos.	18 psi.	-	1250	1500
	5.2	12	-	K 14.0 QR (OT)	12 Nos.	75 psi.	-	1500	2000
	1.5	12	-	K 14.0 QR (OT)	20 Nos.	18 psi.	-	1250	1500

	Table:- D.08-T1: Foam Sprinkler/ Deluge System Requirements
ITEMS	**REQUIREMENTS**
20. SPRINKLERS AND IN RACK SPRINKLERS SCHEMES AND LAYOUTS	i. Sprinklers and Inrack sprinklers schemes and layouts shall be in accordance with **Table:- D-08-T1.AC.**

	Table:- D.08-T1.AC..: Sprinkler and In rack sprinkler Schemes and Layouts
SHEMES	**REQUIREMENTS**
1. SCHEME S-A	i. The horizontal barrier shall be 10mm plywood or 22 gauge sheet metal. They shall be spaced as indicated in the figures **D.08.F5.A, D.08.F5.B & D.08.F5.C,** Whichever is applicable. ii. Where adjacent rack bays are not dedicated to storage of liquids, the barrier and in-rack sprinkler protection shall be extended at least 8 ft. (2.4 m) beyond the area devoted to liquid storage including aisle. iii. In-rack sprinkler shall be ordinary temperature and quick response type with minimum K Factor of 8.0. Intermediate temperature sprinklers shall be used where ambient conditions require. iv. In-rack sprinkler shall be provided below each barrier level. v. In-rack sprinkler design shall be based on 6 most remote sprinklers for one level of in-rack sprinkler or 4 most remote sprinklers for top 2 levels for two levels or more level of in-rack sprinklers. vi. In-rack sprinkler minimum operating flow shall be 57 gpm. vii. In-rack sprinkler discharge pressure shall not be less than a gauge pressure of 10 psi(0.69 Bar) viii. Any sprinkler type shall be acceptable for the ceiling sprinkler protection. ix. If standard spray sprinklers are used, they shall be capable of providing not less than 0.20 gpm/ft2 over 3000 ft2 (8 mm/min over 270 m2). x. Barriers shall not be required for liquids with closed cup flash points of 450°F (230°C) or greater. If barriers are omitted, the following shall apply: a. Ceiling sprinkler protection shall provide a minimum density of 0.3 gpm/ft2 over the most hydraulically remote 2000 ft2 (12 mm/min over 180 m2) using ordinary temperature, standard response sprinklers. Sprinklers shall have a nominal K-factor equal to or greater than 8.0. Intermediate-temperature sprinklers shall be used where ambient conditions require. b. The sprinklers located at the rack face shall be staggered vertically.

2. SCHEME S-B	i. Horizontal barrier shall be 10 mm plywood or 22 gauge sheet metal. They shall be spaced as indicated in the figures **D.08.F6.A, D.08.F6.B & D.08.F6.C,** whichever is applicable. ii. Where adjacent rack bays are not dedicated to storage of liquids, the barrier and in-rack sprinkler protection shall be extended at least 8 ft. (2.4 m) beyond the area devoted to liquid storage including aisle. iii. In-rack sprinkler shall be ordinary temperature and quick response type with minimum K Factor of 8.0. Intermediate temperature sprinklers shall be used where ambient conditions require. iv. In-rack sprinkler shall be provided below each barrier level. v. In-rack sprinkler design shall be based on 6 most remote sprinklers for one level of in-rack sprinkler or 4 most remote sprinklers for top 2 levels, if two levels or more level of in-rack sprinklers. vi. In-rack sprinkler minimum operating flow shall be 57 gpm. vii. In-rack sprinkler discharge pressure shall not be less than a gauge pressure of 10 psi(0.69 Bar). viii. Any sprinkler type shall be acceptable for the ceiling sprinkler protection. ix. If standard spray sprinklers are used, they shall be capable of providing not less than 0.20 gpm/ft2 over 3000 ft2(8 L/min over 270 m2). x. Ceiling sprinklers for containers that exceed 1 gal (3.8 L) capacity, but do not exceed 60 gal (230 L), shall meet the following requirements: xi. Ceiling sprinkler protection shall provide a minimum density of 0.45 gpm/ft2 (18.3 mm/min) over the most hydraulically remote 3000 ft2 (270 m2), using high temperature, standard response sprinklers of nominal K-factor of 11.2 or greater. Other types of sprinklers shall not be used. xii. Ceiling sprinklers for containers that exceed 60 gal(230 L) capacity, but do not exceed 793 gal (3000 L), shall meet the following requirements: xiii. Ceiling sprinklers shall be designed to provide a minimum density of 0.60 gpm/ft2 over 3000 ft2 (24 mm/min over the most remote 270 m2), using high-temperature rated, standard response sprinklers of nominal K-factor of 11.2 or greater. Other types of sprinklers shall not be used.
3. SCHEME S-C	i. Horizontal barrier shall be 10 mm plywood or 22 gauge sheet metal. They shall be spaced as indicated in the figures **D.08.F7.A, D.08.F7.B & D.08.F7.C.** whichever is applicable. ii. Where adjacent rack bays are not dedicated to storage of liquids, the barrier and in-rack sprinkler protection shall be extended at least 8 ft. (2.4 m) beyond the area devoted to liquid storage including aisle. iii. In-rack sprinkler shall be ordinary temperature and quick response type with minimum K Factor of 8.0. Intermediate temperature sprinklers shall be used where ambient conditions require. iv. In-rack sprinkler shall be provided below each barrier level. v. In-rack sprinkler design shall be based on 6 most remote sprinklers for one level of in-rack sprinkler or 4 most remote sprinklers for top 2 levels, if two levels or more level of in-rack sprinklers. vi. In-rack sprinkler minimum operating flow shall be 30 gpm. vii. In-rack sprinkler discharge pressure shall not be less than a gauge pressure of 10 psi(0.69 Bar). viii. Any sprinkler type shall be acceptable for the ceiling sprinkler protection. ix. If standard spray sprinklers are used, they shall be capable of providing not less than 0.20 gpm/ft2 over 3000 ft2(8 L/min over 270 m2).

4. SCHEME S-D	i. Horizontal barrier shall be 10 mm plywood or 22 gauge sheet metal. They shall be spaced as indicated in the figures **D.08.F8.A, D.08.F8.B** whichever is applicable. ii. Where adjacent rack bays are not dedicated to storage of liquids, the barrier and in-rack sprinkler protection shall be extended at least 8 ft. (2.4 m) beyond the area devoted to liquid storage including aisle. iii. In-rack sprinkler shall be ordinary temperature and quick response type with minimum K Factor of 8.0. iv. In-rack sprinkler design shall be based on 8 most remote sprinklers for one level of in-rack sprinkler or 7 most remote sprinklers for top 2 levels(Total 14), if two levels or more level of in-rack sprinklers. v. In-rack sprinkler minimum operating flow shall be 30 gpm. vi. Ceiling sprinklers shall be designed to provide a minimum density of 0.3 gpm/ft2 (12.2 mm/min) over the most remote 2000 ft2 (185 m2) using ordinary temperature rated, standard response spray sprinklers, having a nominal K-factor of 8.0 or 11.2.
5. SCHEME S-E	i. Horizontal barrier shall be 10 mm plywood or 22 gauge sheet metal. ii. Where adjacent rack bays are not dedicated to storage of liquids, the barrier and in-rack sprinkler protection shall be extended at least 8 ft. (2.4 m) beyond the area devoted to liquid storage including aisle. iii. All ignitable (flammable or combustible) liquid storage shall be located beneath a barrier. iv. Vertical baffles shall not be installed between in-rack sprinklers. v. In-rack sprinklers shall be intermediate temperature rated, pendent sprinklers with a nominal K-factor of 25.2, RTI of 50 (m/sec)1⁄2 or less, and be listed as extended coverage control mode density/area storage sprinklers. vi. In-rack sprinkler shall be provided below each barrier level. vii. Where one level of in-rack sprinklers is installed, the design shall include the four most hydraulically remote sprinklers (i.e., four on one line).Where two levels of in-rack sprinklers are installed, the design shall include the three most hydraulically remote sprinklers on each level. Where three or more levels of in-rack sprinklers are installed, the design shall include the three most hydraulically remote sprinklers on the top three levels. viii. The minimum in-rack sprinkler discharge pressure shall not be less than a gauge pressure of 30 psi. ix. Foam-water sprinkler protection shall be permitted to be substituted for water sprinkler protection, provided the same design criteria is used. x. Any sprinkler type shall be acceptable for the ceiling sprinkler protection. xi. If standard spray sprinklers are used, they shall be capable of providing not less than 0.30 gpm/ft2 over 3000 ft2 (8 mm/min over 270 m2) when supplied with water.

4. SCHEME S-F	i. Horizontal barrier shall be 10 mm plywood or 22 gauge sheet metal. They shall be spaced as indicated in the figures **D.08.F9.A, D.08.F9.B** whichever is applicable. ii. Where adjacent rack bays are not dedicated to storage of liquids, the barrier and in-rack sprinkler protection shall be extended at least 8 ft. (2.4 m) beyond the area devoted to liquid storage including aisle. iii. In-rack sprinkler shall be ordinary temperature and quick response type with minimum K-factor of 8.0 (115) or 11.2 (160). iv. In-rack sprinkler design shall be based on 6 most remote sprinklers for one level of in-rack sprinkler or 6 most remote sprinklers for top 2 levels, 6 most remote sprinklers for top 3 levels if three levels or more level of in-rack sprinklers. v. In-rack sprinklers shall provide a minimum discharge flow of 30 gpm
5. Layouts	i. Refer **Figure:- D.08.F10.** to **Figure:- D.08.F12.B** for layout 7 to Layout 9.

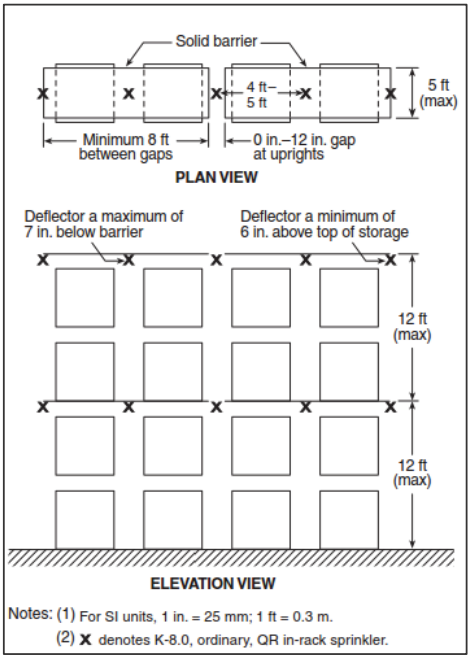


Figure:- D.08.F5.A.:Scheme A

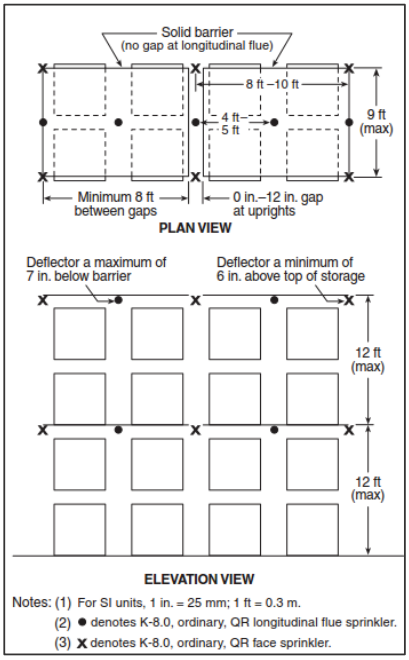


Figure:- D.08.F5.B.:Scheme A

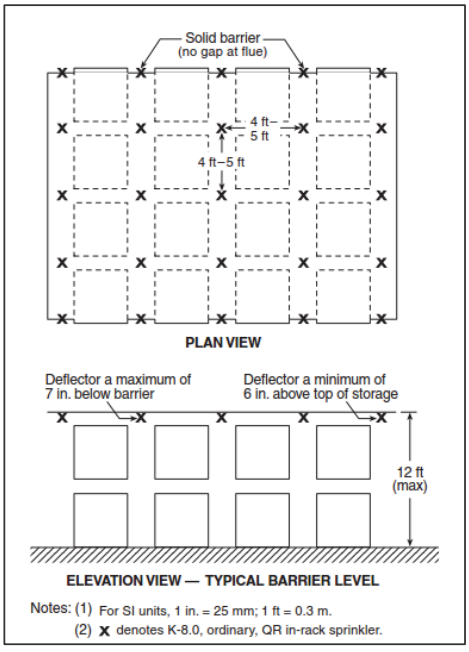


Figure:- D.08.F5.C.:Scheme A

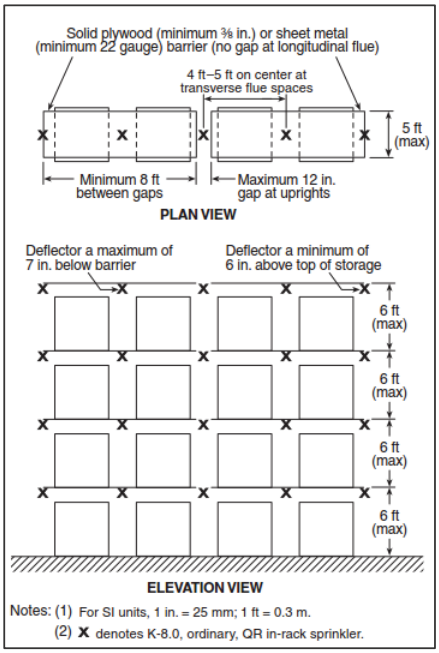


Figure:- D.08.F6.A.:Scheme B

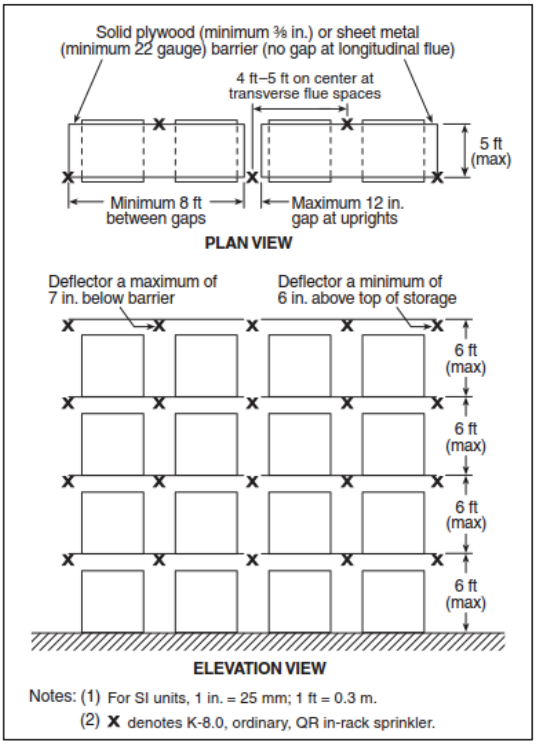


Figure:- D.08.F6.B.:Scheme B

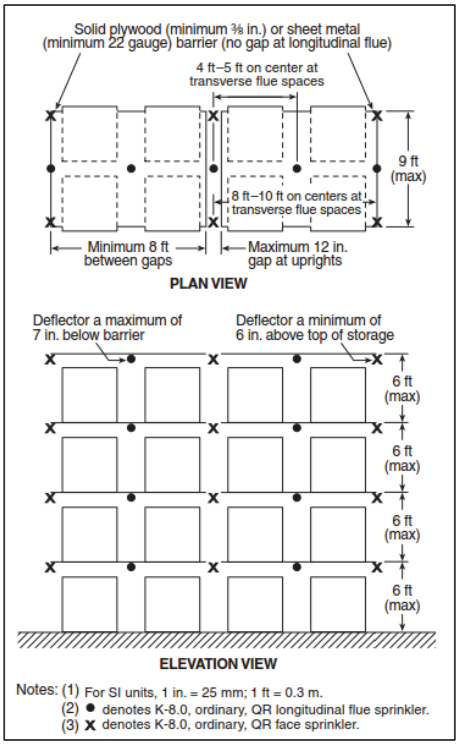
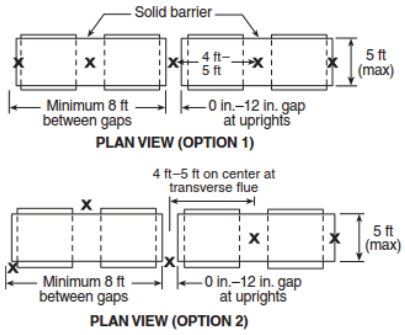


Figure:- D.08.F6.C.:Scheme B



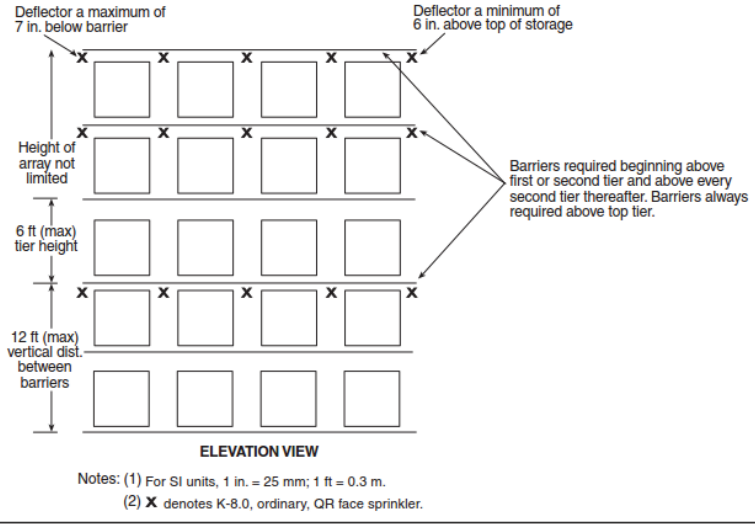


Figure:- D.08.F7.A.:Scheme C

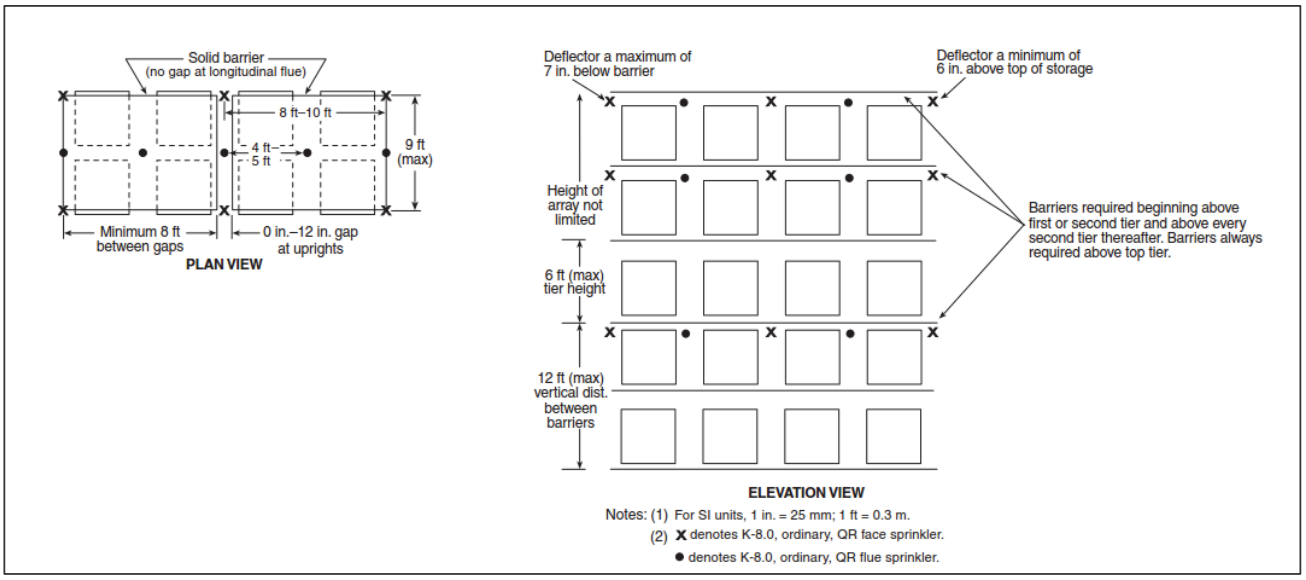


Figure:- D.08.F7.B.:Scheme C

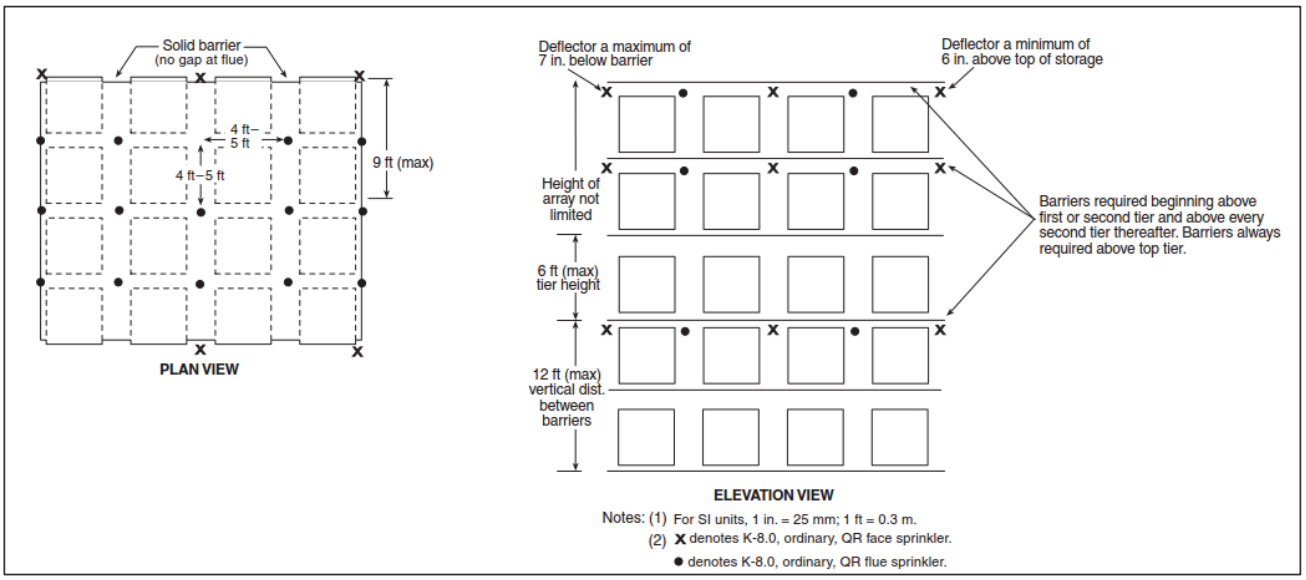


Figure:- D.08.F7.C.:Scheme C

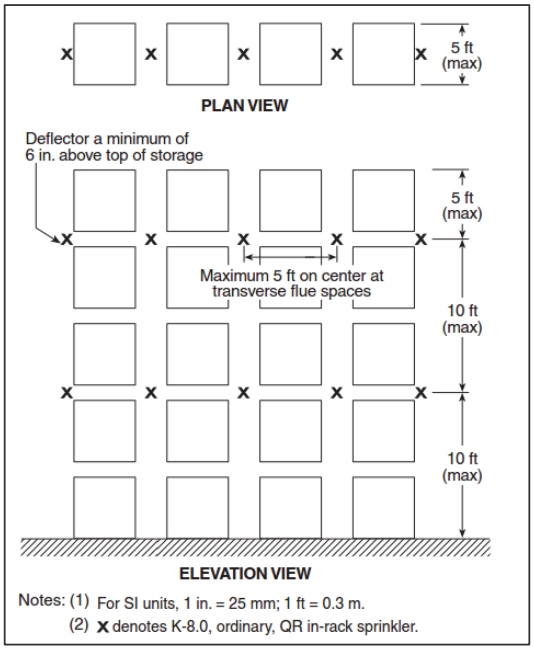


Figure:- D.08.F8.A.:Scheme D

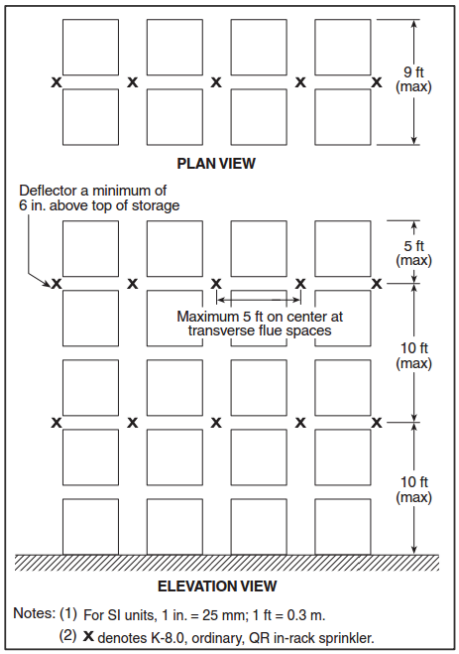


Figure:- D.08.F8.B.:Scheme D

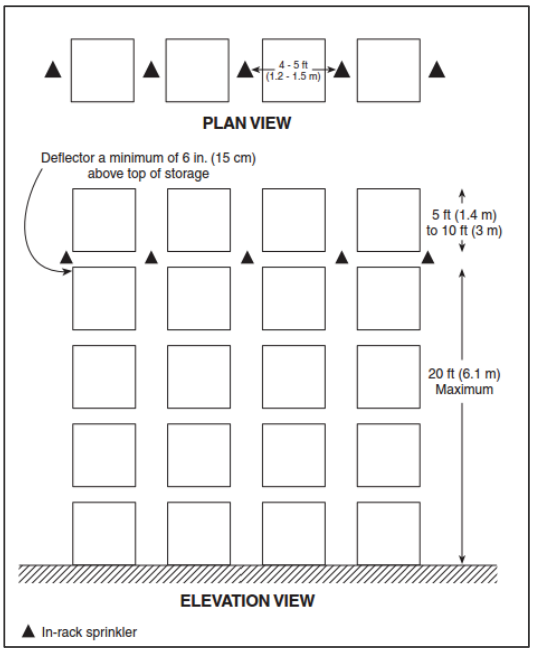


Figure:- D.08.F9.A.:Scheme F

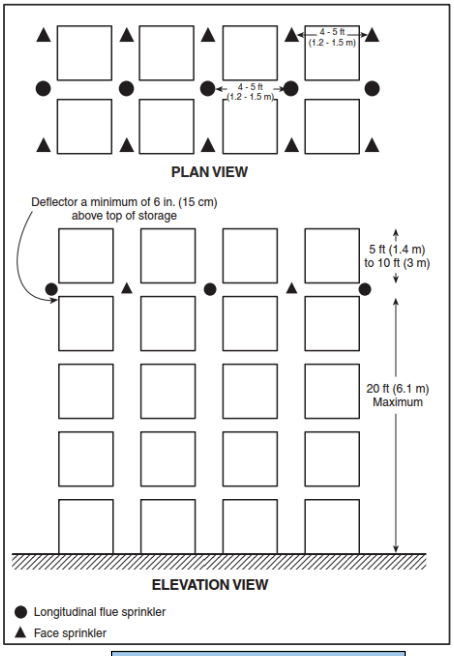


Figure:- D.08.F9.B.:Scheme F

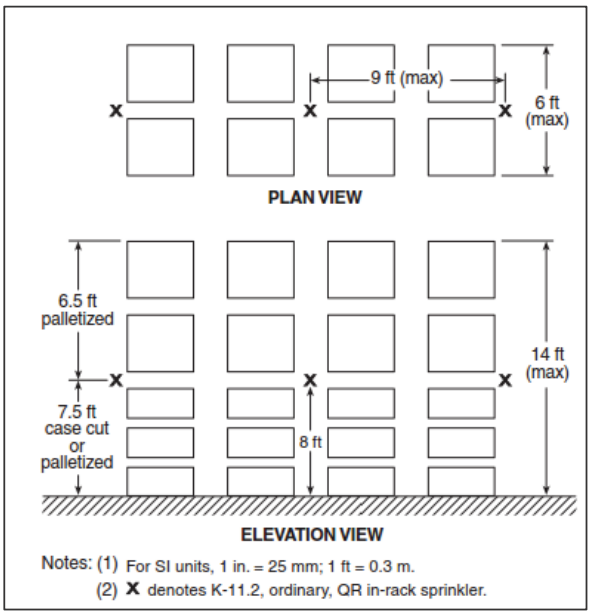


Figure:- D.08.F10.:Layout 7

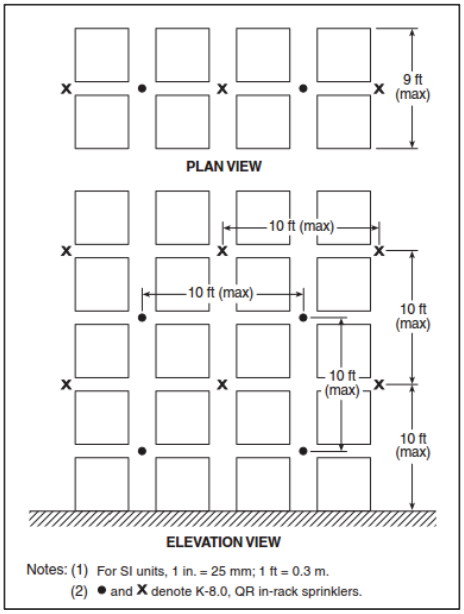


Figure:- D.08.F11.A:Layout 8 (Option 1)

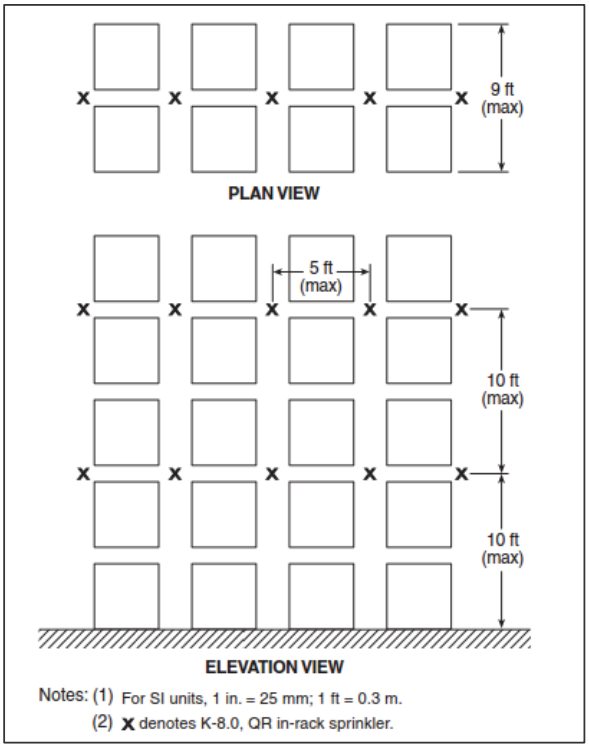


Figure:- D.08.F11.B:Layout 8 (Option 2)

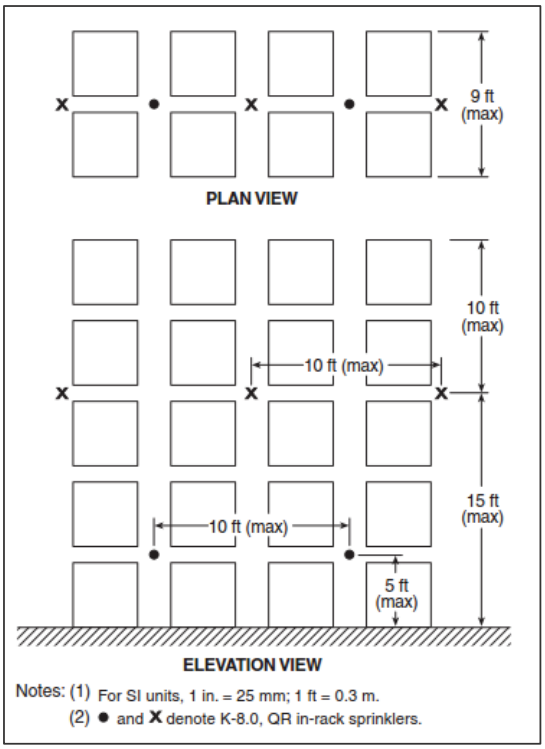


Figure:- D.08.F12.A:Layout 9 (Option 1)

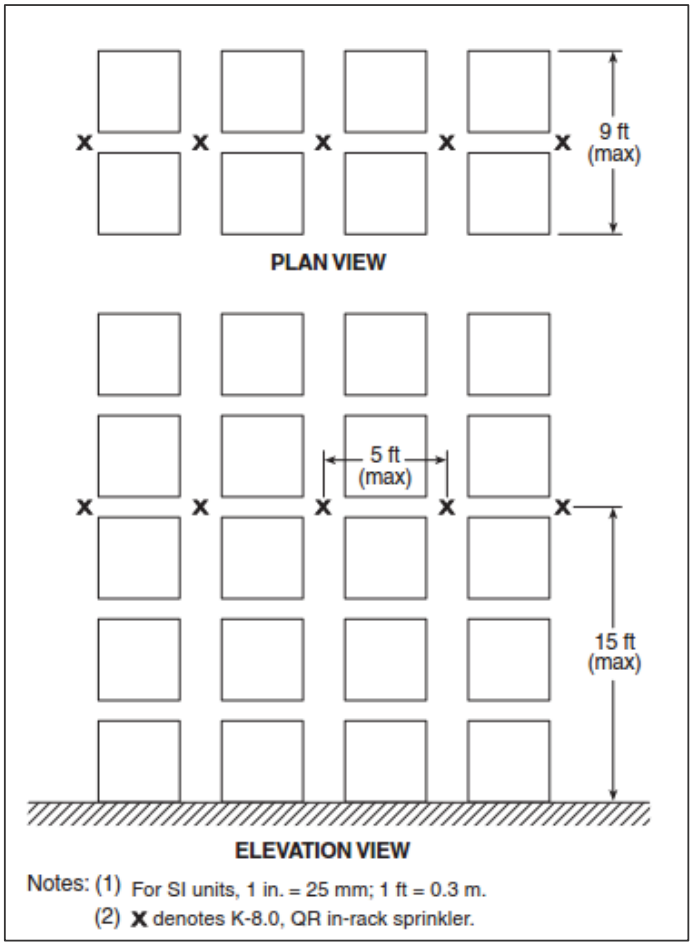


Figure:- D.08.F12.B:Layout 9 (Option 2)

5.0. Inspection and maintenance

5.1. Foam Systems shall be inspected and maintained as per minimum guidelines in accordance with **Table:- D.08-T1.O.** However, detailed acceptance, inspection tests and maintenance shall be as per **NFPA 13, NFPA 11, NFPA 16 and NFPA 25.**

Table:- D.08-T1.O.: Foam Systems Inspection and Maintenance

ITEM	REQUIREMENTS
1. ACCEPTANCE TEST	**1. FLUSHING** i. Water supply mains shall be flushed before connecting to system piping. ii. The minimum flow rate shall not be less than the hydraulically calculated water demand flow rate of the system plus hose demands. **2. HYDROSTATIC TEST** i. The piping network shall be tested hydrostatically at not less than 13.8 bar (200 psi) of pressure for 2 hours, or at 3.5 bar (50 psi) in excess of the maximum pressure where the maximum pressure is in excess of 10.3 bar (150 psi). Pressure shall be maintained for 2 hours. ii. The piping, joints and discharge devices shall show no leakage. iii. Any leakage that results in a loss of pressure in excess of 0.1 bar (1½ psi) during a continuous 24-hour period shall be corrected. iv. The installing contractor shall furnish a certificate for flushing and hydrostatic test prior to the start of the fire pump and field acceptance test. v. Hose connections and General Directorate of Civil Defence - Kingdom of Bahrain. Breeching inlet connections shall be tested for compatibility. (All connections are instantaneous coupling type). vi. The piping between the Breeching inlet connection and the check valve in the inlet pipe shall be tested hydrostatically in the same manner. **3. FIELD ACCEPRANCE TEST** i. The tests for total flooding systems shall establish that all automatic closing devices for doors, windows, and conveyor openings, and automatic equipment interlocks, as well as automatic opening of heat and smoke vents or ventilators, will function upon system operation. ii. Deluge and pre-action and sprinkler systems shall be tested as per **Section D, Chapter-05 and Chapter-05.** iii. The foam quality (expansion and one-quarter drain time) or foam discharge shall be conducted, or the foam discharge shall be visually inspected to ensure that it is satisfactory for the purpose intended. iv. The foam proportion shall not be less than rated concentration. v. Where conditions permit, flow tests shall be conducted to ensure that the hazard is fully protected in conformance with the design specification vi. Waterflow detecting devices including the associated alarm circuits shall be flow tested through the inspector's test connection and shall result in an audible alarm on the premises within 5 minutes after such flow begins and until such flow stops vii. Testing shall be conducted while fire pumps are running. viii. For Foam sprinkler systems, at least one remote sprinkler head shall be burst open with heating device and associated system functions such as alarm gong operation, fire pump operation, flow switch operation etc. shall be tested and verified. ix. The automatic operation of a deluge or pre-action valve shall be tested in accordance with the manufacturer's instructions. x. All control valves shall be fully closed and opened under the system water pressure to ensure proper operation. xi. Signs, both in English and Arabic shall be verified on site. xii. The consultant shall hand over one set of stamped record drawings and one copy of the completed test report to the building owner.

Table:- D.08-T1.O.: Foam Systems Inspection and Maintenance

ITEM	REQUIREMENTS
2. QUARTERLY INSPECTION	i. At least annually, an inspection shall be made of foam concentrates and their tanks or storage containers for evidence of excessive sludging or deterioration. ii. The foam solution sample shall be annually tested at a laboratory to ensure the foam concentrate quality. iii. The proportioning system shall be inspected for good working condition. iv. The sight glass where provided on bladder tanks shall be cleaned. v. The piping shall not show signs of leakage vi. Pressure and flow gauges shall be free of damage and in good working condition. vii. The position (open or closed) of valves shall be verified in accordance with specified operating conditions. viii. Strainers shall be periodically inspected and shall be cleaned after each use and flow test. ix. The water flow alarm and supervisory signal initiating devices shall be inspected quarterly to verify that they are free of physical damage. x. The hydraulic design information sign shall be inspected quarterly to verify that it is provided, attached securely to the sprinkler riser, and is legible.
3. ANNUAL TEST	i. Systems shall be tested annually as per FIELD ACCEPTANCE TEST as required by D.08-T1.O.1., and this table, by the General Directorate of Civil Defence Permitted maintenance contractor. ii. The foam concentrate pump shall be tested as per the manufacturers specifications and manual.
4. MAINTENANCE	i. Valves shall be lubricated to ensure their smooth operation. ii. Pressure, flow gauges, supervisory signal devices and water flow devices shall be verified for good working condition. iii. The detection system for deluge and pre-action systems shall be verified for good working condition. iv. Leaking, damaged and corroded parts shall be replaced.

6.0. Material Test Standards and Permits.

6.1. Acceptable Test Standards and criteria

6.1.1. All the Valves, Pumps, Piping, Hose, Nozzles, Devices, Sprinklers, Motors, Materials, Systems, Assemblies, equipment, Products and Accessories, referred to in this chapter with respect to Life Safety, Fire Safety and Emergency Services shall be Listed, Permitted and Registered by the General Directorate of Civil Defence - Kingdom of Bahrain.

6.1.2. **There is no year of edition mentioned against any test standards. It is the intent of General Directorate of Civil Defence - Kingdom of Bahrain.to invite the customers seeking laboratory tests and the test laboratories to follow the "LATEST EDITION OF THE TEST STANDARD, AS AND WHEN THEY ARE UPGRADED/REVISED/AMENDED, TO THE DATE" , NFPA 16, NFPA 11 and NFPA 30.**

6.1.3. Fire Fighting Nozzles

- **i.** FM 5511 - Firefighting Nozzles for Use with Hose, Monitor Assemblies and other Firefighting Equipment.
- **ii.** UL 401, Portable Spray Hose Nozzles for Fire-Protection Service

6.1.4. Fire Fighting Monitors

- **i.** FM 1421 - Monitor Assembly

6.1.5. Foam System

- **i.** UL 162, Standard for Safety Foam Equipment and Liquid Concentrates.
- **ii.** UL 139, Standard for Medium and High Expansion foam Equipment and Liquid Concentrates.
  FM-5133, Standard for Safety Foam Equipment
- **iii.** FM 5130 - Foam Extinguishing Systems

6.1.6. Fire rated Cable, Certified for 120 minutes

- **i.** EN 50200, Method of test for resistance to fire of unprotected small cables for use in emergency circuits
- **ii.** UL 2196, Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control, and Data Cables
- **iii.** BS 8434-2, Methods of test for assessment of the fire integrity of electric cables. Test for unprotected small cables for use in emergency circuits. BS EN 50200 with a 930° flame and with water spray.
- **iv.** BS 7629-1, Electric cables. Specification for 300/500 V fire resistant screened cables having low emission of smoke and corrosive gases when affected by fire. Multicore and multipair cables.
- **v.** BS 6387, Test method for resistance to fire of cables required to maintain circuit integrity under fire conditions.

vi. IEC 60331-1, Tests for electric cables under fire conditions.
vii. IEC 60331-2, Tests for electric cables under fire conditions.
viii. IEC 60332-2-2, Tests on electric and optical fibre cables under fire conditions.
ix. IEC 60332-3-10, Tests on electric and optical fibre cables under fire conditions.
x. IEC 60331-2, Tests for electric cables under fire conditions.
xi. UL 1724, Outline of Investigation for Fire Tests for Electrical Circuit Protective Systems.
xii. UL 1685, Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables.
xiii. UL 1666, UL 1666 Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts.



Chapter 9 Clean agent systems



Chapter 9

Clean agent systems



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1.0 Scope

1.1 This standard contains minimum requirements for the design, installation, permit, and maintenance of total flooding and local-application fire extinguishing systems that use one of the gaseous agents in **Table:- D.09-T1.**

1.2 The scope of this standard does not include fire extinguishing systems that use carbon dioxide or water as the primary extinguishing media

1.3 This standard is prepared for use by and guidance of those charged with purchasing, designing, installing, testing, inspecting, permitting, listing, operating, and maintaining engineered or pre-engineered clean agent extinguishing systems.

2.0 Definitions

2.1 General

2.1.1 Shall

It is a mandatory requirement by General Directorate of Civil Defence – Kingdom of Bahrain

2.1.2. Should

It is a recommendation but it is not mandatory by General Directorate of Civil Defence – Kingdom of Bahrain.

2.1.3. Listed

Permitted and registered by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain.

2.1.4. Unit of Measurement

Unit of Measurement in this code are international system of units. (SI).

- 1 in. = 25.4 mm
- l gal= 3.785 L
- 1 ft3 = 0.028317 m3
- 1 lb= 0.4536 kg
- 1 lb/ft^3= 16.0185 kg/m3
- 1 psi = 6895 Pa
- 1 psi= 0.0689 bar
- 1 bar= 10^5 Pa

2.1.5. Fire Suppression

Sharply reducing the heat release rate of a fire and preventing its regrowth by means of direct and sufficient application of extinguishing agents such as water or gas or chemicals through the fire plume to the burning fuel surface.

2.1.6. NOAEL – No Observed Adverse Effect Level

The Highest concentration at which no adverse physiological or toxicological effect has been observed.

2.1.7. LOAEL – Lowest Observed Adverse Effect Level

The Lowest concentration at which an adverse physiological or toxicological effect has been observed.

2.1.8. Clean Agent

Electrically nonconducting, volatile, or gaseous fire extinguishing agent that does not leave a residue upon discharge.

2.1.9. Clean Agent Concentration

The portion of agent in an agent-air mixture expressed in volume percent.

2.1.10. Halocarbon Agent

An agent that contains as primary components one or more organic compounds containing one or more of the elements fluorine, chlorine, bromine, or iodine.

2.1.11. Inert Gas Agent

An agent that contains as primary components one or more of the gases helium, neon, argon, or nitrogen. Inert gas agents that are blends of gases can also contain carbon dioxide as a secondary component.

2.1.12. Total Flooding Quantity

The amount of halocarbon agent required to achieve the design concentration.

2.1.13. Minimum Design Quantity (MDQ)

The quantity of agent required to achieve the minimum design concentration.

2.1.14. Design Factor

A fraction of the agent Minimum Design Quantity (MDQ) added thereto deemed appropriate due to a specific feature of the protection application or design of the suppression system.

2.1.15. Final Design Quantity

The quantity of agent determined from the agent minimum design quantity as adjusted to account for design factors and pressure adjustment.

2.1.16. Local Application System.

A system consisting of a supply of extinguishing agent arranged to discharge directly on the burning material or equipment.

2.1.17. Pre-Engineered System.

A system having predetermined flow rates, nozzle pressures, and quantities of agent. These systems have the specific pipe size, maximum and minimum pipe lengths, flexible hose specifications, number of fittings, and number and types of nozzles prescribed by a testing laboratory. The type and size of hazard protected by these systems must be certified from an approval laboratory consisting of the actual fire tests. Limitations on hazards that can be protected by these systems are contained in the manufacturer's installation manual, which is referenced as part of the listing.

2.1.18 Total Flooding System.

A system consisting of an agent supply and distribution network with discharge nozzles designed to achieve a total flooding condition in a hazard volume.

2.1.19 Safety Factor (SF) .

A multiplier of the minimum extinguishing concentration or inerting concentration to determine the agent minimum design concentration.

2.1.20. Fill Density
Mass of agent per unit of container volume (the customary units are lb/ft^3 or kg/m^3).

2.1.21. No Observed Adverse Effect Level (NOAEL)
The highest concentration at which no adverse toxicological or physiological effect has been observed.

2.1.22. Lowest Observed Adverse Effect Level (LOAEL)
The lowest concentration at which adverse toxicological or physiological effect has been observed.

2.1.23. Normally Occupied Area
Area that is intended for occupancy.

2.1.24. Unoccupied Area
Area that is intended only for equipment and machinery providing services with periodic visits by personnel for repair and maintenance.
However, with respect to the use of clean agent systems, the LV rooms, transformer rooms, telephone rooms, generator rooms and other such equipment/ machinery rooms located in the occupied buildings or attached to occupied buildings, are not considered as unoccupied area because of the proximity of these rooms to public movement and the possible adverse effects of clean agents.

2.1.25 Class A Fire.
A fire in ordinary combustible materials, such as wood, cloth, paper, rubber, and many plastics.

2.1.26 Class B Fire.
A fire in flammable liquids, combustible liquids, petroleum greases, tars, oils, oil-based paints, solvents, lacquers, alcohols, and flammable gases.

2.1.27 Class C Fire.
A fire that involves energized electrical equipment.

2.1.28 Abort Switch.
A system control that, when operated during the releasing panel's release delay countdown, extends the delay in accordance with a predetermined effect.

2.1.29 Manual Release.
A manually operated initiating device used to initiate release of fire suppression agent.

3.0 Clean agent system Requirements

3.1 The requirements for Clean Agent System material, design, installation shall be as per **Table:-D.09-T1**

Table:-D.09-T1.: Clean Agent Systems Requirements

ITEMS	REQUIREMENTS
1. DEFINITION	i. The Clean agents allowed in this code shall be electrically non-conducting and leave no residue upon evaporation. ii. Any agent mentioned in this section is subject to the periodic evaluation by General Directorate of Civil Defence and Supreme council of Environment based on Environmental Protection Agency's (EPA) SNAP (Significant New Alternative Policy) . Such evaluations shall be based on the clean agents' adverse effects on Human, Marine, Animal health and environmental adverse effects. iii. Halocarbon Agents are a. Hydrofluorocarbons (HFCs) b. Hydrochlorofluorocarbons (HCFCs) c. Perfluorocarbons (PFCs or FCs) d. Fluoroiodocarbons (FICs) e. Fluoroketones (FKs). iv. Inert Gas Agents are a. IG-01 b. IG-100 c. IG-55 d. IG-541 v. Unnecessary exposure to Halocarbon clean agents OR Inert gas agents including at and below the NOAEL and halocarbon decomposition products
2. SAFETY	i. In not normally occupied areas, where egress takes longer than 30 seconds but less than 1 minute, the halocarbon agent shall not be used in a concentration exceeding its LOAEL. See **Table:-D.09-T1.A. for Halocarbon NOAEL and LOAEL.** ii. Unnecessary exposure to inert gas agent systems resulting in low oxygen atmospheres shall be avoided. The maximum exposure time in any case shall not exceed 5 minutes. See **Table:-D.09-T1.B. for Inert Gas NOAEL and LOAEL.**

Table:-D.09-T1.A: Halocarbon Agent NOAEL and LOAEL

AGENT	NOAEL (No Observed Adverse Effect Level)	LOAEL (Low Observed Adverse Effect Level)
1. **FK-5-1-12**	10 %	> 10 %
2. **HCFC Blend A**	10 %	> 10 %
3. **HCFC-124**	1 %	2.5 %
4. **HFC-125**	7.5 %	10 %
5. **HFC-227ea**	9 %	> 10.5 %
6. **HFC-23**	30 %	> 30 %
7. **HFC-236fa**	10 %	15 %

Table:-D.09-T1.B: Inert Gas Safety Levels

INERT GAS CONCENTRATION LEVELS	EXPOSURE LIMIT
1. < 43 % (12% Oxygen)	5 minutes
2. 43 % -52 % (12 % -10 % Oxygen)	3 minutes
3. 52 % -62 % (10 % -8 % Oxygen)	Only used in normally unoccupied spaces
4. > 62 % (Below 8% Oxygen)	Only used in normally unoccupied spaces

	Table:-D.09-T1.: Clean Agent Systems Requirements
ITEMS	**REQUIREMENTS**
3. LISTING	i. All Clean Agent systems, Clean Agent, Equipment, Design, Calculations, Installation and Maintenance manual shall be listed by General Directorate of Civil Defence – Kingdom of Bahrain.
4. COMPONENTS	i. Clean Agent container, Detectors, Control System, Pipes, Tubes, Fittings, Valves, Discharge Nozzles, pressure gauges, Manual actuators, Time Delays and Signage.
5. SYSTEM FLOW CALCULATIONS	i. System flow calculations shall be performed using a calculation method listed or permitted by General Directorate of Civil Defence –Kingdom of Bahrain. The system design shall be within the manufacturer's listed limitations.
6. ROOM INTEGRITY AND AIR TIGHTNESS	i. The room Integrity with airtight rooms shall be ensured for effective protection using clean agent systems. ii. Room tightness, measured in n50 value, shall be carried out using a blower door measurement method. (The Blower door measurement is a scientific approach to identify and control air filtration. It is primarily used to check for any possible leakages in a given area by applying two types of pressure: over pressure and under pressure. Calculation is based on the Air Change per Hour (ACH), meaning the number of time each hour, an amount of air equal to the volume of the area to be protected, leaks out at a pressure of 50Pa. The ventilator of the blower door measuring device creates a standard over/under pressure of 10 – 60 pa in the protected area. The air escapes over the leakage surfaces of the walls, doors and windows to the outside during overpressure measurement or enters from there during under pressure measurement. The device measures the required flow volume so that the pressure difference of 50 Pa (as an example) needed for measuring can be maintained in the area. After input of all the relevant values the program calculates the n50 value, which regulates itself and relates to the created pressure value of 50Pa). iii. The protected enclosure shall have the structural strength and integrity necessary to contain the agent discharge. If the developed pressures present a threat to the structural strength of the enclosure, venting shall be provided to prevent excessive pressures. iv. If there is a central air conditioning system, it must be an independent unit for the protected room or a fire damper must be provided for air conditioning unit to ensure that the clean agent gas does not pass through air conditioning unit to adjacent occcupancies. v. The doors and windows used for the protected areas shall comply with fire regulation and shall also be air tight to prevent leakage. The doors and windows shall have a mechanism for closing automatically in case of an emergency situation. For fire prevention systems the doors and windows shall be kept closed at all times except for access. vi. All penetrations in the enclosure shall be sealed to ensure airtightness. vii. The air tightness in terms of n50 values of the protected enclosure shall be as per **Table:-D.09-T1.C.**

	Table:-D.09-T1.C.: n50 values for Room Tightness
ROOM VOLUME	**n50 VALUE**
1. 1 m^3	5.0 /hour
2. 100 m^3	1.5 /hour
3. 1000 m^3	1.0 /hour
4. 10.000 m^3	0.1 /hour
5. 50,000 m^3	0.05 /hour
6. 500,000 m^3	0.01 /hour

	Table:-D.09-T1.: Clean Agent Systems Requirements
ITEMS	**REQUIREMENTS**
7. ELECTRICAL CLEARANCE	i. All Clean Agent System equipment and component shall be located to maintain the required electrical clearance as per the manufacturer's specifications. ii. Where the design basic insulation level (BIL) is not available and where nominal voltage is used for the design criteria, the highest minimum clearance specified for this group shall be used.
8. DESIGN CONCENTRATION	i. The flame extinguishing or inerting concentrations shall be used in determining the agent design concentration for a particular fuel. ii. For combinations of fuels, the flame extinguishment or inerting value for the fuel requiring the greatest concentration shall be used unless tests are made on the actual mixture. iii. Design concentrations shall comply with NFPA 2001 and manufacturer's specifications.
9. TOTAL FLOODING QUANTITY	i. The amount of halocarbon agent required to achieve the design concentration shall be calculated from the following formula. $W = \frac{V}{S}\left(\frac{C}{100-C}\right)$ Where, W—Weight of Clean Agent, Kg V—Net Volume of the Hazard, m^3 S– Specific volume of superheated agent vapor, t(m^3/Kg) C– Agent design concentration (Volume%) t– Minimum anticipated Temperature of protected volume, ^{0}C ii. The amount of inert gas agent required to achieve the design concentration shall be calculated from the following formula. $X = 2.303\left(\frac{V_s}{s}\right)\text{Log}_{10}\left(\frac{100}{100-C}\right)$ Where, X—Volume of Inert gas added per volume of protected space, Kg V_s—Specific Volume of Inert Gas agent at 21^{0}C and 1.013 bar S– Specific volume of Inert gas, t(m^3/Kg) C– Inert Gas design concentration (Volume%) t– Minimum anticipated Temperature of protected volume, ^{0}C
10. DISCHARGE TIME	i. The minimum design rate of application shall be based on the quantity of agent required for the desired concentration and the time allotted to achieve the desired concentration. ii. The discharge time period is defined as the time required to discharge from the nozzles 95 percent of the agent mass, at 70°F (21°C), necessary to achieve the minimum design concentration based on 20 percent safety factor for flame extinguishment. iii. For Halocarbon agents, the discharge time required to achieve 95 percent of the minimum design concentration for flame extinguishment based on a 20 percent safety factor shall not exceed 10 seconds. iv. For Inert gas agents, the discharge time required to achieve 95 percent of the minimum design concentration for flame extinguishment based on a 20 percent safety factor shall not exceed 60 seconds for Class B fuel hazards, 120 seconds for Class A surface fire hazards or Class C hazards.

	Table:-D.09-T1.: Clean Agent Systems Requirements
ITEMS	**REQUIREMENTS**
11. STORAGE CONTAINERS	i. The agent shall be stored in containers designed to hold that specific agent at ambient temperatures. Containers shall be charged to a fill density or super pressurization level within the range specified in the manufacturer's listed manual. ii. Each agent container shall have a permanent nameplate or other permanent marking that indicates a. For Halocarbon agent containers, the agent, tare and gross weights, and super pressurization level (where applicable) of the container. b. For Inert gas agent containers, the agent and the pressurization level of the container and nominal agent volume. iii. Containers connected in manifold, for Halocarbon clean agents in a multiple container system, and supplying the same manifold outlet for distribution of the same agent shall be interchangeable and of one selected size and charge. iv. Containers connected in manifold, for Inert gas agents shall be permitted to utilize multiple storage container sizes connected to a common manifold. v. Storage temperatures shall not exceed or be less than the manufacturer's listed limits. vi. Clean agent containers shall be located as close to hazard as possible or in the protected room next to the exit.
12. PIPES AND FITTINGS	i. Pipes and pipe connections shall be made of metal (seamless or welding) and be able to withstand the pressures as specified and calculated and any low temperature encountered. ii. The test pressure for the Inert Gas System's pipe between the cylinders and the area valve should have 1.5 times of the service pressure. (i.e. if 200-300 bar cylinder –test pressure, then pipe pressure resistance should be 300-450 bar). The test pressure for the pipe between the area valve and the protected area should have 1.5 times of the service pressure (i.e. if 60 bar is test pressure – 90 bar should be pipe pressure resistance). iii. Fittings shall be calculated for the occurring service pressure. Fittings shall be suitable for deeper temperatures (approx. –50°C). In sections of the pipe that are subjected to static head pressure (closed pipe work) the service pressure must not be exceeded and if needed a safety valve shall be fitted. iv. The pipe work between the cylinder and area valve shall be marked by the manufacturer, so that the identification according to the test certificates is possible after installation. Manifolds and distribution pipes may be marked as a kit by an authorized person. An unambiguous assignment to the test certificate shall be possible. Flexible pipes and hoses etc. shall only be used where fixed pipes are unsuitable. Flexible pipes and hoses shall be as short as possible and permitted. v. The inside and outside of pipes shall be effectively protected against corrosion if this is necessitated by environmental conditions. To protect sensitive machinery, e.g. computers, from corrosive particles in the pipe work, galvanized steel should be used as a minimum. vi. Special-alloy steels and/or suitable surface protection coatings shall be used if the use of pipes and connections made of steel does not provide sufficient corrosion protection. vii. The pipe work shall be arranged so that it cannot be damaged by its own weight, temperature fluctuations, vibration, release of gas or other installation inherent influences. viii. All pipe work shall be accessible. The gas installation pipe work shall be earthed. If necessary, potential equalization conductors (i.e. regarding non-conductive pipe joints) between all pipes shall be provided or the installation shall be earthed at different points (auxiliary equipotent bonding). ix. Pipes shall be secured especially near nozzles to prevent pipe movement due to the high-pressure during discharge.

	Table:-D.09-T1.: Clean Agent Systems Requirements
ITEMS	**REQUIREMENTS**
13. NOZZLES	i. The selection of the type of nozzles, numbers, spacing etc., shall be as per the manufacturer's design specifications. ii. Discharge nozzles shall be listed for their intended use. Listing criteria shall include flow characteristics, area coverage, height limits, and minimum pressures. Discharge orifices and discharge orifice plates and inserts shall be of a material that is corrosion resistant to the agent used and the atmosphere in the intended application. iii. Special corrosion-resistant materials or coatings shall be required in severely corrosive atmospheres. iv. Discharge nozzles shall be permanently marked to identify the manufacturer as well as the type and size of the orifice. v. Where clogging by external foreign materials is likely, discharge nozzles shall be provided with frangible discs, blow off caps, or other suitable devices. These devices shall provide an unobstructed opening upon system operation and shall be located such that they will not injure personnel.
14. FIRE DETECTION AND ALARM	i. Automatic detection shall be by any listed method or device capable of detecting and indicating heat, flame, smoke, combustible vapors, or an abnormal condition in the hazard, such as a process trouble, that is likely to produce fire. ii. The fire detection, actuation and alarm system shall comply with **Section C, Chapter 01. Fire Detection and Alarm Systems.** iii. Clean agent discharge shall be automatic. However, additional manual release stations shall be provided for easy access. iv. All devices shall be located, installed, or suitably protected so that they are not subject to mechanical, chemical, or other damage that would render them inoperative. v. Audible and visual pre-discharge alarms shall be provided within the protected area to give positive warning of impending discharge. The operation of the warning devices shall be continued after agent discharge until positive action has been taken to acknowledge the alarm and proceed with appropriate action. vi. Abort switches, where provided, shall be located within the protected area an near the means of egress for the area. The abort switch shall be of a type that requires a constant manual pressure to cause abort. In all cases the normal and manual emergency control shall override the abort function. Operation of the abort function shall result in both audible and distinct visual indications of system impairment. The abort switch shall be clearly recognizable for the purpose intended.
15. TIME DELAYS	i. For clean agent extinguishing systems, a pre-discharge alarm and time delay, sufficient to allow the personnel evacuation prior to discharge, shall be provided. ii. Time delays shall be used only for the evacuation of personnel or to prepare the hazard area for discharge. iii. Warning and instruction signs at entrances to and inside protected areas shall be provided in both Arabic and English.
	 

Figure:- D.09.F1.: Warning Signs Outside Clean Agent protected Area

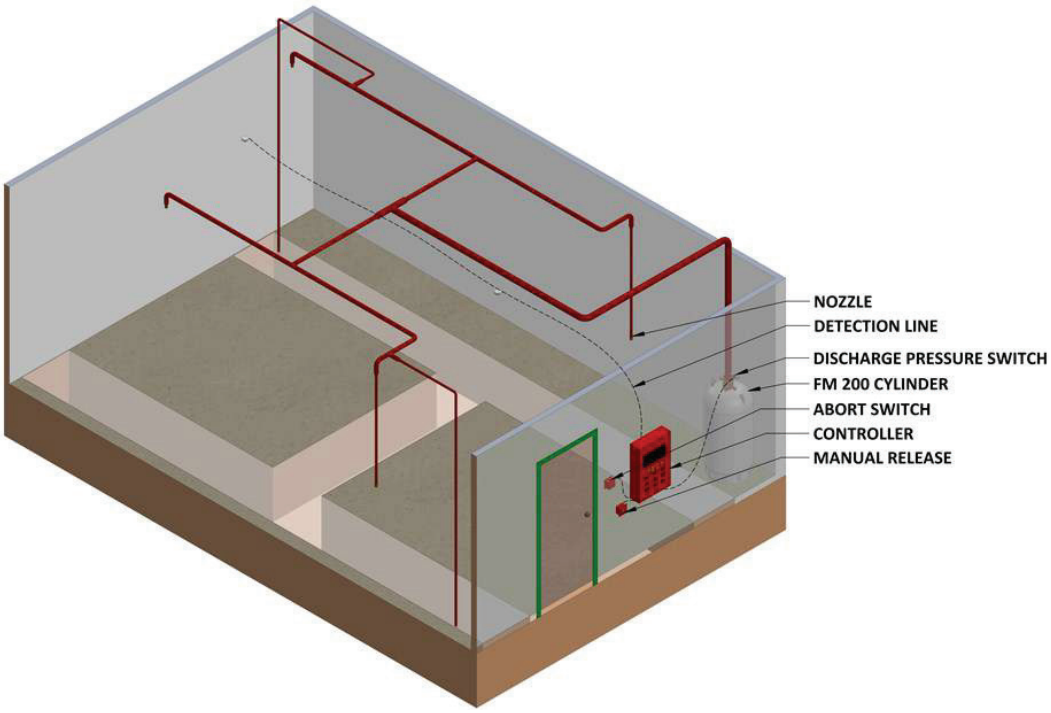

Figure:- D.09.F2: Typical Chemical (Halocarbon) Gas System

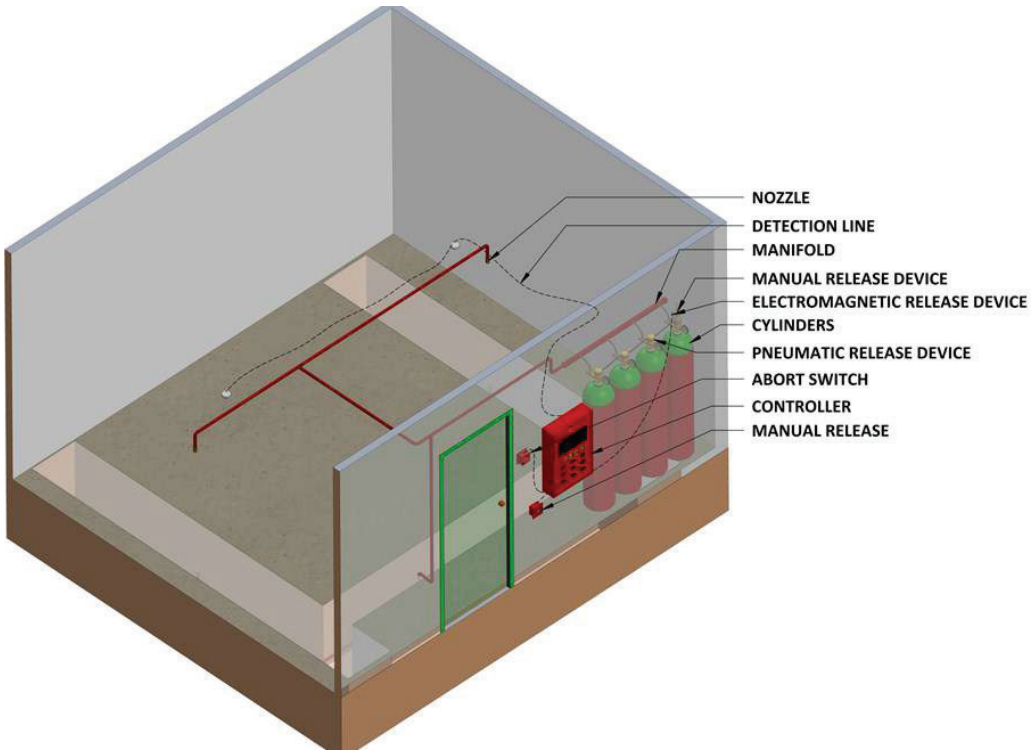

Figure:- D.09.F3.: Typical Inert Gas System

	Table:-D.09-T1.: Clean Agent Systems Requirements
ITEMS	**REQUIREMENTS**
16. GENERAL EPA SAFETY RECOMMEN-DATIONS FOR ALL CLEAN AGENTS AND FIRE SUPPRESSION AGENTS	i. Must conform with OSHA 29 CFR 1910 Subpart L Sections 1910.160 and 1910.162. ii. Per OSHA requirements, protective gear (SCBA) must be available in the event personnel must reenter the area. iii. Discharge testing should be strictly limited only to that which is essential to meet safety or performance requirements. The agent should be recovered from the fire protection system in conjunction with testing or servicing, and recycled for later use or destroyed. iv. EPA (Environmental Protection Agency, USA) recommends that users consult Section VIII of the OSHA Technical Manual for information on selecting the appropriate types of personal protective equipment for all listed fire suppression agents. EPA has no intention of duplicating or displacing OSHA coverage related to the use of personal protective equipment (e.g., respiratory protection), fire protection, hazard communication, worker training or any other occupational safety and health standard with respect to EPAs regulation of halon substitutes (Fire suppression agents). v. The NFPA 2001 Standard for Clean Agent Fire Extinguishing Systems gives guidelines for blends that contain HFC-134a or HCFC-22 and other acceptable total flooding agents, rather than referring to HFC-134a or HCFC-22 alone.
17. APPLICATION OF CHEMICAL GASES	i. The application of Halocarbon Agents shall comply with **Table:-D.09-T1.D.** ii. The Halocarbon (Chemical) Agents and their application acceptable to General Directorate of Civil Defence – Kingdom of Bahrain based on Environmental Protection Agency - EPA's SNAP (Significant New Alternative Policy) program, as of October 2016. iii. The EPA continuously reviews and updates their policy of these alternate substitutes and same shall be adopted by General Directorate of Civil Defence – Kingdom of Bahrain based on their periodic evaluation of environmental and health risks, including factors such as ozone depletion potential, global warming potential, toxicity, flammability, exposure potential and acceptance in occupied spaces etc., of all the fire suppression agents. iv. Where EPA's SNAP or manufacturers comment or recommend any of the precautionary and safety measures such as a. Avoid unnecessary exposure b. Container labels of potential hazard and handling procedures to reduce risk c. Only manual activation in occupied areas d. Install ventilation e. Immediate spillage cleaning in accordance with good hygiene practices f. Training of the personnel involved For any clean agent, such installations shall not be acceptable in occupied spaces unless all of the additional justifications mentioned below are furnished to General Directorate of Civil Defence – Kingdom of Bahrain acceptance and permit. a. NOC from concerned authority such as Supreme Council for the Environment for disposal of hazardous wastes. b. NOC from concerned authority such as National Health Regulatory Authority which ensures that the clean agent is not toxic to humans and animals before and after release. c. Manufacturer's training certificate for the engineers and technicians who are involved in handling, installing, maintaining and servicing such clean agent installation.

	Table:-D.09-T1.D.: Application of Chemical (Halocarbon) Agents		
HALOCARBON AGENT	**COMMERCIAL NAME**	**TECHNICAL INFORMATION**	**EPA COMMENTS**
1. HFC 227ea	FM-200, FE-227, MH 227, Solkaflam 227	i. Consists of Carbon, Fluorine and Hydrogen ii. Super pressurized with Nitrogen to 2482 Kpa iii. Colorless, Odorless and Electrically Non- conductive iv. Operating temperature is -12.2 0C to 65.6 0C	v. Stored in liquid form at 24-42 bar vi. Use of this agent should be in accordance with the safety guide lines in the latest edition of the NFPA 2001 Standard for Clean Agent. Fire Extinguishing Systems. vii. See additional comments i, ii, iii, iv, v. in **Table:-D.09-T1.16.**
2. C6-PERFLUORO-KETONE *1,1,1,2,2,4,5,5,5-nonafluoro-4-(trifluoromethyl)-3-pentanone+	Novec 1230	i. Boiling point of 49^{0}C ii. Stored in liquid form, Super pressurized with Nitrogen to 25 bar	iii. Use of the agent should be in accordance with the safety guide lines in the latest edition of the NFPA 2001 Standard for Clean Agent Fire Extinguishing Systems. iv. For operations that install and maintain total flooding systems using this agent, EPA recommends the following: - install and use adequate ventilation; clean up all spills immediately in accordance with good industrial hygiene practices; and provide training for safe handling procedures to all employees that would be likely to handle containers of the agent or extinguishing units filled with the agent. v. See additional comments i, ii, iii, iv, v. in **Table:-D.09-T1.16.**
3. HFC 125, HFC-227ea with 0.1% d-limonene	NAF S 125, NAF S 227 ECARO-25,	i. Super-pressurized with Nitrogen to 2482 Kpa ii. Colorless, Odorless and Electrically Non-conductive iii. Operating temperature is -12.2 ◦C to 65.6 ◦C iv. Stored in liquid form at 24 bar	v. Use of the agent should be in accordance with the safety guidelines in the latest edition of the NFPA 2001 Standard for Clean Agent Fire Extinguishing Systems. vi. Extinguisher bottles should be clearly labeled with the potential hazards associated with the use of HFC-125 and d-limonene, as well as handling procedures to reduce risk resulting from these hazards. vii. See additional comments i, ii, iii, iv, v. in **Table:-D.09-T1.16.**
4. HFC 125	FE-25	i. Super-pressurized with Nitrogen to 2482 Kpa ii. Colorless, Odorless and Electrically Non-conductive iii. Operating temperature is -12.2°C to 65.6°C iv. Stored in liquid form at 24 bar	v. Use of this agent should be in accordance with the safety guidelines in the latest edition of the NFPA 2001 Standard for Clean Agent. Fire Extinguishing Systems. vi. See additional comments i, ii, iii, iv, v. in **Table:-D.09-T1.16.**

	Table:-D.09-T1.D.: Application of Chemical (Halocarbon) Agents		
HALOCARBON AGENT	**COMMERCIAL NAME**	**TECHNICAL INFORMATION**	**EPA COMMENTS**
5. HCFC Blend A	NAF-S-III	i. Super-pressurized with Nitrogen to 2482 Kpa ii. Colorless, Odorless and Electrically Non-conductive iii. Operating temperature is -12.2 ◦C to 65.6 ◦C iv. Stored in liquid form at 24 bar	v. Use of this agent should be in accordance with the safety guidelines in the latest edition of the NFPA 2001 Standard for Clean Agent. Fire Extinguishing Systems. vi. See additional comments i, ii, iii, iv, v. in **Table:-D.09-T1.16.**
NOT ACCEPTABLE AGENTS	HFC 32, HCFC 22 FM-100, HFC 227 BC, Gelled HFC, Halotron II, FE-36, C3F8, C4F10, CF31	NOT ACCEPTABLE BY GENERAL DIRECTORATE OF CIVIL DEFENCE AND NOT AVAILABLE IN NFPA 2001	NA

	Table:-D.09-T1: Clean Agent Systems Requirements
ITEMS	**REQUIREMENTS**
18. APPLICATION OF INERT GASES	i. Application of Inert Gas Agents shall comply with **Table:-D.09-T1.E.** ii. Inert gas agents are compressed and stored in very high pressurized containers. All containers shall be listed for such high pressures, allowable filling density and operating temperatures. ii. Inert gas containers shall not be located in the hazard they protect. The exposure to high temperatures of fires cause rupture and explosions of containers. iv. The rooms where inert gas containers are stored, shall be temperature controlled and protected with sprinklers or clean agents. v. The Inert Agents and their application acceptable to General Directorate of Civil Defence – Kingdom of Bahrain are based on Environmental Protection Agency-EPA's SNAP (Significant New Alternatives Policy) program, as of October 2016. vi. The EPA continuously reviews and updates their policy of these alternate substitutes and same shall be adopted by General Directorate of Civil Defence – Kingdom of Bahrain based on their periodic evaluation of environmental and health risks, including factors such as ozone depletion potential, global warming potential, toxicity, flammability, exposure potential and acceptance in occupied spaces etc., of all the fire suppression agents. vii. Where EPA's SNAP or manufacturers comment or recommend any of the precautionary and safety measures such as a. Avoid unnecessary exposure b. Asphyxiation at high concentrations c. High CO2 d. Low residual oxygen levels e. Container labels of potential hazard and handling procedures to reduce risk f. Only manual activation in occupied areas g. Install ventilation h. Immediate spillage cleaning in accordance with good hygiene practices i. Training of the personnel involved j. Eye wash, For any clean agent, such installations shall not be acceptable in occupied spaces unless all of the additional justifications mentioned below are furnished to General Directorate of Civil Defence acceptance and permit. a. NOC from concerned authority such as Supreme council for the environment control for disposal of hazardous wastes. b. NOC from concerned authority such as National Health Regulatory Authority Bahrain which ensures that the clean agent is not toxic to humans and animals before and after release. c. Manufacturer's training certificate for the engineers and technicians who are involved in handling, installing, maintaining and servicing such clean agent installations.

	Table:-D.09-T1.E.: Application of Inert Gas Agents		
HALOCARBON AGENT	**COMMERCIAL NAME**	**TECHNICAL INFORMATION**	**EPA COMMENTS**
1. IG-01	Argotec, Inert Gas Blend C.	i. Density- 1.165 kg/m^3 ii. Does not mix in reservoirs iii. Low friction loss iv. Cylinder pressure –200 bar	v. Use of this agent should be in accordance with the safety guidelines in the latest edition of the NFPA 2001 Standard for Clean Agent. Fire Extinguishing Systems. vi. See additional comments i, ii, v. in **Table:-D.09-T1.16.**
2. NITROGEN IG 100	IG 100 NN 100	i. Density- 1.165 kg/ m^3 ii. Does not mix in reservoirs iii. Low friction loss iv. Cylinder pressure –200 bar	v. Use of this agent should be in accordance with the safety guidelines in the latest edition of the NFPA 2001 Standard for Clean Agent. Fire Extinguishing Systems. vi. See additional comments i, ii, v. in **Table:-D.09-T1.16.**
3. IG 541	INERGEN	i. Density- 1.418 kg/m^3 ii. Does not mix in reservoirs iii. Low friction loss iv. Cylinder pressure –300 bar	v. Use of this agent should be in accordance with the safety guidelines in the latest edition of the NFPA 2001 Standard for Clean Agent Fire Extinguishing Systems. vi. This agent contains CO2, which is intended to increase blood oxygenation and cerebral blood flow in low oxygen atmospheres. vii. The design concentration should result in no more than 5% CO2. viii. See additional comments i, ii, v. in **Table:-D.09-T1.16.**
4. ARGONITE IG 55	IG 55	i. Density- 1.412 kg/m^3 ii. Does not mix in reservoirs iii. Low friction loss iv. Cylinder pressure –300 bar	v. Use of this agent should be in accordance with the safety guidelines in the latest edition of the NFPA 2001 Standard for Clean Agent. Fire Extinguishing Systems. vi. See additional comments i, ii, v. in **Table:-D.09-T1.16.**
5. INERT GAS AND POWDERED AEROSOL BLENDS	FS 0140 ETC.	NOT ACCEPTABLE BY GENERAL DIRECTORATE OF CIVIL DEFENCE	NA

4.0 Inspection and Maintenance

4.1 Clean Agent Systems shall be inspected and maintained as per the minimum guidelines in accordance with **Table:-D.09-T2.** However, detailed acceptance, inspection tests and maintenance shall be as per **NFPA 2001, and Manufacturer's guidelines.**

Table:-D.09-T2.: Clean Agent Systems Testing, Inspection and Maintenance

ITEM	REQUIREMENTS
1. ACCEPTANCE TEST/ INSPECTIONS	i. The completed system shall be reviewed and tested by qualified personnel to meet the permit of General Directorate of Civil Defence – Kingdom of Bahrain. Only listed equipment and devices shall be used in the systems. To determine that the system has been properly installed and will function as specified, following inspection tests shall be performed. ii. The piping distribution system shall be inspected to determine that it is in compliance with the design and installation documents. iii. Nozzles and pipe size shall be in accordance with system drawings. Means of pipe size reduction and attitudes of tees shall be checked for their conformance to the design. iv. Piping joints, discharge nozzles, and piping supports shall be securely fastened to prevent unacceptable vertical or lateral movement during discharge. Discharge nozzles shall be installed in such a manner that piping cannot become detached during discharge. v. During assembly, the piping distribution system shall be inspected internally to detect the possibility of any oil or particulate matter soiling the hazard area or affecting the agent distribution due to a reduction in the effective nozzle orifice area. vi. The discharge nozzle shall be oriented in such a manner that an optimum agent dispersal can be effected. vii. If nozzle deflectors are installed, they shall be positioned to obtain the maximum benefit. viii. The discharge nozzles, piping, and mounting brackets shall be installed in such a manner that they will not potentially cause injury to personnel. Agent shall not directly impinge on areas where personnel could be found in the normal work area. The agent shall not directly impinge on any loose objects or shelves, cabinet tops, or similar surfaces where loose objects could be present and become missiles. ix. All agent storage containers shall be properly located in accordance with an permitted set of system drawings. x. All containers and mounting brackets shall be fastened securely in accordance with the manufacturer's requirements. xi. All total flooding systems shall have the enclosure examined and tested to locate and then effectively seal any significant air leaks that could result in a failure of the enclosure to hold the specified agent concentration level for the specified holding period. The currently preferred method is using a blower door fan unit and smoke pencil. Quantitative results shall be obtained and recorded to indicate that the specified agent concentration for the specified duration of protection is in compliance with the consultant's permitted designs. xii. The power shall be supplied to the control unit from a separate dedicated source that will not be shut down on system operation. xiii. Adequate and reliable primary and 24-hour minimum standby sources of energy shall be used to provide for operation of the detection, signaling, control, and actuation requirements of the system. xiv. The piping shall be pneumatically tested in a closed circuit for a period of 10 minutes at 40 psig (276 kPa). At the end of 10 minutes, the pressure drop shall not exceed 20 percent of the test pressure. xv. A flow test using nitrogen or an inert gas shall be performed on the piping network to verify that flow is continuous and that the piping and nozzles are unobstructed.

Table:-D.09-T2.: Clean Agent Systems Testing, Inspection and Maintenance	
ITEM	**REQUIREMENTS**
2. FUNCTIONAL TESTS	i. Disable each agent storage container release mechanism so that activation of the release circuit will not release the agent. Reconnect the release circuit with a functional device in lieu of each agent storage container release mechanism. For electrically actuated release mechanisms, these devices can include 24-V lamps, flashbulbs, or circuit breakers. Pneumatically actuated release mechanisms can include pressure gauges. Refer to the manufacturer's recommendations in all cases. ii. Operate detection initiating circuit(s). Verify that all alarm functions occur according to the design specifications. iii. Operate the necessary circuit to initiate a second alarm circuit if present. Verify that all second alarm functions occur according to design specifications. iv. Operate manual release. Verify that manual release functions occur according to design specifications. v. Operate the abort switch circuit if supplied. Verify that abort functions occur according to the design specifications. Confirm that visual and audible supervisory signals are received at the control panel. vi. Test all automatic valves unless testing the valve will release agent or damage the valve (destructive testing). vii. Check pneumatic equipment, where required, for integrity to ensure proper operation. viii. When all pre-discharge work is completed, each agent storage container shall be reconnected so that activation of the release circuit will release the agent. The system shall be returned to its fully operational design condition.
3. MAINTENANCE	i. For halocarbon clean agents, if a container shows a loss in agent quantity of more than 5 percent or a loss in pressure (adjusted for temperature) of more than 10 percent, it shall be refilled or replaced. ii. For inert gas clean agents that are not liquefied, pressure is an indication of agent quantity. If an inert gas clean agent container shows a loss in pressure (adjusted for temperature) of more than 5 percent, it shall be refilled or replaced. Where container pressure gauges are used for this purpose, they shall be compared to a separate calibrated device at least annually. iii. Where the amount of agent in the container is determined by special measuring devices, these devices shall be listed. iv. All halocarbon clean agent removed from refillable containers during service or maintenance procedures shall be collected and recycled or disposed of in an environmentally sound manner and in accordance with existing laws and regulations. v. Factory-charged and nonrefillable containers that do not have a means of pressure indication shall have the agent quantity checked at least semiannually. If a container shows a loss in agent quantity of more than 5 percent, it shall be replaced. All factory-charged and nonrefillable containers removed from useful service shall be returned for recycling of the agent or disposed of in an environmentally sound manner and in accordance with existing laws and regulations and certification body and manufacturer's guidelines and warnings. vi. For halocarbon clean agents, the date of inspection, gross weight of cylinder plus agent or net weight of agent, the type of agent, the person performing the inspection, and, where applicable, the pressure at a recorded temperature shall be recorded on a tag attached to the container. For inert gas clean agents, the date of inspection, the type of agent, the person performing the inspection, and the pressure at a recorded temperature shall be recorded on a tag attached to the container. vii. Cylinders continuously in service without discharging shall be given a complete external visual inspection every 5 years or more frequently if required. The visual inspection shall be in accordance with Section 3 of CGA C-6, Standard for Visual Inspection of Steel Compressed Gas Cylinders, except that the cylinders not needed to be emptied or stamped while under pressure. Inspections shall be made only by competent personnel, permitted by General Directorate of Civil Defence – Kingdom of Bahrain, and the reports shall be furnished to the owner.

5.0 Material Test Standards and Permits.

5.1. Acceptable Test Standards and criteria

5.1.1 All the Piping, Hose, Nozzles, Devices, Systems, Assemblies, equipment, Products and Accessories, referred to in this chapter with respect to Life Safety, Fire Safety and Emergency Services shall be Listed, permitted and Registered by the General Directorate of Civil Defence – Kingdom of Bahrain.

5.1.2. There is no year of edition mentioned against any test standards. It is the intent of General Directorate of Civil Defence – Kingdom of Bahrain to invite the customers seeking laboratory tests and the test laboratories to follow the "LATEST EDITION OF THE TEST STANDARD, AS AND WHEN THEY ARE UPGRADED/REVISED/ AMENDED, TO THE DATE"

5.1.3. Inert Gas Clean Agent Systems

- **i.** UL 2127, Standard for Inert Gas Clean Agent Extinguishing System Units.
- **ii.** FM 5600 - Clean Agent Extinguishing Systems

5.1.4. Chemical Gas Clean Agent Systems

- **i.** UL 2166, Standard for Halocarbon Clean Agent Extinguishing System Units.
- **ii.** FM 5600 - Clean Agent Extinguishing Systems

5.1.5. CO2 Systems (Industrial Use Only)

- **i.** FM 5420 - Carbon Dioxide Extinguishing Systems

5.1.6. Fire rated Cable, Certified for 120 minutes

- **i.** EN 50200, Method of test for resistance to fire of unprotected small cables for use in emergency circuits
- **ii.** UL 2196, Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control, and Data Cables
- **iii.** BS 8434-2, Methods of test for assessment of the fire integrity of electric cables. Test for unprotected small cables for use in emergency circuits. BS EN 50200 with a 930° flame and with water spray.
- **iv.** BS 7629-1, Electric cables. Specification for 300/500 V fire resistant screened cables having low emission of smoke and corrosive gases when affected by fire. Multicore and multipair cables.
- **v.** BS 6387, Test method for resistance to fire of cables required to maintain circuit integrity under fire conditions.
- **vi.** IEC 60331-1, Tests for electric cables under fire conditions.
- **vii.** IEC 60331-2, Tests for electric cables under fire conditions.
- **viii.** IEC 60332-2-2, Tests on electric and optical fiber cables under fire conditions.
- **ix.** IEC 60332-3-10, Tests on electric and optical fiber cables under fire conditions.
- **x.** IEC 60331-2, Tests for electric cables under fire conditions.
- **xi.** UL 1724, Outline of Investigation for Fire Tests for Electrical Circuit Protective Systems.
- **xii.** UL 1685, Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables.
- **xiii.** UL 1666, UL 1666 Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts.



Chapter 10

Other Extinguishing Agent and Systems

Section D

Chapter 10

Other Extinguishing Agent and Systems



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1.0 Scope

1.1 This code provides general information on design, installation, permits, listing, inspection and maintenance of Water mist Fire Protection system.

1.2 To provide protection for life and property from fire through standardization of design, installation, maintenance and testing requirements for water based fire suppression system that use a specific spray (mist) that absorbs heat, displaces oxygen or block the radiant heat to control, suppress or extinguish fires.

2.0 Definitions

2.1. General

2.1.1. Shall

It is a mandatory requirement by General Directorate of Civil Defence - Kingdom of Bahrain.

2.1.2. Should

It is a recommendation but it is not mandatory by General Directorate of Civil Defence - Kingdom of Bahrain.

2.1.3. Listed

Permitted and registered by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain.

2.1.4. Bar (bar)

Unit of measurement for pressure. Though it is not a SI unit, it is a common practice to use this unit of measurement in fire protection.

2.1.5. Unit of Measurement

The Unit of Measurement in this code are international system of units. (SI).

- 1 in. = 25.4 mm
- 1 ft^2 = 0.0929 m^2
- 1 gal = 3.785 dm^3
- 1 gal = 3.785 L
- 1 gpm/ft^2 = (40.746 L/min)/ m^2
- 1 ft^3 = 0.028317 m^3
- 1 lb = 0.4536 Kg
- 1 lb/ ft^3 = 16.0183 Kg/m^3
- 1 psi = 6894.757 Pa
- 1 psi = 0.0689 bar
- 1 bar = 10^5 Pa
- 1 mm = 1000 µ

2.1.6. GPM (Gallons per minute)

Unit of measurement for flow. Though it is not a SI unit, it is widely a practice to use this unit of measurement for water flow per square feet in fire protection. 1 GPM (gpm/minute) = 3.78 Liter/minute (LPM).

2.1.7. Fire Suppression

Sharply reducing the heat release rate of a fire and preventing its regrowth by means of direct and sufficient application of extinguishing agents such as water or gas or chemicals through the fire plume to the burning fuel surface.

2.1.8. Gas and Chemical based Fire Suppression Systems

Gas extinguishing technology is based mainly on the principle of removing oxygen. By introducing a gaseous extinguishing agent into the room's atmosphere the oxygen content is reduced to the point where the combustion process is halted. The gas extinguishing process uses either inert or chemical gases. This technique and mechanism using various gases and chemicals such as Clean Agents, CO2, Dry Chemical and Wet Chemical agents and their fire extinguishing properties to fight and extinguish fires are called Gas and Chemical based Fire Protection Systems.

2.1.9 Dry Chemical

A powder composed of very small particles, usually sodium bicarbonate, and potassium bicarbonate, or ammonium phosphate based with added particulate material supplemented by a special treatment to provide resistance to packing, resistance to moisture absorption (caking), and the proper flow capabilities.

2.1.10. Multipurpose Dry Chemical

Ammonium phosphate-based extinguishing agent that is effective on fires involving both ordinary combustibles, such as wood or paper, and fires involving flammable liquids.

2.1.11. Dry Chemical System

A means of applying dry chemical that can be automatically or manually activated to discharge through a distribution system onto or into the protected hazard. The system includes auxiliary equipment.

2.1.12. Engineered System

Those requiring individual calculation and design to determine the flow rates, nozzle pressures, pipe size, area or volume protected by each nozzle, quantities of dry chemical, number and types of nozzles, and their placement in a specific system.

2.1.13. Pre-Engineered Systems

Those having predetermined flow rates, nozzle pressures, and quantities of dry chemical.

2.1.14. Local Application System

A supply of dry chemical permanently connected to fixed piping with nozzles arranged to discharge directly onto the fire.

2.1.15. Total Flooding System

A supply of dry chemical permanently connected to fixed piping and nozzles that are arranged to discharge dry chemical into an enclosure surrounding the hazard.

2.1.16. Expellant Gas

The medium used to discharge dry chemicals from container.

2.1.17. Discharge Nozzle
Device from which the dry chemical is discharged to provide for the suppression of a fire in the designated hazard.

2.1.18. Caking
A phenomenon that occurs when moisture chemically reacts with a dry chemical Fire extinguishing agent. This reaction results in materials that, being hydrated by moisture, stick together to form a large agglomerate, or what is more commonly referred to as lumps.

2.1.19. Wet Chemical, Liquid Agent, Wet Agent
Normally an aqueous solution of organic or inorganic salts or a combination there-of that forms an extinguishing agent.

2.1.20. Pre-Engineered Systems
Those having predetermined flow rates, nozzle pressures, and quantities of extinguishing agent. These systems have the specific pipe size, maximum and minimum pipe lengths, flexible hose specifications, number of fittings, and number and types of nozzles prescribed by a testing laboratory. The maximum and minimum pipe lengths and the number of fittings shall be permitted to be expressed in equivalent feet of pipe. The hazards protected by these systems are specifically limited as to type and size by a testing laboratory, based on actual fire tests. Limitations on hazards that are permitted to be protected by these systems and piping and nozzle configurations are contained in the manufacturer's listed installation and maintenance manual, which is part of the listing of the system. Pre-engineered systems can be wet as well as dry chemical systems.

2.1.21. Automatic Operation
Operation without human intervention. This operation includes, but is not limited to, heat, rate of heat rise, smoke, or pressure change.

2.1.22. Expellant Gas
The medium used to discharge the extinguishing agent from container.

2.1.23. Auxiliary Equipment
Listed equipment used in conjunction with the wet chemical systems, for example, to shut down power, fuel, or ventilation to the hazard being protected or to initiate signaling devices.

2.1.24. Branch Duct
The duct work that contains the exhaust air from a single hood or hazard area.

2.1.25. Common Duct
The duct work containing the exhaust air from two or more branch ducts.

2.1.26. Recharge
The replacement of the extinguishing agent and expellant gas.

2.1.27 Unoccupied Area
Area that is intended only for equipment and machinery providing services with periodic visits by personnel for repair and maintenance. However, with respect to the use of Clean agent, Aerosols, CO2 and other fire suppression systems, the LV rooms, transformer rooms, telephone rooms, generator rooms and other such equipment/ machinery rooms located in the occupied buildings or attached to occupied buildings, are not considered as unoccupied areas because of the proximity of these rooms to public movement and the possible adverse effects of fire suppression agents.

2.1.28 Combustible Dust

Combustible dust, or explosive dust, is defined by Occupational Safety & Health Administration (OSHA) as "a solid material, composed of distinct particles or pieces, which presents a fire or hazard when suspended in air or some other oxidizing medium. Any material can be combustible dust if it contains a sufficient concentration of small enough particles (under 500 microns) suspended in the air or dispersed in a dust cloud that can burn rapidly, causing an explosion or flash fire. (Metals, Powder paint, Rubber Industries).

3.0 General Requirements

3.0.1. The requirements for various other Extinguishing System material, design, installation shall be as per this section and **Table:- D.10-T1, Table:-D,10-T2 and D.10-T3.**

3.0.2 The fire suppression Agents and their application acceptable to General Directorate of Civil Defence and Supreme Council of environment based on Environmental Protection Agency - EPA's SNAP (Significant New Alternatives Policy) program, as of October 2016.

3.0.3. The EPA continuously reviews and updates their policy of these alternate substitutes and same shall be adopted by General Directorate of Civil Defence based on their periodic evaluation of environmental and health risks, including factors such as ozone depletion potential, global warming potential, toxicity, flammability, exposure potential and acceptance in occupied spaces etc., of all the fire suppression agents.

3.0.4. Where EPA's SNAP or manufacturers comment or recommend any of the precautionary and safety measures such as

a. Avoid unnecessary exposure
b. Asphyxiation at high concentrations
c. High CO2
d. Low residual oxygen levels
e. Container labels of potential hazard and handling procedures to reduce risk
f. Only manual activation in occupied areas
g. Install ventilation
h. Immediate spillage cleaning in accordance with good hygiene practices
i. Training of the personnel involved
g. Eye wash,

For any clean agent, such installations shall not be acceptable in occupied spaces unless all of the additional justifications mentioned below are furnished to General Directorate of Civil Defence acceptance and permits.

a. NOC from concerned authority such as supreme council of environment approval for disposal of hazardous wastes.
b. NOC from concerned authority such as Health Authority which ensures that the clean agent is not toxic to humans and animals before and after release.
c. Manufacturer's training certificate for the engineers and technicians who are involved in handling, installing, maintaining and servicing such clean agent installations.

3.1. Wet Chemical Systems

3.1.1. The requirements for Wet Chemical System material, design, installation shall be as per **Table:- D.10-T1 .**

Table:- D.10-T1 : Wet Chemical System Requirements

ITEMS	REQUIREMENTS
1. DEFINITION	i. Generally a wet chemical solution is, including but not limited to, potassium carbonate based, potassium acetate–based, potassium citrate–based, or a combination thereof, and is mixed with water to form an alkaline solution capable of being discharged through piping or tubing when under expellant gas pressure. ii. The wet Chemical System in this code refers to pre-engineered systems, that discharge wet chemical from fixed nozzles and piping by means of an expellant gas. iii. Wet chemical extinguishing agents shall not be acceptable for use in areas where fires involve an energized electrical equipment. iv. The building owner(s) shall be responsible for the protection of a common exhaust duct(s) used by more than one tenant and the tenant shall be responsible for the protection of common exhaust duct(s) serving hoods located within the tenant's space and up to the point of connection to the building owner's common exhaust duct.
2. APPLICATION	i. The pre-engineered Wet Chemical System can be used to protect hazards such as Commercial Kitchen Hoods, Plenums, Ducts and associated cooking appliances Grease removal devices and emergency recovery devices installed in exhaust system. ii. Each protected cooking appliance, individual hood, and branch exhaust duct directly connected to the hood shall be protected by a system or systems designed
3. COMPONENTS	i. Wet Chemical container, Detectors, Control System, Expellant Gas cartridge, Pipes, Tubes, Fittings, Hose, Discharge Nozzles, pressure gauges, Manual actuators, Isolation valves, and Solenoid Valves. ii. The wet Chemical system as an entire system with its design, installation and maintenance manual from the manufacturer shall be listed and permitted by General Directorate of Civil Defence – Kingdom of Bahrain.
4. NOZZLE	i. Nozzle shall be listed and shall be provided with an internal strainer or a separate listed strainer located immediately upstream. ii. Discharge nozzles shall be of brass, stainless steel, or other corrosion-resistant materials, or be protected inside and out against corrosion. iii. All discharge nozzles shall be provided with caps or other suitable devices to prevent the entrance of grease vapors, moisture, or other foreign materials into the piping and shall blow off or open during discharge.
5. DETECTORS / OPERATING DEVICES	i. Operating devices shall be designed to function properly through a minimum temperature range from 0°C to 49°C or marked to indicate their temperature limitations. ii. Detectors or Operating devices and control system shall be part of the listed system as assembly. iii. The detection of Wet Chemical System shall be interfaced with the main fire detection and alarm system. iv. At least one fusible link or heat detector shall be installed within each exhaust duct opening and cooking appliance in accordance with the manufacturer's listing.
6. FUEL/POWER SHUT-OFF	i. On activation of any cooking equipment of the fire-extinguishing system, all sources of fuel and electric power that produce heat to all equipment protected by the system shall be shut down. ii. Gas appliances not requiring protection but located under the same ventilation equipment shall also be shut off. iii. Shutoff devices shall require manual resetting prior to fuel or power being restored.

	Table:- D.10-T1 : Wet Chemical System Requirements
7. SYSTEM ACTUATION	i. Wet Chemical Systems shall have both automatic and manual methods of actuation. ii. A readily accessible means for the manual activation shall be located in a path of egress. When manual activation is used for cooking related protection, the manual activation device shall be installed no more than 1200 mm, nor less than 1067 mm above the floor and shall clearly identify the hazard protected.
8. EXPELLANT GAS	i. A method and instructions shall be provided for checking the amount or the pressure of expellant gas to ensure that it is sufficient for the proper operation of the system.
9. LOCATION	i. Dry chemical containers and expellant gas assemblies shall be located within the temperature range specified in the manufacturer's listed installation and maintenance manual.
10. DESIGN	i. Wet Chemical Systems can be Total flooding, Local application type, Hand hose type or combinations. Any Wet Chemical System shall be Engineered or Pre-engineered. ii. All the system, cylinders, containers, Wet Chemical, expellant gas, piping, valves and nozzles shall be as per Manufacturer's instructions with permit and listing for particular applications and same shall be listed with General Directorate of Civil Defence – Kingdom of Bahrain iii. To expel the agent, most systems use pressurized cartridges of nitrogen or carbon dioxide. iv. In kitchen hood and common exhaust duct protection, each protected cooking appliance(s), individual hood(s), and branch exhaust duct(s) directly connected to the hood or common exhaust duct shall be protected by a single system or by systems designed for simultaneous operation. v. Maximum Discharge time shall not exceed 30 seconds.

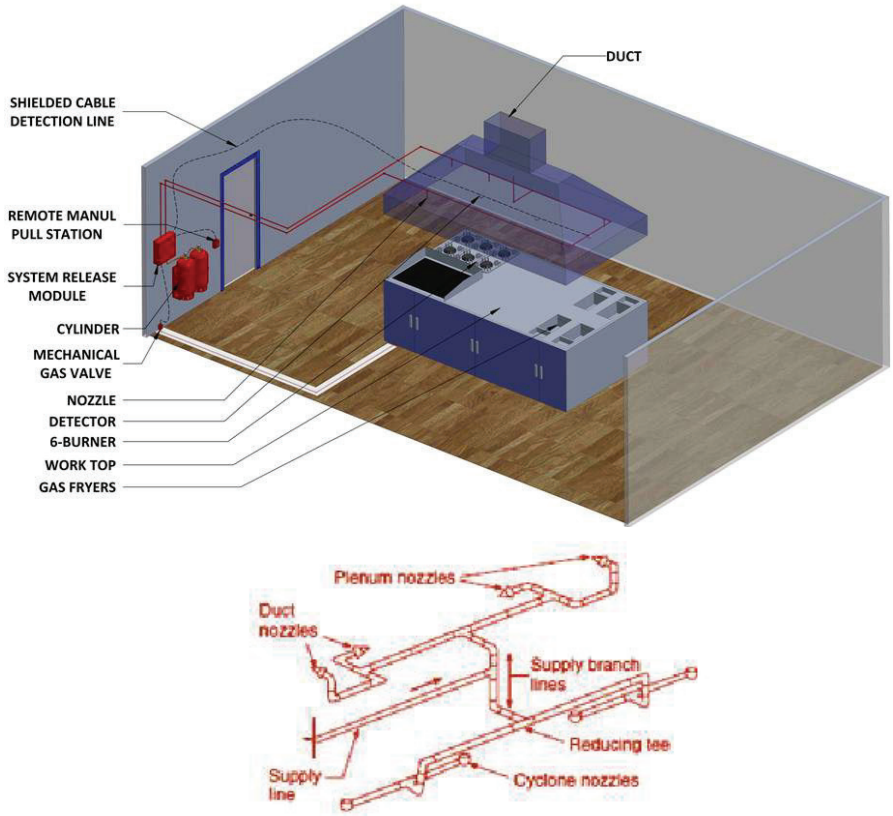

Figure:- D.10-F1: Illustrative Wet Chemical System protection for Kitchen Hood

3.2. Dry Chemical Systems

3.2.1. The requirements for Dry Chemical System material, design, installation shall be as per **Table:- D.10-T2 .**

Table:- D.10-T2: Dry Chemical System Requirements

ITEMS	REQUIREMENTS
1. DEFINITION	i. A Dry Chemical extinguishing agent is a finely divided powdered material that has been specially treated to be water repellent and capable of being fluidized and free-flowing so that it can be discharged through hose lines and piping when under expellant gas pressure. ii. The dry Chemical System in this code refers to pre-engineered systems, that discharge the dry chemical from either hand hose line or fixed nozzles and piping by means of an expellant gas. iii. The sodium bicarbonate-based dry chemical agent consists primarily of sodium bicarbonate (NaHCO3) and is suitable for use on all types of flammable liquid and gas fires (Class B) and for fires involving energized electrical equipment (Class C), Cooking oils and Fats. iv. Commercially available agents are essentially potassium bicarbonate (KHCO3), potassium chloride (KCl), and urea-based potassium bicarbonate (KC2N2H3O3). v. The multipurpose Dry Chemical agent has as its base monoammonium phosphate (NH4H2PO4) and is similar in its effect on Class B and Class C fires to the other dry chemicals. The multipurpose Dry Chemical shall not be used on deep- fat fryers and delicate electrical equipment. vi. Different types of Dry Chemicals from different manufacturer's shall not be mixed for protection purpose.
2. APPLICATION	i. A pre-engineered Dry Chemical System can be used to protect hazards such as Flammable and Combustible Liquids/ Gases/ Solids/ Plastics, Oil filled transformers, circuit breakers, commercial kitchen hoods. ii. Dry Chemical extinguishing systems shall not be used for protection of Cellulose Nitrate and Combustible metals, such as sodium, potassium, magnesium, titanium and zirconium. iii. Multiple systems protecting common hazards shall be designed for a simultaneous operation.
3. COMPONENTS	i. Dry Chemical container, Detectors, Control System, Expellant Gas cartridge, Pipes, Tubes, Fittings, Hand Hose, Discharge Nozzles, pressure gauges, Manual actuators, Isolation valves, and Solenoid Valves. ii. The dry chemical system as an entire system with its design, installation and maintenance manual from manufacturer shall be listed and permitted by General Directorate of Civil Defence – Kingdom of Bahrain.
4. ELECTRICAL CLEARANCE	i. All the dry chemical System equipment and component shall be located to maintain the required electrical clearance as per the manufacturer's specifications. ii. Where the design basic insulation level (BIL) is not available and where nominal voltage is used for the design criteria, the highest minimum clearance specified for this group shall be used.
5. NOZZLE	i. The nozzle shall be listed and shall be provided with an internal strainer or a separate listed strainer located immediately upstream of the nozzle. ii. Discharge nozzles shall be of brass, stainless steel or other corrosion-resistant materials, or be protected inside and out against corrosion. iii. All discharge nozzles shall be provided with caps or other suitable devices to prevent the entrance of grease vapors, moisture or other foreign materials into the piping and shall blow off or open during discharge.

Table:- D.10-T2: Dry Chemical System Requirements	
ITEMS	**REQUIREMENTS**
6. DETECTORS / OPERATING DEVICES	i. The operating devices shall be designed to function properly through a minimum temperature range from 0°C to 49°C or marked to indicate their temperature limitations. ii. The detectors or Operating devices and control system shall be part of the listed system as assembly. iii. The detection of Dry Chemical System shall be interfaced with The main fire detection and alarm system.
7. FUEL/POWER SHUT-OFF	i. Shutdown of Ventilation, fans, openings, doors and windows, shutdown of fuel, gas, electrical power to the protected equipment etc. shall be achieved at the time of system discharge for the successful extinguishing of fire. ii. Shutoff devices shall require manual resetting prior to fuel or power being restored.
8. SYSTEM ACTUATION	i. Dry Chemical Systems shall have both automatic and manual methods of actuation except for hand hose line systems. ii. At least one manual actuator shall be provided for each system. iii. A readily accessible means for manual activation shall be located in a path of egress. The manual activation device shall be installed no more than 1200 mm, nor less than 1067 mm, above the floor and shall clearly identify the hazard protected.
9. TOTAL FLOODING SYSTEMS	i. A total flooding type of system shall be used only where there is a permanent enclosure surrounding the hazard that adequately enables the required concentration to be built up. ii. The total area of un-closable openings shall not exceed 15 percent of the total area of the sides, top and bottom of the enclosure. iii. Where un-closable openings exceed 15 percent of the total enclosure surface area, a local application system shall be used to protect the entire hazard. iv. Where possible, openings such as doorways, windows, and so on, shall be arranged to close before, or simultaneously with, the start of the dry chemical discharge. v. In engineered systems, the minimum design rate of application shall be based on the quantity of dry chemical and the maximum time to obtain the design concentration, as described in the manufacturer's listed design and installation manual. vi. In engineered systems, the rate of application shall be such that the design concentration in all parts of the enclosure shall be obtained within 30 seconds.
10. LOCAL APPLICATION SYSTEMS	i. Local application systems shall be used for the extinguishment of fires in flammable or combustible liquids, gases, and shallow solids (e.g., paint deposits) where the hazard is not enclosed or where the enclosure does not conform to the requirements for total flooding. ii. For flammable liquid fires, the nozzles shall be placed tank side or overhead, or a combination of tank side and overhead within the limits of the listing, and located to prevent splashing during discharge. iii. The minimum effective discharge time and required minimum quantity of dry chemical and the minimum application rate shall be as per the manufacturer's specifications.

Table:- D.10-T2: Dry Chemical System Requirements	
ITEMS	**REQUIREMENTS**
11. HAND HOSE LINE SYSTEMS	i. Hand hose systems shall not be used as a substitute for dry chemical extinguishing systems equipped with fixed nozzles except where the hazard cannot be adequately or economically provided with a fixed nozzle protection. ii. If a single dry chemical supply is used for both a hand hose line system and a fixed nozzle system, the hazards protected by the two systems shall be separated so that the hand hose lines cannot be simultaneously used on the hazard protected by the fixed nozzle system. iii. Hand hose line stations shall be placed so that they are easily accessible and shall have hose lines long enough to reach the most distant hazard that they are expected to protect. iv. Manual actuation of the dry chemical system shall be possible at each hose line station. v. A hand hose line shall have a sufficient quantity of dry chemical to permit its effective use for a minimum of 30 seconds. vi. Where simultaneous use of two or more hose lines is possible, a sufficient quantity of dry chemical shall be available to supply the maximum number of nozzles that are likely to be used at any time for at least 30 seconds and at the appropriate flow rates.

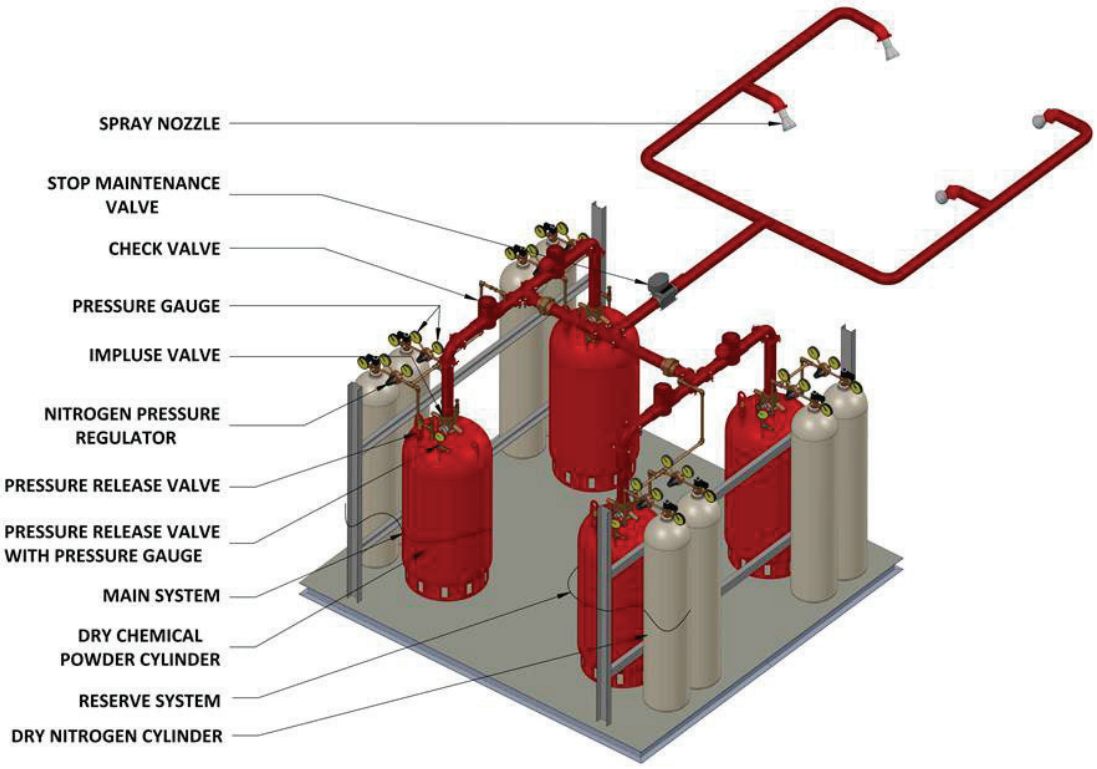

Figure:- D.10-F2. Typical Dry Chemical System protection

3.3. Other Gas and Powdered Agent Systems

3.3.1. The requirements for Dry Chemical System material, design, installation shall be as per **Table:- D.10-T3.**

Table:- D.10-T3 : Other Extinguishing Systems Requirements

ITEMS	REQUIREMENTS	EPA COMMENTS
1. CARBON DIOXIDE	i. Design, Calculations, Design Concentrations, Materials, Installation, Testing, Inspection and maintenance shall be as per the manufacturer's instructions and listed manual. ii. All the material and design manuals shall be listed and permitted by General Directorate of Civil Defence.	iii. System design must adhere to OSHA 1910.162(b)(5) and NFPA Standard 12
2. POWDERED AEROSOLS, D	i. Design, Calculations, Design Concentrations, Materials, Installation, Testing, Inspection and maintenance shall be as per NFPA 2010 and the manufacturer's instructions and listed manual. i. All the material and design manual shall be listed and permitted by General Directorate of Civil Defence. iii. All system components shall be located to maintain no less than minimum clearances from energized electrical parts in accordance with ANSI C2, NFPA 70 and 29 CFR 1910, subpart S. iv. Aerosol shall not be installed in the following locations where a. Deep-seated fires in Class A materials b. Certain chemicals or mixtures of chemicals, such as cellulose nitrate and gunpowder, that are capable of rapid oxidation in the absence of air. c. Reactive metals such as lithium, sodium, potassium, magnesium, titanium, zirconium, uranium, and plutonium. d. Metal hydrides e. Chemicals capable of undergoing auto thermal decomposition, such as certain organic peroxides and hydrazine. v. Condensed aerosol generators shall not be used to protect classified hazards or similar spaces containing flammable liquids or dusts that can be present in explosive air–fuel mixtures unless the generators are specifically listed for use in those environments.	vi. Use of this agent should be in accordance with the safety guidelines in the latest edition of the NFPA 2010 standard for Aerosol Extinguishing Systems. vii. For establishments manufacturing the agent or filling, installing, or servicing containers or systems to be used in total flooding applications, EPA recommends the following: adequate ventilation should be in place to reduce airborne exposure to constituents of agent; an eye wash fountain and quick drench facility should be close to the production area; training for safe handling procedures should be provided to all employees that would be likely to handle containers of the agent or extinguishing units filled with the agent; workers responsible for cleanup should allow for maximum settling of all particulates before reentering area and wear appropriate protective equipment; and - all spills should be cleaned up immediately in accordance with good industrial hygiene practices. viii. See additional comments i, ii, iii, iv, v. in **Table:- D.09-T1.16**

Table:- D.10-T3 : Other Extinguishing Systems Requirements

ITEMS	REQUIREMENTS	EPA COMMENTS
3. **OTHER POWDERED AEROSOLS SUCH AS A, C, F, G, E AND CONDENSED AEROSOL SYSTEMS**	ACCEPTABLE ONLY IN UNOCCUPIED AREAS **(See Definition in Sub Section 2.1.27)**	i. Conduct an evaluation of foreseeable conditions of end use. ii. Determine that the physical or chemical properties or other technical constraints of the other available agents preclude their use. iii. Determine that human exposure to the other alternative extinguishing agents may result in failure to meet applicable use conditions. iv. Use of this agent should be in accordance with the safety guidelines in the latest edition of the NFPA 2010 standard for Aerosol Extinguishing Systems. v. For establishments manufacturing the agent or filling, installing, or servicing containers or systems to be used in total flooding applications, EPA recommends the following: adequate ventilation should be in place to reduce airborne exposure to constituents of agent; an eye wash fountain and quick drench facility should be close to the production area; training for safe handling procedures should be provided to all employees that would be likely to handle containers of the agent or extinguishing units filled with the agent; workers responsible for cleanup should allow for maximum settling of all particulates before reentering area and wear appropriate protective equipment; and - all spills should be cleaned up immediately in accordance with good industrial hygiene practices. vi. See additional comments i, ii, iii, iv, v. in **Table:- D.09-T1.16**
4. MODULAR TYPE EXTINGUISHERS WITH SPRINKLER HEADS OR OTHER ACTUATING DEVICES	NOT ACCEPTABLE BY GENERAL DIRECTORATE OF CIVIL DEFENCE	NA

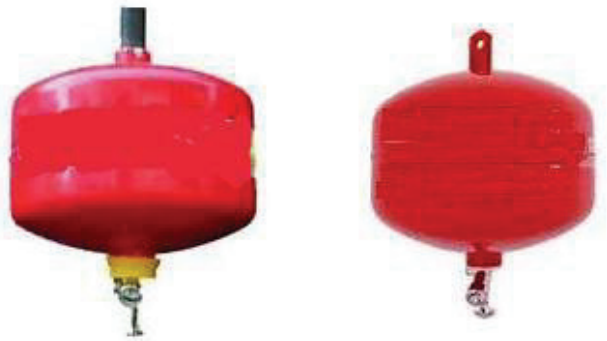

Figure:- D.10-F3.: Typical Modular Type Extinguishers which are not Acceptable

4.0 Design, Installation, Inspection and Maintenance of Fire Protection Systems

4.1. Design/Specification and Submittals

4.1.1. Design, Specifications and Submittals to General Directorate of Civil Defence for permit shall be the main consultant's responsibility. The consultant shall have competent and knowledgeable personnel to understand the General Directorate of Civil Defence requirements and codes and standards.

4.1.2. The design submittals shall be complete with system hydraulic calculations, design criteria, appropriate selection of types of systems and their components, in compliance with this code.

4.2. Installation

4.2.1. The installation of Fire Protection Systems shall be carried out only by General Directorate of Civil Defence permitted and licensed contractors. General contractors, MEP contractors and plumbing contractors shall not be allowed to install fire protection systems.

4.2.2. The qualification and permit of the installation by General Directorate of Civil Defence – Kingdom of Bahrain is based on their training from the respective system manufacturers, their experience and their understanding of codes and standards and workmanship.

4.2.3. Installation contractors shall apply to General Directorate of Civil Defence and secure passing marks in General Directorate of Civil Defence examination to gain the license and be qualified as "permitted fire contractors".

4.2.4. The installation contractor shall not commence work on site without receiving the General Directorate of Civil Defence stamped and permitted drawings from the Consultant.

4.2.5. It is the contractors responsibility to adhere to consultant's General Directorate of Civil Defence permitted drawings and specifications.

4.3. Inspection, Acceptance and Maintenance

4.3.1. Inspection and acceptance shall be the main consultant's responsibility.

4.3.2. The main consultant shall inspect the contractor's work during installations and ensure that all systems are installed, tested, commissioned and performing as per the General Directorate of Civil Defence permitted drawings and their intended purpose.

4.3.3. The consultant shall handover the system inspection and acceptance reports and the maintenance manuals to the owner.

4.3.4. The building owner, his appointed representative and the facility management shall be responsible to ensure that all the Fire Protection Systems in the facility are inspected regularly, maintained and repaired to serve their intended purpose during emergencies.

5.0 Material Test Standards and Permits.

5.1. Acceptable Test Standards and criteria

5.1.1. All the Valves, Pumps, Piping, Hose, Nozzles, Devices, Sprinklers, Motors, Materials, Systems, Assemblies, equipment, Products and Accessories, referred to in this chapter with respect to Life Safety, Fire Safety and Emergency Services shall be Listed, Permitted and Registered by the General Directorate of Civil Defence.

5.1.2. There is no year of edition mentioned against any test standards. It is the intent of General Directorate of Civil Defence to invite the customers seeking laboratory tests and the test laboratories to follow the "LATEST EDITION OF THE TEST STANDARD, AS AND WHEN THEY ARE UPGRADED/REVISED/AMENDED, TO THE DATE"

5.1.3. Wet Chemical Systems

- **i.** UL 300, Fire Testing of Fire Extinguishing Systems for Protection of Commercial Cooking Equipment.
- **ii.** LPS 1223, Requirements & Testing Procedures for permit of fixed Fire Ext Systems for Catering Equipment

5.1.4. Dry Chemical Systems

- **i.** UL 1254, Standard for pre-engineered Dry Chemical Fire extinguishing System.
- **ii.** FM 5320 - Dry Chemical Extinguishing Systems

5.1.5. Chemical Gas Clean Agent Systems

- **i.** UL 2166, Standard for Halocarbon Clean Agent Extinguishing System Units.
- **ii.** FM 5600 - Clean Agent Extinguishing Systems

5.1.6. CO2 Systems (Industrial Use Only)

- **i.** FM 5420 - Carbon Dioxide Extinguishing Systems



Chapter 11 Application of fire system



Section D

Chapter

Application of fire system



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1.0 SCOPE

1.1 This code provides wide information on selection of Fire Protection system, performance Requirements based on individual category..

1.2 To familiarize end users of various category of Protection depends on the project nature.

1.3 To enable designers and owners to choose Fire Protection appropriately according to the hazard.

1.4 Definition of various types of area consideration.

2.0 Definitions

2.1. General

2.1.1. Shall

It is a mandatory requirement from General Directorate of Civil Defence – Kingdom of Bahrain.

2.1.2. Should

It is a recommendation but not mandatory by General Directorate of Civil Defence – Kingdom of Bahrain.

2.1.3. Listed

Permitted and registered by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain.

2.1.4. Unit of Measurement

Unit of Measurement in this code are international system of units. (SI).

- 1 in. = 25.4 mm
- 1 ft^2 = 0.0929 m^2
- 1 gal = 3.785 dm^3
- 1 gal = 3.785 L
- 1 gpm/ft^2 = (40.746 L/min)/ m^2
- 1 ft^3 = 0.028317 m^3
- 1 lb = 0.4536 Kg
- 1 lb/ ft^3 = 16.0183 Kg/m^3
- 1 psi = 6894.757 Pa
- 1 psi = 0.0689 bar
- 1 bar = 10^5 Pa
- 1 mm = 1000 µ

2.1.5. Plot Area

The plot area is the total area available under the 'Plot Number', including the ground floor area on which buildings and structures are built, set back areas, landscaping areas, parking areas and open spaces available part of such that plot area.

2.1.6. Built-up Area

The total floor areas of the buildings and structures including carpet areas, wall thickness, column thickness, stair shafts, elevator and service shafts of all the floors, including mezzanines.

2.1.7. Built-up ground floor area

The total ground floor area alone upon which the individual buildings and structures are built. It is the total ground floor area of the individual building and structure including carpet areas, wall thickness, column thickness, stair shafts, elevator and service shafts of the ground floor alone.

2.1.8. Sum of built-up ground floor areas

The sum of total ground floor areas alone upon which the buildings and structures are built. It is the accumulative total ground floor area of the various building and structures, within the same plot, excluding separated service blocks, security guard house and separated wash- rooms.

2.1.9. Unit Compartment Area

The total built-up ground floor area alone of the individual unit which is separated by adjacent units with a fire resistance rated separation. It is the total built-up ground floor area of such an individual unit of the multi-unit building or structure.

2.1.10. Carpet Area

The total occupiable area inside the built-up area, excluding wall thickness, column thickness, stair shaft, elevator shaft and service shaft.

2.1.11. Unoccupied Area

Area that is intended only for equipment and machinery providing services with periodic visits by personnel for repair and maintenance. However, with respect to the use of Clean agent, Aerosols, CO2 and other fire suppression systems, the LV rooms, transformer rooms, telephone rooms, generator rooms and other such equipment/ machinery rooms located in the occupied buildings or attached to occupied buildings, are not considered as unoccupied areas because of the proximity of these rooms to public movement and the possible adverse effects of fire suppression agents.

2.1.12. Common Fire Pump and Fire Water Tank

Where multiple buildings at single plot or multiple plots are owned by a single owner, the fire pump set and fire water tank shall be permitted to be common, provided the arrangement satisfies the required hydraulic calculations and the involved plots and property are managed and maintained by such single owner.

2.1.13. Master Water Tank

Developers are encouraged to consider master water tanks having a size of a minimum of 500,000 gallons, common to the entire development, from which individual buildings can tap from to individual pump rooms and General Directorate of Civil Defence – Kingdom of Bahrain can refill their fire trucks during emergencies in that development or nearby developments.

3.0. General Requirements

3.1. Reference

3.1.1. Guidelines in this section are minimum requirements for the application of various Fire Protection Systems. The protection criteria, design criteria, required design density, types of suppression methods and Fire Pump capacities may vary and shall be verified with the General Directorate of Civil Defence - Kingdom of Bahrain engineers and the relevant **NFPA** references such **NFPA 10, NFPA 11, NFPA 12, NFPA 13, NFPA 14, NFPA 15, NFPA 16, NFPA 17, NFPA 20, NFPA 22, NFPA 24, NFPA 25, NFPA 30, NFPA 33, NFPA 45, NFPA 75, NFPA 76, NFPA 110, NFPA 750, NFPA 2001, NFPA 2010, NFPA Handbook, IBC, IFC**, Manufacturer's design guidelines and installation specifications..

3.2. Fire Protection Systems

3.2.1 Intention

3.2.1.1 The Fire Protection System requirements are to address the following.

i. To provide an automatic as well as manual approach to extinguish fires.

ii. Along with their equipment, Civil Defence Firefighters also utilize the Fire Protection Systems installed in the occupancies, to manually fight fires thereby protecting the property and lives of people. Thus ensuring the design of the fire protection system of the building and that its installation is in good working condition represents a priority of Civil Defence.

iii. To ensure that the maintenance of Fire Protection systems is carried out periodically through Civil Defence permitted contractors.

3.2.2 Fire Protection Concept

3.2.2.1 Fire Protection or Fire Extinguishment can be achieved with various techniques and mechanisms. However, the concepts behind all the extinguishing measures are basically one or more of the following.

i. Physically separate the combustible material from the flame.

ii. Removing or Reducing the Oxygen supply.

iii. Reducing the temperature of the combustible or the flame.

iv. Introducing the chemicals that modify the combustion chemistry.

3.2.2.2 The requirements, design criteria, system specifications, inspection and maintenance requirements etc. provided in this chapter are minimum guidelines and a code of practice. It is the consultant's responsibility to refer to further codes and standards, international or local as mentioned but not limited to **Section 2.2.3.,** to evaluate the design details, the applications of fire protection systems, their suitability, the environmental impact and test certifications to comply in full in their design, material specifications, installation, inspection and maintenance.

3.2.2.3 International codes and standards referred to for this chapter are **NFPA 11, NFPA 12, NFPA 13, NFPA 14, NFPA 15, NFPA 16, NFPA 17, NFPA 20, NFPA 22, NFPA 24, NFPA 25, 30, NFPA 33, NFPA 45, NFPA 75, NFPA 76, NFPA 110, NFPA 750, NFPA 2001, NFPA 2010, NFPA Handbook, IBC, IFC, Manufacturer's design guidelines and installation specifications.**

3.2.3 Types of Fire Protection Systems

3.2.3.1. Fire Protection Systems discussed in this chapter are limited to the Civil Defence listed and permitted Systems. Any system that is not already listed or registered by Civil Defence is not mentioned in this Chapter.

3.2.3.2 Water based Fire Protection Systems

I. Dry Riser System (DRS)
II. Wet Riser System (WRS)
III. Yard Hydrant System (YHS)
IV. Fire Hose Reel/Rack System (FHS)
V. Automatic Sprinkler System (AS)
VI. Pre-action Sprinkler System (YHS)
VII. Water Spray System (WSS)
VIII. Water Mist System (WMS)
IX. Water Deluge System (WDS)

3.2.3.3. Foam and Water based Fire Protection Systems

I. Foam Sprinkler System (FSS)
II. Foam Monitor System (FMS)
III. Foam Injection System (FIS)
IV. Foam Deluge System (FDS)
V. Foam Pouring System (FPS)
VI. Foam Hand Hose System (FHS)

3.2.3.4. Clean Agent based Fire Protection Systems

I. Chemical agent System (CCAS)
II. Inert Gas System (ICAS)

3.2.3.5. Dry Chemical System (DCS)
3.2.3.6. Wet Chemical System (WCS)
3.2.3.7. Portable Fire Extinguisher (FE)

3.3. Equipments and Materials

3.2.1. The requirements of Materials shall be as per **Table:- D.11-T1.**

Table:- D.11-T1.: General Requirements of Water based Fire Protection Systems

ITEMS	REQUIREMENTS
1. ISOLATION OR SECTION CONTROL VALVES	i. All the isolation valves installed in the Fire Protection system shall be supervised O.S. & Y gate valve or supervised butterfly valves installed with a tamper or supervisory switch connected to the building fire alarm system for monitoring or secured in open position by a padlock or riveted strap unless otherwise specified. ii. All Valves shall be permitted by the General Directorate of Civil Defence – Kingdom of Bahrain. iii. All isolating valves installed shall be so constructed that in order to shut the valve the spindle must turn clockwise. The hand wheels of all stop valves shall be clearly marked to indicate which direction the wheel is to be turned to close the valve. iv. An indication showing whether the valve is open or shut shall also be provided. v. An isolation valves shall be installed in each sprinkler riser on upstream side of an alarm check valve such that the isolation of single sprinkler riser will not interrupt the water supply to other sprinkler risers from the same source of supply. vi. The valve on downstream side of the flow meter in the fire pump test line shall be a globe type valve for the ease of throttling. vii. The valves of the suction side of fire pumps and water tank outlets shall be O.S.&Y type gate valve only. viii. All the valves shall be rated for the system working pressure. ix. All the isolation / section or floor control valves shall be installed in an easily accessible & visible locations. x. Isolation and control valves shall be provided with an identification sign board in a visible location in both Arabic & English. xi. Where isolation / control valves are located in a closed room or shaft, access door or panel shall be provided with an identification sign board in visible location in both Arabic & English.
2. CHECK VALVE	i. All the check valves shall be installed in easily accessible & visible locations. ii. Where there is more than one source of water supply, a check valve shall be installed in each connection. iii. Where sprinklers are installed on two adjacent sides of a building, protecting against two separate and distinct exposures, with separate control valves for each side, the end lines shall be connected with check valves located so that one sprinkler around the corner will operate. The intermediate pipe between the two check automatic fire pumps, no check valve is required in the cushion tank connection. vi. Check valves shall be installed in a vertical or horizontal position in accordance with their listing. vii. Where a single wet pipe sprinkler system is equipped with a Breeching inlet connection, the alarm valve is considered a check valve, and an additional check valve shall not be required. viii. Check valves shall be permitted by General Directorate of Civil Defence as per **Section 6. of this chapter.**
3. VALVE SUPERVISION	i. Valves on connections to water supplies, sectional control and isolation valves, and other valves in supply pipes to sprinklers and other fixed water-based fire suppression systems shall be supervised by one of the following methods: a. Central station, proprietary, or remote station signaling service b. Local signaling service that will cause the sounding of an audible signal at a constantly attended point c. Valves locked in the correct position d. Valves located within fenced enclosures under the control of the owner, sealed in the open position, and inspected weekly as part of an permitted procedure

4. PRESSURE GAUGE	i. Pressure gauges with a control valve (gauge cock) having drain arrangement shall be installed on the upstream and downstream side of alarm check valves to read supply and system pressures. ii. Pressure gauges shall be installed on top of each sprinkler riser and in each zone control valve assembly. iii. The pressure gauges shall be rated for the system working pressure and water temperature service and permitted by the General Directorate of Civil Defence - Kingdom of Bahrain as per **Sub Section 6. of this chapter.** iv. The maximum reading of the scale shall be 150% of the maximum system pressure and each scale shall have divisions not exceeding 0.2bar. v. All the pressure gauges shall be filled with glycerin liquid to prevent damage of their needles due to the system water pressure surge.
5. BREECHING INLET	i. A breeching inlet shall be provided for the building active systems. ii. A separate dedicated breeching inlet, located within 18 m of fire truck parking, shall be provided directly to fire water tank to refill directly by the General Directorate of Civil Defence - Kingdom of Bahrain fire trucks. A signage "FIRE WATER TANK DIRECT REFILLING" shall be provided for such a breeching inlet. iii. See **Section A, Chapter 01, Sub Section 3.5.** for signage. Signage shall clearly distinguish the set feeding the building active systems and the one feeding directly fire water tank. iv. A breeching inlet shall be instantaneous male coupling inlets, located at the Fire Access level for General Directorate of Civil Defence - Kingdom of Bahrain. v. General Directorate of Civil Defence breeching inlets shall be located in an easily accessible and visible location, especially at the Main entrance of the buildings, within 18 meters from the General Directorate of Civil Defence - Kingdom of Bahrain vehicle approach road. vi. There shall be no shutoff valve in the Breeching inlet. vii. Breeching inlet shall be located not less than 457 mm nor more than 1219 mm above the finished ground level. viii. Breeching inlets shall be equipped with caps to protect the system from the entry of dust and debris.
6. INSTALLER QUALIFICATIONS	i. The installation of fire protection systems shall be carried out only by General Directorate of Civil Defence permitted and registered fire specialist contractors. ii. The installation personnel shall be qualified or shall be supervised by persons who are qualified in the installation, inspection and testing of fire protection systems. iii. Each installer shall have a General Directorate of Civil Defence - Kingdom of Bahrain' valid license, which is issued upon his successful passing of General Directorate of Civil Defence - Kingdom of Bahrain qualification examinations. iv. Qualifications or certification of the personnel and General Directorate of Civil Defence - Kingdom of Bahrain license shall be produced at any time when requested by the General Directorate of Civil Defence - Kingdom of Bahrain Authorities.

7. PIPING	i. The aboveground fire protection Pipes shall be threaded for Low-rise buildings and in welded steel for Midrise and High-rise buildings, permitted and listed by General Directorate of Civil Defence – Kingdom of Bahrain as per test standards mentioned in **Sub Section 6.0. of this chapter.** ii. Underground fire protection pipes shall be HDPE (High density polyethylene), minimum of SDR (Standard Dimension Ratio) or DR-9 (Dimension Ratio) rating, compatible with the local temperature ratings, permitted and listed by General Directorate of Civil Defence – Kingdom of Bahrain as per test standards mentioned in **Sub Section 6.0. of this chapter** . iii. Pipes shall be rated for working pressures not less than the maximum pressure it serves as per the design and corresponding locations within the system. iv. Pipes shall be rated for working temperatures not less than the maximum temperature statistics of the country terrain.
8. FITTINGS	i. Steel Fittings shall be threaded for Lowrise buildings and in butt welded steel for Midrise and Highrise buildings, permitted and listed by Civil Defence as per tests mentioned in **Sub Section 6.0. of this chapter.** ii. The underground piping network fittings shall be HDPE, SDR or DR-9, permitted and listed by General Directorate of Civil Defence – Kingdom of Bahrain as per tests mentioned in **Sub Section 6.0. of this chapter.** HDPE fittings shall be butt fusion welded as per the manufacturer's instructions. v. Fittings shall be rated for working pressures not less than the maximum pressure it serves as per the design and corresponding locations within the system. vi. Pipes shall be rated for working temperatures not less than the maximum temperature statistics of the country terrain. v. Screwed unions shall not be used. vi. A one piece reducing fitting shall be used wherever a change is made in the size of pipe.
9. PAINT COLOR	i. All steel pipes & fittings used for fire fighting service shall be painted in red color. ii. There shall be directional arrow marks to indicate the direction of water flow in the system. **See Figure:- D.03-F1.**  **Figure:- D.03-F1.: Fire Water Flow Directional Signs**
10. HANGERS	i. Hangers shall be designed to support five times the weight of the water-filled pipe plus 250 lb (115 kg) at each point of piping support. ii. The minimum distance between hanger supports, size of hangar rods, fasteners, bolts, clamps etc. shall be designed & selected and installed to withstand the load 5 times the weight of water filled pipe, plus 115 kg load. iii. These points of support shall be adequate to support the system. iv. Hanger components shall be ferrous, listed and permitted by General Directorate of Civil Defence as per **Sub Section 6.0 of this chapter** v. All the supports provided for the sprinkler system piping shall allow the free movement for expansion or contraction of pipe work and shall be located by ensuring that the branch lines or fittings are not affected by the supports during expansion or contraction of the pipe installation. vi. Sprinkler system main risers shall be supported by riser clamps or by hangers located on the horizontal connections within 600 mm of the center line of the riser. Riser clamps supporting risers by means of set screws and riser clamps anchored to walls using hanger rods in the horizontal position shall not be permitted to vertically support risers.

4. Application of Fire Protection Systems

4.1. Super High-rise Building Fire Protection Systems

4.1.1. Super Highrise buildings having a building height greater than 90 m, of any occupancy classification shall be provided with Fire protection Systems in compliance with **Table:- D.11-T2.** and Auxiliary Rooms Fire Protection Systems as per **Table:- D.11-T14.**

Table:- D.11-T2.: Super Highrise Building Fire Protection Systems

CATEGORY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
A. SUPER HIGHRISE BUILDING WITH PLOT AREA EXCEEDING 20,000 M^2	i. Sprinklers shall be provided throughout the building including basements and podiums (open as well as closed) as per **Section D, Chapter 05.** ii. Auxiliary rooms and various areas of the building shall be protected as per **Table:- D.11-T14.** iii. The wet riser (Hose reel + Landing Valve) System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 6.0.** iv. Wet risers shall be provided with High zones and Low zones according to pressure limitations as per **Table:- D.03-T4.13.** v. Wet risers shall be interconnected both at the lowest level and at the highest level of each zone. vi. A multi level Pump set arrangement shall be provided every 90 m height from the lowest fire pump set level as per **Table:- D.03-T4.13** vii. Yard Fire Hydrants shall be provided where the plot area exceeds 20,000 m^2 , as per **Section D, Chapter 04.** viii. Yard hydrants shall not be required where infrastructure yard hydrants are available subject to testing, if the existing hydrant provided by relevant authority in kingdom of Bahrain within 60 m is well maintained and providing required water pressure, an additional yard hydrant shall not be required and tapping from existing yard hydrant network shall be permitted to extend the yard hydrants to comply with coverage requirements.	ix. Where a fire pump set is combined and serves both yard hydrants and internal building systems, the capacity of the first fire pump set at the lowest level of the building shall be 1000 gpm (Irrespective of number of stairs and standpipes) at 17 bar. x. Where a fire pump set is combined and serves both yard hydrants and internal building systems, the combined water tank at the lowest level of the building shall have a capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet for refill and instantaneous refilling arrangement for the utility supply. xi. Where a fire pump set only serves internal building systems, the capacity of the pump sets located vertically at every 90 m intermediate intervals from the lowest level fire pump shall be 750 gpm if there are 2 standpipes and 1000 gpm, if there are more than 2 standpipes, at pressure as required to satisfy 6.9 bar at the most remote landing valve and for efficient tank filling for the intermediate level water tanks. xii. Fire water tank shall be provided for every upper level pump sets (At every 90 m intervals). Such upper level water tanks shall be for 30 minutes operation, complete with automatic low water level detection, instantaneous refilling arrangement, pumping and piping to refill tanks from lower levels.

Table:- D.11-T2.: Super Highrise Building Fire Protection Systems

CATEGORY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
B. SUPER HIGHRISE BUILDING WITH PLOT AREA LESS THAN 20,000 M^2 **OR** **C. WHERE SUPER HIGHRISE BUILDING IS PROVIDED WITH YARD HYDRANT SYSTEM, IRRESPECTIVE OF PLOT AREA, AS PART OF INFRASTRUCTURE DEVELOPMENT**	i. Sprinklers shall be provided throughout the building including basements and podiums (open as well as closed) as per **Section D, Chapter 05.** ii. Auxiliary rooms and various areas of the building shall be protected as per **Table:- D.11-T14.** iii. The wet riser (Hose reel + Landing Valve) System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 6.0.** iv. Wet risers shall be provided with High zones and Low zones according to pressure limitations as per **Table:- D.03-T4.13.** v. Wet risers shall be interconnected both at the lowest level and at the highest level of each zone. vi. A multi-level Pump set arrangement shall be provided every 90 m height from the lowest fire pump set level as per **Table:- D.03-T4.13.**	vii. The capacity of the first fire pump set at the lowest level of the building shall be 1000 gpm (Irrespective of the number of standpipes) at 17 bar. viii. The water tank at the lowest level of the building shall have a capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet for refill and instantaneous refilling arrangement for the utility supply.. ix. The capacity of the upper level pump sets located at every 90 m intervals from the lowest level fire pump, shall be 750 gpm if there are 2 standpipes and 1000 gpm, if there are more than 2 standpipes, at pressure as required to satisfy 6.9 bar at the most remote landing valve and for efficient tank filling for the intermediate level water tanks. x. Fire water tank shall be provided for every upper level pump sets (At every 90 m intervals). Such upper level water tanks shall be for 30 minutes operation, complete with automatic low water level detection, instantaneous refilling arrangement, pumping and piping to refill tanks from lower levels.

4.2. High-rise Building Fire Protection Systems

4.2.1. High-rise building having building height of more than 23 m but less than 90 m, of any occupancy classification shall be provided with Fire protection Systems in compliance with **Table:- D.11-T3** and auxiliary rooms Fire Protection Systems as per **Table:- D.11-T14.**

Table:- D.11-T3.: High-rise Building Fire Protection Systems

CATEGORY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
A. HIGHRISE BUILDING HAVING HEIGHT OF MORE THAN 45 M BUT BELOW 90 M FROM LOWEST PUMP SET LEVEL **AND** **PLOT AREA EXCEEDING 20,000 M²**	i. Sprinklers shall be provided throughout the building including basements and podiums (open as well as closed) as per **Section D, Chapter 05.** ii. Auxiliary rooms and various areas of the building shall be protected as per **Table:- D.11-T14.** iii. The wet riser (Hose reel + Landing Valve) System shall be provided throughout the building as per **Section D, Chapter 3, Sub Section 6.0.** iv. The wet risers shall be provided with looped High zones and Low zones according to the pressure limitations as per **Table:- D.03-T4.13** v. Wet risers shall be interconnected both at lowest level and at the highest level of each zone. vi. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04.** vii. Yard hydrants shall not be required where infrastructure yard hydrants are available subject to testing, if the existing hydrant provided by relevant authority in kingdom of Bahrain within 60 m is well maintained and providing required water pressure, an additional yard hydrant shall not be required and tapping from existing yard hydrant network shall be permitted to extend the yard hydrants to comply with coverage requirements.	viii. Where a fire pump set is combined and serves yard hydrants and internal building systems, the capacity of the fire pump set shall be 1000 gpm (Irrespective of number of stairs) at pressure as required to satisfy 6.9 bar at the most remote landing valve. ix. Where a fire pump set is combined and serves yard hydrants and internal building systems, the combined water tank shall have capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet for refilling and instantaneous refilling arrangement for the utility supply.
B. HIGHRISE BUILDING HAVING HEIGHT OF MORE THAN 45 M BUT BELOW 90 M FROM LOWEST PUMP SET LEVEL **AND** **PLOT AREA LESS THAN 20,000 M²**	i. Sprinklers shall be provided throughout the building including basements and podiums (Open as well as closed) as per **Section D, Chapter 05.** ii. Auxiliary rooms and various areas of the building shall be protected as per **Table:- D.11-T14.** iii. A wet riser (Hose reel + Landing Valve) System shall be provided throughout the building as per **Table:- D.03-T4.13** iv. The wet risers shall be provided with High Zones and Low zones according to pressure limitations as per **Table:- D.03-T4.13** v. The wet risers shall be interconnected both at lowest level and at the highest level of each zone.	vi. The capacity of the fire pump set shall be 750 gpm if there are 2 standpipes and 1000 gpm if there are more than 2 standpipes, at pressure as required to satisfy 6.9 bar at the most remote landing valve. vii. Water tank shall have capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet for refilling and instantaneous refilling arrangement for the utility water supply.

Table:- D.11-T3 : High-rise Building Fire Protection Systems

CATEGORY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
C. HIGHRISE BUILDING HAVING HEIGHT OF MORE THAN 23 M BUT BELOW 45 M AND PLOT AREA EXCEEDING 20,000 M^2	i. Sprinklers shall be provided throughout the building including basements and podiums (open as well as closed) as per **Section D, Chapter 05.** ii. Auxiliary rooms and various areas of the building shall be protected as per **Table:- D.11-T14.** iii. A wet riser(Hose reel + Landing Valve) System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 6.0.** iv. The wet risers shall be interconnected both at lowest level and at the highest level of each zone. v. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04.** vi. Yard hydrants shall not be required where infrastructure yard hydrants are available subject to testing, if the existing hydrant provided by relevant authority in kingdom of Bahrain within 60 m is well maintained and providing required water pressure, an additional yard hydrant shall not be required and tapping from existing yard hydrant network shall be permitted to extend the yard hydrants to comply with coverage requirements.	vii. Where a fire pump set is combined and serves yard hydrants and internal building systems, capacity of the fire pump set shall be 1000 gpm irrespective of number of standpipes, at pressure as required to satisfy 6.9 bar at the most remote landing valve and the yard hydrant. viii. The combined water tank shall have capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet for refilling and instantaneous refilling arrangement for utility water supply.
D. HIGHRISE BUILDING HAVING HEIGHT OF MORE THAN 23 M BUT BELOW 45 M AND PLOT AREA LESS THAN 20,000 M^2	i. Sprinklers shall be provided throughout the building including basements and podiums (open as well as closed) as per **Section D, Chapter 05.** ii. Auxiliary rooms and various areas of the building shall be protected as per **Table:- D.11-T14.** iii. A wet riser System (Hose reel + Landing Valve) shall be provided throughout the building as per **Table:- D.03-T4.13** iv. The wet risers shall be interconnected both at lowest level and at the highest level of each zone.	v. The capacity of the fire pump set shall be 750 gpm if the building has 2 standpipes and 1000 gpm if the building has more than 2 standpipes. vi. Pressure shall be as required to satisfy 6.9 bar at the most remote landing valve. vii. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement for utility water supply.

4.3. Mid-rise Building Fire Protection Systems

4.3.1. Midrise buildings (Assembly, Education, Healthcare, Mercantile, Hotel, Daycare, Mixed and Multiple and High depth underground buildings) having a building height from more than 15 m to less than 23 m shall be provided with Fire protection Systems in compliance with **Table:- D.11-T4.a.,** and Auxiliary Rooms Fire Protection Systems as per **Table:- D.11-T14.**

Table:- D.11-T4.a : Midrise Building Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
A. ASSEMBLY GROUP A, B, C. **B. EDUCATION GROUP A, B, C.** **C. HEALTHCARE GROUP A** **D. MERCANTILE GROUP A, B** **E. HOTEL GROUP A, B, C.** **F. DAY CARE GROUP A, B, C.** **G. MIXED AND MULTIPLE OCCUPANCIES** **H. HIGH DEPTH UNDERGROUND BUILDINGS OR BUILDINGS WITH 3 OR MORE BASEMENTS**	**1. IF PLOT AREA IS LESS THAN 20,000 m^2** i. Sprinklers shall be provided throughout the building including basements, podiums (Open as well as closed) as per **Section D, Chapter 05.** ii. Auxiliary rooms and various areas of the building shall be protected as per **Table:- D.11-T14.** iii. A wet riser System (Hose reel + Landing Valve) shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 6.0.** iv. The wet risers shall be interconnected at the highest level. **2. IF PLOT AREA IS MORE THAN 20,000m^2** i. Sprinklers shall be provided throughout the building including basements, podiums (Open as well as closed) as per **Section D, Chapter 05.** ii. Auxiliary rooms and various areas of the building shall be protected as per **Table:- D.11-T14.** iii. A wet riser (Hose reel + Landing Valve) System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 6.0.** iv. The wet risers shall be interconnected at the highest level. v. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04.** vi. Yard hydrants shall not be required where infrastructure yard hydrants are available subject to testing, if the existing hydrant provided by relevant authority in kingdom of Bahrain within 60 m is well maintained and providing required water pressure, an additional yard hydrant shall not be required and tapping from existing yard hydrant network shall be permitted to extend, the yard hydrants to comply with coverage requirements.	**1. IF PLOT AREA IS LESS THAN 20,000 m^2** v. The capacity of the fire pump set shall be 750 gpm if there are 2 standpipes, 1000 gpm if there are more than 2 standpipes at a pressure as required to satisfy 6.9 bar at the most remote landing valve. vi. The water tank shall have a capacity of 45 minutes of operation, complete with low water level detection, dedicated direct breeching inlet for refilling and instantaneous refilling arrangement for utility water supply.. **2. IF PLOT AREA IS MORE THAN 20,000 m^2** vii. Where a fire pump set is combined and serves yard hydrants and internal building systems, capacity of the fire pump set shall be 1000gpm irrespective of number of standpipes at pressure as required to satisfy 6.9 bar at the most remote landing valve and the hydrant. viii. Where a fire pump set is combined and serves yard hydrants and internal building systems, the combined water tank shall have capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet for refilling and instantaneous refilling arrangement for utility water supply.

4.3. Mid-rise Building Fire Protection Systems

4.3.2. Midrise buildings (Residential, Labour Accommodation, Staff Accommodation, Hostels, Business and Animal Housing) having a building height from more than 15m to less than 23 m shall be provided with Fire protection Systems in compliance with **Table:- D.11-T4.b.,** and Auxiliary Rooms Fire Protection Systems as per **Table:- D.11-T14.**

Table:- D.11-T4.b. : Midrise Building Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
A. RESIDENTIAL GROUP A, B,C **(APARTMENTS, LABOR ACCOM-MODATION, STAFF ACCOMMODATION, HOSTEL)** **B. HEALTHCARE GROUP B, C.** **C. MERCANTILE GROUP C (KIOSKS)** **D. BUSINESS GROUP A, B,C.** **E. ANIMAL HOUSING GROUP A, B,C**	**1. IF BUILT-UP GROUND FLOOR AREA IS UP TO 900 m^2** i. The dry riser + Hose Reel system shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 4.0 and 5.0.** ii. Dry risers shall be interconnected at the highest level. **2. IF BUILT-UP GROUND FLOOR AREA IS 901 m^2 TO 3600 m^2** i. Sprinklers shall be provided throughout the building including basements and podiums (open as well as closed) as per **Section D, Chapter 05.** ii. Auxiliary rooms and various areas of the building shall be protected as per **Table:- D.11-T14.** iii. The dry riser + hose reel system shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 4.0 and 5.0.** iv. Dry risers shall be interconnected at the highest level. **3. IF BUILT-UP GROUND FLOOR AREA IS MORE THAN 3600 m^2** i. Sprinklers shall be provided throughout the building including basements and podiums (open as well as closed) as per **Section D, Chapter 05.** ii. A wet riser (Hose reel + Landing Valve) System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 6.0** iii. Wet risers shall be interconnected at the highest level. iv. Auxiliary rooms and various areas of the building shall be protected as per **Table:- D.11-T14.**	**1. IF BUILT-UP GROUND FLOOR AREA IS UP TO 900 m^2** iii. The capacity of the fire pump set shall be 50 gpm at a pressure as required to satisfy 4.5 bar at the most remote Hose valve. iv. The water tank shall have capacity of 45 minutes of operation, complete with low water level detection, dedicated direct breeching inlet for refilling and instantaneous refilling arrangement for utility water supply. **2. IF BUILT-UP GROUND FLOOR AREA IS 901 m^2 TO 3600 m^2** v. The capacity of the fire pump set shall be 300 gpm at pressure as required to satisfy 4.5 bar at the most remote Hose reel. vi. Water tank shall have capacity of 45 minutes of operation, complete with low water level detection, dedicated direct breeching inlet for refilling and instantaneous refilling arrangement for utility water supply. **3. IF BUILT-UP GROUND FLOOR AREA IS MORE THAN 3600 m^2** v. Capacity of the fire pump set shall be 750 gpm if there are 2 standpipes, 1000 gpm if there are more than 2 standpipes at pressure as required to satisfy 6.9 bar at the most remote Landing valve. vi. Water tank shall have capacity of 45 minutes of operation, complete with low water level detection, dedicated direct breeching inlet for refilling and instantaneous refilling arrangement for utility water supply.

Table:- D.11-T4.b. : Midrise Building Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
A. RESIDENTIAL GROUP A, B,C **(APARTMENTS, LABOR ACCOM-MODATION, STAFF ACCOMMODATION, HOSTEL)** **B. HEALTHCARE GROUP B, C.** **C. MERCANTILE GROUP C (KIOSKS)** **D. BUSINESS GROUP A, B, C.** **E. ANIMAL HOUSING GROUP A, B,C**	**4. IF PLOT AREA IS MORE THAN 20,000 m^2** i. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04.** ii. Yard hydrants shall not be required where infrastructure yard hydrants are available within 60 m of such building. In this scenario, requirements of **Table:- D.11-T4.b.3.** shall apply. iii. Sprinklers shall be provided throughout the building including basements and podiums (open as well as closed) as per **Section D, Chapter 05. in accordance with Table:- D.11-T4.b.1., 2., or 3., as applicable.** iv. A wet riser System or hose reel system shall be provided throughout the building **in accordance with Table D.11-T4.b.1., 2., or 3., as applicable. And Section D, Chapter 03, Sub Section 6.0.** v. Auxiliary rooms and various areas of the building shall be protected as per **Table:- D.11-T14.**	**4. IF PLOT AREA IS MORE THAN 20,000 m^2** vi. Where a fire pump set is combined and serves yard hydrants and internal building systems, the combined fire pump capacity shall be 1000 gpm. vii. Where fire pump set independently serves only the yard fire hydrants, pump capacity shall be 1000 gpm. viii. Fire water tank shall have capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement.

4.3. Midrise Building Fire Protection Systems

4.3.3. Midrise buildings having a building height from more than 15 m to less than 23 m and having a single exit stair and built-up ground floor area of up to 500 m^2 shall be provided with Fire protection Systems in compliance with **Table:- D.11-T4.c.,** and Auxiliary Rooms Fire Protection Systems as per **Table:- D.11-T14.**

Table:- D.11-T4.c .: Midrise Building Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
A. RESIDENTIAL GROUP A, B, C. **(APARTMENTS, LABOR ACCOMMODATION, STAFF ACCOMMODATION, HOSTEL)** **HAVING GROUND FLOOR BUILT-UP AREA OF UPTO 500 m^2 AND A SINGLE EXIT STAIR** **B. BUSINESS GROUP A, B, C.** **HAVING GROUND FLOOR BUILT-UP AREA OF UPTO 500 m^2 AND A SINGLE EXIT STAIR** **C. ANIMAL HOUSING GROUP A, B, C.** **HAVING GROUND FLOOR BUILT-UP AREA OF UPTO 500 m^2 AND A SINGLE EXIT STAIR**	**1. IF BUILT-UP GROUND FLOOR AREA IS UPTO 500 M^2 AND A SINGLE EXIT STAIR** i. Sprinklers shall be provided throughout the building including basements and podiums (open as well as closed) as per **Section D, Chapter 05.** ii. A wet riser (Hose reel + Landing Valve) System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 6.0.** iii. Wet risers shall be interconnected at the highest level. iv. Auxiliary rooms and various areas of the building shall be protected as per **Table:- D.11-T14.**	**1. IF BUILT-UP GROUND FLOOR AREA IS UPTO 500 M^2 AND A SINGLE EXIT STAIR** v. Capacity of the fire pump set shall be 500 gpm at pressure as required to satisfy 6.9 bar at the most remote Landing valve. vi. Water tank shall have capacity of 45 minutes of operation, complete with low water level detection, dedicated direct breeching inlet for refilling and instantaneous refilling arrangement for utility water supply.

4.3. Midrise Building Fire Protection Systems

4.3.4. Midrise buildings (Detention and Correctional, Prisons) having a building height from more than 15 m to less than 23 m shall be provided with Fire protection Systems in compliance with **Table:- D.11-T4.d.,** and Auxiliary Rooms Fire Protection Systems as per **Table:- D.11-T14.**

Table:- D.11-T4.d .: Midrise Building Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
A. DETENTION AND CORRECTIONAL GROUP A, B, C.	**1. FOR CELLS AND INMATES AREAS** i. Pre-action type Sprinklers shall be provided throughout as per **Section D, Chapter 04.** **2. FOR AREAS OTHER THAN CELLS AND INMATES AREAS** i. Sprinklers shall be provided throughout the building including basements and podiums (open as well as closed) as per **Section D, Chapter 05.** ii. Auxiliary rooms and various areas of the building shall be protected as per **Table:- D.11-T14.** iii. A wet riser (Hose reel + Landing Valve) System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 6.0.** iv. The wet risers shall be interconnected at the highest level. v. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04.** vi. Yard hydrants shall not be required where infrastructure yard hydrants are available subject to testing, if the existing hydrant provided by relevant authority in kingdom of Bahrain within 60 m is well maintained and providing required water pressure, an additional yard hydrant shall not be required and tapping from existing yard hydrant network shall be permitted to extend the yard hydrants to comply with coverage requirements.	vii. Where a fire pump set is combined and serves yard hydrants and internal building systems, the capacity of the fire pump set shall be 1000 gpm (irrespective of number of standpipes) at a pressure as required to satisfy 6.9 bar at the most remote landing valve and the hydrant. viii. Where a fire pump set serves yard hydrants and internal building systems, the combined water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet for refilling and instantaneous refilling arrangement for utility water supply. ix. Where a fire pump set serves only internal building systems, the capacity of the fire pump set shall be 750 gpm if building has 2 standpipes and 1000 gpm if the building has more than 2 standpipes. Pressure shall be as required to satisfy 6.9 bar at the most remote landing valve. x. Where a fire pump set serves only internal building systems, the water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet for refilling and instantaneous refilling arrangement for utility water supply.

4.4. Lowrise Building Fire Protection Systems

4.4.1. Lowrise buildings having building height of up to 15 m and low depth underground buildings or basements shall be provided with Fire protection Systems in compliance with **Table:- D.11-T5.a.** and Auxiliary Rooms Fire Protection Systems as per **Table:- D.11-T14.**

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Table:- D.11-T5.a.: Lowrise Building Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
A. ASSEMBLY GROUP A, B, C. **B. EDUCATION GROUP A, B, C.** **C. HEALTHCARE GROUP A,** **D. MERCANTILE GROUP A, B** **E. HOTEL GROUP A, B, C.** **F. DAY CARE GROUP A, B, C.** **G. DETENTION AND CORRECTIONAL GROUP A, B, C.** **H. MIXED AND MULTIPLE OCCUPANCIES** **I. LOW DEPTH UNDERGROUND BUILDINGS OR BUILDINGS WITH 2 OR LESS BASEMENTS**	**1. IF BUILT-UP GROUND FLOOR AREA IS UP TO 500 m^2** i. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** ii. Dry landing valves shall not be required. **2. IF BUILT-UP GROUND FLOOR AREA IS 501 m^2 TO 3600 m^2** i. Sprinklers shall be provided throughout the building including basements and podiums (open as well as closed) as per **Section D, Chapter 05.** ii. Auxiliary rooms and various areas of the building shall be protected as per **Table:- D.11-T14.** iii. Hose reel system shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** iv. Dry landing valves shall not be required. **3. IF BUILT-UP GROUND FLOOR AREA IS MORE THAN 3600 m^2** i. Sprinklers shall be provided throughout the building including basements and podiums (open as well as closed) as per **Section D, Chapter 05.** ii. Auxiliary rooms and various areas of the building shall be protected as per **Table:- D.11-T14.** iii. Wet riser (Hose reel + Landing Valve) System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 6.0.** iv. Wet risers shall be interconnected at the highest level.	**1. IF BUILT-UP GROUND FLOOR AREA IS UP TO 500 m^2** iii. The capacity of the fire pump set shall be 50 gpm at pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. iv. The water tank shall have capacity of 30 minutes of operation, complete with low water level detection and instantaneous refilling arrangement for utility water supply. v. Fire Pump and/or Fire water tank shall be permitted to be installed on the roof, if existing structure is capable of accommodating such additional load. **2. IF BUILT-UP GROUND FLOOR AREA IS 501 m^2 TO 3600 m^2** v. The capacity of the fire pump set shall be 300 gpm at pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. vi. The water tank shall have capacity of 30 minutes of operation, complete with low water level detection and instantaneous refilling arrangement for utility water supply. **3. IF BUILT-UP GROUND FLOOR AREA IS MORE THAN 3600 m^2** v. The capacity of the fire pump set shall be 750 gpm if there are 2 standpipes and 1000 gpm if there are more than 2 standpipes at pressure as required to satisfy 6.9 bar at the most remote Landing Valve. vi. The water tank shall have capacity of 30 minutes of operation, complete with low water level detection, dedicated direct breeching inlet for refilling and instantaneous refilling arrangement for utility water supply.

4.4. Lowrise Building Fire Protection Systems

4.4.2. Lowrise buildings having building height of up to 15 m and low depth underground buildings or basements shall be provided with Fire protection Systems in compliance with **Table:- D.11-T5.a** and Auxiliary Rooms Fire Protection Systems as per **Table:- D.11-T14.**

Table:- D.11-T5.a : Lowrise Building Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
A. ASSEMBLY GROUP A, B, C. **B. EDUCATION GROUP A, B, C.** **C. HEALTHCARE GROUP A,** **D. MERCANTILE GROUP A, B** **E. HOTEL GROUP A, B, C.** **F. DAY CARE GROUP A, B, C.** **G. MIXED AND MULTIPLE OCCUPANCIES** **H. LOW DEPTH UNDERGROUND BUILDINGS OR BUILDINGS WITH 2 OR LESS BASEMENTS**	**4. IF PLOT AREA IS MORE THAN 20,000 m^2** i. Sprinklers, hose reels or and wet risers shall be provided throughout the building including basements and podiums (open as well as closed) **in accordance with Table:- D.11-T5.a. 1, 2, or 3 as applicable.** ii. Auxiliary rooms and various areas of the building shall be protected as per **Table:- D.11-T14.** iii. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04.** iv. Yard hydrants shall not be required where infrastructure yard hydrants are available subject to testing, if the existing hydrant provided by relevant authority in kingdom of Bahrain within 60 m is well maintained and providing required water pressure, an additional yard hydrant shall not be required and tapping from existing yard hydrant network shall be permitted to extend the yard hydrants to comply with coverage requirements. In this scenario, requirements of **Table:- D.11-T5.a .4.i.** shall apply.	**4. IF PLOT AREA IS MORE THAN 20,000 m^2** v. Where a fire pump set is combined and serves yard hydrants and internal building systems, the capacity of the fire pump set shall be 1000 gpm irrespective of number of standpipes at pressure as required to satisfy 6.9 bar at the most remote landing valve and hydrant valve. vi. Where fire pump set is combined and serves yard hydrants and internal fire systems, the combined water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement.

4.4. Low-rise Building Fire Protection Systems

4.4.3. Lowrise buildings having building height of up to 15 m and low depth underground buildings or basements shall be provided with Fire protection Systems in compliance with **Table:- D.11-T5.b** and Auxiliary Rooms Fire Protection Systems as per **Table:- D.11-T14.**

Table:- D.11-T5.b .: Lowrise Building Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
A. RESIDENTIAL GROUP A, B, C. **(APARTMENTS, LABOR ACCOMMODATION, STAFF ACCOMMODATION, HOSTEL)** **B. HEALTHCARE GROUP B, C.** **C. BUSINESS GROUP A, B, C.** **D. ANIMAL HOUSING GROUP A, B, C.**	**1. IF BUILT-UP GROUND FLOOR AREA IS UP TO 3600 m^2** i. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** ii. Dry landing valves shall not be required. **2. IF BUILT-UP GROUND FLOOR AREA IS MORE THAN 3600 m^2** i. Sprinklers shall be provided throughout the building including basements and podiums (open as well as closed) as per **Section D, Chapter 05.** ii. Auxiliary rooms and various areas of the building shall be protected as per **Table:- D.11-T14.** iii. Wet riser System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 6.0.** iv. Wet risers shall be interconnected at the highest level.	**1. IF BUILT-UP GROUND FLOOR AREA IS UP TO 3600 m^2** iii. The capacity of the fire pump set shall be 50 gpm at pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. iv. The water tank shall have capacity of 30 minutes of operation, complete with low water level detection and instantaneous refilling arrangement for utility water supply. v. Fire Pump and/or Fire water tank shall be permitted to be installed on the roof, if existing structure is capable of accommodating such additional load. **2. IF BUILT-UP GROUND FLOOR AREA IS MORE THAN 3600 m^2** v. The capacity of the fire pump set shall be 750 gpm if there are 2 standpipes and 1000 gpm if there are more than 2 standpipes at pressure as required to satisfy 6.9 bar at the most remote Landing Valve. vi. The water tank shall have capacity of 30 minutes of operation, complete with low water level detection, dedicated direct breeching inlet for refilling and instantaneous refilling arrangement for utility water supply.

4.4. Low-rise Building Fire Protection Systems

4.4.4. Lowrise buildings having building height of up to 15 m and low depth underground buildings or basements shall be provided with Fire protection Systems in compliance with **Table:- D.11-T5.b .** and Auxiliary Rooms Fire Protection Systems as per **Table:- D.11-T14.**

Table:- D.11-T5.b .: Lowrise Building Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
A. RESIDENTIAL GROUP A, B, C. **(APARTMENTS, LABOR ACCOMMO-DATION, STAFF ACCOMMODATION, HOSTEL)** **B. HEALTHCARE GROUP B, C.** **C. BUSINESS GROUP A, B, C.** **D. ANIMAL HOUSING GROUP A, B, C.**	**3. IF PLOT AREA IS MORE THAN 20,000 m^2** i. Sprinklers, hose reels or and wet risers shall be provided throughout the building including basements and podiums (open as well as closed) **in accordance with Table:- D.11-T5.a. 1., 2., or 3., as applicable.** ii. Auxiliary rooms and various areas of the building shall be protected as per **Table:- D.11-T14.** iii. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04.** iv. Yard hydrants shall not be required where infrastructure yard hydrants are available subject to testing, if the existing hydrant provided by relevant authority in kingdom of Bahrain within 60 m is well maintained and providing required water pressure, an additional yard hydrant shall not be required and tapping from existing yard hydrant network shall be permitted to extend the yard hydrants to comply with coverage requirements. In this scenario, requirements of **Table:- D.11-T5.b** shall apply.	**3. IF PLOT AREA IS MORE THAN 20,000 m^2** v. Where a fire pump set is combined and serves yard hydrants and internal building systems, the capacity of the fire pump set shall be 1000 gpm irrespective of number of standpipes at pressure as required to satisfy 6.9 bar at the most remote landing valve and hydrant valve. vi. Where fire pump set is combined and serves yard hydrants and internal fire systems, the combined water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet for refilling and instantaneous refilling arrangement for utility water supply.

4.4. Low-rise Building Fire Protection Systems

4.4.5. Lowrise buildings having building height of up to 15 m and low depth underground buildings or basements but **single exit stair** shall be provided with Fire protection Systems in compliance with **Table:- D.11-T5.c.** and Auxiliary Rooms Fire Protection Systems as per **Table:- D.11-T14.**

Table:- D.11-T5.c.: Lowrise Building Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
A. RESIDENTIAL GROUP A (APARTMENTS) **WITH SINGLE EXIT STAIR COMPLYING TO SECTION A, CHAPTER 03, Table:- A.03-T24.2.1.** **B. BUSINESS GROUP A, B, C** **WITH SINGLE EXIT STAIR COMPLYING TO SECTION A, CHAPTER 03, Table:- A.03-T19.2.** **C. MERCANTILE GROUP A, B** **WITH SINGLE EXIT STAIR COMPLYING TO SECTION A, CHAPTER 03, Table:- A.03-T32.5.** **D. HOTEL GROUP A, B, C.** **WITH SINGLE EXIT STAIR**	**1. IF BUILT-UP GROUND FLOOR AREA IS UP TO 500 m²** i. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** ii. Dry landing valves shall not be required. **2. IF BUILT-UP GROUND FLOOR AREA IS MORE THAN 500 m²** i. Sprinklers shall be provided throughout the building including basements and podiums (open as well as closed) as per **Section D, Chapter 05.** ii. Auxiliary rooms and various areas of the building shall be protected as per **Table:- D.11-T14.** iii. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** iv. Dry landing valves shall not be required.	**1. IF BUILT-UP GROUND FLOOR AREA IS UP TO 500 m²** iii. Capacity of the fire pump set shall be 50 gpm at pressure as required to satisfy 4.5 bar at the most remote Hose Outlet. iv. Water tank shall have capacity of 30 minutes of operation, complete with low water level detection, dedicated direct breeching inlet for refilling and instantaneous refilling arrangement for utility water supply. v. Fire Pump and/or Fire water tank shall be permitted to be installed on the roof, if existing structure is capable of accommodating such additional load. **2. IF BUILT-UP GROUND FLOOR AREA IS MORE THAN 500 m²** v. Capacity of the fire pump set shall be 300 gpm at pressure as required to satisfy 4.5 bar at the most remote Hose Outlet. vi. Water tank shall have capacity of 30 minutes of operation, complete with low water level detection, dedicated direct breeching inlet for refilling and instantaneous refilling arrangement for utility water supply. vii. Fire Pump and/or Fire water tank shall be permitted to be installed on the roof, if existing structure is capable of accommodating such additional load.

4.4. Low-rise Building Fire Protection Systems

4.4.6. Lowrise existing villas converted to commercial outlets shall be provided with Fire protection Systems in compliance with **Table:- D.11-T5.d.** and Auxiliary Rooms Fire Protection Systems as per **Table:- D.11-T14.**

Table:- D.11-T5.d .: Lowrise Building Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
A. EXISTING VILLAS (G+1) **CONVERTED TO NURSERIES, CLINICS, DAY CARE CENTERS, RESTAURANTS, SHOW ROOMS, BOUTIQUES OR SUCH COMMERCIAL OUTLETS**	**1. IF BUILT-UP GROUND FLOOR AREA IS LESS THAN 900 M² IRRESPECTIVE OF NUMBER OF STAIRS** i. Fire Extinguishers as per **Section D, Chapter-01.** **2. IF BUILT-UP GROUND FLOOR AREA IS MORE THAN 900 M² BUT TWO EXIT STAIRS ARE AVAILABLE** i. Fire Extinguishers as per **Section D, Chapter-01.** **3. IF BUILT-UP GROUND FLOOR AREA IS MORE THAN 900 M² AND SECOND EXIT STAIR IS NOT AVAILABLE** i. It is highly recommended to the owner to consider providing second exit stair externally from first floor. **OR** ii. It is mandatory to consider providing automatic sprinkler system throughout the building including basements as per **Section D, Chapter 05.** and Hose Reel System as per **Section D, Chapter 03, Sub Section 5.0**	**1. IF BUILT-UP GROUND FLOOR AREA IS LESS THAN 900 M² IRRESPECTIVE OF NUMBER OF STAIRS** NA **2. IF BUILT-UP GROUND FLOOR AREA IS MORE THAN 900 M² BUT TWO EXIT STAIRS ARE AVAILABLE** NA **3. IF BUILT-UP GROUND FLOOR AREA IS MORE THAN 900 M² AND SECOND EXIT STAIR IS NOT AVAILABLE** iii. Where automatic sprinkler system is considered, the capacity of the fire pump set shall be 250 gpm with pressure of 4.5 bar available at most remote hose reel outlet. iv. The water tank shall have capacity of 30 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. v. Fire Pump and/or Fire water tank shall be permitted to be installed on the roof, if existing structure is capable of accommodating such additional load.

4.4. Low-rise Building Fire Protection Systems

4.4.7. Lowrise villas, business and mosques having commercial and mercantile outlets attached to it or in the same plot shall be provided with Fire protection Systems in compliance with **Table:- D.11-T5.e.** and Auxiliary Rooms Fire Protection Systems as per **Table:- D.11-T14.**

Table:- D.11-T5.e.: Lowrise Building Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
A. VILLAS (G+1) **HAVING COMMERCIAL OUTLETS ATTACHED TO IT OR IN THE SAME PLOT** **B. BUSINESS (GROUP A, B, C)** **HAVING COMMERCIAL OUTLETS ATTACHED TO IT OR IN THE SAME PLOT** **C. MOSQUES** **HAVING COMMERCIAL OUTLETS ATTACHED TO IT OR IN THE SAME PLOT**	**1. IF BUILT-UP GROUND FLOOR AREA OF THE COMMERCIAL OUTLET IS UPTO 900 M^2** i. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0** . ii. Dry landing valves shall not be required. iii. Hose reels or dry landing valves shall not be required if the infrastructure yard hydrants are available and cover the commercial outlet. **2. IF BUILT-UP GROUND FLOOR AREA OF THE COMMERCIAL OUTLET IS MORE THAN 900 M^2** i. Sprinklers shall be provided throughout the building including basements as per **Section D, Chapter 05.** ii. Auxiliary rooms and various areas of the building shall be protected as per **Table:- D.11-T14.** iii. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0** . iv. Dry landing valves shall not be required. v. Hose reels or dry landing valves shall not be required if the infrastructure yard hydrants are available and cover the commercial outlet.	**1. IF BUILT-UP GROUND FLOOR AREA OF THE COMMERCIAL OUTLET IS UPTO 900 M^2** iv. Capacity of the fire pump set shall be 50 gpm at pressure as required to satisfy 4.5 bar at the most remote Hose Outlet. v. Water tank shall have capacity of 30 minutes of operation, complete with low water level detection, dedicated direct breeching inlet for refilling and instantaneous refilling arrangement for utility water supply. vi. Fire Pump and/or Fire water tank shall be permitted to be installed on the roof, if structure is capable of accommodating such additional load. **2. IF BUILT-UP GROUND FLOOR AREA OF THE COMMERCIAL OUTLET IS MORE THAN 900 M^2** vi. Capacity of the fire pump set shall be 300gpm at pressure as required to satisfy 4.5 bar at the most remote Hose Outlet. vi. Water tank shall have capacity of 30 minutes of operation, complete with low water level detection, dedicated direct breeching inlet for refilling and instantaneous refilling arrangement for utility water supply. vii. Fire Pump and/or Fire water tank shall be permitted to be installed on the roof, if structure is capable of accommodating such additional load.

4.4. Low-rise Building Fire Protection Systems

4.4.8. Tents, marquees, site offices, site dwellings shall be provided with Fire protection Systems in compliance with **Table:- D.11-T5.f.** and Auxiliary Rooms Fire Protection Systems as per **Table:- D.11-T14.**

Table:- D.11-T5.f.: Lowrise Building Fire Protection Systems

PREDOMINAT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
A. TEMPORARY TENTS AND MARQUEES	i. Fire Extinguishers as per **Section D, Chapter-01.**	NA
B. PERMANENT TENTS AND MARQUEES	i. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0** . ii. Dry landing valves shall not be required.	ii. The capacity of the fire pump set shall be 50 gpm with pressure of 4.5 bar available at most remote hose reel outlet. iii. The water tank shall have capacity of 30 minutes of operation, complete with low water level detection and instantaneous refilling arrangement.
C. PERMANENT COMMERCIAL TENTS AND DESERT CAMPS	i. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0** . ii. Dry landing valves shall not be required.	ii. The capacity of the fire pump set shall be 50 gpm with pressure of 4.5 bar available at most remote hose reel outlet. iii. The water tank shall have capacity of 30 minutes of operation, complete with low water level detection and instantaneous refilling arrangement.
D. SITE OFFICES (REQUIRED FOR LESS THAN 6 MONTHS)	i. Fire Extinguishers as per **Section D, Chapter-01.**	
E. SITE OFFICES (REQUIRED FOR MORE THAN 6 MONTHS)	i. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0** . ii. Dry landing valves shall not be required.	ii. The capacity of the fire pump set shall be 50 gpm with pressure of 4.5 bar available at most remote hose reel outlet. iii. The water tank shall have capacity of 30 minutes of operation, complete with low water level detection and instantaneous refilling arrangement.
F. DETACHED G+1 BUILDINGS HAVING GROUND FLOOR BUILT UP AREA OF UPTO 150 SQ M, OF ANY OCCUPANCY	i. Fire Extinguishers as per **Section D, Chapter-01.**	

4.5. Mall Fire Protection Systems

4.5.1. Malls (Covered, Open and Mixed) shall be provided with Fire protection Systems in compliance with **Table:- D.11-T6** and Auxiliary Rooms Fire Protection Systems as per **Table:- D.11-T14.**

Table:- D.11-T6 .: Mall Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
A. COVERED MALL	**1. IRRESPECTIVE OF AREA OR FLOORS** i. Sprinklers shall be provided throughout the building including basements and podiums (open as well as closed) as per **Section D, Chapter 05.** ii. Auxiliary rooms and various areas of the building shall be protected as per **Table:- D.11-T14.** iii. A wet riser (Hose reel + Landing Valve) System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 6.0** iv. Wet risers shall be interconnected at the highest level. v. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04.** vi. Yard hydrants shall not be required where infrastructure yard hydrants are available within 120 m of every exterior part of the mall. Tapping from existing yard hydrant network shall be permitted to extend the yard hydrants to comply with coverage requirements. In this scenario, requirements of **Table:- D.11-T6 .1.xii. and xiii** shall apply. vii. A minimum of 2 breeching inlets shall be provided at two separate locations along the fire access road. viii. Every tenant space shall be provided with an isolation valve to enable the isolation of the tenant areas from rest of the Mall , during repairs, renovation or maintenance. ix. Supermarket storage areas, Hypermarket storage areas, large clothing storage areas and such storage hazards shall be provided with ESFR sprinklers as per relevant codes of this chapter.	**1. IRRESPECTIVE OF AREA OR FLOORS** x. Where a fire pump set is combined and serves yard hydrants and internal building systems, the capacity of the fire pump set shall be 2000 gpm (irrespective of number of standpipes) at a pressure as required to satisfy 6.9 bar at the most remote landing valve. xi. Where a fire pump set serves yard hydrants and internal building systems, the combined water tank shall have a capacity of 60 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. xii. Where a fire pump set serves only internal building systems, the capacity of the fire pump set shall be 1500 gpm (irrespective of number of standpipes) at a pressure as required to satisfy 6.9 bar at the most remote landing valve. xiii. Where a fire pump set serves only internal building systems, the water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement. xiv. Multiple breeching inlets shall be provided across the mall and along the fire access road.

4.5. Mall Fire Protection Systems

Table:- D.11-T6 .: Mall Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
B. OPEN MALL **THE REQUIREMENT IS ONLY FOR OPEN CIRCULATION AREA AND NOT FOR TENANT SPACES. TENANT SPACES SHALL COMPLY WITH OTHER APPLICABLE SECTIONS AS PER OCCUPANCY TYPES** **COMBINED FIRE PUMP SET AND FIRE WATER TANK FOR BOTH OPEN MALL CIRCULATION AREA AND THE TENANT BUILDING INTERNAL FIRE PROTECTION SYSTEM SHALL BE PERMITTED**	**1. IF TOTAL PLOT AREA IS UP TO 900 M^2** i. Hose Reel System, exterior type, shall be provided throughout the open circulation area, along the fire access road, as per **Section D, Chapter 03, Sub Section 5.0** . ii. Dry landing valves and risers shall not be required. **2. IF TOTAL PLOT AREA IS MORE THAN 900 M^2 UPTO 2000 M^2** i. Exterior Wet riser System shall be provided throughout the open circulation area, along the fire access road and such that all tenant buildings are within 30 m of the hose outlet, as per **Section D, Chapter 03, Sub Section 6.0** . ii. Dry landing valves and risers shall not be required. iii. Minimum of 2 breeching inlets shall be provided at two separate locations along the fire access road. **OR** i. Yard Fire Hydrants shall be provided as per **Table:- D.11-T6.B.3.** ii. Wet risers shall not be required. iii. Yard hydrants, wet risers or hose reel system shall not be required where infrastructure yard hydrants are available within 120 m of every exterior part of the tenant buildings. Tapping from existing yard hydrant network shall be permitted to extend the yard hydrants to comply with coverage requirements. **3. IF PLOT AREA IS MORE THAN 2000 M^2** i. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04.** ii. Yard hydrants or wet risers shall not be required where infrastructure yard hydrants are available within 120 m of every exterior part of the tenant buildings. iii. Minimum of 2 breeching inlets shall be provided at two separate locations along the fire access road. iv. Wet risers and dry landing valves shall not be required.	**1. IF TOTAL PLOT AREA IS UP TO 900 M^2** iii. The capacity of the fire pump set shall be 50 gpm at a pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve.. iv. The water tank shall have capacity of 30 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **2. IF TOTAL PLOT AREA IS MORE THAN 900 M^2 UPTO 2000 M^2** iv. The capacity of the fire pump set shall be 750 gpm at a pressure as required to satisfy 6.9 bar at the most remote landing valve. v. The water tank shall have capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement. vi. Where yard hydrant is considered, the capacity of the fire pump set shall be 1000 gpm at a pressure as required to satisfy 6.9 bar at the most remote hydrant outlet. vii. The water tank shall have capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement. **3. IF PLOT AREA IS MORE THAN 2000 M^2** v. The capacity of the fire pump set shall be 1000 gpm at a pressure as required to satisfy 6.9 bar at the most remote landing valve. vi. The water tank shall have capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement.

4.5. Mall Fire Protection Systems

Table:- D.11-T6 .: Mall Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
C. MIXED MALL **(MERCANTILE DEVLEOPMENTS WHERE COVERED MALL AND OPEN MALL ARE MIXED AND INTERMINGLE)**	**1. IRRESPECTIVE OF AREA OR FLOORS** i. Sprinklers shall be provided throughout the enclosed buildings, retails, restaurants and service blocks including basements and podiums (open as well as closed) as per **Section D, Chapter 05.** ii. Auxiliary rooms and various areas of the building shall be protected as per **Table:- D.11-T14.** iii. A wet riser (Hose reel + Landing Valve) System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 6.0** iv. Wet risers shall be interconnected at the highest level. v. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04.** vi. Yard hydrants shall not be required where infrastructure yard hydrants are available within 120 m of every exterior part of the mall. Tapping from existing yard hydrant network shall be permitted to extend the yard hydrants to comply with coverage requirements. In this scenario, requirements of **Table:- D.11-T6 .1.xii. and xiii** shall apply. vii. A minimum of 2 breeching inlets shall be provided at two separate locations along the fire access road. viii. Every tenant space shall be provided with an isolation valve to enable the isolation of the tenant areas from rest of the Mall , during repairs, renovation or maintenance. ix. Enclosed supermarket storage areas, Hypermarket storage areas, large clothing storage areas and such enclosed storage hazards shall be provided with ESFR sprinklers as per relevant codes of this chapter.	**1. IRRESPECTIVE OF AREA OR FLOORS** x. Where a fire pump set is combined and serves yard hydrants and internal building systems, the capacity of the fire pump set shall be 2000 gpm (irrespective of number of standpipes) at a pressure as required to satisfy 6.9 bar at the most remote landing valve. xi. Where a fire pump set serves yard hydrants and internal building systems, the combined water tank shall have a capacity of 60 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. xii. Where a fire pump set serves only internal building systems, the capacity of the fire pump set shall be 1500 gpm (irrespective of number of standpipes) at a pressure as required to satisfy 6.9 bar at the most remote landing valve. xiii. Where a fire pump set serves only internal building systems, the water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement. xiv. Multiple breeching inlets shall be provided across the mall and along the fire access road.

4.6. Villa Fire Protection Systems

4.6.1. Private and Commercial Villas shall be provided with Fire protection Systems in compliance with **Table:- D.11-T7** and Auxiliary Rooms Fire Protection Systems if any shall be as per **Table:- D.11-T14.**

Table:- D.11-T7.: Private and Commercial Villa Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
A. PRIVATE VILLA	**1. IF GROUND FLOOR BUILT-UP AREA IS MORE THAN 1500 M^2** i. Sprinklers shall be provided throughout the building including basements (open as well as closed) as per **Section D, Chapter 05.** ii. Hose Reel System shall be provided throughout the basement and ground floor as per **Section D, Chapter 03, Sub Section 5.0.** iii. Dry landing valves and risers shall not be required. iv. For Commercial developments, Fire Pump Room and Fire water tank are developer's responsibility and shall be provided at developer's facility management service block or areas. **2. IF BASEMENT FLOOR BUILT-UP AREA IS MORE THAN 1500 M^2** i. Sprinklers shall be provided throughout the basements (open as well as closed) as per **Section D, Chapter 05. .** ii. Hose Reel System shall be provided throughout the basement and ground floor as per **Section D, Chapter 03, Sub Section 5.0.** iii. Dry landing valves and risers shall not be required. iv. For Commercial developments, Fire Pump Room and Fire water tank are developer's responsibility and shall be provided at developer's facility management service block or areas.	**1. IF GROUND FLOOR BUILT-UP AREA IS MORE THAN 1500 M^2** v. The capacity of the fire pump set shall be 250 gpm at pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. vi. The water tank shall have capacity of 30 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **2. IF BASEMENT FLOOR BUILT-UP AREA IS MORE THAN 1500 M^2** v. The capacity of the fire pump set shall be 250 gpm at pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. vi. The water tank shall have capacity of 30 minutes of operation, complete with low water level detection and instantaneous refilling arrangement.

4.6. Villa Fire Protection Systems

4.6.2. Private and Commercial Villas shall be provided with Fire protection Systems in compliance with **Table:- D.11-T7 .** and Auxiliary Rooms, if any, Fire Protection Systems as per **Table:- D.11-T14.**

Table:- D.11-T7 .: Private and Commercial Villa Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
B. COMMERCIAL VILLA	**1. Though it is not mandatory, it is highly recommended to consider providing automatic sprinklers throughout the Villas irrespective of built-up area.** **2. ALL COMMERCIAL VILLA DEVELOPMENTS HAVING PLOT AREA OF 20,000 M^2 OR MORE** i. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04.**	1.a. Domestic type and residential type sprinkler systems shall be permitted. **2. ALL COMMERCIAL VILLA DEVELOPMENTS HAVING PLOT AREA OF 20,000 M^2 OR MORE** ii. The capacity of the fire pump set shall be 1000 gpm at pressure as required to satisfy 6.9 bar at the most remote hydrant outlet valve. iii. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement.
	3. IF GROUND FLOOR BUILT-UP AREA OF COMMERCIAL VILLA IS MORE THAN 1500 M^2 i. Sprinklers shall be provided throughout the building including basements (open as well as closed) as per **Section D, Chapter 05.** ii. Hose Reel System shall be provided throughout the basement and ground floor as per **Section D, Chapter 03, Sub Section 5.0.** iii. Dry landing valves and risers shall not be required. iv. For Commercial developments, Fire Pump Room and Fire water tank are developer's responsibility and shall be provided at developer's facility management service block or areas. **4. IF BASEMENT FLOOR BUILT-UP AREA IS MORE THAN 1500 m^2** i. Sprinklers shall be provided throughout the basements (open as well as closed) as per **Section D, Chapter 05.** ii. Hose Reel System shall be provided throughout the basement and ground floor as per **Section D, Chapter 03, Sub Section 5.0.** iii. Dry landing valves and risers shall not be required. iv. For Commercial developments, Fire Pump Room and Fire water tank are developer's responsibility and shall be provided at developer's facility management service block or areas.	**3. IF GROUND FLOOR BUILT-UP AREA OF COMMERCIAL VILLA IS MORE THAN 1500 M^2** v. The capacity of the fire pump set shall be 250 gpm at pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. vi. The water tank shall have capacity of 30 minutes of operation, complete with low water level detection and instantaneous refilling arrangement vii. Where infrastructure yard hydrants are provided, the required villa sprinkler system shall be permitted to be fed by the yard hydrant pump set and water. **4. IF BASEMENT FLOOR BUILT-UP AREA IS MORE THAN 1500 M^2** v. The capacity of the fire pump set shall be 250 gpm at pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. vi. The water tank shall have capacity of 30 minutes of operation, complete with low water level detection and instantaneous refilling arrangement.

4.7. Parking Facilities Fire Protection Systems

4.7.1. Parking facilities shall be provided with fire protection systems in compliance with **Table:- D.11-T8.** and Auxiliary Rooms Fire Protection Systems as per **Table:- D.11-T14.**

Table:- D.11-T8.: Parking Facility Fire Protection Systems

OCCUPANCY	SYSTEM REQUIREMENTS	FIRE PUMP AND FIRE WATER TANK CAPACITIES
A. PARKING GROUP A , ENCLOSED PARKING STRUCTURE	**1. IF BUILT-UP GROUND FLOOR AREA IS UP TO 900 M^2 AND STRUCTURE HEIGHT IS UP TO 15 M (LOWRISE)** i. A dry riser + Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 4.0 and 5.0.** ii. Dry risers shall be interconnected at the highest level.	**1. IF BUILT-UP GROUND FLOOR AREA IS UP TO 900 M^2 AND STRUCTURE HEIGHT IS UP TO 15 M (LOWRISE)** iii. The capacity of the fire pump set shall be 50 gpm at a pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. iv. The water tank shall have a capacity of 30 minutes of operation, complete with low water level detection and instantaneous refilling arrangement.
	2. IF BUILT-UP GROUND FLOOR AREA IS 901 M^2 TO 3600 M^2 AND STRUCTURE HEIGHT IS UP TO 15 M (LOWRISE) i. Sprinklers shall be provided throughout the parking structure as per **Section D, Chapter 05.** ii. Auxiliary rooms and various areas of the building shall be protected as per **Table:- D.11-T14.** iii. A dry riser + Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 4.0 and 5.0.** iv. Dry risers shall be interconnected at the highest level.	**2. IF BUILT-UP GROUND FLOOR AREA IS 901 M^2 TO 3600 M^2 AND STRUCTURE HEIGHT IS UP TO 15 M (LOWRISE)** v. The capacity of the fire pump set shall be 300 gpm at a pressure as required to satisfy 4.5 bar at the most remote Hose valve. vi. The water tank shall have a capacity of 30 minutes of operation, complete with low water level detection and instantaneous refilling arrangement.
	3. IF BUILT-UP GROUND FLOOR AREA IS MORE THAN 3600 M^2 OR STRUCTURE HEIGHT EXCEEDS 15 M (MIDRISE AND ABOVE) i. Sprinklers shall be provided throughout the Parking structure as per **Section D, Chapter 05.** **ii.** Auxiliary rooms and various areas of the building shall be protected as per **Table:- D.11-T14.** iii. A wet riser System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 6.0.** **iv.** Wet risers shall be interconnected at the highest level.	**3. IF BUILT-UP GROUND FLOOR AREA IS MORE THAN 3600 M^2 OR STRUCTURE HEIGHT EXCEEDS 15 M (MIDRISE AND ABOVE)** v. The capacity of the fire pump set shall be 750 gpm if there are 2 standpipes, 1000 gpm if there are more than 3 standpipes at a pressure as required to satisfy 6.9 bar at the most remote landing valve. vi. The water tank shall have capacity of 60 minutes of operation, complete with low water level detection and instantaneous refilling arrangement.

Table:- D.11-T8.: Parking Facility Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
A. PARKING GROUP A , ENCLOSED PARKING STRUCTURE	**4. IF PLOT AREA IS MORE THAN 20,000 m^2** i. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04.** in a loop to cover the entire development. ii. Yard hydrants shall not be required where infrastructure yard hydrants are available within 60 m of every exterior part of the structure. Tapping from existing yard hydrant network shall be permitted to extend the yard hydrants to comply with coverage requirements. iii. Sprinklers, wet risers and hose reel system shall be provided for the building in accordance with **Table:- D.11-T8.A.1., 2., or 3.** as applicable.	**4. IF PLOT AREA IS MORE THAN 20,000 m^2** iv. Where a fire pump set is combined and serves yard hydrants and internal building systems, the capacity of the fire pump set shall be 1000 gpm at a pressure as required to satisfy 6.9 bar at the most remote hydrant valve and the hose outlet. v. Where fire pump set serves only the yard fire hydrants, pump capacity shall be 1000 gpm at a pressure as required to satisfy 6.9 bar at the most remote hydrant valve. vi. The combined Fire water tank shall have capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement.
B. PARKING GROUP B , MECHANICAL/ ROBOTIC PARKING STRUCTURE	**1. IRRESPECTIVE OF AREA** i. A deluge water spray system shall be provided as per **Section D, Chapter 06** such that each vehicle is under the deluge spray coverage. ii. A wet riser (Hose reel + Landing Valve) system shall be provided throughout the building, near stairs and on access walkways as per **Section D, Chapter 03, Sub Section 6.0.** iii. Wet risers shall be interconnected at the highest level. **2. IF PLOT AREA IS MORE THAN 20,000 m^2** i. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04.** in a loop to cover the entire development. The fire Hose for interior of the building shall be tapped from the hydrant loop. ii. Yard hydrants shall not be required where infrastructure yard hydrants are available within 60 m of every exterior part of the structure. Tapping from existing yard hydrant network shall be permitted to extend the yard hydrants to comply with coverage requirements.	**1. IRRESPECTIVE OF AREA** iv. The capacity of the fire pump set shall be sufficient to satisfy minimum of 2 adjacent deluge water spray system zones at a pressure as required to satisfy 6.9 bar at the most remote Hose reel outlet valve. v. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **2. IF PLOT AREA IS MORE THAN 20,000 m^2** iii. Where a fire pump set is combined and serves yard hydrants and internal building systems, the capacity of the fire pump set shall be 1000 gpm at a pressure as required to satisfy 6.9 bar at the most remote landing valve and the hydrant outlet. iv. Where fire pump set serves only the yard fire hydrants, pump capacity shall be 1000 gpm at a pressure as required to satisfy 6.9 bar at the most remote hydrant outlet. v. The combined Fire water tank shall have capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement

Table:- D.11-T8.: Parking Facility Fire Protection Systems

C. PARKING GROUP C OPEN PARKING STRUCTURE	**1. IF BUILT-UP GROUND FLOOR AREA IS UP TO 2000 M² AND BUILDING HEIGHT IS LESS THAN 15 M** i. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0** ii. Dry risers shall not be required. **2. IF BUILT-UP GROUND FLOOR AREA IS UP TO 2000 M² AND STRUCTURE HEIGHT IS 15 M UP TO LESS THAN 23 M** i. A wet riser (Hose reel + Landing Valve) System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 6.0** ii. Wet risers shall be interconnected at the highest level. **3. IF BUILT-UP GROUND FLOOR AREA IS MORE THAN 2000 M² OR BUILDING HEIGHT IS 23 m AND ABOVE** i. Sprinklers shall be provided throughout the Parking structure as per **Section D, Chapter 05.** ii. A wet riser (Hose reel + Landing Valve) system shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 6.0** iii. Wet risers shall be interconnected at the highest level. **4. IF PLOT AREA IS MORE THAN 20,000 m²** i. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04.,** in a loop to cover the entire development. ii. Yard hydrants shall not be required where infrastructure yard hydrants are available within 60 m of every exterior part of the structure. Tapping from existing yard hydrant network shall be permitted to extend the yard hydrants to comply with coverage requirements. iii. Sprinklers, wet risers or hose reel system shall be in accordance with **Section D, Chapter 03.** as applicable.	**1. IF BUILT-UP GROUND FLOOR AREA IS UP TO 2000 M² AND BUILDING HEIGHT IS LESS THAN 15 M** iii. The capacity of the fire pump set shall be 50 gpm at a pressure as required to satisfy 4.5bar at the most remote Hose reel outlet valve iv. The water tank shall have capacity of 45 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **2. IF BUILT-UP GROUND FLOOR AREA IS UP TO 2000 m² AND STRUCTURE HEIGHT IS 15 M UP TO LESS THAN 23 M** iii. The capacity of the fire pump set shall be 75gpm if there are 2 stairs, 1000 gpm if there are 3 stairs and 1000 gpm if there are more than 3 stairs at pressure as required to satisfy 6.9 bar at the most remote landing valve. iv. The water tank shall have capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement. **3. IF BUILT-UP GROUND FLOOR AREA IS MORE THAN 2000 m² OR BUILDING HEIGHT IS 23 m AND ABOVE** iv. The capacity of the fire pump set shall be 1000 gpm at a pressure as required to satisfy 6.9 bar at the most remote Landing Valve. v. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement **4. IF PLOT AREA IS MORE THAN 20,000 m²** iv. Where a fire pump set is combined and serves yard hydrants and internal building systems, the capacity of the fire pump set shall be 1000 gpm at a pressure as required to satisfy 6.9 bar at the most remote Landing Valve and yard hydrant. v. Where fire pump set serves only the yard fire hydrants, pump capacity shall be 1000 gpm at a pressure as required to satisfy 6.9 bar at the most remote hydrant valve. vi. Combined Fire water tank shall have capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement

Table:- D.11-T8.: Parking Facility Fire Protection Systems

OCCUPANCY	SYSTEM REQUIREMENTS	FIRE PUMP AND FIRE WATER TANK CAPACITIES
D. PARKING GROUP C COVERED / SHADED PARKING **HAVING ONE LEVEL ONLY**	**1. IF COVERED/SHADED PARKING AREA IS 3600 M^2 TO LESS THAN 20,000 M^2** i. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0** ii. Dry riser shall not be required. **2. IF COVERED/SHADED PARKING AREA IS MORE THAN 20,000 M^2** i. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04.,** in a loop to cover the entire development. Where yard hydrants are provided, hose reel system shall not be required. ii. Yard hydrants or hose reel system shall not be required where infrastructure yard hydrants are available within 60 m of every exterior part of the structure.	**1. IF COVERED/SHADED PARKING AREA IS 3600 M^2 TO LESS THAN 20,000 M^2** iii. The capacity of the fire pump set shall be 50 gpm at a pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. iv. The water tank shall have capacity of 60 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. 2. **IF COVERED/SHADED PARKING AREA IS MORE THAN 20,000 M^2** iii. The fire pump set capacity shall be 1000 gpm. iv. Fire water tank shall have capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement

4.8. Motor Fuel Dispensing Facility Fire Protection Systems

4.8.1. Motor fuel dispensing Facilities shall be provided with Fire protection Systems in compliance with **Table:- D.11-T9.** and Auxiliary Rooms Fire Protection Systems as per **Table:- D.11-T14.**

Table:- D.11-T9.: Motor Fuel Dispensing Facility Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
A. GROUP A **PETROL/GAS STATIONS HAVING UNDERGROUND FUEL STORAGE TANKS WITH MINI MARTS, RESTAURANTS, DINING, FOOD COURTS, RETAIL, BUSINESS AND SERVICE/REPAIR STATIONS AS INDIVIDUAL BUILDINGS**	i. Sprinklers shall be provided throughout the mini marts, restaurants, dining areas, business, retail, service Stations as per **Section D, Chapter 05.** ii. A Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0** iii. Dry landing valves and risers shall not be required.	iv. The capacity of the fire pump set shall be 300 gpm at a pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. v. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement.
B. GROUP B **PETROL/GAS STATIONS HAVING UNDERGROUND FUEL STORAGE TANKS WITH RESTAURANTS/BAKERIES, WITHIN A SINGLE MINI MART BUILDING AND SERVICE/REPAIR STATIONS** **FLEET VEHICLE FUEL DISPENSING,** **MARINE MOTOR FUEL DISPENSING**	i. A hose reel system shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0** ii. Dry landing valves and risers shall not be required.	iii. The capacity of the fire pump set shall be 50 gpm at pressure as required to satisfy 6.9 bar at the most remote hydrant outlet valve. iv. The water tank shall have capacity of 60 minutes of operation, complete with low water level detection and instantaneous refilling arrangement.
C. GROUP C **PETROL/GAS STATIONS HAVING UNDERGROUND FUEL STORAGE TANKS** **WITH MINI MARTS ONLY WITH-OUT SERVICE/REPAIR STATIONS** **ELECTRIC CHARGING UNITS**	i. Extinguishers shall be provided as per **Section D, Chapter 01.**	ii. NA.

4.9. Infrastructure Fire Protection Systems

4.9.1. All new developments' infrastructure, marina developments, waterfront developments, theme parks, amusement parks and commercial developments shall be provided with Fire protection Systems in compliance with **Table:- D.11-T10.** and auxiliary rooms fire Protection Systems, if any, as per **Table:- D.11-T14.**

Table:- D.11-T10.: Infrastructure Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
A. INFRASTRUCTURE	i. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04** ii. A combined network with irrigation network is not acceptable. The yard hydrant network shall be dedicated with dedicated fire pump and fire water tank. iii. A fire pump room and Fire water tank shall be provided in service blocks or suitable facility management block areas. iv. A dedicated corridor/Trench shall be provided for the Hydrant piping network complete with strategic accessible manholes. v. Yard hydrants shall be provided along the fire access road at interval as mentioned in **Section D, Chapter 04.**	vi. The capacity of the stand-alone dedicated fire pump set, serving only the yard hydrant system shall be 1000 gpm at pressure as required to satisfy 6.9 bar at the most remote hydrant outlet valve. vii. The water tank shall have a capacity of 90 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement. viii. TSE (Treated Sewage Water), tested as acceptable for fire protection purpose shall be acceptable upon submission of test reports to General Directorate of Civil Defence Kingdom of Bahrain. ix. Sweet water of lakes and ponds shall be acceptable, provided that an adequate water level reserve is ensured at all times.
B. MARINA AND WATERFRONT INFRASTRUCTURE	i. Marinas and waterfront property infrastructure and associated facilities shall be provided with Fire Protection systems in accordance with **Section B, Chapter 01, Marina.**	

4.10. Storage, Warehouse and Industrial Facility Fire Protection Systems

4.10.1. Storage, warehouse and industrial facilities shall be provided with Fire protection Systems in compliance with **Table:- D.11-T11.** and auxiliary rooms fire protection systems as per **Table:- D.11-T14. However, all warehouse and industrial sprinkler protection designers shall first consider and consult the relevant Material Safety Data Sheet (MSDS) before designing and proposing the sprinkler system.**

Table:- D.11-T11.: Storage, Warehouse and Industrial Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
A. MULTI TENANT WAREHOUSE AND FACTORIES FOR RENTAL PURPOSE **(LIMITED TO LIGHT HAZARD MATERIALS AS PER SECTION D, CHAPTER 05, TABLE:- D.05-T1.A AND LIGHT HAZARD ACTIVITY AS PER TABLE:- D.05-T2.)**	**1. IF TOTAL BUILT-UP GROUND FLOOR AREA IS LESS THAN 900 M^2 AND EACH INDIVIDUAL UNIT COMPARTMENT AREA IS LESS THAN 230 M^2** i. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0** ii. Hose Reel System shall be extended to mezzanine levels, if any. iii. Dry landing valves and risers shall not be required. **2. IF TOTAL BUILT-UP GROUND FLOOR AREA IS MORE THAN 900 M^2 OR ANY INDIVIDUAL UNIT COMPARTMENT AREA IS 230 m^2–UP TO 900 M^2** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be 0.15 gpm with area of sprinkler operation of 1500 ft^2 (140 m^2). iii. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0** iv. Dry landing valves and risers shall not be required. **3. IF INDIVIDUAL COMPARTMENT OR UNIT AREA IS MORE THAN 900 M^2** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be 0.15 gpm with area of sprinkler operation of 1500 ft^2 (140 m^2). iii. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0** **4. IF SUM OF ALL GROUND FLOOR BUILT-UP AREAS IS MORE THAN 3600 M^2** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. Sprinkler design density shall be 0.15 gpm with area of sprinkler operation of 1500 ft^2 (140 m^2). iii. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04.** in a loop to cover the entire facility. iv. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** v. Wet risers and internal landing valves shall not be required.	**1. IF TOTAL BUILT-UP GROUND FLOOR AREA IS LESS THAN 900 M^2 AND EACH INDIVIDUAL UNIT COMPARTMENT AREA IS LESS THAN 230 M^2** iv. The capacity of the fire pump set shall be 50 gpm at a pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. v. The water tank shall have a capacity of 30 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **2. IF TOTAL BUILT-UP GROUND FLOOR AREA IS MORE THAN 900 M^2 OR ANY INDIVIDUAL UNIT COMPARTMENT AREA IS 230 m^2–UP TO 900 M^2** v. The capacity of the fire pump set shall be 250 gpm at pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. vi. The water tank shall have capacity of 45 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. 3. **IF INDIVIDUAL COMPARTMENT OR UNIT AREA IS MORE THAN 900 M^2** iv. The capacity of the fire pump set shall be 250 gpm at a pressure as required to satisfy 4.5 bar at the most remote hose reel valve. v. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement. **4. IF SUM OF ALL GROUND FLOOR BUILT-UP AREAS IS MORE THAN 3600 M^2** vi. The capacity of the fire pump set shall be 750 gpm at a pressure as required to satisfy 6.9 bar at the most remote Hydrant valve. vii. The water tank shall have capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement.

Table:- D.11-T11.: Storage, Warehouse and Industrial Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
B. MULTI TENANT INDUSTRIES, AND FACTORIES **(ORDINARY HAZARD, GROUP 1 CATEGORY ACTIVITIES AS PER SECTION-D, CHAPTER-05 DEFINITION 2.2.2.h.)**	**1. IF TOTAL BUILT-UP GROUND FLOOR AREA IS LESS THAN 900 M^2 AND EACH INDIVIDUAL UNIT COMPARTMENT AREA IS LESS THAN 230 M^2** i. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0** ii. Hose Reel System shall be extended to mezzanine levels, if any. iii. Dry landing valves and risers shall not be required. **2. IF TOTAL BUILT-UP GROUND FLOOR AREA IS MORE THAN 900 M^2 OR ANY INDIVIDUAL UNIT COMPARTMENT AREA IS 230 M^2–UP TO 900 M^2** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be 0.15 gpm with area of sprinkler operation of 1500 ft^2 (140 m^2). iii. Hose Reel System shall be provided throughout the building as per **and Section D, Chapter 03, Sub Section 5.0** iv. Dry landing valves and risers shall not be required. **3. IF INDIVIDUAL COMPARTMENT OR UNIT AREA IS MORE THAN 900 M^2** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be 0.15 gpm with area of sprinkler operation of 1500 ft^2 (140 m^2). iii. Hose Reel System shall be provided throughout the building as per **and Section D, Chapter 03, Sub Section 5.0** iv. Dry landing valves and risers shall not be required. **4. IF SUM OF ALL GROUND FLOOR BUILT -UP AREAS IS MORE THAN 3600 M^2** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. Sprinkler design density shall be 0.15 gpm with area of sprinkler operation of 1500 ft^2 (140 m^2). iii. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04,** in a loop to cover the entire facility. iv. Hose Reel System shall be provided throughout the building as per **and Section D, Chapter 03, Sub Section 5.0** v. Wet risers and internal landing valves shall not be required.	**1. IF TOTAL BUILT-UP GROUND FLOOR AREA IS LESS THAN 900 M^2 AND EACH INDIVIDUAL UNIT COMPARTMENT AREA IS LESS THAN 230 M^2** iv. The capacity of the fire pump set shall be 50 gpm at a pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. v. The water tank shall have a capacity of 30 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **2. IF TOTAL BUILT-UP GROUND FLOOR AREA IS MORE THAN 900 M^2 OR ANY INDIVIDUAL UNIT COMPARTMENT AREA IS 230 M^2–UP TO 900 M^2** v. The capacity of the fire pump set shall be 300 gpm at pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. vi. The water tank shall have capacity of 45 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **3. IF INDIVIDUAL COMPARTMENT OR UNIT AREA IS MORE THAN 900 M^2** v. The capacity of the fire pump set shall be 300 gpm at a pressure as required to satisfy 4.5 bar at the most remote hose reel valve. vi. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement. **4. 4. IF SUM OF ALL GROUND FLOOR BUILT-UP AREAS IS MORE THAN 3600 M^2** vi. The capacity of the fire pump set shall be 750 gpm at a pressure as required to satisfy 6.9 bar at the most remote Hydrant valve. vii. The water tank shall have capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement.

Table:- D.11-T11.: Storage, Warehouse and Industrial Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
C. MULTI TENANT INDUSTRIES, AND FACTORIES **(ORDINARY HAZARD,GROUP 2 CATEGORY ACTIVITIES AS PER SECTION-D, CHAPTER-05 DEFINITION 2.2.3.c)**	**1. IF TOTAL BUILT-UP GROUND FLOOR AREA IS LESS THAN 900 m^2 AND EACH INDIVIDUAL UNIT COMPARTMENT AREA IS LESS THAN 230 m^2** i. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** ii. Hose Reel System shall be extended to mezzanine levels, if any. iii. Dry landing valves and risers shall not be required. **2. IF TOTAL BUILT-UP GROUND FLOOR AREA IS MORE THAN 900 m^2 OR ANY INDIVIDUAL UNIT COMPARTMENT AREA IS 230 m^2–UP TO 900 m^2** i. Sprinklers shall be provided throughper **Section D, Chapter 05.** ii. The sprinkler design density shall be 0.20 gpm with area of sprinkler operation of 1500 ft^2 (140 m^2). iii. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** iv. No dry landing valves required. **3. IF INDIVIDUAL COMPARTMENT OR UNIT AREA IS MORE THAN 900 m^2** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be 0.20 gpm with area of sprinkler operation of 1500 ft^2 (140 m^2). iii. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** iv. No dry landing valves required. **4. IF SUM OF ALL GROUND FLOOR BUILT-UP AREAS IS MORE THAN 3600 m^2** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. Sprinkler design density shall be 0.20 gpm with area of sprinkler operation of 1500 ft^2 (140 m^2). iii. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04,** in a loop to cover the entire facility. iv. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** v. Wet risers and internal landing valves shall not be required.	**1. IF TOTAL BUILT-UP GROUND FLOOR AREA IS LESS THAN 900 m^2 AND EACH INDIVIDUAL UNIT COMPARTMENT AREA IS LESS THAN 230 m^2** iv. The capacity of the fire pump set shall be 50 gpm at a pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. v. The water tank shall have a capacity of 30 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **2. IF TOTAL BUILT-UP GROUND FLOOR AREA IS MORE THAN 900 m^2 OR ANY INDIVIDUAL UNIT COMPARTMENT AREA IS 230 m^2–UP TO 900 m^2** v. The capacity of the fire pump set shall be 350 gpm at pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. vi. The water tank shall have capacity of 45 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **3. IF INDIVIDUAL COMPARTMENT OR UNIT AREA IS MORE THAN 900 m^2** v. The capacity of the fire pump set shall be 350 gpm at a pressure as required to satisfy 4.5 bar at the most remote hose reel valve. vi. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement. **4. IF SUM OF ALL GROUND FLOOR BUILT-UP AREAS IS MORE THAN 3600 m^2** vi. The capacity of the fire pump set shall be 750 gpm at a pressure as required to satisfy 6.9 bar at the most remote Hydrant valve. vii. The water tank shall have capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement.

Table:- D.11-T11.: Storage, Warehouse and Industrial Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
D. MULTI TENANT INDUSTRIES, AND FACTORIES **(EXTRA HAZARD, GROUP 1 CATEGORY ACTIVITIES AS PER SECTION-D, CHAPTER-05 DEFINITION 2.2.4.a)**	**1. IF TOTAL GROUND FLOOR BUILT-UP AREA IS LESS THAN 3600 m^2** i. Sprinklers shall be provided through- out the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be 0.30 gpm with area of sprinkler operation of 2500 ft^2 (232 m^2). iii. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** iv. Dry landing valves and risers shall not be required. **2. IF SUM OF ALL GROUND FLOOR BUILT-UP AREAS IS MORE THAN 3600 m^2** i. Sprinklers shall be provided through- out the facility as per **Section D, Chapter 05.** ii. Sprinkler design density shall be 0.30 gpm with area of sprinkler operation of 2500 ft^2 (232 m^2). iii. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04,** in a loop to cover the entire facility. iv. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** v. Wet risers and internal landing valves shall not be required.	**1. IF TOTAL GROUND FLOOR BUILT-UP AREA IS LESS THAN 3600 m^2** v. The capacity of the fire pump set shall be 750 gpm at pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. vi. The water tank shall have capacity of 60 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **2. IF SUM OF ALL GROUND FLOOR BUILT-UP AREAS IS MORE THAN 3600 m^2** vi. The capacity of the fire pump set shall be 1250 gpm at a pressure as required to satisfy 6.9 bar at the most remote Hydrant valve. vii. The water tank shall have capacity of 90 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement.

Table:- D.11-T11.: Storage, Warehouse and Industrial Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
E. MULTI TENANT INDUSTRIES, AND FACTORIES **(EXTRA HAZARD, GROUP 2 CATEGORY ACTIVITIES AS PER SECTION-D, CHAPTER-05 DEFINITION 2.2.5.a)**	**1. IF TOTAL GROUND FLOOR BUILT-UP AREA IS LESS THAN 3600 m^2** i. Sprinklers shall be provided through-out the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be 0.40 gpm with area of sprinkler operation of 2500 ft^2 (232 m^2). iii. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** iv. Dry landing valves and risers shall not be required. **2. IF SUM OF ALL GROUND FLOOR BUILT -UP AREAS IS MORE THAN 3600 m^2** i. Sprinklers shall be provided through-out the facility as per **Section D, Chapter 05.** ii. Sprinkler design density shall be 0.40 gpm with area of sprinkler operation of 2500 ft^2 (232 m^2). iii. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04,** in a loop to cover the entire facility. iv. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** v. Wet risers and internal landing valves shall not be required.	**1. IF TOTAL GROUND FLOOR BUILT-UP AREA IS LESS THAN 3600 m^2** v. The capacity of the fire pump set shall be 1000 gpm at pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. vi. The water tank shall have capacity of 60 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **4. IF SUM OF ALL GROUND FLOOR BUILT-UP AREAS IS MORE THAN 3600 m^2** vi. The capacity of the fire pump set shall be 1500 gpm at a pressure as required to satisfy 6.9 bar at the most remote Hydrant valve. vii. The water tank shall have capacity of 120 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement.

Table:- D.11-T11.: Storage, Warehouse and Industrial Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
F. SINGLE TENANT WAREHOUSE AND FACTORIES **(LIMITED TO LIGHT HAZARD MATERIALS AS PER SECTION D, CHAPTER 05, TABLE:-D.05-T1.A AND LIGHT HAZARD ACTIVITY AS PER TABLE:- D.05-T2.)**	**1. IF TOTAL BUILT-UP GROUND FLOOR AREA IS LESS THAN 900 m^2** i. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** ii. Dry landing valves and risers shall not be required. **2. IF TOTAL BUILT-UP GROUND FLOOR AREA IS 900 m^2—3600 m^2** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be 0.15 gpm with area of sprinkler operation of 1500 ft^2 (140 m^2). iii. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** iv. No dry landing valves required. **3. IF SUM OF ALL GROUND FLOOR BUILT-UP AREAS IS MORE THAN 3600 m^2** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. Sprinkler design density shall be 0.15 gpm with an area of sprinkler operation of 1500 ft2 (140 m^2). iii. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04,** in a loop to cover the entire facility. iv. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** v. Wet risers and internal landing valves shall not be required.	**1. IF TOTAL BUILT-UP GROUND FLOOR AREA IS LESS THAN 900 m^2** iii. The capacity of the fire pump set shall be 50 gpm at a pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. iv. The water tank shall have a capacity of 45 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **2. IF TOTAL BUILT-UP GROUND FLOOR AREA IS 900 m^2—3600 m^2** v. The capacity of the fire pump set shall be 250 gpm at a pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. vi. The water tank shall have a capacity of 60 minutes of operation, dedicated direct breeching inlet complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement. **3. IF SUM OF ALL GROUND FLOOR BUILT-UP AREAS IS MORE THAN 3600 m^2** vi. The capacity of the fire pump set shall be 750 gpm at a pressure as required to satisfy 6.9 bar at the most remote landing valve. vii. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement.

Table:- D.11-T11.: Storage, Warehouse and Industrial Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
G. SINGLE TENANT INDUSTRIES, AND FACTORIES **(ORDINARY HAZARD, GROUP 1 CATEGORY ACTIVITIES AS PER SECTION-D, CHAPTER-05 DEFINITION 2.2.2.h.)**	**1. IF TOTAL BUILT-UP GROUND FLOOR AREA IS LESS THAN 900 m^2** i. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** ii. Dry landing valves and risers shall not be required. **2. IF TOTAL BUILT-UP GROUND FLOOR AREA IS 900 m^2—3600 m^2** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be 0.15 gpm with area of sprinkler operation of 1500 ft^2 (140 m^2). iii. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** **3. IF SUM OF ALL GROUND FLOOR BUILT-UP AREAS IS MORE THAN 3600 m^2** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. Sprinkler design density shall be 0.15 gpm with an area of sprinkler operation of 1500 ft^2 (140 m^2). iii. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04,** in a loop to cover the entire facility. iv. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** v. Wet risers and internal landing valves shall not be required.	**1. IF TOTAL BUILT-UP GROUND FLOOR AREA IS LESS THAN 900 m^2** iii. The capacity of the fire pump set shall be 50 gpm at a pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. iv. The water tank shall have a capacity of 45 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **2. IF TOTAL BUILT-UP GROUND FLOOR AREA IS 900 m^2—3600 m^2** iv. The capacity of the fire pump set shall be 300 gpm at a pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. v. The water tank shall have a capacity of 60 minutes of operation, dedicated direct breeching inlet complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement. **3. IF SUM OF ALL GROUND FLOOR BUILT-UP AREAS IS MORE THAN 3600 m^2** vi. The capacity of the fire pump set shall be 750 gpm at a pressure as required to satisfy 6.9 bar at the most remote landing valve. vii. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement.

Table:- D.11-T11.: Storage, Warehouse and Industrial Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
H. SINGLE TENANT INDUSTRIES, AND FACTORIES **(ORDINARY HAZARD, GROUP 2 CATEGORY ACTIVITIES AS PER SECTION-D, CHAPTER-05 DEFINITION 2.2.3.c)**	**1. IF TOTAL BUILT-UP GROUND FLOOR AREA IS LESS THAN 900 m^2** i. Hose Reel System shall be provided throughout the building as per **Section 3.3.** ii. Dry landing valves and risers shall not be required. **2. IF TOTAL BUILT-UP GROUND FLOOR AREA IS 900 m^2—3600 m^2** i. Sprinklers shall be provided through-out the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be 0.20 gpm with area of sprinkler operation of 1500 ft^2 (140 m^2). iii. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** iv. Dry landing valves shall not be required. **3. IF SUM OF ALL GROUND FLOOR BUILT-UP AREAS IS MORE THAN 3600 m^2** i. Sprinklers shall be provided through-out the facility as per **Section 3.5.** ii. Sprinkler design density shall be 0.20 gpm with an area of sprinkler operation of 1500 ft^2 (140 m^2). iii. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04,** in a loop to cover the entire facility. iv. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** v. Wet risers and internal landing valves shall not be required.	**1. IF TOTAL BUILT-UP GROUND FLOOR AREA IS LESS THAN 900 m^2** iii. The capacity of the fire pump set shall be 50 gpm at a pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. iv. The water tank shall have a capacity of 45 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **2. IF TOTAL BUILT-UP GROUND FLOOR AREA IS 900 m^2—3600 m^2** v. The capacity of the fire pump set shall be 350 gpm at a pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. vi. The water tank shall have a capacity of 60 minutes of operation, dedicated direct breeching inlet complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement. **3. IF SUM OF ALL GROUND FLOOR BUILT -UP AREAS IS MORE THAN 3600 m^2** vi. The capacity of the fire pump set shall be 750 gpm at a pressure as required to satisfy 6.9 bar at the most remote landing valve. vii. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement.

Table:- D.11-T11.: Storage, Warehouse and Industrial Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
I. SINGLE TENANT INDUSTRIES, AND FACTORIES **(EXTRA HAZARD, GROUP 1 CATEGORY ACTIVITIES AS PER SECTION-D, CHAPTER-05 DEFINITION 2.2.4.a)**	**1. IF TOTAL GROUND FLOOR BUILT-UP AREA IS LESS THAN 3600 m^2** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be 0.30 gpm with area of sprinkler operation of 2500 ft^2 (232 m^2). iii. Where activity and material MSDS demands foam sprinkler system, Foam Sprinklers shall be provided throughout the facility as per **Section D, Chapter 08.** iv. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** v. Dry landing valves shall not be required. **2. IF SUM OF ALL GROUND FLOOR BUILT-UP AREAS IS MORE THAN 3600 m^2** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. Sprinkler design density shall be 0.30 gpm with an area of sprinkler operation of 2500 ft^2 (232 m^2). iii. Where activity and material MSDS demands foam sprinkler system, Foam Sprinklers shall be provided throughout the facility as per **Section D, Chapter 08.** iv. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04** in a loop to cover the entire facility. v. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** vi. A dry riser and wet riser System shall not be required.	**1. IF TOTAL GROUND FLOOR BUILT-UP AREA IS LESS THAN 3600 m^2** vi. The capacity of the fire pump set shall be 750 gpm at pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. vii. The water tank shall have capacity of 60 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **2. IF SUM OF ALL GROUND FLOOR BUILT -UP AREAS IS MORE THAN 3600 m^2** vii. The capacity of the fire pump set shall be 1250 gpm at a pressure as required to satisfy 6.9 bar at the most remote landing valve. viii. The water tank shall have a capacity of 90 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement.

Table:- D.11-T11.: Storage, Warehouse and Industrial Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
J. SINGLE TENANT INDUSTRIES, AND FACTORIES **(EXTRA HAZARD, GROUP 2 CATEGORY ACTIVITIES AS PER SECTION-D, CHAPTER-05 DEFINITION 2.2.5.a)**	**1. IF TOTAL BUILT-UP GROUND FLOOR AREA IS LESS THAN 3600 m^2** i. Sprinklers shall be provided through- out the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be 0.40 gpm with area of sprinkler operation of 2500 ft^2 (232 m^2). iii. Where activity and material MSDS demands foam sprinkler system, Foam Sprinklers shall be provided throughout the facility as per **Section D, Chapter 08.** iv. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** v. Dry landing valves shall not be required. **3. IF SUM OF ALL GROUND FLOOR BUILT- UP AREAS IS MORE THAN 3600 m^2** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. Sprinkler design density shall be 0.40 gpm with an area of sprinkler operation of 2500 ft^2 (232 m^2). iii. Where activity and material MSDS de mands foam sprinkler system, Foam Sprinklers shall be provided through- out the facility as per **Section D, Chapter 08.** iv. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04** in a loop to cover the entire facility. v. Hose Reel System shall be provided throughout the building as **Section D, Chapter 03, Sub Section 5.0.** vi. A dry riser and wet riser System shall not be required.	**1. IF TOTAL BUILT-UP GROUND FLOOR AREA IS LESS THAN 3600 m^2** vi. The capacity of the fire pump set shall be 1000 gpm at a pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. vii. The water tank shall have a capacity of 60 minutes of operation, dedicated direct breeching inlet complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement. **3. IF SUM OF ALL GROUND FLOOR BUILT -UP AREAS IS MORE THAN 3600 m^2** vii. The capacity of the fire pump set shall be 1500 gpm at a pressure as required to satisfy 6.9 bar at the most remote landing valve. viii. The water tank shall have a capacity of 120 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement.

Table:- D.11-T11.: Storage, Warehouse and Industrial Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
K. WAREHOUSE **IDLE WOODEN AND PLASTIC PALLETS**	**1. IF TOTAL BUILT-UP GROUND FLOOR AREA IS LESS THAN 900 m^2** i. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** ii. Dry landing valves and risers shall not be required. **2. IF TOTAL BUILT-UP GROUND FLOOR AREA IS 900 m^2 - 3600 m^2** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be as per storage height and arrangement, in accordance with **Table:- D.05-T6.C, D.05-T6.D, D.05-T6.E, D.05-T6.F, D.05-T6.H and D.05-T6.I.** iii. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** iv. Dry landing valves shall not be required. **3. IF SUM OF ALL GROUND FLOOR BUILT-UP AREAS IS MORE THAN 3600 m^2** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be as per storage height and arrangement, in accordance with **Table:- D.05-T6.C, D.05-T6.D, D.05-T6.E, D.05-T6.F, D.05-T6.H and D.05-T6.I.** iii. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04** in a loop to cover the entire facility. iv. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** v. A dry riser and wet riser System shall not be required.	**1. IF TOTAL BUILT-UP GROUND FLOOR AREA IS LESS THAN 900 m^2** iii. The fire pump capacity shall be 50 gpm at pressure of 4.5 bar available at the remote Hose reel valve. iv. Water tank shall have capacity of 45 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **2. IF TOTAL BUILT-UP GROUND FLOOR AREA IS 900 m^2 - 3600 m^2** v. The capacity of the fire pump set shall be as per storage height and arrangement, in accordance with **Table:- D.05-T6.C, D.05-T6.D, D.05-T6.E, D.05-T6.F, D.05-T6.H and D.05-T6.I** at pressure as required to satisfy 4.5 bar at the most remote hose reel valve. vi. The water tank shall have capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement. **3. IF SUM OF ALL GROUND FLOOR BUILT-UP AREAS IS MORE THAN 3600 m^2** vi. The capacity of the fire pump set shall be as per storage height and arrangement, in accordance with **Table:- D.05-T6.C, D.05-T6.D, D.05-T6.E, D.05-T6.F, D.05-T6.H and D.05-T6.I** at pressure as required to satisfy 6.9 bar at the most remote Hydrant valve. vii. The water tank shall have capacity of 60 minutes of operation, complete with low water level detection, dedicated direct breeching inlet and instantaneous refilling arrangement.

Table:- D.11-T11.: Storage, Warehouse and Industrial Fire Protection

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
L. WAREHOUSE WITH CLASS I—IV MATERIALS **(IDENTIFICATION OF CLASSES OF MATERIALS SHALL BE AS PER SECTION D, CHAPTER 05, DEFINITION 2.3.1)**	**1. IF TOTAL BUILT-UP GROUND FLOOR AREA IS LESS THAN 230 m²** i. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** Dry landing valves shall not be required. **2. IF TOTAL BUILT-UP GROUND FLOOR AREA OF THE COMPARTMENT IS 230 m²—900 m²** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be as per storage height and arrangement, in accordance with **Table:- D.05-T6.G and D.05-T6.J.** iii. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** iv. Dry landing valves shall not be required. **3. IF TOTAL BUILT-UP GROUND FLOOR AREA IS 901 m²- 3600 m²** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be as per storage height and arrangement, in accordance with **Table:- D.05-T6.J.a, D.05-T6.L, D.05-T6.P, D.05-T6.M, D.05-T6.N, D.05-T6.O, D.05-T6.Q, D.05-T6.S, and D.05-T6.U.** iii. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** iv. Dry landing valves shall not be required. **4. IF SUM OF ALL GROUND FLOOR BUILT-UP AREAS IS MORE THAN 3600 m²** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be as per storage height and arrangement, in accordance with **Table:- D.05-T6.J.a, D.05-T6.L, D.05-T6.P, D.05-T6.M, D.05-T6.N, D.05-T6.O, D.05-T6.Q, D.05-T6.S, and D.05-T6.U.** iii. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04,** in a loop to cover the entire facility. iv. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** v. A dry riser and wet riser System shall not be required.	**1. IF TOTAL BUILT-UP GROUND FLOOR AREA IS LESS THAN 230 m²** ii. The fire pump capacity shall be 50 gpm at pressure of 4.5 bar available at the remote hose reel valve. iii. The water tank shall have capacity of 45 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **2. IF TOTAL BUILT-UP GROUND FLOOR AREA OF THE COMPARTMENT IS 230 m²—900 m²** v. The capacity of the fire pump set shall be as per storage height and storage arrangement, in accordance with **Table:- D.05-T6.G and D.05-T6.J** at a pressure as required to satisfy 4.5 bar at the most remote Hose reel valve. vi. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **3. IF TOTAL BUILT-UP GROUND FLOOR AREA IS 901 m²- 3600 m²** v. The capacity of the fire pump set shall be as per storage height and storage arrangement, in accordance with **Table:- D.05-T6.J.a, D.05-T6.L, D.05-T6.P, D.05-T6.M, D.05-T6.N, D.05-T6.O, D.05-T6.Q, D.05-T6.S, and D.05-T6.U** at a pressure as required to satisfy 4.5 bar at the most remote hose reel valve. vi. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, direct breeching inlet and instantaneous refilling arrangement. **4. IF SUM OF ALL GROUND FLOOR BUILT-UP AREAS IS MORE THAN 3600 m²** vi. The capacity of the fire pump set shall be as per storage height and storage arrangement, in accordance with **Table:- D.05-T6.J.a, D.05-T6.L, D.05-T6.P, D.05-T6.M, D.05-T6.N, D.05-T6.O, D.05-T6.Q, D.05-T6.S, and D.05-T6.U** at a pressure as required to satisfy 6.9 bar at the most remote Hydrant valve. vii. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, direct breeching inlet and instantaneous refilling arrangement.

Table:- D.11-T11.: Storage, Warehouse and Industrial Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
M. WAREHOUSE **(PLASTIC, RUBBER)**	**1. IF TOTAL BUILT-UP GROUND FLOOR AREA OF THE COMPARTMENT IS LESS THAN 230 m²** i. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** ii. Dry landing valves and risers shall not be required. **2. IF TOTAL BUILT-UP GROUND FLOOR AREA OF THE COMPARTMENT IS 230 m²—900 m²** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be as per storage height and storage arrangement, in accordance with **Table:- D.05-T6.J.b, D.05-T6.R, D.05-T6.T, D.05-T6.U** iii. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** iv. Dry landing valves are not required. **3. IF TOTAL BUILT-UP GROUND FLOOR AREA IS 901 m² - 3600 m²** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be as per storage height and storage arrangement, in accordance with **Table:- D.05-T6.J.b, D.05-T6.R, D.05-T6.T, D.05-T6.U** iii. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** iv. Dry landing valves are not required. **4. IF SUM OF ALL GROUND FLOOR BUILT-UP AREA IS MORE THAN 3600 m²** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be as per storage height and storage arrangement, in accordance with **Table:- D.05-T6.J.b, D.05-T6.R, D.05-T6.T, D.05-T6.U** iii. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04** in a loop to cover the entire facility. iv. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** v. A dry riser and wet riser System shall not be required.	**1. IF TOTAL BUILT-UP GROUND FLOOR AREA OF THE COMPARTMENT IS LESS THAN 230 m²** iii. The fire pump capacity shall be 50 gpm at a pressure of 4.5 bar available at the remote Hose reel valve. iv. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **2. IF TOTAL BUILT-UP GROUND FLOOR AREA OF THE COMPARTMENT IS 230 m²—900 m²** v. The capacity of the fire pump set shall be as per storage height and storage arrangement, in accordance with **Table:- D.05-T6.J.b, D.05-T6.R, D.05-T6.T, D.05-T6.U** at a pressure as required to satisfy 4.5 bar at the most remote Hose reel valve. vi. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, direct breeching inlet and instantaneous refilling arrangement. **3. IF TOTAL BUILT-UP GROUND FLOOR AREA IS 901 m² - 3600 m²** v. The capacity of the fire pump set shall be as per storage height and storage arrangement, in accordance with **Table:- D.05-T6.J.b, D.05-T6.R, D.05-T6.T, D.05-T6.U** at a pressure as required to satisfy 4.5 bar at the most remote hose reel valve. vi. The water tank shall have a capacity of 90 minutes of operation, complete with low water level detection, direct breeching inlet and instantaneous refilling arrangement. **4. IF SUM OF ALL GROUND FLOOR BUILT -UP AREAS IS MORE THAN 3600 m²** vi. The capacity of the fire pump set shall be as per storage height and storage arrangement, in accordance with **Table:- D.05-T6.J.b, D.05-T6.R, D.05-T6.T, D.05-T6.U** at a pressure as required to satisfy 6.9 bar at the most remote Hydrant valve. vii. The water tank shall have a capacity of 90 minutes of operation, complete with low water level detection, direct breeching inlet and instantaneous refilling arrangement.

Table:- D.11-T11.: Storage, Warehouse and Industrial Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
N. WAREHOUSE **(TIRES)**	**1. IF TOTAL BUILT-UP FLOOR AREA OF THE COMPARTMENT IS LESS THAN 230 m^2** i. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** ii. Dry landing valves and risers shall not be required. **2. IF TOTAL BUILT-UP FLOOR AREA OF THE COMPARTMENT IS 230 m^2—900 m^2** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be as per storage height and storage arrangement, in accordance with **Table:- D.05-T6.J.c and D.05-T6.V.** iii. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** iv. Dry landing valves are not required. **3. IF TOTAL BUILT-UP FLOOR AREA IS 901 m^2 - 3600 m^2** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be as per storage height and storage arrangement, in accordance with **Table:- D.05-T6.J.c and D.05-T6.V.** iii. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** iv. Dry landing valves are not required. **4. IF SUM OF ALL GROUND FLOOR BUILT-UP AREAS IS MORE THAN 3600 m^2** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be as per storage height and storage arrangement, in accordance with **Table:- D.05-T6.J.c and D.05-T6.V.** iii. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04.,** in a loop to cover the entire facility. iv. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** v. A dry riser and wet riser System shall not be required.	**1. IF TOTAL BUILT-UP FLOOR AREA OF THE COMPARTMENT IS LESS THAN 230 m^2** iii. The fire pump capacity shall be 50 gpm at a pressure of 4.5 bar available at the remote Hose reel valve. iv. The water tank shall have a capacity of 45 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **2. IF TOTAL BUILT-UP FLOOR AREA OF THE COMPARTMENT IS 230 m^2—900 m^2** v. The capacity of the fire pump set shall be as per storage height and storage arrangement, in accordance with **Table:- D.05-T6.J.c and D.05-T6.V.** at a pressure as required to satisfy 4.5 bar at the most remote Hose reel valve. vi. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **3. IF TOTAL BUILT-UP FLOOR AREA IS 901 m^2 - 3600 m^2** v. The capacity of the fire pump set shall be as per storage height and storage arrangement, in accordance with **Table:- D.05-T6.J.c and D.05-T6.V.** at a pressure as required to satisfy 4.5 bar at the most remote hose reel valve. vi. The water tank shall have a capacity of 90 minutes of operation, complete with low water level detection direct breeching inlet and instantaneous refilling arrangement. **4. IF SUM OF ALL GROUND FLOOR BUILT-UP AREAS IS MORE THAN 3600 m^2** vi. The capacity of the fire pump set shall be as per storage height and storage arrangement, in accordance with **Table:- D.05-T6.J.c and D.05-T6.V.** at a pressure as required to satisfy 6.9 bar at the most remote Hydrant valve. vii. The water tank shall have a capacity of 90 minutes of operation, complete with low water level detection, direct breeching inlet and instantaneous refilling arrangement.

Table:- D.11-T11.: Storage, Warehouse and Industrial Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
O. WAREHOUSE **(ROLLED PAPER)**	**1. IF TOTAL BUILT-UP FLOOR AREA OF THE COMPARTMENT IS LESS THAN 230 m²** i. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** ii. Dry landing valves and risers shall not be required. **2. IF TOTAL BUILT-UP FLOOR AREA OF THE COMPARTMENT IS 230 m²—900 m²** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be as per storage height and storage arrangement, in accordance with **Table:- D.05-T6.J.d and D.05-T6.W.** iii. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** iv. Dry landing valves are not required. **3. IF TOTAL BUILT-UP FLOOR AREA IS 901 m²- 3600 m²** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be as per storage height and storage arrangement, in accordance with **Table:- D.05-T6.J.d and D.05-T6.W.** iii. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** iv. Dry landing valves are not required **4. IF SUM OF ALL GROUND FLOOR BUILT-UP AREAS IS MORE THAN 3600 m²** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be as per storage height and storage arrangement, in accordance with **Table:- D.05-T6.J.d and D.05-T6.W.** iii. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04,** in a loop to cover the entire facility. iv. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** v. A dry riser and wet riser System shall not be required.	**1. IF TOTAL BUILT-UP FLOOR AREA OF THE COMPARTMENT IS LESS THAN 230 m²** iii. The fire pump capacity shall be 50 gpm at a pressure of 4.5 bar available at the remote Hose reel valve. iv. The water tank shall have a capacity of 45 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **2. IF TOTAL BUILT-UP FLOOR AREA OF THE COMPARTMENT IS 230 m²—900 m²** v. The capacity of the fire pump set shall be as per storage height and storage arrangement, in accordance with **Table:- D.05-T6.J.d and D.05-T6.W.** at a pressure as required to satisfy 4.5 bar at the most remote Hose reel valve. vi. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **3. IF TOTAL BUILT-UP FLOOR AREA IS 901 m²- 3600 m²** v. The capacity of the fire pump set shall be as per storage height and storage arrangement, in accordance with **Table:- D.05-T6.J.d and D.05-T6.W.** at a pressure as required to satisfy 4.5 bar at the most remote hose reel valve. vi. The water tank shall have a capacity of 90 minutes of operation, complete with low water level detection, direct breeching inlet and instantaneous refilling arrangement. **4. IF SUM OF ALL GROUND FLOOR BUILT -UP AREAS IS MORE THAN 3600 m²** vi. The capacity of the fire pump set shall be as per storage height and storage arrangement, in accordance with **Table:- D.05-T6.J.d and D.05-T6.W.** at a pressure as required to satisfy 6.9 bar at the most remote Hydrant valve. vii. The water tank shall have a capacity of 90 minutes of operation, complete with low water level detection, direct breeching inlet and instantaneous refilling arrangement.

Table:- D.11-T11.: Storage, Warehouse and Industrial Fire Protection Systems

OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
P. COLD STORAGE **(STORAGE FACILITIES WITH BELOW 4°C TEMPERATURES)**	**1. IF TOTAL BUILT-UP FLOOR AREA IS LESS THAN 230 m^2** i. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** ii. Dry landing valves and risers shall not be required. **2. IF TOTAL BUILT-UP FLOOR AREA IS BETWEEN 230 m^2—900 m^2** i. Dry Type Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be as per hazard classification, storage height and storage arrangement, in accordance with **Table:- D.05-T6.D, D.05-T6.E, D.05-T7.A, D.05-T6.S.** iii. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** iv. Dry landing valves shall not be required. **3. IF TOTAL FLOOR AREA IS BETWEEN 901 m^2—3600 m^2** i. Dry Type Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be as per storage height and storage arrangement, in accordance with **Table:- D.05-T6.D, D.05-T6.E, D.05-T7.A, D.05-T6.S.** iii. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** iv. Dry landing valves shall not be required.	**1. IF TOTAL BUILT-UP FLOOR AREA IS LESS THAN 230 m^2** iii. The capacity of the fire pump set shall be 50 gpm at a pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. iv. The water tank shall have a capacity of 30 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **2. IF TOTAL BUILT-UP FLOOR AREA IS BETWEEN 230 m^2—900 m^2** v. The capacity of the fire pump set shall be as per storage height and storage arrangement, in accordance with **Table:- D.05-T6.D, D.05-T6.E, D.05-T7.A, D.05-T6.S** at a pressure as required to satisfy 4.5 bar at the most remote Hose reel valve. vi. The water tank shall have a capacity of 45 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **3. IF TOTAL FLOOR AREA IS BETWEEN 901 m^2—3600 m^2** v. The capacity of the fire pump set shall be as per storage height and storage arrangement, in accordance **Table:- D.05-T6.D, D.05-T6.E, D.05-T7.A, D.05-T6.S** at a pressure as required to satisfy 6.9 bar at the most remote Hose reel valve. vi. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, direct breeching inlet and instantaneous refilling arrangement.

Table:- D.11-T11.: Storage, Warehouse and Industrial Fire Protection Systems

OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
P. COLD STORAGE **(STORAGE FACILITIES WITH BELOW 4°C TEMPERATURES)**	**4. IF SUM OF ALL GROUND FLOOR BUILT-UP AREAS IS MORE THAN 3600 m^2** i. Dry Type Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. The sprinkler design density shall be as per storage height and storage arrangement, in accordance **Table:- D.05-T6.D, D.05-T6.E, D.05-T7.A, D.05-T6.S.** iii. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04** in a loop to cover the entire facility. iv. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** v. A dry riser and wet riser System shall not be required.	**4. IF SUM OF ALL GROUND FLOOR BUILT -UP AREAS IS MORE THAN 3600 m^2** vi. The capacity of the fire pump set shall be as per storage height and storage arrangement, in accordance **Table:- D.05-T6.D, D.05-T6.E, D.05-T7.A, D.05-T6.S** at a pressure as required to satisfy 6.9 bar at the most remote Hydrant valve. vii. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, direct breeching inlet and instantaneous refilling arrangement.

Table:- D.11-T11.: Storage, Warehouse and Industrial Fire Protection Systems

OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
Q. AIRCRAFT HANGERS	**1. GROUP I AIRCRAFT HANGERS (Access door height over 8.5 m/A single fire area is in excess of 3716 m^2)** i. A foam water deluge system shall be provided for the hanger as per **Section D, Chapter 08.** ii. The foam discharge density shall be a minimum of 0.16 gpm/ft^2 iii. The area of operation under a single foam water deluge system shall not exceed 1394 m^2 (15,000ft^2). iv. The maximum distance between sprinklers/open discharge devices either on branch line or between branch line shall not exceed 3.7 m. v. If the open door of the hanger interferes in the intended discharge pattern, additional sprinkler/open discharge devices heads shall be installed near the door. vi. Sprinklers/open discharge devices of different orifice sizes and plates shall not be used. vii. A foam water hand hose system shall be installed throughout the hanger as per **NFPA 409.** viii. Each hand hose connection shall be a minimum of 38 mm (11⁄2 in.) in size and fitted with a control valve. The hose shall be of a diameter to provide a minimum flow of 60 gpm. ix. Standard Sprinklers shall be provided at office, tool rooms and non-service and non aircraft storage area as per **Section D, Chapter 05.** x. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04,** in a loop to cover the entire hanger or group of hangers. xi. A dry riser, wet riser and hose Reel system shall not be required.	**1. GROUP I AIRCRAFT HANGERS (Access door height over 8.5 m/A single fire area is in excess of 3716 m^2)** xii. The capacity of the fire pump set shall be 3000 gpm at a pressure as required to satisfy 6.9 bar at the most remote yard hydrant outlet valve. However, the fire pump capacity might increase depending on the zone and fire area considerations which are dependent on the aircraft size. xiii. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. xiv. The foam concentrate shall be for a minimum of 10 minute duration.

Table:- D.11-T11.: Storage, Warehouse and Industrial Fire Protection

OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
Q. AIRCRAFT HANGERS	**2. GROUP II AND III AIRCRAFT HANGERS (Access door height is 8.5 m or less and A single fire area is below 3716 m^2) AND PAINT HANGERS** i. The foam water deluge system shall be provided for the hanger as per **Section D, Chapter 08.** A supplementary system should also be provided under wings in accordance with **NFPA 409.** ii. The foam discharge density shall be minimum of 0.17 gpm/ft^2 iii. Area of operation under a single foam water deluge system shall not exceed 465 m^2 (5,000ft^2). iv. The maximum distance between sprinklers/ open discharge devices either on branch line or between branch line shall not exceed 3.7 m. v. If open door of the hanger interferes in the intended discharge pattern, additional sprinkler/ open discharge devices heads shall be installed near the door. vi. Sprinklers/open discharge devices of different orifice sizes and plates shall not be used. vii. A foam water hand hose system shall be installed throughout the hanger as per **NFPA 409.** viii.Each hand hose connection shall be a minimum of 38 mm (11⁄2 in.) in size and fitted with a control valve. The hose shall be of a diameter to provide a minimum flow of 60 gpm. ix. Standard Sprinklers shall be provided at office, tool rooms and non-service and non aircraft storage area as per **Section D, Chapter 05.** x. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04** in a loop to cover the entire hanger or group of hangers. xi. A dry riser, wet riser and hose Reel system shall not be required. **3. GROUP IV AIRCRAFT HANGERS (Membrane covered steel structure) AND UNFUELED AIRCRAFT HANGERS** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05.** ii. The design density shall be a minimum of 0.17 gpm over the operating area of 465 m^2 (5,000ft^2). iii. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04** in a loop to cover the entire hanger or group of hangers. iv. A dry riser, wet riser and hose Reel system shall not be required.	**2. GROUP II AND III AIRCRAFT HANGERS (Access door height is 8.5 m or less and A single fire area is below 3716 m^2) AND PAINT HANGERS** xii. The capacity of the fire pump set shall be 1500 gpm at a pressure as required to satisfy 6.9 bar at the most remote Yard hydrant outlet valve. However, the fire pump capacity might increase depending on the simultaneously activated zones and fire area considerations which are dependent on the aircraft size. xiii. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, direct breeching inlet and instantaneous refilling arrangement. xiv. The foam concentrate shall be for a minimum of 10 minute duration. **3. GROUP IV AIRCRAFT HANGERS (Membrane covered steel structure) AND UNFUELED AIRCRAFT HANGERS** v. The capacity of the fire pump set shall be 1500 gpm at a pressure as required to satisfy 6.9 bar at the most remote Yard hydrant outlet valve. However, fire pump capacity might increase depending on the might increase depending on the simultaneously activated zones and fire area considerations which are dependent on the aircraft size vi. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, direct breeching inlet and instantaneous refilling arrangement.

Table:- D.11-T11.: Storage, Warehouse and Industrial Fire Protection Systems

OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
R. WAREHOUSE FOR INDOOR STORAGE OF FLAMMABLE AND COMBUSTIBLE LIQUIDS AND AEROSOLS	**1. IF TOTAL BUILT-UP FLOOR AREA OF THE COMPARTMENT IS LESS THAN 230 m2** i. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** ii. Dry landing valves and risers shall not be required. **2. IF TOTAL BUILT-UP FLOOR AREA OF THE COMPARTMENT IS 231 m²—900 m²** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05. or** Foam Sprinklers shall be provided throughout as per **Section D, Chapter 08.** ii. The design criteria shall be as per storage height and storage arrangement, in accordance with **Table:- D.08-T1.L through D.08-T1.Z, D.08-T1.AA, D.08-T1.AB** and in-rack arrangement as per **Table:- D.08-T1.AC** iii. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** Dry landing valves shall not be required. **3. IF TOTAL BUILT-UP FLOOR AREA IS 901 m²- 3600 m²** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05. or** foam sprinkler shall be provided throughout as per **Section D, Chapter 08.** ii. The design criteria shall be as per storage height and storage arrangement, in accordance with **Table:- D.08-T1.L through D.08-T1.Z, D.08-T1.AA, D.08-T1.AB** and in-rack arrangement as per **Table:- D.08-T1.AC** iii. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** iv. Dry landing valves shall not be required. **4. IF SUM OF ALL GROUND FLOOR BUILT-UP AREAS IS MORE THAN 3600 m²** i. Sprinklers shall be provided throughout the facility as per **Section D, Chapter 05. or** Foam Sprinkler shall be provided throughout as per **Section D, Chapter 08.** ii. The design criteria shall be as per storage height and storage arrangement, in accordance with **Table:- D.08-T1.L through D.08-T1.Z, D.08-T1.AA, D.08-T1.AB** and in-rack arrangement as per **Table:- D.08-T1.AC** iii. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04** in a loop to cover the entire facility. Where foam sprinklers are provided, hydrant system shall also incorporate foam discharge. iv. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** v. A dry riser and wet riser System shall not be required.	**1. IF TOTAL BUILT-UP FLOOR AREA OF THE COMPARTMENT IS LESS THAN 230 m²** ii. The fire pump capacity shall be 50 gpm at pressure of 4.5 bar available at the most remote hose reel valve. iii. The water tank shall have capacity of 45 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **2. IF TOTAL BUILT-UP FLOOR AREA OF THE COMPARTMENT IS 231 m²—900 m²** iv. The capacity of the fire pump set shall be as per storage configuration and storage arrangement, in accordance with **Table:- D.08-T1.L through D.08-T1.Z, D.08-T1.AA, D.08-T1.AB** at a pressure as required to satisfy 4.5 bar at the most remote Hose reel valve. v. The water tank shall have a capacity of 120 minutes of operation, complete with low water level detection, direct breeching inlet and instantaneous refilling arrangement. vi. The foam solution reserve shall be for 15 minutes operation. **3. IF TOTAL BUILT-UP FLOOR AREA IS 901 m²- 3600 m²** iv. The capacity of the fire pump set shall be as per storage configuration and storage arrangement, in accordance with **Table:- D.08-T1.L through D.08-T1.Z, D.08-T1.AA, D.08-T1.AB** at a pressure as required to satisfy 6.9 bar at the most remote hose reel valve. v. The water tank shall have a capacity of 120 minutes of operation, complete with low water level detection, direct breeching inlet and instantaneous refilling arrangement. vi. The foam solution reserve shall be for 15 minutes operation. **4. IF SUM OF ALL GROUND FLOOR BUILT-UP AREAS IS MORE THAN 3600 m²** vi. The capacity of the fire pump set shall be as per storage configuration and storage arrangement, in accordance with **Table:- D.08-T1.L through D.08-T1.Z, D.08-T1.AA, D.08-T1.AB** at a pressure as required to satisfy 6.9 bar at the most remote Hydrant Valve. vii. The water tank shall have a capacity of 120 minutes of operation, complete with low water level detection, direct breeching inlet and instantaneous re-filling arrangement. viii. The foam solution reserve shall be for 15 minutes operation.

Table:- D.11-T11.: Storage, Warehouse and Industrial Fire Protection Systems

OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
S. INDUSTRIAL OCCUPANCY INVOLVING PROCESSES, ACTIVITIES THAT HANDLE FLAMMABLE AND COM-BUSTIBLE LIQUIDS (EXCEPT HANGER). **(FOR HANGERS , REFER TABLE D.11-T11.Q AND NFPA 409)**	**1. IF TOTAL BUILT-UP FLOOR AREA OF THE COMPARTMENT IS LESS THAN 230 m^2** i. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0 and 6.0.** ii. Dry landing valves and risers shall not be required. **2. IF TOTAL BUILT-UP FLOOR AREA OF THE COMPARTMENT IS 230 m^2—900 m^2** i. Foam Sprinklers shall be provided throughout the facility as per **Section D, Chapter 08.** ii. The foam sprinkler Design criteria shall be as per as per **Table:- D.08-T1.E** iii. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** Hose system shall also incorporate the foam application. iv. Dry landing valves shall not be required. **3. IF TOTAL BUILT-UP FLOOR AREA IS 901 m^2- 3600 m^2** i. Foam Sprinklers shall be provided throughout the facility as per **Section D, Chapter 08.** ii. The foam sprinkler Design criteria shall be as per as per **Table:- D.08-T1.E** iii. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** The hose system shall also incorporate foam application. iv. Dry landing valves shall not be required. **4. IF SUM OF ALL GROUND FLOOR BUILT-UP AREAS IS MORE THAN 3600 m^2** i. Foam Sprinklers shall be provided throughout the facility as per **Section D, Chapter 08.** ii. The foam sprinkler Design criteria shall be as per as per **Table:- D.08-T1.E** iii. Yard Fire Hydrants shall be provided as per **Section D, Chapter 04** in a loop to cover the entire facility. Where foam sprinklers are provided, hydrant system shall also incorporate foam discharge. iv. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** v. A dry riser and wet riser System shall not be required.	**1. IF TOTAL BUILT-UP FLOOR AREA OF THE COMPARTMENT IS LESS THAN 230 m^2** iii. The fire pump capacity shall be 50 gpm at a pressure of 4.5 bar available at the remote Hose reel valve. iv. The water tank shall have a capacity of 45 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **2. IF TOTAL BUILT-UP FLOOR AREA OF THE COMPARTMENT IS 230 m2—900 m2** v. The capacity of the fire pump set shall be as per **Table:- D.08-T1.E** at pressure as required to satisfy 4.5 bar at the most remote Hose reel valve. vi. The water tank shall have a capacity of 120 minutes of operation, complete with low water level detection, direct breeching inlet and instantaneous refilling arrangement. vii. The foam solution reserve shall be for 15 minutes operation. **3. IF TOTAL BUILT-UP FLOOR AREA IS 901 m^2- 3600 m^2** v. The capacity of the fire pump set shall be as per **Table:- D.08- T1.E** at a pressure as required to satisfy 6.9 bar at the most remote hose reel valve. vi. The water tank shall have a capacity of 120 minutes of operation, complete with low water level detection, direct breeching inlet and instantaneous refilling arrangement. vii. The foam solution reserve shall be for a 15 minutes operation. **4. IF SUM OF ALL GROUND FLOOR BUILT-UP AREAS IS MORE THAN 3600 m^2** vi. The capacity of the fire pump set shall be as per **Table:- D.08- T1.E** at pressure as required to satisfy 6.9 bar at the most remote hydrant valve. vii. The water tank shall have capacity of 120 minutes of operation, complete with low water level detection, direct breeching inlet and instantaneous refilling arrangement. viii. The foam solution reserve shall be for 15 minutes operation.

Table:- D.11-T11.: Storage, Warehouse and Industrial Fire Protection Systems

PREDOMINANT OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
T. STORAGE OF FLAMMABLE AND COMBUSTIBLE LIQUIDS IN ABOVE GROUND STORAGE TANKS	**1. IF THE STORAGE AREA IS LESS THAN 230 m^2 AND CAPACITY OF FLAMMABLE, COMSBUTIBLE LIQUID STORAGE TANK IS LESS THAN 190 m^3** i. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0** ii. The hose stations shall incorporate the foam application. iii. Dry landing valves and risers shall not be required. **2. IF THE STORAGE AREA IS MORE THAN 230 m^2 OR CAPACITY OF FLAMMABLE, COMSBUTIBLE LIQUID STORAGE TANK IS MORE THAN 190 m^3** i. Aboveground storage tank storing class I or class II liquids shall be protected with fixed low expansion foam system in accordance with **Section D, Chapter 08.** and **Table:- D.08-T1.A, D.08-T1.F and D.08-T1.G.** (as applicable). ii. The tanks or section of the tanks exposed to heat radiation of greater than 12.2 Kw/m^2 due to fire in adjacent tanks or facility, shall be provided cooling with deluge water spray system in accordance with **Section D, Chapter 06.** iii. Yard hydrant shall be provided as per **Section D, Chapter 04** , in loop to cover the entire facility. Hydrant shall incorporate option for foam application as per **Section D, Chapter 08** and **Table:- D.08-T1.E, D.08-T1.H and D.08-T1.I.** (as applicable). iv. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0** v. The hose stations shall incorporate the foam application. vi. Dry landing valves and risers shall not be required.	**1. IF THE STORAGE AREA IS LESS THAN 230 m^2 AND CAPACITY OF FLAMMABLE, COMSBUTIBLE LIQUID STORAGE TANK IS LESS THAN 190 m^3** iv. The fire pump capacity shall be 100 gpm at a pressure of 4.5 bar available at the remote Hose reel valve. v. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. vi. The foam reserve shall be for a 15 minutes operation. **2. IF THE STORAGE AREA IS MORE THAN 230 m^2 OR CAPACITY OF FLAMMABLE, COMSBUTIBLE LIQUID STORAGE TANK IS MORE THAN 190 m^3** vii. The capacity of the fire pump set and foam reserve shall be suitable for a single largest hazard. Additional capacity of 1000 gpm shall be added for hose stream demand. viii. The water tank shall have a capacity of 120 minutes of operation, complete with low water level detection, direct breeching inlet and instantaneous refilling arrangement.

Table:- D.11-T11 : Storage, Warehouse and Industrial Fire Protection Systems

OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
U. OPEN YARD STORAGE OF MATERIALS OTHER THAN FLAMMABLE AND COMBUSTIBLE MATERIALS	**1. IF TOTAL OPEN STORAGE YARD IS LESS THAN 2000 m² AND STORING LIGHT HAZARD MATERIALS AS PER SECTION D, CHAPTER 05, 2.3.1., AND TABLE:-D.05-T1.A** i. Fire extinguishers as per **Section D, Chapter 01.** **2. IF TOTAL OPEN STORAGE YARD IS MORE THAN 2000 m² AND STORING LIGHT HAZARD MATERIALS AS PER SECTION D, CHAPTER 05, 2.3.1., AND TABLE:-D.05-T1.A** i. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** Dry landing valves are not required. ii. Equipment and cabinet shall be permitted for outdoor door application. 3. **IF TOTAL OPEN STORAGE YARD IS MORE THAN 1000 m² AND STORING MATERIALS OTHER THAN LIGHT HAZARD MATERIALS AS PER SECTION D, CHAPTER 05, 2.3.1., AND TABLE:-D.05-T1.A** i. Hose Reel System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 5.0.** Dry landing valves are not required. ii. The equipment and cabinet shall be permitted for outdoor door application. 4. **IF TOTAL OPEN STORAGE YARD IS MORE THAN 3600 m² AND STORING ANY MATERIALS, OTHER THAN FLAMMABLE AND COMBUSTIBLE MATERIALS** i. Yard hydrant shall be provided as per **Section D, Chapter 04,** in loop to cover the entire facility. ii. Trolley type foam extinguishers shall be provided for the outdoor emergencies. iii. The equipment and cabinet shall be permitted for outdoor door application. iv. Hose reel system or landing valves shall not be required.	**2. IF TOTAL OPEN STORAGE YARD IS MORE THAN 2000 m² AND STORING LIGHT HAZARD MATERIALS AS PER SECTION D, CHAPTER 05, 2.3.1., AND TABLE:-D.05-T1.A** iii. The fire pump capacity shall be 50 gpm at a pressure of 4.5 bar available at the remote Hose reel valve. iv. The water tank shall have a capacity of 30 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. 3. **IF TOTAL OPEN STORAGE YARD IS MORE THAN 1000 m² AND STORING MATERIALS OTHER THAN LIGHT HAZARD MATERIALS AS PER SECTION D, CHAPTER 05, 2.3.1., AND TABLE:-D.05-T1.A** iii. The fire pump capacity shall be 50 gpm at a pressure of 4.5 bar available at the remote Hose reel valve. iv. The water tank shall have a capacity of 30 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. 4. **IF TOTAL OPEN STORAGE YARD IS MORE THAN 3600 m² AND STORING ANY MATERIALS, OTHER THAN FLAMMABLE AND COMBUSTIBLE MATERIALS** v. The fire pump capacity shall be 500 gpm at a pressure of 6.9 bar available at the most remote hydrant valve. vi. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, direct breeching inlet and instantaneous refilling arrangement.
V. NURSERIES (PLANTS AND VEGETATION)	i. Fire extinguishers as per **Section D, Chapter 01.**	

4.11. Tunnel Fire Protection Systems

4.11.1. Tunnel shall be provided with Fire protection Systems in compliance with **Table:- D.11-T12.** and Auxiliary Rooms fire protection systems, if any, as per **Table:- D.11-T14.**

Table:- D.11-T12. : Tunnel Fire Protection Systems

OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
A. CABLE TUNNELS	**1. IF LENGTH OF THE CABLE TUNNEL IS LESS THAN 60 m** i. An automatic Deluge Water Spray System as per **Section D, Chapter 06. OR** Automatic Water Mist System, as per **Section D, Chapter 07,** shall be provided. ii. A dry riser + Hose Reel System shall be provided at the Tunnel entry points, as per **Section D, Chapter 03, Sub Section 4.0 and 5.0.** **2. IF LENGTH OF THE TUNNEL IS MORE THAN 60 m** i. An automatic Deluge Water Spray as per **Section D, Chapter 06. . OR** Automatic Water Mist System, as per **Section D, Chapter 07,** shall be provided. ii. A wet riser System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 6.0.**	**1. IF LENGTH OF THE TUNNEL IS LESS THAN 60 m** iii. The capacity of the fire pump set shall be sufficient to satisfy minimum of 2 adjacent deluge water spray system zones at a pressure as required to satisfy 4.5 bar at the most remote Hose reel outlet valve. iv. Where water mist is provided, the capacity of the fire pump set for water mist system shall be as per the manufacturer's specifications and permitted design and installation guideline. v. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection and instantaneous refilling arrangement. **2. IF LENGTH OF THE TUNNEL IS MORE THAN 60 m** iii. The capacity of the fire pump set shall be sufficient to satisfy minimum of 2 adjacent deluge water spray system zones at a pressure as required to satisfy 6.9 bar at the most remote landing valve. iv. Where water mist is provided, the capacity of the fire pump set for water mist system shall be as per the manufacturer's specifications and permitted design and installation guideline. v. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, direct breeching inlet and instantaneous refilling arrangement.
B. ROAD/RAIL TUNNELS	**1. IF LENGTH OF THE TUNNEL IS LESS THAN 90 M** **i.** None **2. IF LENGTH OF THE TUNNEL IS 90 m—1000 m** i. A wet riser System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 6.0.**	**2. IF LENGTH OF THE TUNNEL IS 90 m—1000 m** ii. The capacity of the fire pump set shall be 750 gpm at a pressure as required to satisfy 6.9 bar at the most remote Landing valve. iii. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection, direct breeching inlet and instantaneous refilling arrangement.

Table:- D.11-T12.: Tunnel Fire Protection

OCCUPANCY	SYSTEM REQUIREMENTS	COMBINED FIRE PUMP SET AND FIRE WATER TANK CAPACITIES
B. ROAD/RAIL TUNNELS	**3. IF LENGTH OF THE TUNNEL IS MORE THAN 1000 m** i. An automatic deluge Water Spray system as per **Section D, Chapter 06 OR** an automatic water mist system, as per **Section D, Chapter 07,** shall be provided. ii. A Class III wet riser System shall be provided throughout the building as per **Section D, Chapter 03, Sub Section 6.0.** iii. Breeching inlets shall be provided at both openings of the tunnel.	**3. IF LENGTH OF THE TUNNEL IS MORE THAN 1000 m** iv. The capacity of the fire pump set shall be sufficient to satisfy minimum of 2 adjacent deluge water spray system zones at a pressure as required to satisfy 6.9 bar at the most remote landing valve. v. Where water mist is provided, the capacity of the fire pump set for water mist system shall be for a period of 1 hour and shall be as per the manufacturer's specifications and permitted design and installation guideline. vi. The water tank shall have a capacity of 60 minutes of operation, complete with low water level detection and instantaneous refilling arrangement.


TUNNEL WATER SPRAY SYSTEM FOR ILLUSTRATION

4.12. Various Locations and Extension of Fire Protection Systems

4.12.1. Various locations in a building shall be protected with Automatic Sprinkler Systems as per **Section D, Chapter 05.** The building sprinkler system shall be extended to comply with requirements of **Table:- D.11-T13.**

Table:- D.11-T13.: Various Locations and Extension of Fire Protection

LOCATION/ HAZARD	SYSTEM REQUIREMENTS
A. ATRIUMS	i. Atriums should be provided with automatic sprinkler system as per **Section D, Chapter 05.** ii. Sprinkler heads should be installed immediately adjacent to atrium opening and non-combustible material draft stops of 450 mm deep shall be provided.
B. BALCONIES	i. Exterior balconies shall be provided with automatic sprinkler system as per **Section D, Chapter 05.** ii. Sidewall Sprinkler heads or pendent sprinklers shall be installed at exterior balconies of such buildings where sprinkler protection is required. iii. Balcony sprinkler coverage shall not exceed 12 m^2 per sprinkler head. iv. Sprinkler temperature rating shall be 79°C.
C. RAIN SCREEN/ GLAZING	i. Glazing of the building envelope shall be protected with sprinkler system as per **Section D, Chapter 05.** ii. Sprinkler protection shall be from the interior of the building by extending sprinkler system on ceiling with window type pendent or on walls with window type side wall sprinklers, installed such that discharge pattern covers the interior of the glazing to provide draft curtain effect.
D. STAIRS	i. The stair top (Top of the shaft) and first accessible landing above the bottom of the shaft shall be provided with sprinkler system as per **Section D, Chapter 05.**
E. ELEVATOR SHAFT	i. The sidewall spray sprinklers in accordance with **Section D, Chapter 05.** shall be installed at the bottom of each elevator hoistway (shaft) not more than 600 mm above the floor of the pit.
F. ABOVE FALSE CEILING	i. Sprinklers shall not be required. However, compartmentation and fire stopping shall be considered at regular intervals. ii. In bathrooms above false ceiling spaces where heaters are installed, such above false ceiling spaces shall be protected with sprinklers as per **Section D, Chapter 05.**
G. BATHROOMS	i. In bathrooms above false ceiling spaces where heaters are installed, such above false ceiling spaces shall be protected with sprinklers as per **Section D, Chapter 05.** ii. Public washrooms and bathrooms more than 5.1 m^2 in area shall be provided with sprinkler system as per **Section D, Chapter 05.** iii. Sprinkler shall be required in bathroom opening directly onto public corridor or exit ways. iv. Residential, Hotel and Apartment washrooms and bathrooms shall not require Sprinkler protection.
H. LAUNDRY/ STORAGE	i. Laundry and storage rooms of residential buildings, residential apartment buildings and hotel apartment buildings shall be provided with sprinkler system as per **Section D, Chapter 05.**
I. PANTRIES	i. Pantries in business occupancies and commercial buildings shall be provided with a sprinkler system as per **Section D, Chapter 05.**
J. STAGES	i. Permanent stages in assembly occupancies shall be installed with a sprinkler system under the stages, dressing rooms, store rooms and workshops, in accordance with **Section D, Chapter 05.**

Table:- D.11-T13.: Various Locations and Extension of Fire Protection Systems

LOCATION/ HAZARD	SYSTEM REQUIREMENTS
K. ROOF	i. Building roofs having LPG tanks as per Section F, Chapter 01 – Hazmat chapter requirements, roof spaces to used for restaurant seating, assembly and as sheesha bars shall be provided with a wet riser System subject to GDCD approval and as per **Section D, Chapter 03, Sub Section 6.0.** The building wet riser with hose reel shall be extended to such roofs.
L. GARBAGE CHUTE	i. A garbage chute shaft shall be provided with one sprinkler head at the top of the shaft, one sprinkler head at alternating floors and one sprinkler head at the lowest level, as per **Section D, Chapter 05.**
M. CEILINGS EXCEEDING 10 M IN HEIGHT	i. Where building ceiling height exceeds 10 m in height, sprinklers shall be provided in accordance with **Section D, Chapter 05.**and **Table:- D.11-T13.A. High Ceiling Sprinkler Protection.** ii. The sprinklers for high ceiling protection shall be extended coverage, 160°F (70°c), listed and permitted for such applications. iii. The requirements of **Table:- D.11-T13.A. High Ceiling Sprinkler Protection,** is a minimum guideline. Other design criteria recommended by permitted and listed manufacturer's detailed design guideline specifically for high ceiling sprinkler protection shall be permitted.

5.0 AUXILIARY PROTECTION

5.1. Auxiliary Rooms and Selection of Fire Protection Systems

5.1.1. Auxiliary rooms shall be protected with the options of Fire Protection Systems as per **Table:- D.11-T14. However, where any rooms and equipment are provided with fire protection systems as per Table:- D.11-T14., the designers shall first consider and consult the relevant Material Safety Data Sheet (MSDS) before designing and proposing such fire protection systems.**

Table:- D.11-T14.: Auxiliary Rooms Fire Protection Systems

LOCATION / HAZARD	SYSTEM REQUIREMENTS
A. ANESTHETIZING ROOMS	i. An automatic sprinkler system shall be provided as per **Section D, Chapter 05.** **OR** ii. A double interlocked Pre-action sprinkler system shall be provided as per **Section D, Chapter 05.**
B. BATTERY CHARGER ROOMS	i. Clean agent system shall be provided as per **Section D, Chapter 09.** **OR** ii. A double interlocked Pre-action sprinkler system shall be provided as per **Section D, Chapter 05.**
C. BMS ROOMS	i. Clean agent system shall be provided as per **Section 3.14.** **OR** ii. A double interlocked Pre-action sprinkler system shall be provided as per **Section D, Chapter 05.** iii. BMS rooms which are less than 10 m^2 in area and are not with critical building monitoring and management systems shall not be required to be protected.
D. BATTERY ROOMS	i. None
E. COMPUTER ROOMS	i. Clean agent system shall be provided as per **Section D, Chapter 09.** **OR** ii. A double interlocked pre-action sprinkler system shall be provided as per **Section D, Chapter 05.** **OR** iii. Computer rooms which are less than 10 m^2 in area and are not with critical life or building monitoring and management systems shall not be required to be protected.
F. CONTROL ROOMS/ FIRE COMMAND CENTERS	i. Clean agent system shall be provided as per **Section D, Chapter 9.** **OR** ii. A double interlocked Pre-action sprinkler system shall be provided as per **Section D, Chapter 05.** **OR** iii. Rooms which are less than 10 m^2 in area and are not with critical life or building monitoring and control systems shall not be required to be protected. iv. Rooms which are separated as part of separated service blocks and detached from the predominant occupancy, by a separation distance of 3 m, shall not be required to be protected.
G. DIESEL GENERATOR ROOMS	i. Foam sprinkler system shall be provided as per **Section 3.9.** ii. Diesel generator rooms which are separated as part of separated service blocks and detached from the predominant occupancy, by a separation distance of 3 m, shall not be required to be protected.

5.1.1 Auxiliary Rooms and Selection of Fire Protection Systems

Table:- D.11-T14.: Auxiliary Rooms Fire Protection Systems

LOCATION / HAZARD	SYSTEM REQUIREMENTS
H. MAIN ELECTRICAL ROOMS	i. Clean agent system shall be provided as per **Section D, Chapter 09.** ii. Electrical rooms which are less than 10 m^2 in area OR are located on typical floors shall not be required to be protected. How- ever, such typical floor electrical rooms shall be 1 hour fire rated enclosures and shall be limited to distribution boards and junction boxes and fully compliant to penetration fire stopping. iii. Electrical rooms which are separated as part of separated service blocks and detached from the predominant occupancy, by a separation distance of 3 m, shall not be required to be protected.
I. AHU ROOMS	i. An automatic sprinkler system shall be provided as per **Section D, Chapter 05.**
J. LV ROOMS AND MV ROOMS	i. Clean agent system shall be provided as per **Section D, Chapter 09.** Where louvers are provided for LV rooms protected with clean agent system, louvers shall be motorized and closed upon clean agent discharge to maintain room tightness. ii. Rooms which are separated as part of separated service blocks and detached from the predominant occupancy, by a separation distance of 3 m, shall not be required to be protected. iii. Rooms which are less than 10 m^2 in area OR are located on typical floors shall not be required to be protected. However, such typical floor or podium floor rooms shall be 1 hour fire rated enclosures and shall be limited to distribution boards and junction boxes and fully compliant to penetration fire stopping.
K. TRANSFORMER ROOMS OWNED BY POWER UTILITY COMPANIES, ENCLOSED AND SITUATED IN LOCATIONS OTHER THAN SUBSTATIONS	i. None, unless power utility company specifies. ii. Where specified and required, A clean agent system shall be provided as per **Section D, Chapter 09.** **OR** iii. Deluge Water Spray system shall be provided in accordance with **Section D, Chapter 06.** **OR** iv. Water Mist system shall be provided in accordance with **Section D, Chapter 07.**
L. TRANSFORMER ROOMS NOT OWNED BY POWER UTILITY COMPANIES, ENCLOSED AND SITUATED IN LOCATIONS OTHER THAN SUBSTATIONS	i. A clean agent system shall be provided as per **Section D, Chapter 09.** **OR** ii. Deluge Water Spray system shall be provided in accordance with **Section D, Chapter 06.** **OR** iii. Water Mist system shall be provided in accordance with **Section D, Chapter 07.** **OR** iv. Transformer Rooms shall be 2 hour fire rated enclosures with 90 minutes fire doors or 90 minutes fire rated motorized louvers, housing exclusively dry type electrical equipment and no other storage. v. Private enclosed transformer rooms which are separated as part of separated service blocks and detached from the predominant occupancy, by a separation distance of 3 m, shall not be required to be protected.

5.1.1 Auxiliary Rooms and Selection of Fire Protection Systems

Table:- D.11-T14.: Auxiliary Rooms Fire Protection Systems

LOCATION / HAZARD	SYSTEM REQUIREMENTS
M. LIFT MACHINE ROOMS	i. An automatic sprinkler system shall be provided as per **Section D, Chapter 05.** ii. Lift machine rooms which do not contain control equipment, mechanical equipment or spaces which serve 'machine room less elevators' shall not be required to be protected.
N. MAIN TELEPHONE ROOM	i. Clean agent system shall be provided as per **Section D, Chapter 09.** **OR** ii. Telephone rooms which are less than 10 m^2 in area or are located on typical floors shall not be required to be protected. However, such typical floor telephone rooms shall be limited to distribution boards and junction boxes and fully compliant penetration fire stopping. iii. Telephone rooms which are separated as part of separated service blocks and detached from the predominant occupancy, by a separation distance of 3 m, shall not be required to be protected.
O. MAIN SERVER ROOMS	i. Clean agent system shall be provided as per **Section D, Chapter 09** ii. Server rooms which are less than 10 m^2 in area or are located on typical floors shall not be required to be protected. However, such typical floor server rooms shall be compartmented with fully compliant penetration fire stopping systems. iii. Server cabinets which are exposed to occupied rooms shall not be required to be protected, provided the room is provided with automatic sprinkler system. iv. Server rooms which are separated as part of separated service blocks and detached from the predominant occupancy, by a separation distance of 3 m, shall not be required to be protected.
P. RMU /IDF/ MDF/ CDF/MMR ROOMS	i. Clean agent system shall be provided as per **Section D, Chapter 09** ii. Rooms which are less than 10 m^2 in area or are located on typical floors shall not be required to be protected. However, such typical floor rooms shall be compartmented with fully compliant fire stopping systems. iii. Rooms which are separated as part of separated service blocks and detached from the predominant occupancy, by a separation distance of 3 m, shall not be required to be protected.
Q. GSM ROOMS	i. Clean agent system shall be provided as per **Section D, Chapter 09** ii. Rooms which are less than 10 m^2 in area or are located on typical floors shall not be required to be protected. However, such typical floor rooms shall be compartmented with fully compliant fire stopping systems. iii. Rooms which are separated as part of separated service blocks and detached from the predominant occupancy, by a separation distance of 3 m, shall not be required to be protected.

5.1.1 Auxiliary Rooms and Selection of Fire Protection Systems

Table:- D.11-T14.: Auxiliary Rooms Fire Protection Systems

LOCATION / HAZARD	SYSTEM REQUIREMENTS
R. OPERATION THEATERS	i. A double interlocked pre-action sprinkler system shall be provided as per **Section D, Chapter 05.** **OR** ii. Rooms shall be 2 hour fire rated enclosures with 90 minutes fire doors, housing exclusively dry type medical and electrical equipment and no other storage.
S. MRI/SCANNING ROOMS	i. An automatic sprinkler system shall be provided as per **Section D, Chapter 05.** **OR** ii. A double interlocked pre-action sprinkler system shall be provided as per **Section D, Chapter 05.** **OR** iii. Rooms shall be 2 hour fire rated enclosures with 90 minutes fire doors, housing exclusively dry type medical and electrical equipment and no other storage.
T. RECORDS ROOM	i. An automatic sprinkler system shall be provided as per **Section D, Chapter 05.** **OR** ii. A double interlocked pre-action sprinkler system shall be provided as per **Section D, Chapter 05.** **OR** iii. Clean agent system shall be provided as per **Section D, Chapter 09.**
U. UPS Rooms	i. Clean agent system shall be provided as per **Section D, Chapter 09.** **OR** ii. A double interlocked Pre-action sprinkler system shall be provided as per **Section D, Chapter 05.** **OR** iii. Rooms shall be 2 hour fire rated enclosures with 90 minutes fire doors, housing exclusively dry type battery, dry electrical equipment and no other storage.
V. COLD/FREEZER ROOMS	i. Dry type sprinklers or dry pre-action system shall be provided. ii. Rooms which are less than 20 m^2 in area need not be protected. However, such rooms shall be compartmented with fully compliant penetration fire stopping systems. iii. Modular type cold rooms which are exposed to occupied rooms shall not be required to be protected, provided the room is provided with automatic sprinkler system. iv. Rooms which are separated as part of separated service blocks and detached from the predominant occupancy, by a separation distance of 3 m, shall not be required to be protected.

5.2. Equipment and Machinery

5.2.1. The equipment and machinery shall be protected with options of Fire Protection Systems as per **Table:- D.11-T15**

Table:- D.11-T15.: Equipment Fire Protection Systems

EQUIPMENT/ HAZARD	SYSTEM REQUIREMENTS
A. KITCHEN HOOD	i. An automatic Wet Chemical system shall be provided as per **Section D, Chapter 10.** for commercial kitchens having 3 or more burners. ii. Grease filters shall be installed for the kitchen hood.
B. LPG TANKS	i. Where building is sprinkler protected, and LPG tanks are installed above- ground or on roofs or podiums, an automatic Water Deluge Spray System shall be provided as per **Section D, Chapter 06.** ii. Where building is not sprinklered and LPG tanks are installed aboveground or on roofs or podiums, a dry type deluge spray system shall be provided with breeching inlet. iii. Where LPG tanks are installed aboveground, no protection shall be required, unless the proximity of such tanks is more than 6 m from any point of structure.
C. FLAMMABLE LIQUID TANKS	i. An automatic foam systems as appropriate as per **Section D, Chapter 08.** shall be provided. Refer to **Section F, Chapter 01.**
D. CABLE SPREAD AREAS	i. An automatic Water Deluge Spray System shall be provided as per **Section D, Chapter 06.** **OR** ii. An automatic Water Mist System shall be provided as per **Section D, Chapter 07**
E. DIESEL GENERATOR ROOM	i. Foam sprinkler system shall be provided as per **Section D, Chapter 08.** ii. Diesel generator rooms which are separated as part of separated service blocks and detached from the predominant occupancy, by a separation distance of 3 m, shall not be required to be protected.
F. BOILERS/BOILER ROOMS	i. An automatic sprinkler system shall be provided as per **Section D, Chapter 05**
G. COOLING TOWERS	i. Where the cooling tower material is not tested and certified for non-combustibility, automatic Water Deluge Spray System shall be provided as per **Section D, Chapter 06.**
H. TRANSFORMERS —OIL FILLED	i. An automatic Water Deluge Spray System shall be provided as per **Section D, Chapter 06.**
I. BULK OIL STORAGE	i. Suppression Systems shall be based on comprehensive Risk assessment and shall be proposed and stamped by the General Directorate of Civil Defence permitted House of Expertise. Refer to **Section F, Chapter 01.**
J. BULK FLAMMABLE LIQUID STORAGE	i. Suppression Systems shall be based on comprehensive Risk assessment and shall be proposed and stamped by the General Directorate of Civil Defence permitted House of Expertise. Refer to **Section F, Chapter 01, and Section D, Chapter 8.**

Table:- D.11-T15.: Equipment Fire Protection

EQUIPMENT/ HAZARD	SYSTEM REQUIREMENTS
K. BULK FLAMMABLE GAS STORAGE	i. Suppression Systems shall be based on comprehensive Risk assessment and shall be proposed and stamped by the GDCD - General Directorate of Civil Defence - Kingdom of Bahrain permitted House of Expertise.
L. BULK FLAMMABLE SOLID STORAGE	i. Suppression Systems shall be based on a comprehensive Risk assessment and shall be proposed and stamped by the GDCD - General Directorate of Civil Defence - Kingdom of Bahrain permitted House of Expertise.
M. HIGH HAZARD LOGISTICS	i. Suppression Systems shall be based on a comprehensive Risk assessment and shall be proposed and stamped by the GDCD - General Directorate of Civil Defence - Kingdom of Bahrain permitted House of Expertise.
N. CHEMICAL WAREHOUSES	i. Suppression Systems shall be based on a comprehensive Risk assessment and shall be proposed and stamped by the GDCD - General Directorate of Civil Defence - Kingdom of Bahrain permitted House of Expertise.
O. ARMS, AMMUNITION, EXPLOSIVES	i. Suppression Systems shall be based on a comprehensive Risk assessment and shall be proposed and stamped by the GDCD - General Directorate of Civil Defence - Kingdom of Bahrain permitted House of Expertise.
P. PROCESSING, GENERATING PLANTS	i. Suppression Systems shall be based on a comprehensive Risk assessment and shall be proposed and stamped by the GDCD - General Directorate of Civil Defence - Kingdom of Bahrain permitted House of Expertise.

6.0 Material Test Standards and Permit.

6.1. Acceptable Test Standards and criteria

6.1.1. All the Valves, Pumps, Piping, Hose, Nozzles, Devices, Sprinklers, Motors, Materials, Systems, Assemblies, equipment, Products and Accessories, referred to in this chapter with respect to Life Safety, Fire Safety and Emergency Services shall be Listed and Permitted by the General Directorate of Civil Defence.

6.1.2. **There is no year of edition mentioned against any test standards. It is the intent of General Directorate of Civil Defence to invite the customers seeking laboratory tests and the test laboratories to follow the "LATEST EDITION OF THE TEST STANDARD, AS AND WHEN THEY ARE UPGRADED/REVISED/AMENDED, TO THE DATE"**

6.1.3. **Fire Pump., Tested successfully at 150% of the rated flow.**

- **i.** UL 448, Standard for Centrifugal Stationary Pumps for Fire-Protection Service.
- **ii.** UL 448B, Standard for residential Fire Pumps intended for one and two family dwellings and manufactured homes.
- **iii.** UL 448C, Standard for Stationary, Rotary type, positive displacement pumps for Fire Protection Service.
- **iv.** FM 1319, Permitted Standard for Centrifugal Fire Pumps (Horizontal, End Suction Type)
- **v.** FM 1370, Permitted Standard for Centrifugal Fire Pumps (Vertical Shaft, Turbine Type, Barrel).
- **vi.** FM 1313, Permitted Standard for Positive Displacement Fire Pumps (Rotary Gear Type)
- **vii.** FM 1312, Permitted Standard for Centrifugal Fire Pumps (Vertical Shaft, Turbine Type).
- **viii.** UL 162A, Fixed water motor coupled pumps for foam concentrate proportioning.
- **ix.** LPS 1131, Requirements and testing methods for pumps for automatic sprinkler installation pump sets.
- **x.** EN 12259-12, Fixed fire fighting systems — Components for sprinkler and water spray systems — Part 12: Pumps
- **xi.** LPS 1240, Requirements for LPCB Permitted fire sprinkler pump sets used in automatic sprinkler installations

6.1.4. **Fire Pump Motor**

- **i.** UL 1004-5, Standard for Fire Pump Motor.

6.1.5. **Diesel Engine**

- **i.** UL 1247, Standard for Diesel Engines for Driving Stationary Fire Pumps.
- **ii.** FM 1333, Diesel Engine Fire Pump Drivers
- **iii.** LPS 1239, Requirements and testing procedures for the LPCB permit and listing of diesel engines for sprinkler pump sets

6.1.6. Fire Hose

i. FM 2111,2131, Fire Hose Assemblies and Hose couplings.
ii. FM 2141, Fire Hose racks and reels.
iii. UL 19, Lined Fire Hose and Hose Assemblies.
iv. UL 219, Lined Fire Hose for Interior Standpipes.
v. EN 671-1, Fixed firefighting systems. Hose systems. Hose reels with semi-rigid hose
vi. EN 671-2, Fixed firefighting systems. Hose systems. Hose systems with lay-flat hose
vii. EN 14540, Fire-fighting hoses. Non-percolating layflat hoses for fixed systems
viii. BS EN 694, Fire-fighting hoses. Semi-rigid hoses for fixed systems
ix. BS 336, Fire-fighting hose couplings

6.1.7. Fire Fighting Nozzles

i. FM 5511 - Firefighting Nozzles for Use with Hose, Monitor Assemblies and other Firefighting Equipment.
ii. UL 401, Portable Spray Hose Nozzles for Fire-Protection Service
iii. BSEN 15182 Handheld Branch pipes

6.1.8. Fire Pump Controller.

i. UL 218, Standard for Fire Pump Controller.
ii. FM 1321/1323, Standard for Fire Pump Controller for Electric Motor and Diesel Engine Driven Fire Pumps.
iii. LPS 1236, Requirements for control panels for diesel engine driven pumps used in automatic sprinkler installations.
iv. LPS 1237, Requirements for control panels for electric motor driven pumps used in automatic sprinkler installations

6.1.9. Sprinkler

i. UL 199, Standard for Automatic Sprinklers for Fire Protection Service.
ii. UL 199J, Standard for Automatic Window Sprinklers for Fire Protection Service.
iii. UL 1626, Standard for Residential Sprinklers for Fire Protection Service.
iv. UL 1767, Standard for (ESFR) Early-Suppression Fast-Response Sprinklers.
v. UL 1767B, Standard for Specific application (ESFR) Pendent Sprinklers.
vi. FM 2000, Automatic Control Mode Sprinklers for fire protection.
vii. FM 2030, Residential Automatic Sprinklers for fire protection.
viii. FM 2008, Suppression Mode ESFR Automatic Sprinklers
ix. FM 1632, Telescoping Sprinkler Assemblies for Use in Fire Protection Systems for Anechoic Chambers
x. EN 12259-1, Fixed firefighting systems. Components for sprinkler and water spray systems. Sprinklers
xi. prEN 12259-14, Fixed firefighting systems. Components for sprinkler and water spray systems. Sprinklers- Part 14. Sprinklers for residential applications
xii. LPS 1038, Requirements & Testing Methods for EPEC Sprinklers
xiii. LPS 1039, Requirements & Testing Methods for Automatic Sprinklers (inc TS1 Automatic Sprinklers commercial and domestic & residential, TS 4 Multiple Jet Controls, TS 8 Electrically Operated Sprinkler Heads, TS 9 Dual Sensing Sprinkler Heads)

xiv. LPS 1258, Requirements & Testing Methods for tight operating tolerance glass sprinkler bulbs
xv. LPS 1267, Requirements & Testing Methods for ESFR Sprinkler Heads
xvi. LPS 2072, Requirements & Testing Methods for K160 ELO Sprinkler Heads
xvii. BS 9252, Components for residential sprinkler systems. Specification and test methods for residential sprinklers.
xvii. UL 2167 Water Mist Nozzles for Fire-Protection Service nozzles for Fire-Protection Service
xix. UL 2351, Water Spray Nozzles

6.1.10. Underground Pipes and Fittings

i. FM 1613, Permitted Standard for Polyethylene (PE) Pipe and Fittings for underground fire protection service, in accordance with NFPA 24 and AWWA C906, minimum DR-9 with temperature and pressure rating not less than the system working pressure.
ii. FM 1614, Permitted Standard for Fiber Reinforced Composite (FRC) Pipes and Fittings for underground fire protection service.
iii. FM 1620, Permitted Standard for Pipe joints and anchor fittings for underground fire protection service.
iv. UL 1285 Pipe and Couplings, Polyvinyl Chloride (PVC), and Oriented Polyvinyl Chloride (PVCO) for Underground Fire Service
v. UL 1713 Pressure Pipe and Couplings, Glass Fiber-Reinforced, for Underground Fire Service
vi. UL 194 Gasketed Joints for Ductile-Iron Pipe and Fittings for Fire Protection Service

6.1.11. Aboveground Pipes and Fittings

i. FM 1920, Permitted Standard for Pipe coupling and fittings for aboveground fire protection service.
ii. ANSI/UL 852, Metallic Sprinkler Pipe for Fire Protection Service
iii. ANSI/UL 1821, Thermoplastic Sprinkler Pipe and Fittings for Fire Protection Service
iv. FM 1637, Flexible Sprinkler Hose with Fittings
v. FM 1630, Steel Pipe for Automatic Fire Sprinkler Systems
vi. UL 852, Metallic Sprinkler Pipe for Fire Protection Service
vii. UL 1821, Thermoplastic Sprinkler Pipe and Fittings for Fire Protection Service
viii. ASTM A53, Galvanized Steel ERW Pipe, sch 40.
ix. ASTM A53, Galvanized Steel Seamless Pipe, sch 40.

6.1.12. Valves

i. FM 1041, Permitted Standard for Alarm Check Valve
ii. FM 1021, Dry Pipe Valves
iii. FM 1020, Automatic Water Control Valves
iv. FM 1120, 1130, Fire Service Water Control Valves (OS & Y and NRS Type Gate Valves)
v. FM 1210, Swing Check Valves
vi. FM 1362, Pressure Reducing Valves
vii. FM 1031, Quick Opening Devices (Accelerators and Exhausters) for Dry Pipe Valves
viii. FM 1042, Water flow Alarm Indicators (Vane Type)
ix. FM 1045, Water flow Detector Check Valves

x. FM 1140, Quick Opening Valves 1⁄4 Inch Through 2 Inch Nominal Size
xi. FM 1111, Permitted Standard for Post Indicator Valve assembly
xii. FM 1112, Indicating Valves (Butterfly or Ball Type)
xiii. ANSI/UL 193, Alarm Valves for Fire Protection Service
xiv. ANSI/UL 260, Dry Pipe and Deluge Valves for Fire Protection Service
xv. UL 1478, Fire Pump Relief Valves
xvi. UL 1726, Automatic Drain Valves for Standpipe Systems
xvii. UL 2573, Air release valve
xviii. UL 258, Shutoff Valves for Trim and Drain Purposes
xix. UL 668, Hose Valves for Fire Protection Service
xx. UL 1486, quick Opening Devices for Dry Pipe Valves for Fire Protection Service
xxi. UL 1468, Pressure Reducing Valve
xxii. UL 1726, Automatic Drain Valves for Standpipe Systems
xxiii. UL 258, Shutoff Valves for Trim and Drain Purposes
xxiv. UL 262, Gate Valves for Fire Protection Service
xxv. ANSI/UL 312, Check Valves for Fire Protection Service
xxvi. UL 1091, Butterfly Valves for Fire Protection Service
xxvii. ANSI/UL 1468, Direct Acting Pressure Reducing, Restricting Valves
xxviii. ANSI/UL 1739, Pilot-Operated Pressure-Control Valves
xxix. EN 12259-2, Fixed firefighting systems. Components for sprinkler and water spray systems. Wet alarm assemblies.
xxx. EN 12259-3, Fixed firefighting systems. Components for sprinkler and water spray systems. Dry alarm valve assemblies.
xxxi. BS 5041-1, Fire hydrant systems equipment. Specification for landing valves for wet risers.

6.1.12. Valves

xxxii. BS 5041-2, Fire hydrant systems equipment. Specification for landing valves for dry risers.
xxxiii. BS 5041-4, Fire hydrant systems equipment. Specification for boxes for landing valves for dry risers.
xxxiv. BS 12094-13, Fixed firefighting systems. Components for gas extinguishing systems. Requirements and test methods for check valves and non-return valves.
xxxv. BS 5041-3, Fire hydrant systems equipment. Specification for inlet breeching s for dry riser inlets.
xxxvi. BS 5041-5, Fire hydrant systems equipment. Specification for boxes for foam inlets and dry riser inlets.
xxxvii. BS 5154, Gate Valve.
xxxvii. BS EN 593, Industrial vales. Metallic butterfly valves
xxxviii. LPS 1040, Requirements and Testing Methods for Wet Alarm Valve Sets
xxxix. LPS 1041, Requirements and Testing Procedures for the LPCB Permitted and Listing of Dry Pipe Valve Sets
xxxx. LPS 1185, Requirements for Testing Gear Operated Butterfly Valves
xxxxi. LPS 1186, Requirements and Testing Methods for Check Valves
xxxxii. EN 12259-2, Fixed firefighting systems. Components for sprinkler and water spray systems. Wet alarm valve assemblies
xxxxiii. EN 1074-1, Valves for fire water
xxxxiv. EN 1074-2, Valves for fire water
xxxxv. EN 12259-3, Fixed firefighting systems. Components for sprinkler and water spray systems. Dry alarm valve assemblies

xxxxvi. LPS TS3, Requirements and Testing for Deluge Valves and Actuators
xxxxvii. LPS 2071,Requirements for LPCB Permitted Pre-Action Systems for use in sprinkler systems
xxxxviii. prEN 12259-9. Fixed firefighting systems. Components for sprinkler and water spray systems. Part 9. Deluge alarm valves
xxxxix. UL 789. Indicator Posts for Fire-Protection Service

6.1.13. Hangers

i. ANSI/UL 203, Pipe Hanger Equipment for Fire Protection Service
ii. FM 1951, 1952, 1953, Pipe Hanger Components for Automatic Sprinkler Systems
iii. FM 1950, Seismic Sway Brace Components for Automatic Sprinkler Systems
iv. LPS 1194, Requirements & Test Methods for Pipe Hangers

6.1.14. Fittings

i. Fittings ANSI/UL 213, Rubber Gasketed Fittings for Fire Protection Service
ii. FM 1920, Pipe Couplings and Fittings for Fire Protection Systems
iii. UL 1474, Adjustable Drop Nipples for Sprinkler Systems
iv. FM 1631, Adjustable and Fixed Sprinkler Fittings ½ Inch through 1 Inch Nominal Size
v. ANSI/UL 2443, Flexible Sprinkler Hose with Fittings for Fire Protection Service
vi. LPS 1219, Requirements and testing procedures for the LPCB Permitted and listing of pipe couplings
vii. LPS 1261, Requirements for Testing Flexible Hoses for Sprinkler Systems

6.1.15. Water Motor Gong

i. FM 1055, Permitted Standard for Water Motor Gong.
ii. BS EN 12259-4, Fixed firefighting systems. Components for sprinkler and water spray systems. Water motor alarms.
iii. UL 346, Water flow Indicators for Fire Protective Signaling Systems

6.1.16. Wet Chemical Systems

i. UL 300, Fire Testing of Fire Extinguishing Systems for Protection of Commercial Cooking Equipment.
ii. LPS 1223, Requirements & Testing Procedures for Permitted of fixed Fire Ext Systems for Catering Equipment

6.1.17. Dry Chemical Systems

i. UL 1254, Standard for pre-engineered Dry Chemical Fire extinguishing System.
ii. FM 5320 - Dry Chemical Extinguishing Systems

6.1.18. Inert Gas Clean Agent Systems

i. UL 2127, Standard for Inert Gas Clean Agent Extinguishing System Units.
ii. FM 5600 - Clean Agent Extinguishing Systems

6.1.19. Chemical Gas Clean Agent Systems

i. UL 2166, Standard for Halocarbon Clean Agent Extinguishing System Units.
ii. FM 5600 - Clean Agent Extinguishing Systems

6.1.20. CO2 Systems (Industrial Use Only)

i. FM 5420 - Carbon Dioxide Extinguishing Systems

6.1.21. Foam System

i. UL 162, Standard for Safety Foam Equipment and Liquid Concentrates.
ii. UL 139, Standard for Medium and High Expansion foam Equipment and Liquid Concentrates.
FM-5133, Standard for Safety Foam Equipment
iii. FM 5130 - Foam Extinguishing Systems

6.1.22. Deluge/Pre-action System

i. FM 1011/1012/1013, Deluge and Pre-action Sprinkler Systems.
ii. UL 260/262/260 - Pre-action Systems

6.1.23. Yard Hydrant System, Wet Barrel, above ground

i. UL 246, Standard for Hydrants for Fire Protection.
ii. FM 1510/1511 - Fire Hydrants (Dry/Wet Barrel Type) for Private Fire Service.
iii. EN 1074-6, Fitness for verification test, Hydrants

7.0. Inspection and Maintenance of Fire Protection Systems

7.1. Design/Specification and Submittals

7.1.1. Design, Specifications and Submittals to General Directorate of Civil Defence for Permitted shall be the main consultant's responsibility. The consultant shall have competent and knowledgeable personnel to understand the General Directorate of Civil Defence requirements and codes and standards.

7.1.2. The design submittals shall be complete with system hydraulic calculations, design criteria, appropriate selection of types of systems and their components, in compliance with this code.

7.2. Installation

7.2.1. The installation of Fire Protection Systems shall be carried out only by General Directorate of Civil Defence Permitted and licensed contractors. general contractors, MEP contractors and plumbing contractors shall not be allowed to install fire protection systems.

7.2.2. The qualification and permit of the installation by General Directorate of Civil Defence is based on their training from the respective system manufacturers, their experience and their understanding of codes and standards and workmanship.

7.2.3. Installation contractors shall apply to General Directorate of Civil Defence and secure passing marks in General Directorate of Civil Defence examination to gain the license and be qualified as "Permitted fire contractors".

7.2.4. The installation contractor shall not commence work on site without receiving the General Directorate of Civil Defence stamped and Permitted drawings from the Consultant.

7.2.5. It is the contractors responsibility to adhere to consultant's General Directorate of Civil Defence Permitted drawings and specifications.

7.3. Inspection and Acceptance

7.3.1. Inspection and acceptance shall be the main consultant's responsibility.

7.3.2. The main consultant shall inspect the contractor's work during installations and ensure that all systems are installed, tested, commissioned and performing as per the General Directorate of Civil Defence Permitted drawings and their intended purpose.

7.3.3. The consultant shall handover the system inspection and acceptance reports and the maintenance manuals to the owner.

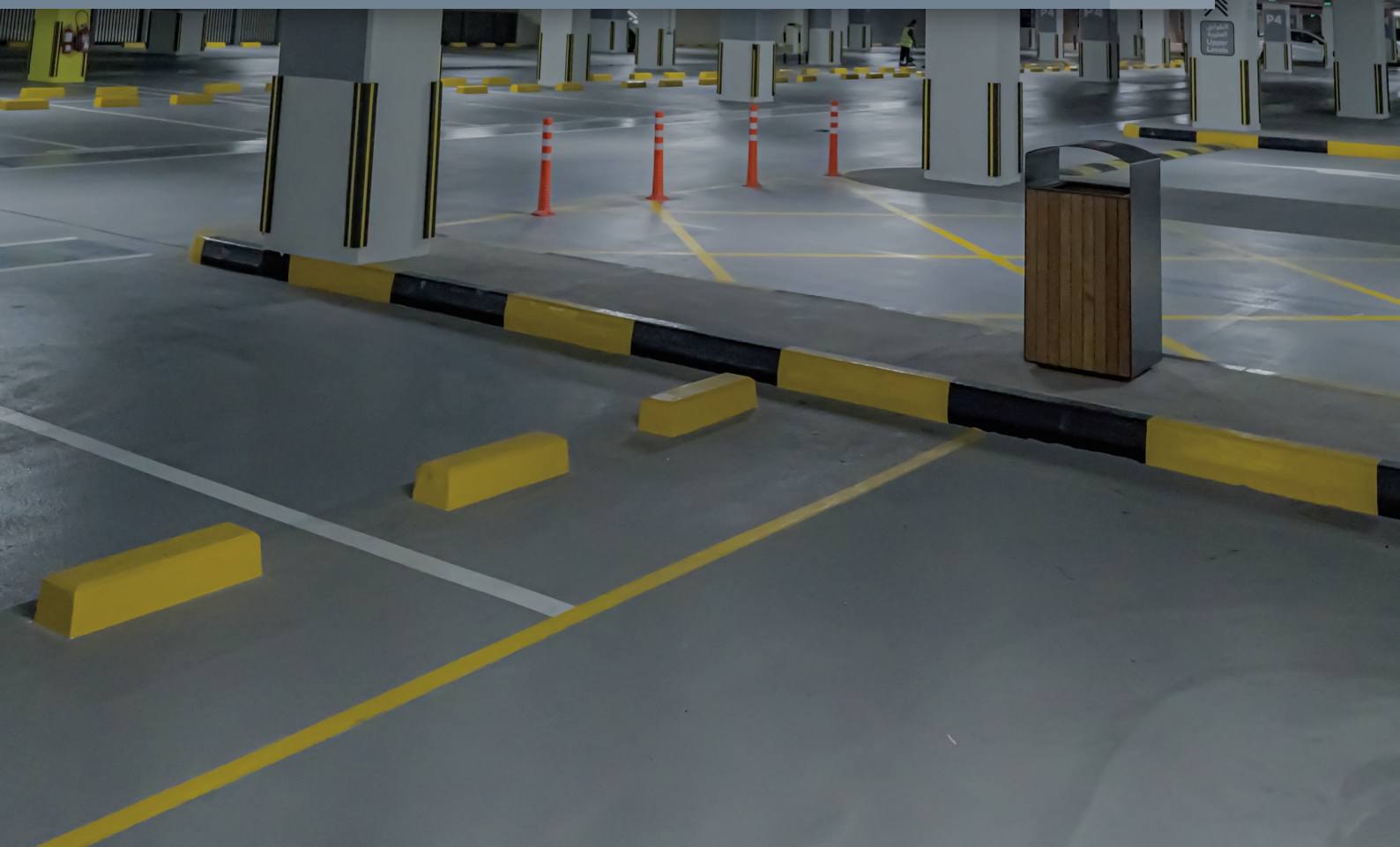
7.4. Inspection and Maintenance

7.4.1. The building owner, his appointed representative and the facility management shall be responsible to ensure that all the Fire Protection Systems in the facility are inspected regularly, maintained and repaired to serve their intended purpose during emergencies.



Chapter 1

Smoke Control and Smoke Management



Section B

Chapter 1

Smoke Control and Smoke Management



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1.0 Scope

a) Smoke Control System requirements in this section are to accomplish the following.

i. Prohibit smoke from entering stairwells, means of egress, smoke refuge areas, elevator shafts or similar areas where evacuees are in the process of egress during fire emergencies.
ii. Maintain a tenable environment in smoke refuge areas and means of egress during the time required for evacuation.
iii. Prohibit the migration of smoke from the smoke zone and Fire area to neighboring zones.
iv. Provide tenable conditions outside the smoke zone that enable emergency response personnel to conduct search and rescue operations and to locate and control the fire.
v. Contribute to the protection of life and to the reduction of property loss. Thus, enabling the reduction of downtime of the affected facility and businesses.

b) Design criteria for ventilation, smoke containment and smoke management systems.
c) Application of smoke control systems for various locations and occupancies.
d) Acceptance tests and maintenance of smoke control systems.
e) Smoke Control System Material Test Standards and Approval.
f) This chapter is based on NFPA 90 A, NFPA 92, NFPA 96, NFPA 30, NFPA 204, NFPA 409, NFPA 130, NFPA 502, EN 12101-6, BS 7346 Part 4, ASHRAE, SFPE guidelines, Manufacturer's specifications, guidelines etc.
g) Integration of smoke management with HVAC system and fire alarm systems.

2.0 Definitions

2.1 General

2.1.1 Shall

It is a mandatory requirement by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain.

2.1.2 Should

It is a suggested requirement recommended by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain but not mandatory.

2.1.3 Listed

Permitted and registered General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain.

2.1.4 Newton (N)

SI unit of force. It is equal to the force that would give a mass of one kilogram an acceleration of one meter per second per second (Second squared)

1 lbf (Pound Force) = 4.4 N (Newton)

2.1.5 Pascal (Pa)

The SI unit of pressure, equal to one newton per square meter.

0.1" w.g. (Inches of water column) = 25 Pa (Pascal)

2.1.6 Cubic Feet Per Minute (cfm)

It is the unit of volumetric flow rate capacity for finding air volume velocity or airflow.

1 cfm = 0.000048 m^3/second

2.1.7 Kilowatt (kW)

It is the unit of energy equivalent to 1 kilowatt of power sustained for 1 hour.

1 Watt is 1 joules per second.

1kW= 3.6 Mega Joules (Energy transferred to an object when force of 1 N is applied to it, in the direction of its motion through distance of 1 meter.

2.1.8 Heat Release Rate (HRR)

The heat release rate (HRR) can be measured in Joules per second, which is termed Watts. Since a fire puts out much more than 1 Watt, it is usually convenient to quantify the HRR in kilowatts (1000 W) or megawatts (a million watts, MW).

2.1.9 Pressure

An expression of force exerted on a surface per unit area.

2.1.10 Air Density

The mass per unit of volume of air depending on temperature and humidity. Air density is variable and changes with altitude.

The sea level standard value of air density r = 1.229 kg/m^3 = 0.00237 slug/$feet^3$.

2.1.11 Design Air Velocity

The desired air velocity through the open door between the pressurized and unpressurized spaces on the fire floor. To achieve design air velocity it is indispensable to provide properly sized air release from the fire floor.

2.1.12 Unit Responsibility

This "smoke management system Unit Performance" shall be declared by a single entity as having the "Unit Responsibility". General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain designates the permitted Smoke Management System Specialist Contractor as such "Unit Responsibility Holder" and the Smoke Management System Specialist Contractor shall declare such unit responsibility in an undertaking and shall be submitted to General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain as part of documentation during system commissioning and maintenance & permit.

2.2 Smoke Control System

2.2.1 Smoke

The airborne solid and liquid particulates and gases evolved when a material undergoes pyrolysis or combustion, together with the quantity of air that is entrained or otherwise mixed into the mass.

2.2.2 Smoke Control

A system that utilizes fans to produce pressure differences to manage smoke movement.

2.2.3 Smoke Management

A smoke control method that utilizes natural or mechanical systems to maintain a tenable environment in the means of egress from a large-volume space or to control and reduce the migration of smoke between the fire area and communicating spaces.

2.2.4 Smoke Zone (Smoke Control Zone)

A big space within a building where smoke may be controlled through extra spaces compartment and pressurization.

2.2.5 Natural Ventilation

A method of supplying or removing, air from a space through openings on the exterior of a building, using natural air movement from the outside.

2.2.6 Mechanical Ventilation

A method of supplying or removing, air from a space with aid of mechanically operated equipment such as Fans and ductwork.

2.2.7 Smoke Exhaust System

A mechanical or gravity system intended to move smoke from the smoke zone to the exterior of the building, including smoke removal, purging, and venting systems, as well as the function of exhaust fans utilized to reduce the pressure in a smoke zone.

2.2.8 Smoke Damper

A device installed within an air-distribution system or within smoke exhaust system to control the movement of smoke, i.e. to stay shut to prevent the spread of smoke into other compartments or sections of the smoke control systems or to open to exhaust smoke outside from the fire zone through smoke exhaust ductwork.

2.2.9 Fire Damper

A device, installed in an air distribution system, designed to close automatically upon detection of heat, or through fire alarm panel signal, to interrupt migratory airflow, and to restrict the passage of flame and heat.

2.2.10 Fire and Smoke Damper combination

A device installed in an air distribution system, designed to close automatically upon detection of heat or through fire alarm signal, to interrupt migratory airflow and to restrict the passage of flame, smoke and heat. Combination fire and smoke damper shall not be installed in a smoke exhaust system for smoke exhaust applications.

2.2.11 Fire rated Wall

A wall separating buildings or subdividing a building to prevent the spread of fire and having a fire resistance rating of complying with NFPA 5000 section 7.2.2.1

2.2.12 Fire Barrier Wall

A partition, other than firewall, having a fire resistance rating.

2.2.13 Smoke Barrier

A 1-hour Fire rated continuous membrane, either vertical or horizontal, such as a wall, floor, or ceiling assembly that is designed and constructed to restrict the movement of smoke.

2.2.14 Smoke Proof Enclosure

An exit enclosure designed and constructed so that the movement of the products of combustion produced by a fire occurring in any part of the building into the enclosure is limited.

2.2.15 Plenum

A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.

2.2.16 Air Connector

A conduit for transferring air between an air duct or plenum and an air terminal unit or an air inlet or air outlet.

2.2.17 Air Duct

A conduit or passageway for conveying air to or from heating, cooling, air conditioning, or ventilating equipment, but not including the plenum.

2.2.18 Atrium

A large-volume space created by a floor opening or series of floor openings connecting two or more stories that is covered at the top of the series of openings and is used for purposes other than an enclosed stairway; an elevator hoist way; an escalator opening; or as a utility shaft used for plumbing, electrical, air-conditioning, or communications facilities.

2.2.19 Mall

A mall comprises a roofed or covered pedestrian area within a building, facilitating access for multiple tenants, and typically spans no more than three interconnected levels.

As per NFPA 101, Section 6.1.1.4, a mall with more than three floor levels must be designed according to multiple occupancy provisions.

2.2.20 Theatre

A building or room where plays, shows, and similar events, are performed on a stage or a room often with rising tiers of seats for assemblies.

2.2.21 Standard Stage Elevation Restriction

A stage with a height of 15 m or less measured from the lowest point on the stage floor to the highest point of the roof or floor deck above.

2.2.22 Legitimate Stage

A stage with a height greater than 15 m measured from the lowest point on the stage floor to the highest point of the roof or floor deck above.

2.2.23 Mechanical Smoke Containment

A smoke control method that uses mechanical equipment to produce pressure differences across smoke barriers.

2.2.24 Smoke Control Mode

Predefined operational configuration of a system/device for the purpose of smoke control.

2.2.25 Smoke Containment Systems

Smoke Containment Systems are designed to contain smoke to a specific zone within a building or prevent it from entering other areas. This containment can be achieved through active smoke control systems or passive methods like Smoke barrier.

2.2.26 Compensated System

A system that adjusts for changing conditions either by modulating supply airflows or by relieving excess pressure.

2.2.27 Tenable Environment

An environment in which smoke, heat and associated products of combustion are limited or otherwise restricted to maintain the impact on occupants to a level that is not life threatening.

2.2.28 Design Pressure Difference

The desired pressure difference between the protected space and an adjacent space measured at the boundary of the protected space under a specified set of conditions with the smoke-control system operating.

2.2.29 Pressurization System

A type of smoke-control system with arrangement of constant or variable capacity Fans, Ducting, Relief Dampers, air grills and other features provided to achieve higher pressure in mechanically pressurized space than in the fire area.

2.2.30 Stair Pressurization

A type of smoke-control system in which stair shafts are mechanically pressurized, with respect to the fire area, with outdoor air to keep smoke from contaminating them during a fire incident.

2.2.31 Multiple-Injection Pressurization System

A type of smoke-control system that has pressurization air supplied from multiple locations.

2.2.32 Single-Injection Pressurization System

A type of smoke-control system that has pressurization air supplied from only one location.

2.2.33 Stack Effect

Pressure differential resulting from a difference in density between two interconnected columns of air at different temperatures, resulting in the movement of air into and out of buildings.

2.2.34 Communicating Space

A space within a building that has an open pathway to a large-volume space such that smoke from a fire either in the communicating space or in a large-volume space can move from one to another without restriction. Communicating space can either open directly to large volume space or through a passageway.

2.2.35 Axisymmetric Plume

A plume that rises above a fire, does not come into contact with walls or other obstacles, and is not disrupted or deflected by airflow.

2.2.36 Balcony Spill Plume

A smoke plume that originates from a compartment fire, flows out the doorway, flows under a balcony, and flows upward after passing the balcony edge.

2.2.37 Air Release

A mechanical or gravity system intended to move air from the interior to the exterior of the building in order to provide air release for pressurization system.

2.2.38 Separated Spaces

Spaces within a building that are isolated from large-volume spaces by smoke barriers.

2.2.39 Smoke Curtain or Draft Curtain

A non-combustible solid material, beam, girder, or similar material or construction that is used to channel or contain smoke and that is attached to the underside of the ceiling and protrudes a limited distance downward.

2.2.40 End-to-End Verification

A self-testing method that provides positive confirmation that the desired result (e.g., pressure difference, airflow or damper position) has been achieved when a controlled device has been activated, such as during smoke control, testing, or manual override operations.

2.2.41 Fuel Limited Fire

A fire that has a heat release rate that is controlled by the material burning.

2.2.42 Growth Time (t_g)

The time interval from the time of effective ignition until the heat release rate of the fire is 1000 Btu/sec (1055 kW) also known as a fire coefficient.

2.2.43 Large-Volume Space

An un compartmented space, generally two or more stories in height, within which smoke from a fire either in the space or in a communicating space can move and accumulate without restriction.

2.2.44 Network Modeling

Network modes consist of representing each rooms in a building as a node, and shafts as a series of vertical nodes. Each node is at one pressure and temperature. The nodes are connected by flow paths that represent leakages such as construction cracks in walls and floors, gaps around doors, and open

doors. A computer program is used to solve for the flows and pressure differences throughout a building.

2.2.45 Plug holing

The condition in which air from below the smoke layer is pulled through the smoke layer into the smoke exhaust due to a high exhaust rate.

2.2.46 Sprinkler Controlled Fire

A fire that has a constant or decaying heat release rate due to the action of sprinkler spray.

2.2.47 Steady Fire

A fire that has a constant heat release rate.

2.2.48 Transition Zone

The layer between the smoke layer interface and the first indication of smoke in which the smoke layer temperature decreases to ambient.

2.2.49 T–squared (t2) Fire

A fire that has a heat release rate that grows proportionally to the square of time from ignition.

2.2.50 Unsteady Fire

A fire that has a heat release rate that varies with respect to time.

2.2.51 Ventilation Limited Fire

A fire where every object in the fire compartment is fully involved in fire and the heat release rate depends on the airflow through the openings to the fire compartment.

2.2.52 Backdraft Damper

A device allowing airflow in one direction only.

2.2.53 Pressure Relief Damper

A device having an adjustable start-open pressure, that is capable of maintaining a relatively constant pressure at various airflows and which closes upon a decrease in differential pressure.

2.2.54 Differential Pressure Sensor

A device that measures the difference between two pressures, one connected to each side of the sensor.

2.2.55 Pressurization Kit

A kit with predefined components capable of producing and controlling set value of pressure differential between mechanically pressurized space and the reference.

2.2.56 Computational Fluid Dynamics (CFD)

The prediction of the behavior of fluids and of the effects of fluid motion past objects by numerical methods.

2.2.57 Forced Airflow Pressurization System

A type of compensated smoke-control system intended to reduce negative influence of wind forces, counteract stack effect using controlled airflow

resistance of pressurized space that automatically adjusts for changing conditions by modulating supply, and exhaust airflows basing on continuous measurement of pressure differences.

2.2.58 Piston Effect

Transient pressures produced by elevator car motion in a pressurized hoist way that can pull smoke into pressurized elevator lobby or hoistway.

2.2.59 Wind forces

Forces influencing pressure layout inside and around the building resulting in positive pressures at the windward façade and negative pressure at the leeward façade.

2.2.60 Door Opening Force

A force required to open the door measured at the knob under specific set of conditions with the smoke-control system operating.

2.2.61 Commissioning

Process by which an installed system is assessed to confirm it meets requirements of relevant standards and tested to verify if it functions according to its design objectives and intent.

2.2.62 Inspection

Actions involving examination and testing of the system carried out in order to determine that the system is in proper technical condition.

2.2.63 Maintenance

Actions necessary for retaining or restoring a system to the specified operable condition.

2.2.64 Smoke Tight Lift Lobbies

Smoke Tight Lift Lobbies are designed to prevent the spread of smoke into elevator shafts and other areas, ensuring safe egress during a fire

3.0 Components of Smoke Control and HVAC Systems

a) Components involved in Smoke Control Systems and HVAC Systems shall comply with **Table:-E.03-T1.**

b) Under One Unit Responsibility Permitted, Smoke Management System Specialist Contractor shall supply complete equipment's involved, and accomplish the installation. The Specialist Contractor responsibility to deliver Undertaking for system performance to General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain as part of documentation during system commissioning and permit.

c) This "smoke management system Unit Performance" shall be declared by a single entity as having the "Unit Responsibility". General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain designates the permitted Smoke Management System Specialist Contractor as such "Unit Responsibility Holder" and the Smoke Management System Specialist Contractor shall declare such unit responsibility in an undertaking and shall be submitted

to General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain as part of documentation during system commissioning and permit.

d) All the smoke management design drawings to be duly signed by registered engineers by unit responsibly contractors install and not design prior to the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain submission. Such unit responsibly contractor shall have General Directorate of Civil Defense permit for supply and installation of smoke management equipment's.

e) Specialist contractor/ manufacturer shall submit the CFD analysis report prepared by the Fan manufacturer based on the project design requirements for review and approval of CDD.

Table:- E.03-T1 Components of Smoke Control Systems

SI.NO	ITEMS	REQUIREMENTS
1	**FANS**	I. Smoke Exhaust and smoke extract fans shall be rated at and capable of operating effectively at 400°C for 2 hours. II. Fresh air supply and pressurization fans don't need to be fire rated, provided they are installed on roof or to the exterior open environment. III. Fans shall be tested under EN-12101-3: Smoke and heat control systems (Specification for powered smoke and heat exhaust ventilators) and shall be listed and permitted by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain. IV. The mechanical smoke exhaust fans shall be interfaced with a cross zoned Fire detection or with sprinkler activation. V. Hurricane type and Natural type smoke extract fans without electrical power shall not be acceptable for smoke purging purpose.
2	**NATURAL SMOKE AND HEAT VENTS**	I. Smoke vents shall be listed and permitted by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain and shall be capable of operating effectively at 300°C for 30 minutes. II. Vents operation shall be interfaced with Fire alarm check valve and Sprinkler zone control valve, to avoid vent opening before the sprinkler response. III. Vents shall be automatically resettable after operation. IV. Battery connected to the smoke vent control panel shall be considered as fail-safe option for smoke vent operation. V. Smoke vents to be tested under EN 12101-2: Smoke and heat control systems and shall be listed and permitted by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain.
3	**SMOKE CONTROL SYSTEM DUCTS**	I. Ductwork for Smoke Control Systems (both exhaust and make-up air ducts) shall be of at least 2-hour fire rated. II. Such fire rating of smoke control system ducts (Type A &B, rated for both fire outside and inside shall be evaluated for the following performance: a. Stability 120 minutes b. Integrity 120 minutes c. Smoke Extraction 120 minutes (based on 75% cross sectional area)

		III. Ducts to be tested under BS 476, Part 24 and shall be listed and permitted by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain.
4	**SMOKE CURTAINS (SMOKE SCREENS)**	I. Smoke Curtains shall be rated at and capable of operating effectively for 600^0C, 2 hours. II. Smoke curtains that are listed and permitted may utilized to implement desired smoke control strategies. These strategies aim to restrict smoke spread to specific zones or direct smoke towards extract fans, thus improving extract fan performance and facilitating rapid smoke clearance. III. All smoke curtains where required, unless permanently fixed in position, shall be brought into the position automatically to provide adequate smoke tightness and effective depth. The effective depth in general is 20% of the total floor ceiling height of the space. IV. Smoke Curtains be tested under EN 12101-1 and shall be listed and permitted by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain.
5	**MOTORIZED SMOKE DAMPERS**	I. Smoke dampers used for the isolation in engineered smoke-control systems shall be classified in accordance with ANSI/UL 555S, Standard for Safety Smoke Dampers and with a minimum Class II leakage rating, and elevated temperature rating shall not be less 2 hours fire rating. II. Smoke dampers be tested under EN 12101-8 / UL 555 S and shall be listed and permitted by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain. III. Maximum delay of 30 seconds in order to allow the operation of all dampers ensuring smoke extraction and partitioning of the smoke extraction zone.
6	**FIRE FIGHTER'S SMOKE CONTROL STATION**	I. Dedicated Smoke Control Panel shall be provided for the Smoke Control Systems for Fire fighter's-controlled operation. II. Such SCP shall be essentially located at the Emergency Command Center or the agreed and permitted location where the Main Fire Alarm Control Panel is located. III. The SCP (Smoke Control Panel) shall be with graphic displays, clearly depicting the building layout, location and working status of smoke control systems and equipment such as Ducts, Fans and Dampers within the building, Smoke zones within the building etc. IV. The SCP should provide the control capability over all smoke-control system equipment or zones within the building to enable fire fighters to readily understand the operation of the system, to activate or isolate certain zones or individual equipment based on their judgment of the emergency situation. SCP shall essentially have a minimum of these features a) Fan ON-AUTO-OFF b) Dampers OPEN-AUTO-CLOSE c) Visual indication of WHITE for Fans, Dampers-NORMAL d) Visual indication of RED for Fans-OFF, Dampers-CLOSED e) Visual indication of GREEN for Fans-ON, Dampers-OPEN f) Visual indication of AMBER for Fans-TROUBLE, Dampers TROUBLE

3.1 Requirements for HVAC Systems

HVAC Systems shall comply with **Table:- E.03-T2.** The relevant components of HVAC systems shall comply with **Table:-E.03-T2. Requirements for HVAC Systems**

Table:- E.03-T2 Requirements for HVAC Systems		
SI.NO	**ITEMS**	**REQUIREMENTS**
1	**GENERAL**	I. In a Fire Condition, HVAC Systems in a building shall automatically shut down, unless they are integral part of a Smoke exhaust and Smoke control systems. II. HAVC equipment shall be guarded for personnel protection and against the intake of foreign matter into the system. III. Each air distribution system shall be provided with at least one manually operable means for stopping the operation of the supply, return, and exhaust fan(s) in an emergency. IV. The means of manual operation shall be located in the emergency command center or in a dedicated protected room. V. Exit passageways, stairs, ramps, and other exits shall not be used as a part of a supply, return, or exhaust air system serving other areas of the building. VI. Egress corridors in health care, detention and correctional, and residential occupancies shall not be used as a portion of a supply, return, or exhaust air system serving adjoining areas. VII. An air transfer opening(s) shall not be permitted in walls or in doors separating egress corridors from adjoining areas. VIII. Air ducts shall be located where they are not subject to damage or rupture, or they shall be protected to maintain their integrity. IX. Air outlets shall be located at least 76 mm (3 in.) above the floor, unless provisions have been made to prevent dirt and dust accumulations from entering the system. X. Shafts used for air ducts shall not accommodate the following, Exhaust ducts used for the removal of smoke- and grease-laden vapors from cooking equipment , Ducts used for the removal of flammable vapors, moving, conveying, or transporting stock, vapor, or dust , removal of nonflammable corrosive fumes and vapors, Refuse and linen chutes, Piping, except for noncombustible piping conveying water or other nonhazardous or nontoxic materials & Combustible storage XI. The installation of electrical wiring and equipment associated with HVAC shall be in accordance with relevant authority regulations. XII. Listed and permitted air duct smoke detectors shall be installed at a) Downstream of the air filters and ahead of any branch connections in air supply systems having a capacity greater than 944 L/sec (2000 ft^3/min). b) At each storey prior to the connection to a common return and prior to any recirculation or fresh air inlet connection in air return systems having a capacity greater than 7080 L/sec (15,000 ft^3/min) and serving more than one storey. Smoke detectors shall automatically stop their respective fan(s) when detecting the presence of smoke, unless they are required not to stop the fan by a smoke control logic.

		XIII. Where the smoke barrier is also constructed and serving as Fire barrier/Wall, a combination (Smoke/Fire) Damper shall be installed for all Ducts and air-transfer openings penetrating such barriers/Walls. XIV. Permitted fire dampers shall be provided for air transfer openings in walls or partitions required to have a fire-resistance rating of 1 hour or more. XV. Where air ducts extend through only one floor and serve only two adjacent stories, the air ducts shall be enclosed, or fire dampers shall be installed at each point where the floor is penetrated. XVI. Fire dampers shall be with fusible link for HVAC systems. XVII. Fire dampers used in any sensitive buildings as healthcare facilities, hotels (occupancy with sleeping risk), education buildings, and any buildings where the habitable height exceeds 23 m shall be controlled by an automatic alarm-initiated device, and shall ensure no smoke leakage and no heat transfer occurs.

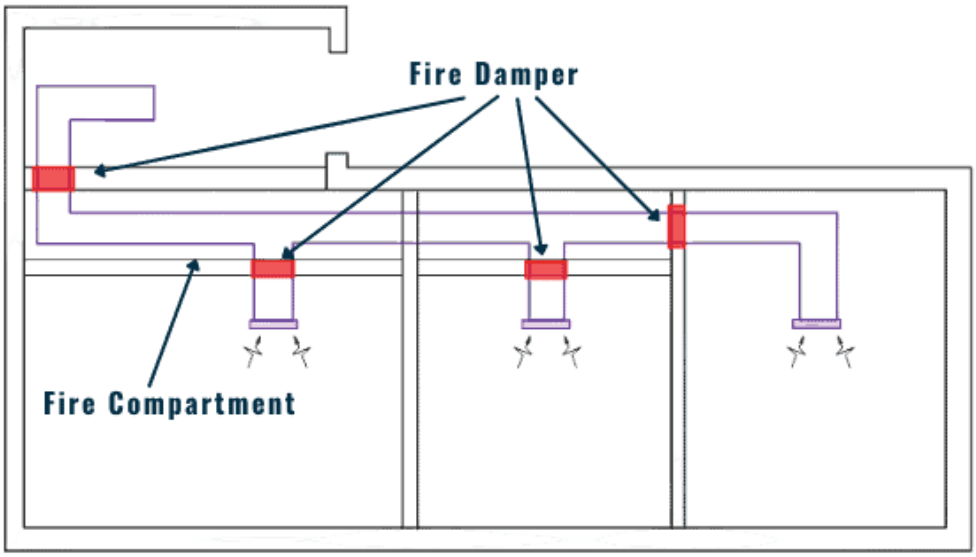


Figure: - E.3-F1: Fire Damper placement

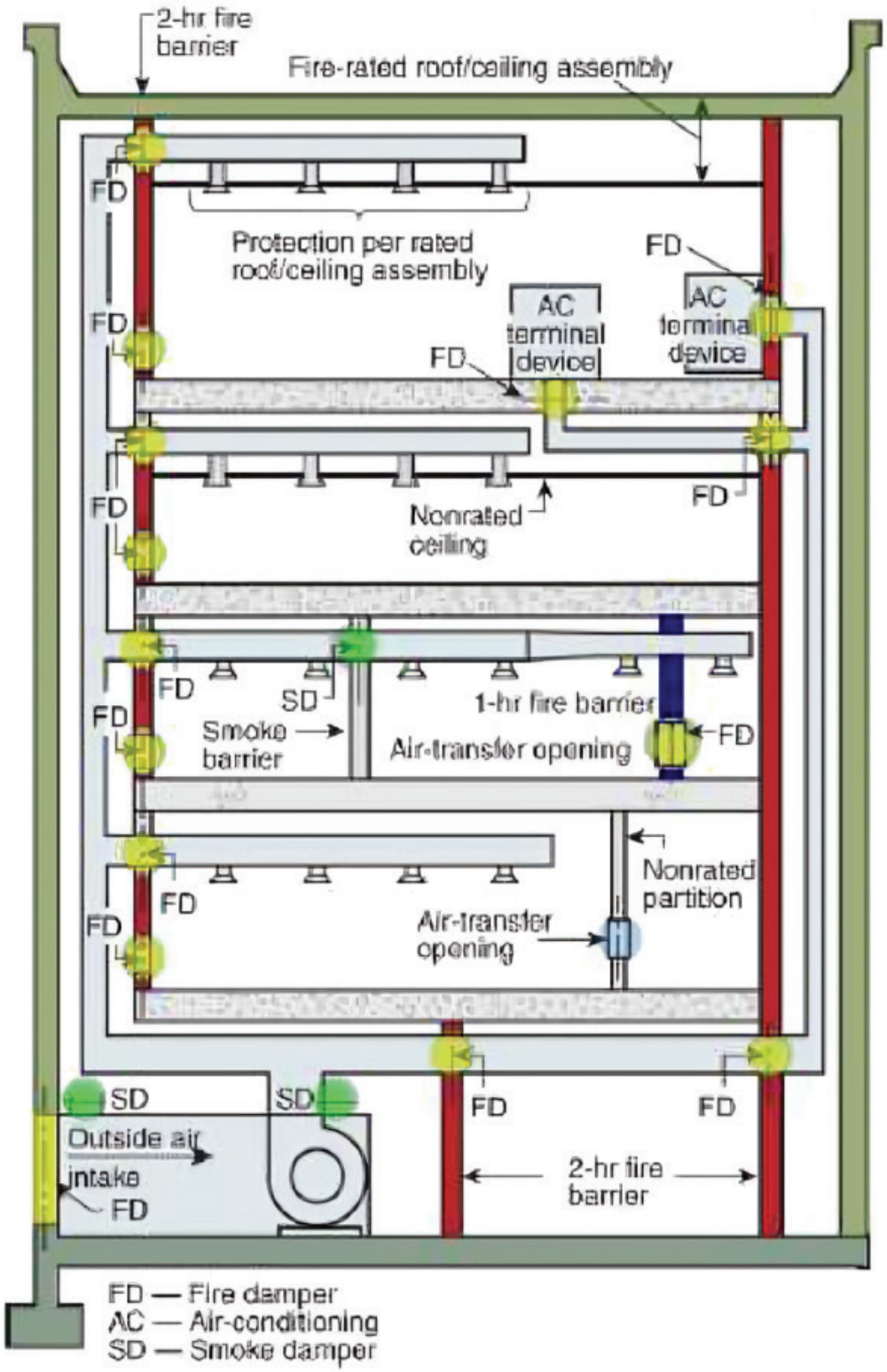


Figure: - E.3-F2: Fire Damper schematic

3.2 Various Smoke Control Approaches

The smoke control Strategy in a facility is broadly classified into two categories.

A. Smoke Containment
B. Smoke Management

3.2.1 Smoke Containment

The design objective of a smoke containment approach is to restrict the smoke to its zone of origin and prevent it from spreading to other zones and areas, thus

a) Limiting the spread of smoke that can affect occupants, before and during evacuation.
b) Allowing sufficient visibility to the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain to approach, locate and extinguish the fire.
c) Limiting smoke damage to building contents.
d) Providing a tenable environment for egress purposes, outside smoke effected areas.

Smoke containment is achieved through pressure differences in zones, where smoke is prevented from entering a zone with a relatively higher pressure than the pressure of the zone of smoke origin.

Smoke containment Systems shall be one or a combination of the following systems, based on the building smoke control strategy.

i. **Stairwell Pressurization System**
ii. **Zoned Smoke Control System**
iii. **Elevator Pressurization System**
iv. **Lobby (Vestibule) Pressurization System**
v. **Smoke Refuge Area Pressurization System**
vi. **Opposed airflow to prevent smoke movement between large volume space and communicating space**
vii. **Smoke curtain in full drop to contain the smoke.**

3.2.2 Smoke Management

The design objective of a Smoke Management system to maintain a tenable environment in smoke refuge areas and means of egress during the time required for evacuation.

Smoke Management Systems shall be one or a combination of the following below systems, based on the building smoke control strategy.

a. **Atrium or large volume Smoke Control System**
b. **Smoke Extraction System**
c. **Corridor and Open circulation area Smoke Purging System**
d. **Natural Ventilation System**
e. **Mechanical Ventilation System**

4.0 General Requirements for Smoke Control Systems

Smoke Control Systems shall comply with the general requirements of **Table:- E.04-T1.**

Table:- E.04-T 1 Smoke Control Systems shall comply with the general requirements		
SI.NO	**ITEMS**	**REQUIREMENTS**
1	**DESIGN FIRE SIZE HEAT OUTPUT (DESIGN FIRE LOAD)**	a) The building to be provided with an engineered smoke control system shall be sprinkler protected unless an engineering analysis through a performance based design methodology is provided with technical justifications and permitted by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain. b) The design fire load over 9.3 m^2 floor space shall be restricted to the following and shall be detailed and justified in the smoke engineering analysis. i) Office building atrium- fire load shall be 2.1 MW at 12m of fire perimeter. ii) Shops and mercantile-fire load shall be 5 MW at 14 m of fire perimeter. iii) Hotel guest rooms-fire load shall be 0.5 MW at 6 m of fire perimeter. iv) Hotel Public Areas-fire load shall be 2.5 MW at 12 m of fire perimeter. v) Assembly with fixed seating-fire load of 2.5 MW at 12m of fire perimeter. vi) Malls and Atrium smoke engineering analysis shall be done by use of computer models.
2	**MINIMUM DESIGN PRESSURE DIFFERENCES ACROSS SMOKE ZONES**	Building ceiling height minimum design pressure difference **1. SPRINKLERED (12.5 Pa) for any height** **2. NON-SPRINKLERED (25 Pa) for 3 m height** **3. NON-SPRINKLERED (35 Pa) for 4.5 m height** **4. NON-SPRINKLERED (45 Pa) for 6.5 m height**

Table:- E.04-T 2 Maximum Allowable Design Pressure differences Across Door						
SNO.	**DOOR CLOSER FORCE (N)**	**DOOR WIDTH 0.81 m**	**Door WIDTH 0.91 m**	**DOOR WIDTH 1.0 m**	**DOOR WIDTH 1.11 m**	**DOOR WIDTH 1.22 m**
1.	25 N	113 Pa	102 Pa	92 Pa	84 Pa	78 Pa
2.	30 N	108 Pa	97 Pa	88 Pa	80 Pa	74 Pa
3.	35 N	103 Pa	93 Pa	83 Pa	77 Pa	71 Pa
4.	40 N	98 Pa	88 Pa	79 Pa	73 Pa	67 Pa
5.	45 N	92 Pa	83 Pa	75 Pa	69 Pa	64 Pa
6.	50 N	87 Pa	78 Pa	71 Pa	65 Pa	60 Pa
7.	55 N	82 Pa	74 Pa	66 Pa	61 Pa	56 Pa
8.	60 N	77 Pa	69 Pa	62 Pa	57 Pa	53 Pa

3	**MAKE UP AIR (REPLACEMENT AIR)**	a) Makeup air for smoke management systems shall be provided by fans or by openings to the outside. b) The design replacement air discharge velocity shall not exceed 5.0 m/s to prevent the escapees being hindered by the air flow

		c) The replacement air intake shall be sited at least 5 m away from any exhaust air discharge. d) The supply points for the makeup air (Replacement air) shall be located beneath the smoke layer interface, unless otherwise determined by computer model analysis. e) The mechanical makeup air shall be less than the mass flow rate of the mechanical smoke exhaust.
4	**EMERGENCY POWER**	All the smoke control systems shall be provided with a secondary source of power supply, a standby generator system, sufficient to smoke management system and all other fire protection systems.
5	**CIRCUIT PROTECTION**	The fans and associated smoke control equipment shall be wired a with 2-hour fire-resistance rating and protected circuits designed to ensure a continued operation in the event of the fire.
6	**SYSTEM ACTIVATION**	a) The smoke control system shall be activated by a sprinkler activation, smoke detectors or beam detectors located in the same smoke control zone. b) The time taken for the smoke control system within a smoke zone to be fully operational shall not exceed 60 seconds from system activation.
7	**ONE UNIT RESPONSIBILITY**	a) Under One Unit Responsibility Permitted, Smoke Management System Specialist Contractor shall supply complete equipment's involved, and accomplish the installation. The Specialist Contractor responsibility to deliver Undertaking for system performance to General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain as part of documentation during system commissioning and acceptance. b) This "smoke management system Unit Performance" shall be declared by a single entity as having the "Unit Responsibility". General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain designates the permitted Smoke Management System Specialist Contractor as such "Unit Responsibility Holder". Smoke Management System Specialist Contractor shall declare such unit responsibility in an undertaking and shall be submitted to General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain as part of documentation during system commissioning and acceptance. c) All the smoke management design drawings to be stamped by unit responsibly contractor prior to the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain submission. Such unit responsibly contractor shall have General Directorate of civil defense approval for supply and installation of smoke management equipment.

5.0 CFD Guideline for Smoke Management System

When designing a smoke management system using Computational Fluid Dynamics (CFD), several guidelines can ensure an effective and accurate simulation. Here is a basic outline of considerations:

i. **Model Geometry:**

- Accurately model the geometry of the building or space, including walls, floors, ceilings, doors, windows, and any obstacles that may affect airflow.
- Pay attention to detail, especially in areas where smoke may accumulate or escape.

ii. **Boundary Conditions:**

- Define appropriate boundary conditions, including inlet and outlet locations for airflow, temperature, and smoke sources.
- Consider the effects of outdoor weather conditions, such as wind direction and speed, on smoke movement.

iii. **Mesh Generation:**

- Generate a high-quality mesh that resolves the flow features and boundary layers appropriately.
- Use adaptive meshing techniques to refine the mesh in areas of interest, such as near vents or exits.
- The grid size to be used in the fire model shall not be larger than 0.2m x 0.2m x 0.2m in the smoke control zone where the fire is located and its adjacent zones. Other than these zones, the grid size shall not be larger than 0.4m x 0.4m x 0.4m.

iv. **Solver Settings:**

- Choose a suitable solver and numerical schemes that can accurately capture the physics of smoke movement and dispersion.
- Ensure convergence criteria are met and perform sensitivity analysis to validate results.

v. **Smoke Source Modeling:**

- Model the smoke sources realistically, considering factors such as heat release rate, temperature, and buoyancy effects.
- Account for variations in smoke composition and density based on the type of fire or combustion process.
- The tenability limit for exposure of skin to radiant heat is approximately 2.5 kW/m^2. Below this incident heat flux level, exposure can be tolerated for 30 minutes or longer without significantly affecting the time available for escape.

vi. **Sensitivity Analysis:**

- Conduct sensitivity analysis to assess the effects of uncertainties in input parameters, such as fire size, ventilation rates, or building geometry, on the simulation outcomes.
- Identify critical parameters that significantly influence the performance of the smoke management system.

vii. Documentation and Reporting:

- Document the modeling assumptions, methodologies, and results in detail to facilitate peer review and regulatory approval.
- Prepare clear and concise reports summarizing the simulation findings, conclusions, and recommendations for smoke management strategies.

By following these guidelines, engineers and designers can use CFD effectively to optimize/ validate the performance of smoke ventilation systems and ensure the safety of building occupants in the event of a fire.

5.1 Acceptance Criteria for Smoke Management System Validation

i. No smoke-logged for at least 20 minutes, regardless of whether the fire is located within the smoke control zone or across the zone boundaries.

ii. Within this smoke-logged area, there shall be at least 1 viable route for the fire fighters where the following conditions are satisfied.
   a. Smoke temperature shall not exceed 250^0C at a height of 1.83 m from floor level.
   b. Visibility shall not be less than 5 m at a height of 1.83 m from floor level.

iii. All other areas outside the smoke-logged area shall be kept substantially free from smoke i.e. smoke temperature not more than 60°C and visibility of at least 25 m.

6.0 Smoke Management Strategy

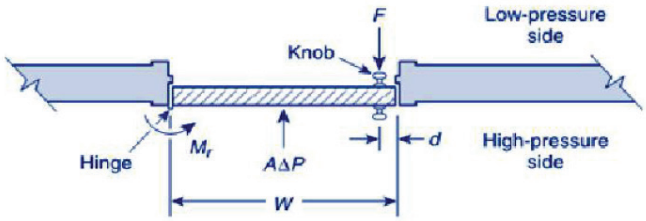
Below Smoke Management Systems shall be one or a combination of the following systems, based on the building smoke control strategy.

6.1 Stairwell Pressurization System

The stair pressurization system shall comply with the general requirements for smoke control systems as per **Table:- E.06-T1.**

Table:- E.06-T 1 Stair Pressurization Requirements

SI.NO	ITEMS	REQUIREMENTS
1	**DESIGN CRITERIA**	a) The minimum pressure difference of 12.5 Pa is intended to prevent smoke from entering the staircase, ensuring its effectiveness both when the doors are open and when they are closed, it explicitly states that the minimum pressure difference applies regardless of the state of the doors, ensuring comprehensive smoke prevention measures. b) The calculations shall consider the 2 (two) number of doors to be opened simultaneously, one door at the floor of fire origin and the exit door at discharge as a minimum. However, pressurization sizing shall be verified by computer airflow models. c) To keep pressurized space clear of smoke contamination air velocity through the open door between the pressurized and unpressurized spaces on the floor of fire origin shall not be less than 1.0 m/s. d) For exit stair pressurization systems, the orifice equation can be used to estimate the flow through building flow paths. The total leakage area of the protected space shall be calculated using input data from NFPA 92, EN 12101-6 standards or other relevant standards $Q = 0.839A\sqrt{\Delta p}$ Where, Q = volumetric airflow rate, m^3/s A = flow area (leakage area), m^2 Δp = pressure difference across flow path, Pa **Note:** Typical Leakage Areas for Walls and Floors of Buildings shall be referred from NFPA 92 Table A.4.4.4.3 e) The force required to open a door in an exit stair pressurization system is as follows: $F = F_{dc} + K(WA\Delta P)/2(W\text{-}d)$ where: A = Door area, square meter, (m^2) d = Distance from door handle to latch edge of door, meter (m) F = Total door opening force, (N) F_{dc} = Force required overcoming closing device, (N) K = Coefficient 5.2 (1.0) W = Door width, meter (m) ΔP = Design pressure difference, Pascal (Pa)

		 **Note:** Maximum Pressure Differences Across Doors shall be referred from NFPA 92 Table A.4.4.2.2.
2	**GENERAL**	a) A single-point injection system shall be permitted to be used where the stairwell height is less than 30.5 m. b) Stairwells more than 30.5 m high shall be provided with multiple-injection systems. c) In order to achieve an even pressure profile within the super high-rise building, the stair shall be either divided into sections not higher than 90 m or provided with a compensated pressurization system counteracting the stack effect. d) The pressure difference across a barrier must not result in door-opening forces that exceed the maximum force of 133 N. e) Supply air for the pressurization system shall be drawn directly from the external and its intake shall not be less than 5 m from any exhaust discharge openings. f) The air velocity at the supply air inlet for the stair pressurization system shall not exceed 5 m/s. g) Supply air for the pressurization system shall be drawn directly from the external and its intake shall not be less than 5 m from any exhaust discharge openings. h) The air velocity at the supply air inlet for the stair pressurization system shall not exceed 5 m/s. i) Outdoor overpressure relief damper system or pressure sensors with frequency Inverters shall be provided to control the overpressure in the pressurized stairwell. j) The pressurization system shall be automatically activated by the building fire alarm system. k) To ensure consistent air distribution throughout the staircase, it is recommended to place supply air outlets at every floor or alternate (one floor apart) level. In any case, supply air outlets should not be placed more than one floor level apart.

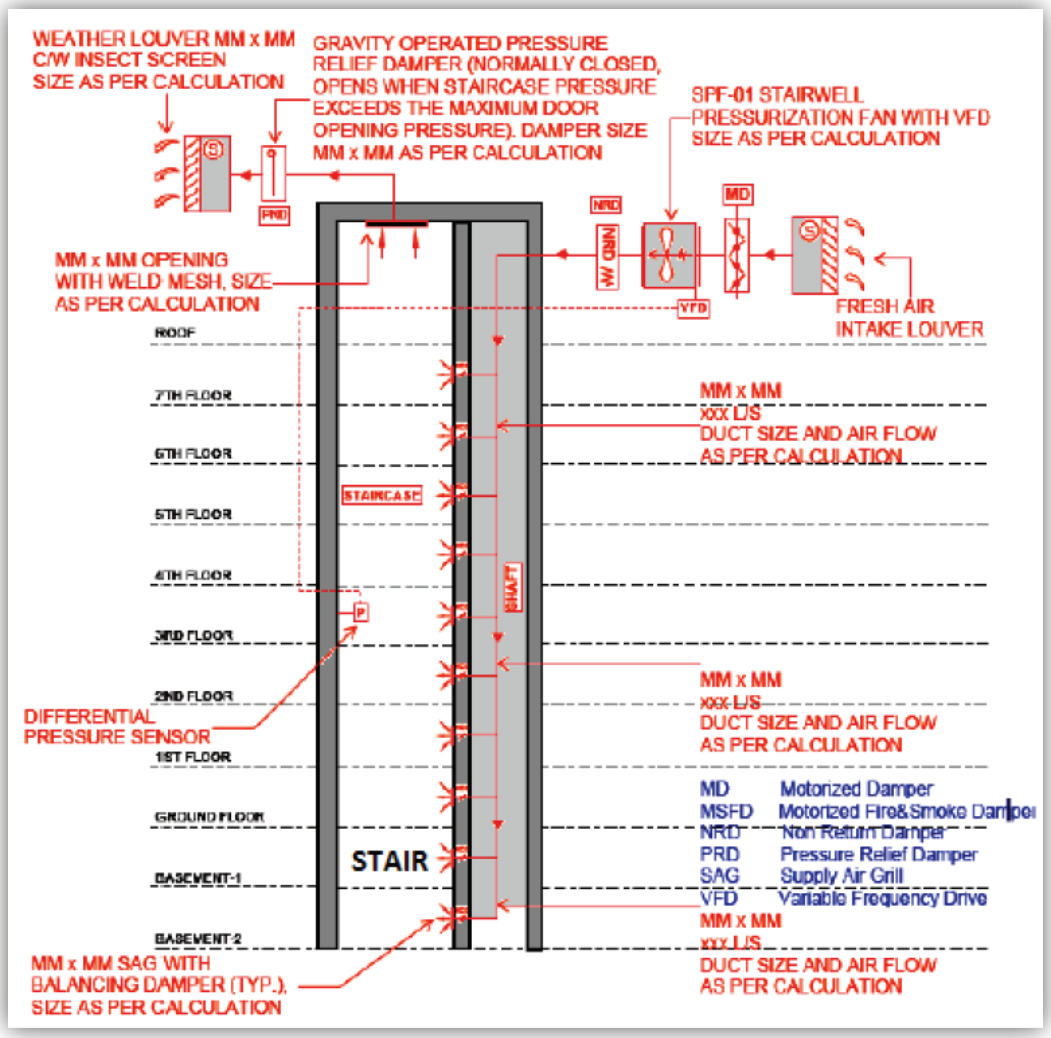


Figure: - E.06-F3: Stair Pressurization System general Schematic with supply air outlets at every floor

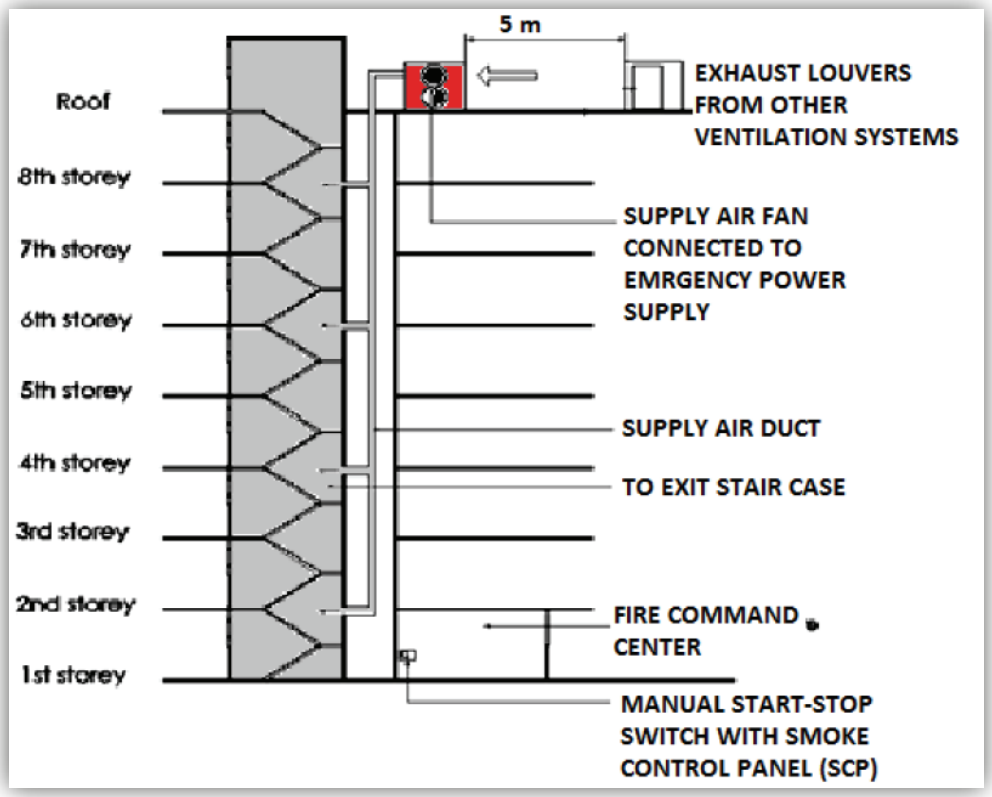


Figure: - E.06-F2: Stair Pressurization System general Schematic with supply air outlets at every alternate (one floor apart) level.

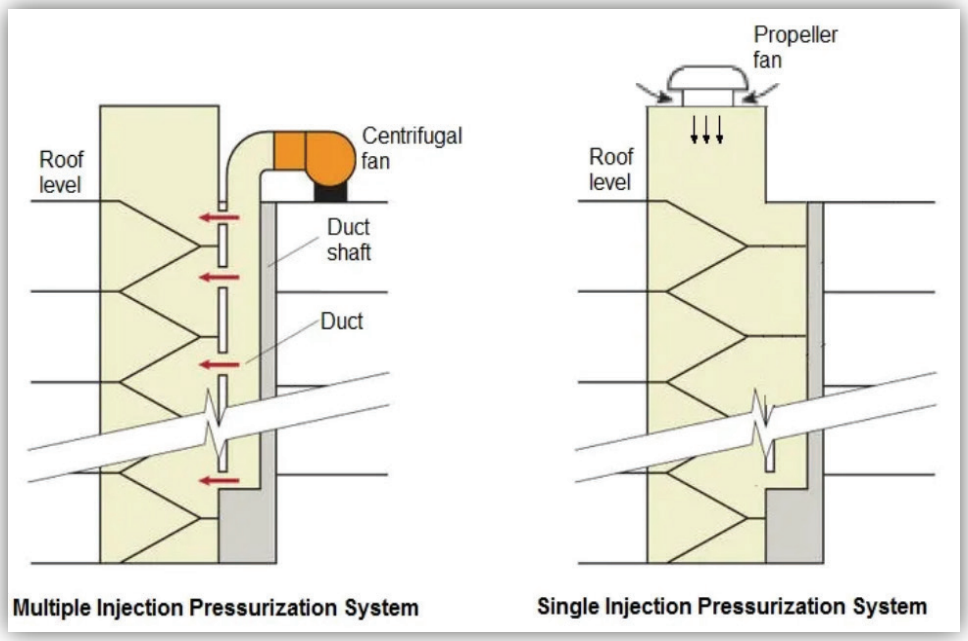


Figure:- E.06-F3: Stair Pressurization System methods

6.2 Atrium and Large Volume Smoke Control System

Atrium Smoke Control systems shall comply with the relevant general requirements for smoke control systems as per **Table:- E.06-T2**.

Table:- E.06-T2: Atrium and Large Volume Smoke Control System Requirements

SI.NO	ITEMS	REQUIREMENTS
1	**DESIGN CRITERIA**	a) Atrium spaces shall be protected by a smoke management system, designed in accordance with an engineering analysis and/or computational software to maintain tenable conditions (smoke interface layer) at a minimum height of 1830 mm above the highest walking surface open to the atrium or floor which serves as part of the means of egress, for a duration of 20 minutes or 1.5 times the calculated egress time, whichever is more. This system shall be engineered to effectively mitigate the stacking effect, ensuring efficient smoke evacuation and maintaining clear egress paths as per NFPA 92 requirements and shall be justified by engineering analysis b) The engineering analysis for the atrium smoke management system should include the following elements i) Fire dynamics ii) Fire size and location iii) Materials likely to be burning iv) Fire plume geometry v) Fire plume of smoke layer impact on means of egress vi) Tenability conditions during the period of occupant egress.

		vii) Response and performance of building systems, including passive barriers, automatic detection and extinguishing, and smoke control. viii) Response time required for building occupants to reach building exits, including any time required to exit through the atrium. ix) Smoke Stratification
2	**SMOKE SCREENS**	Smoke screens or listed smoke curtains shall be provided strategically to channel the smoke towards the atrium volume and towards the extract fans
3	**MAKE-UP AIR (REPLACEMENT AIR)**	a) The makeup air velocity shall not exceed 1.02 m/s where the makeup air could come into contact with the plume, unless a higher makeup air velocity is supported by an engineering analysis. b) Mechanical makeup air shall be designed to achieve 85% to 95% of the exhaust mass flow rate, not including the leakage through these small paths.
4.	**COMMUN-ICATING SPACES AND CONVENIENCE OPENINGS**	a) Convenience Openings and communicating spaces shall not require an atrium smoke management system. However, any of the following methods shall be implemented to prevent smoke spread to the communicating spaces or convenience openings.

		i. Maintaining the smoke layer interface at a level higher than that of the highest opening of the communicating space. ii. Providing a smoke barrier to limit the smoke spread into the communicating space. iii. Providing an opposed airflow through the opening to prohibit smoke spread into the communicating space.
5	**CLEAR LAYER**	The design smoke layer base shall be above the heads of people escaping beneath it. The minimum height shall be 1830mm.
6	**SYSTEM ACTIVATION**	Atrium Smoke Control Systems activation protocols and detection methods shall adhere to the following: a) Activation i. Upon activation of either the required automatic sprinkler system or smoke detectors, the Atrium Smoke Control Systems shall be independently activated, prioritizing the first trigger event. ii. Manual controls accessible to the fire department shall serve as an additional activation method. b) Detection For expansive spaces susceptible to smoke stratification, the detection system shall employ one of the following: i. Beam-type smoke detectors positioned at an upward angle to intercept the smoke layer, regardless of stratification levels. ii. Horizontal placement of beam-type smoke detectors at the ceiling, supplemented by additional detectors at alternate levels to cover unconditioned spaces.

		iii. Horizontal installation of beam-type smoke detectors beneath the anticipated lowest level of stratification. iv. Implementation of an aspiration (air sampling) smoke detection system. c) Control Panel: A Smoke Control Panel (SCP) located at the emergency command center shall facilitate manual initiation and cessation of the smoke management system.
7	**STAND-BY FAN**	Back-up (Stand-by) fans shall not be required for atrium and large volume smoke management systems.
8	**STAND-BY POWER**	Atrium smoke management system, Control panel, automatic Smoke curtains and fans shall be provided with the emergency power.

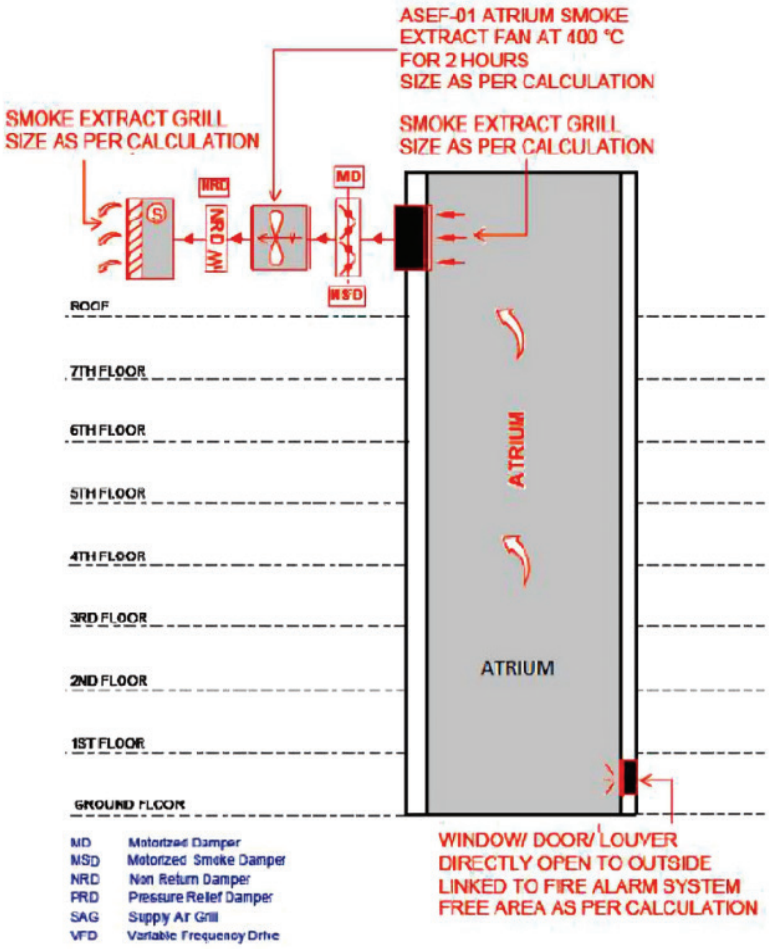


Figure:- E.06-F4: Atrium and Large Volume Smoke Control System

6.3 Corridor and Open Circulation Spaces Smoke Management System

Corridor and Open circulation spaces shall comply with the relevant general requirements for smoke control systems as per **Table:-E.06-T3.**

Table:- E.06-T3: Corridor and Open Circulation Spaces Smoke Purging System Requirements

SI.NO	ITEMS	REQUIREMENTS
1	**DESIGN CRITERIA**	a) Corridor smoke purge mechanical system shall be capable of achieving a minimum of 6 air changes per hour (6 ACH). b) Mechanical air supply inlets shall achieve a minimum 85% airflow rate of the extract. c) Extraction and makeup shall be from the fire floor. d) It is preferable for air supply inlets to have their lower part at least 300 mm above the floor and their highest part at most 1 m above the floor.

		e) Air supply inlets and smoke extraction outlets shall be distributed alternately, such that the horizontal distance between the supply and extraction, measured along the axis of circulation, should not exceed 15 m. f) Extract outlets shall not be located within 6 m of any exit stair or exits.
2	**GENERAL**	In high-rise and super high-rise buildings, the smoke exhaust shall not be at intermediate levels of the building. The smoke exhaust shall only be from roof, open to sky. Make up air is permitted to be drawn from intermediate levels.
3	**FANS**	Smoke extract fans shall comply with **Table:- E.03-T1** and shall be approved for effective operation at 400°C for 2 hour.
4	**MAKE-UP AIR (REPLACEMENT AIR)**	a) Air velocity through air supply inlets shall be lower than 5 m/s. b) Mechanical makeup air shall be less than the mass flow rate of the mechanical smoke exhaust. c) The makeup air shall not cause door-opening force to exceed allowable limits.
5	**EXTRACT OUTLET**	a) Smoke extraction outlets shall have their lower part at least 1.830 m above the floor and be located entirely within the higher third-part of the circulation; See ***Figure:- E.06-F4.*** for illustrations. Extraction outlet should have removable grille for easy actuator access from outer face. b) When a smoke extraction outlet is served by two air supply inlets, the distances between inlets and outlets must be equivalent.
6	**SYSTEM ACTIVATION**	a) The smoke purge systems shall be automatically activated by the Sprinkler Flow switch and/or smoke detection systems serving the corridor zone or open circulation area zone. b) The automatic activation of the purge system by means of a cross-zoned system (activation of two detection devices) shall be preferred and permitted. c) Means for the manual operation of the smoke purge system with the Smoke Control Panel (SCP) shall be provided at an approved location, preferably at the Emergency Command Center where applicable or next to the main fire alarm panel. d) Each smoke exhaust fan must be able to be shut down from the manual control location. e) The control devices must ensure fans startup, within a maximum delay of 30 seconds in order to allow the operation of all activated security devices (dampers and doors) ensuring smoke extraction and partitioning of the smoke extraction zone. f) The open or closed state of fans disconnecting switch must be monitored by SCP and shall be annunciated to the security station or a frequently supervised station. g) Each smoke exhaust fan must be able to be shut down from the manual control location. h) The control devices must ensure fans startup, within a maximum delay of 30 seconds in order to allow the operation of all activated security devices (dampers and doors) ensuring smoke extraction and partitioning of the smoke extraction zone.

		i) The open or closed state of fans disconnecting switch must be monitored by SCP and shall be annunciated to the security station or a frequently supervised station.
7	**USAGE OF HVAC SYSTEM**	a) The building HVAC system shall be permitted for corridor or open circulation areas smoke extraction provided that the system adheres to the provisions of Section 6.3. and such system does not interfere with the natural smoke movement of the area. b) HVAC system used for any smoke purging objective shall be designed and installed with dampers in ducting network such that the activation of the system shall not circulate the smoke back into the air supply network and into the building. c) Any HVAC system put to service for establishing pressure differences or as smoke purge system shall be designed through an engineering analysis.
8	**STAND BY FAN**	Back-up (Stand-by) fans shall not be required for corridor and open circulation area smoke management systems.
10	**STAND-BY POWER**	Corridor and open circulation area smoke management system, Control panel, automatic Smoke curtains, if any, Fans and related equipment shall be provided with an emergency power.

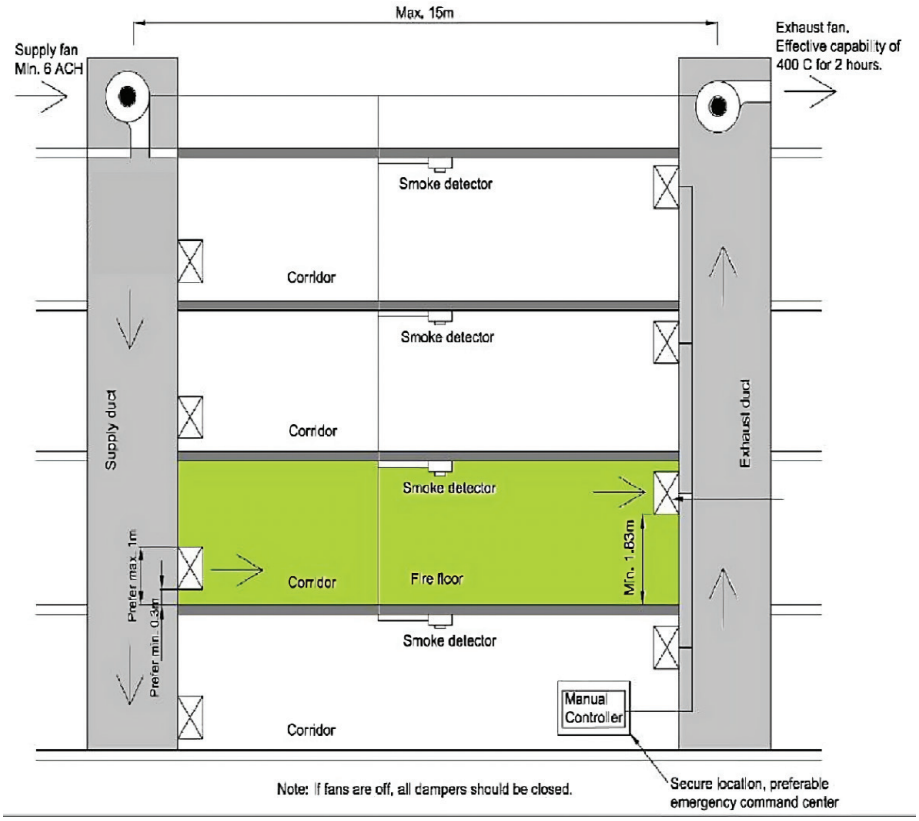


Figure:- E.06-F5: Typical Corridor and Open circulation area Mechanical Smoke Purge System

6.4 Lift Hoist way Pressurization System

Lift Hoist way pressurization systems shall comply with requirements mentioned on below **Table:- E.06-T4.**

Table:- E.06-T4: Lift Hoist way Pressurization System Requirements

SI.NO	ITEMS	REQUIREMENTS
1	**DESIGN CRITERIA**	a) The minimum pressure difference is intended to prevent smoke from entering the lifts. The minimum pressure difference shall be 12.5 Pa. b) Single injection for lift hoist way pressurization shall be limited to a maximum of 30 floors. c) Lift hoist way serving more than 30 floors in height (Super high-rise buildings) shall be provided with a multiple-injection system. d) For lift hoist ways pressurization systems in super high-rise buildings special design provision shall be made taking into consideration the stack effect and the piston effect influence on the pressure profile within the hoist way. This shall be determined either by analytical calculations, network modeling or CFD simulations. e) Outdoor overpressure relief damper system or pressure sensors with frequency Inverters shall be provided to control the overpressure in the pressurized stairwell. f) Lift hoist way pressurization shall not be required if enclosed with smoke partitions.
2	**GENERAL**	a) The maximum pressure difference across lift doors is based on concern about lift doors jamming shut in the closed position. The maximum pressure difference shall not exceed 75 Pa. However, this value shall be reviewed and agreed by the lift supplier in every project, where lift hoist way pressurization is provided. b) If elevators are to be used for evacuation, the lift hoistway pressurization should be accompanied with “Smoke Tight Lift Lobbies”.
3	**STAND BY FAN**	Back-up (Stand-by) fans shall not be required for Lift hoist way pressurization systems.
4	**STAN BY POWER**	The lift hoist way pressurization system fan shall be provided with an emergency power.

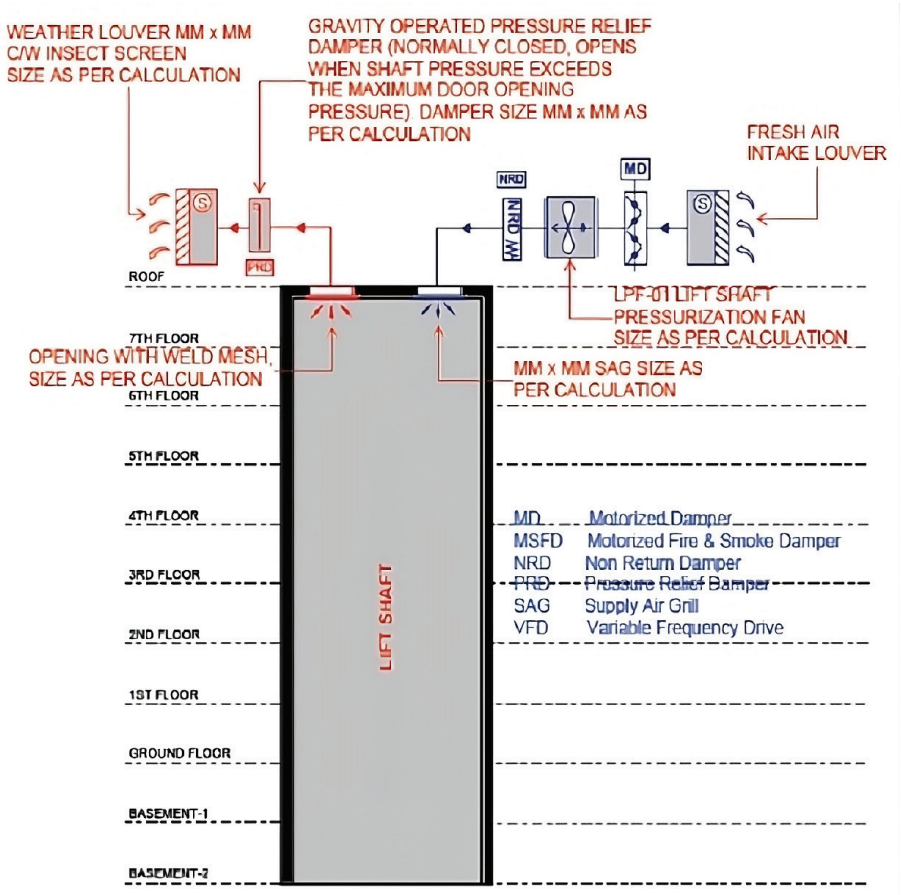


Figure:- E.06-F 6: Lift Shaft Pressurization System general Schematic

6.5 Underground Car Parking / Enclosed Parking Smoke Ventilation System

i. Underground or enclosed car parking is parking located below ground level or within structures, providing shelter and security for vehicles.

ii. Underground Car Parking / Enclosed Parking Smoke Ventilation System shall comply with requirements mentioned on below **Table:- E.06-T5**

Table:- E.06-T 5: Underground Car Park Smoke Ventilation System Requirements		
Sl.NO	**ITEMS**	**REQUIREMENTS**
1	**DESIGN CRITERIA**	a) The mechanical smoke purging system shall be designed to achieve 10 air changes per hour in a single smoke zone of not more than 3600 m^2, assuming a single smoke zone is active at any single point in time. b) Smoke zone areas can vary if justified by an engineering analysis. c) The capacity of the exhaust fan and any associated ducting should be calculated on the basis that the pressure close to the extract points or discharge points is equal to the external atmospheric pressure. d) Mechanical makeup air is permitted to be provided at a minimum rate of 85% of the extract either analytical calculations, network modeling

		or CFD simulations shall determine air via openings directly to the exterior of the building.
2	**GENERAL**	a) Makeup air must be sourced externally, ensuring it's drawn from outside the structure. The intake for makeup air should be located at least 5 meters away from any exhaust discharge openings b) Outlets for the supply air shall be adequately distributed over the area. c) Mechanical makeup air is permitted to be provided at a minimum rate of 85% of the extract air via openings directly to the exterior of the building. d) Make-up air shall not exceed an inlet velocity of 5 m/s. e) Sufficient makeup air shall be available for the natural vents. f) Makeup air shall be provided by either fans, openings to the outside leakage paths, or the combination thereof. g) Where mechanical make-up air is supplied, the supply points for the makeup air shall be located beneath the smoke layer interface. h) Where there is natural supply of air for areas, openings not less than 2.5 % of the floor area of such story, shall be considered as a satisfactory make-up air for the smoke purge system. i) However, such 2.5 % of the floor area openings shall be evenly distributed over the entire area. j) A jet fan system shall not be permitted in enclosed parking. This restriction is crucial for ensuring safety and compliance with regulations. k) Make-up air or replacement air shall not be required for single basement carparks, having an area less than 3600 m2. The driveways (Entry and Exit) shall be permanently open and provide for the required make-up air.

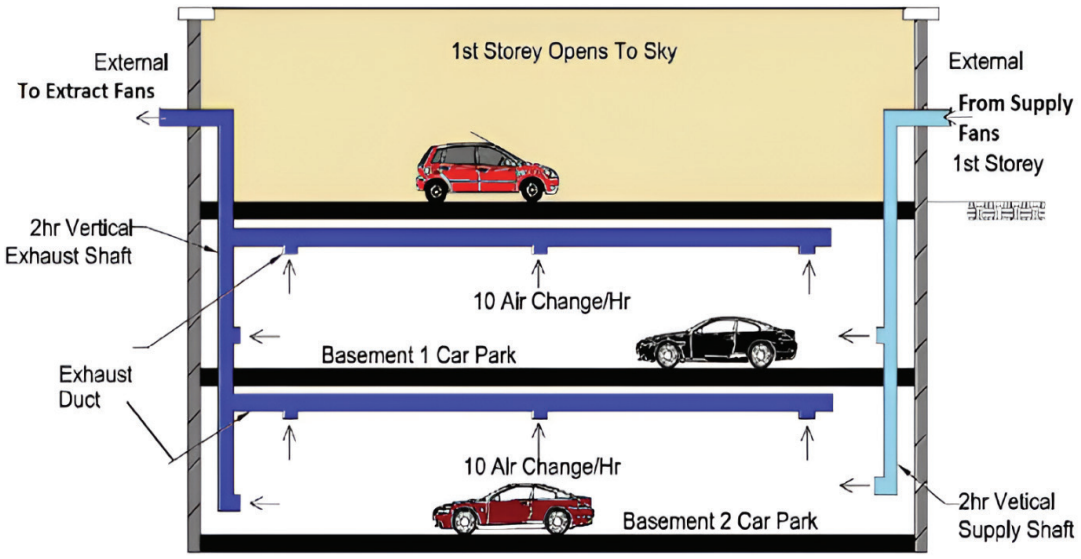


Figure:- E.06-F 7: Typical Mechanical Smoke Purging Using Dedicated Ducting

6.6 Open Car Park Smoke Ventilation System

Open Parking Smoke Ventilation System shall comply with requirements mentioned on below **Table:- E.06-T6.**

Table:- E.06-T6 Open Car Park Smoke Ventilation System Requirements

SI.NO	ITEMS	REQUIREMENTS
1	**DESIGN CRITERIA**	**"OPEN PARKING" HAVING A FLOOR AREA UP TO 4000 m2** a) Open parking complying with open parking regulation mentioned below, and having a total parking floor area of up to 4000 m^2 shall be provided with Jet fan system. b) Stairs at open parking buildings or structures having a height of more than 23 m from the fire access level, shall be provided with a stair pressurization system in accordance with Section 6.1 **"OPEN PARKING" HAVING A FLOOR AREA MORE THAN 4000 m2** c) Open parking complying with open parking regulation mentioned below and having a total parking floor area of more than 4000 m^2, shall be provided with either mechanical smoke purging system using ducting in accordance with Section 6.5. OR Jet fan system OR combination thereof as a hybrid system. d) Stairs at open parking buildings or structures having a height of more than 23 m from the fire access level, shall be provided with stair pressurization system in accordance with Section 6.1. e) Smoke management system zoning shall be permitted to be 4000 m^2.
2	**GENERAL**	a) Each parking level shall have permanent wall openings open to the atmosphere, for an area of not less than 0.4 m^2 for each linear meter of its two opposite exterior wall perimeters. b) Such openings shall be distributed uniformly over at least 40 percent of the perimeter surfaces of each floor, covering each of at least two opposing sides. c) Interior wall lines, column lines and obstructions shall be at least 20 percent open, with openings distributed evenly to provide ventilation. d) Any part of the carpark shall be located within 30 meters of a permanent natural ventilation opening on the perimeter surface to ensure effective ventilation. e) Staircase pressurization shall be provided for all the staircases which are not having openable window regardless of the building height.
3	**JET FAN DESIGN CRITERIA**	a) All jet fans shall be connected to the local jet fan control panel in groups of not more than 3 jet fans, by 120 minutes fire rated cabling in a zigzag configuration. No two consecutive jet fans in a straight line shall be wired in the same group. b) Each smoke control zone shall have its own jet fan system. The exhaust fan system in each zone should be designed to run in

		at least two parts, such that the total exhaust capacity does not fall below 50 % of the required rate of extract in the event
		of failure of any one part and that a fault or failure of the exhaust jet fan system in one zone will not affect the operation of the exhaust jet fan system in the other zones.
		c) The jet fans system design shall take into consideration the presence of any down-stand beams and other obstruction that are of depths of more than 1/10 of the floor to ceiling height of the volume so as to account for any resistance to airflow and turbulence. d) On activation of the jet fans system, the movement of smoke towards the extract/discharge point(s) should not adversely affect the means of escape and cause smoke to be blown into the egress areas. e) The operation of the jet fans system should be such that there are no stagnant areas where smoke can accumulate in the event of fire.



Figure:- E.06-F 8 – Buildings with open parking

6.7 Natural Ventilation System

The natural Ventilation System shall comply with the relevant general requirements for smoke control systems as per **Table:- E.06-T7.**

Table:- E.06-T7 Natural Ventilation System Requirements		
SI.NO	**ITEMS**	**REQUIREMENTS**
1	**DESIGN CRITERIA**	a) Provision of natural ventilation is required where forced ventilation is not applicable, to clear smoke accumulated during and post fire emergencies, and to mitigate issues such as dampness in spaces like offices, stairs, or corridors etc.

2	**OPENINGS**	a) Openings intended for natural venting shall be permanent fixed openings or an automatically operable, fixed opening or vent or window. b) Such an opening shall provide minimum 1 m^2 of open area. c) Where natural venting is serving the stair enclosure, it shall be located at the roof level of the stair core. d) Where natural ventilation is serving an open circulation area or corridor, the total area of openings, such as windows or
		vents, shall be equivalent to 15% of the floor area they are intended to ventilate. e) Such an opening shall be located on the external wall of the area to be ventilated. Openings shall be distributed evenly throughout the exterior wall such that no point in the area is more than 30 m, horizontally from the natural venting openings.
3	**GENERAL**	a) Such openings shall be clearly marked and labeled as "Smoke clearance openable windows". b) A natural exhaust system shall not be provided in the areas or zones provided with engineered smoke control systems or mechanical ventilation systems.

6.8 Mechanical Ventilation System for Fire Pump, Generator & fire command center room.

Mechanical Ventilation System shall comply with the relevant general requirements for as per **Table:- E.06-T 8.**

Table:- E.06-T 8: Mechanical Ventilation System Requirements

SI.NO	ITEMS	REQUIREMENTS
1	**DESIGN CRITERIA**	a) Provision of mechanical ventilation to enclosed spaces like Fire Pump room, Generator rooms and fire command center during fire emergencies to ensure proper ventilation requirements for firefighters. b) The system shall be designed to achieve not less than 3 ACH (air change hour) as occupant ventilation requirement. c) Makeup air for the system shall be drawn directly from the external, with the intake point not less than 5 m from any exhaust discharge openings. d) Makeup air shall not be drawn from adjoining areas, underground, basement, plant rooms or car park spaces. Should be through dedicated ducting or through external atmospheric opening.
2	**GENERAL**	a) The mechanical ventilation system shall be an independent system only exclusive to the particular area. b) Exhaust shall be directly to the exterior, through dedicated ducts or shafts and shall not be less than 5 m from any air intake openings. c) Additional ventilation requirement for diesel engine to be added as per diesel engine supplier recommendation to cater the combustion and diesel engine ventilation requirements.

		d) All equipment's related to Mechanical Ventilation System for Fire Pump room, Generator rooms & fire command center to be fire rated for 2 hours to ensure proper operation of fire emergencies

6.9 Ventilation System for Cooking Operations

Smoke Ventilation Systems for cooking operations shall comply with the relevant general requirements as per **Table:- E.06-T9.**

Ventilation system for cooking operation (Not applicable for residential building).

*This requirement does not apply to mobile or temporary cooking operations, as specified by NFPA 96.

Table:- E.06-T 9 Ventilation System for Cooking Operations Requirements

SI.NO	ITEMS	REQUIREMENTS
1	**DESIGN CRITERIA**	a) The cooking equipment used in processes and commercial kitchens produces smoke and grease laden vapors. Accumulation of these vapors in the exhaust equipment and ducting can be fuel for fires and needs to be adequately ventilated. b) Permitted Smoke Exhaust fans shall be capable of operating effectively at 400°C for 2 hours. c) The air velocity through any duct shall be not less than 152.4 m/min. d) Exhaust air volumes for hoods shall be of a sufficient level to provide for capture and removal of grease-laden cooking vapors.
2	**GENERAL**	a) Kitchen exhaust ducts shall be dedicated and shall not be shared or interact with any other smoke control, ventilation or HVAC systems. b) Exhaust ducts shall be constructed of and supported by carbon steel not less than 1.37 mm (No. 16 MSG) in thickness or stainless steel not less than 1.09 mm (No. 18 MSG) in thickness. c) Kitchen extract ducts shall be 2 Hours fire rated d) In kitchens where, vertical fire barriers are penetrated, the ducts shall be enclosed in a continuous enclosure extending from the first penetrated fire barrier and any subsequent fire barriers or concealed spaces to or through the exterior, to maintain the fire resistance rating of the highest fire barrier penetrated. e) The above-mentioned continuous enclosure provisions shall not be required where a field-applied or factory-built grease duct enclosure is protected with a listed duct-through-penetration protection system equivalent to the fire resistance rating of the assembly being penetrated and where the materials are installed in accordance with the manufacturer's instructions. f) Wiring systems of any type shall not be installed in ducts, unless listed with the system.

		g) A minimum of 500 mm separation distance shall be maintained between any combustibles and the heat source and extraction ducting.
3	**GREASE FILTERS**	a) Permitted grease filters, listed baffles, or other listed grease removal devices for use with commercial cooking equipment shall be provided. b) Grease filters shall be arranged so that all exhaust air passes through the grease filters. c) Grease filters shall be easily accessible and removable for cleaning. d) Grease filters shall be installed at an angle not less than 45 degrees from the horizontal.

		e) Mesh filters shall not be used, unless tested and is part of listed exhaust hood.
4	**DAMPERS**	a) A fire-actuated damper shall be installed in the supply air plenum at each point where a supply air duct inlet or a supply air outlet penetrates the continuously welded shell of the exhaust hood assembly. b) The fire damper shall be listed for such use or be part of a listed exhaust hood with or without an exhaust damper. c) The damper actuation device shall have a maximum temperature rating of 141°C.
5	**HOODS**	a) The hood or that portion of a primary collection means designed for collecting cooking vapors and residues shall be constructed of and be supported by steel not less than 1.09 mm (0.043 in.) (No. 18 MSG) in thickness, stainless steel not less than 0.94 mm (0.037 in.) (No. 20 MSG) in thickness, or other permitted material of equivalent strength and fire and corrosion resistance. b) All seams, joints, and penetrations of the hood enclosure that direct and capture grease-laden vapors and exhaust gases shall have a liquid-tight continuous external weld to the hood's lower outermost perimeter. c) Internal hood joints, seams, filter support frames, and appurtenances attached inside the hood shall be sealed or otherwise made grease-tight. d) Listed exhaust hoods with or without exhaust dampers shall be permitted to be constructed of materials required by the listing.

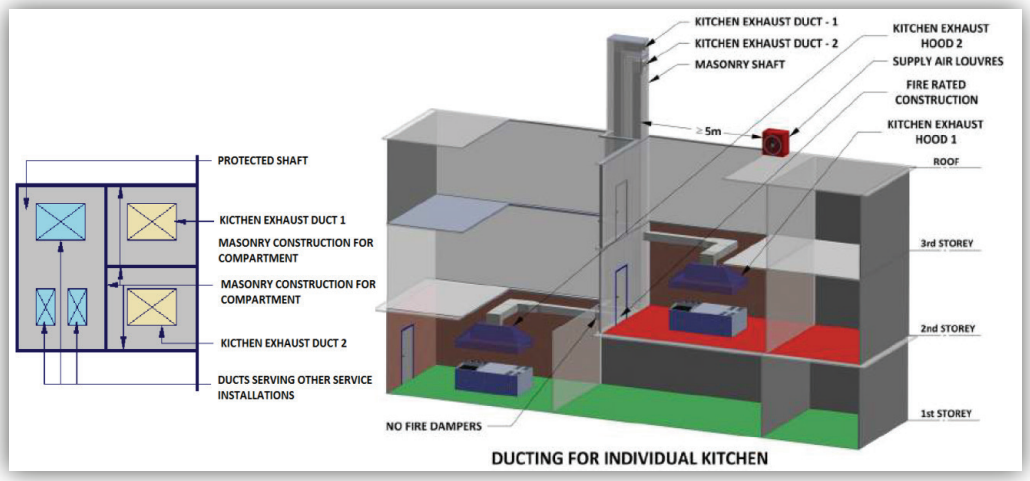


Figure:- E.06-F9 Separated Vertical Shaft for Kitchen Exhaust Ducts

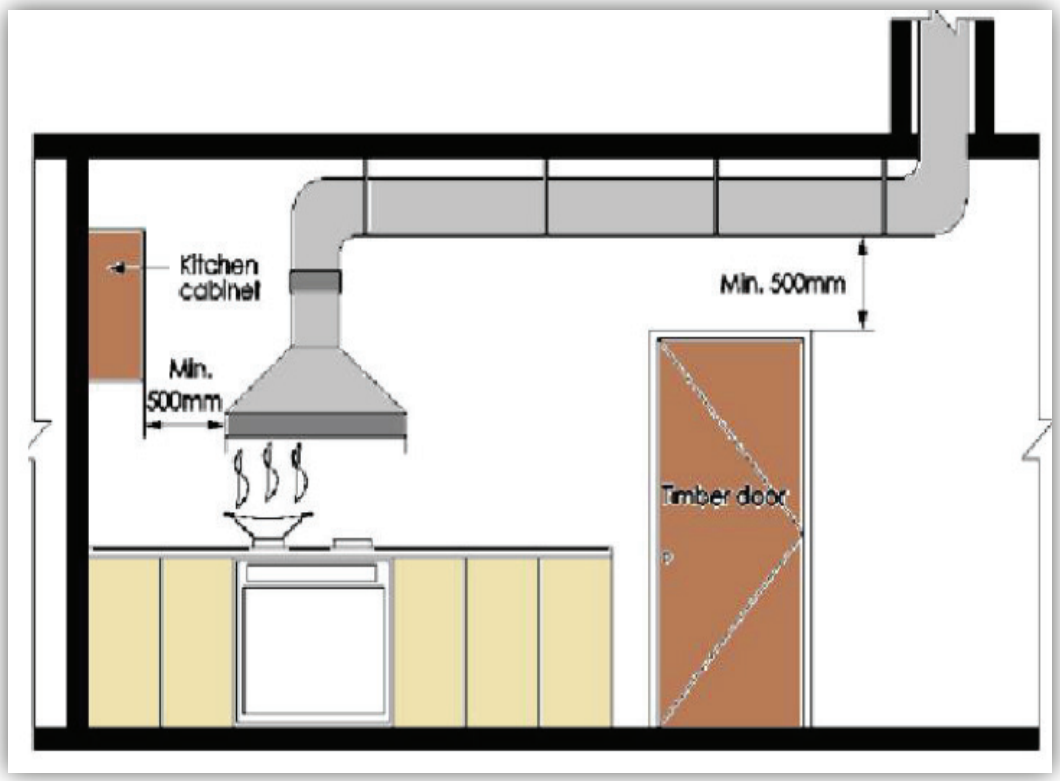


Figure:- E.06-F 10: Hood and heat source separation distance from combustible materials

6.10 Smoke Venting System Using Natural Vents on Roof.

Smoke venting systems using natural vents shall comply with the relevant general requirements for smoke control systems & **Table:- E.06-T 10.**

Table:- E.06-T 10: Smoke Venting System Using Natural Vents on Roof Requirements

SI.NO	ITEMS	REQUIREMENTS
1	**DESIGN CRITERIA**	a) Minimum 1% - 1.5% roof free opening area of the floor area they are serving to be considered as opening requirement.

Maximum distance of vent from any part of the volume	Minimum opening area of vent based on percentage of the floor area	Minimum opening area for make up air opening
18 meter	1% of the floor area	1.5 times of vent open area
21 meter	1.25 % of the floor area	1.5 times of vent open area
24 meter	1.5% of the floor area	1.5 times of vent open area

b) If the proposed area is more than one zone, natural ventilation can be designed in accordance with NFPA 204 requirements

		(D.7 Sizing of Vents), provided design is justified by an engineering or Computational Fluid Dynamics (CFD) analysis. c) Hurricane type smoke vents or vents without electrical power and inability to interface with Fire and Sprinkler systems shall not be acceptable for smoke venting purpose. d) Smoke vents shall be located on the roof, where smoke plume and reservoir are available vertically above the fire loads. e) Vents shall be automatically resettable after operation. f) Sufficient makeup air shall be available for the natural vents. g) In no case the distance between two vents shall exceed 4H, where H is the total floor to ceiling height of the volume. h) Alternatively, in an irregular vent plan, the distance between any point on the wall/partition and the nearest vent should not exceed 2.8H, where H is the total floor to ceiling height of the volume. i) Listed and permitted smoke curtains should be provided to enhance the performance of the natural smoke vents, where floor area exceeds 4000 m^2.

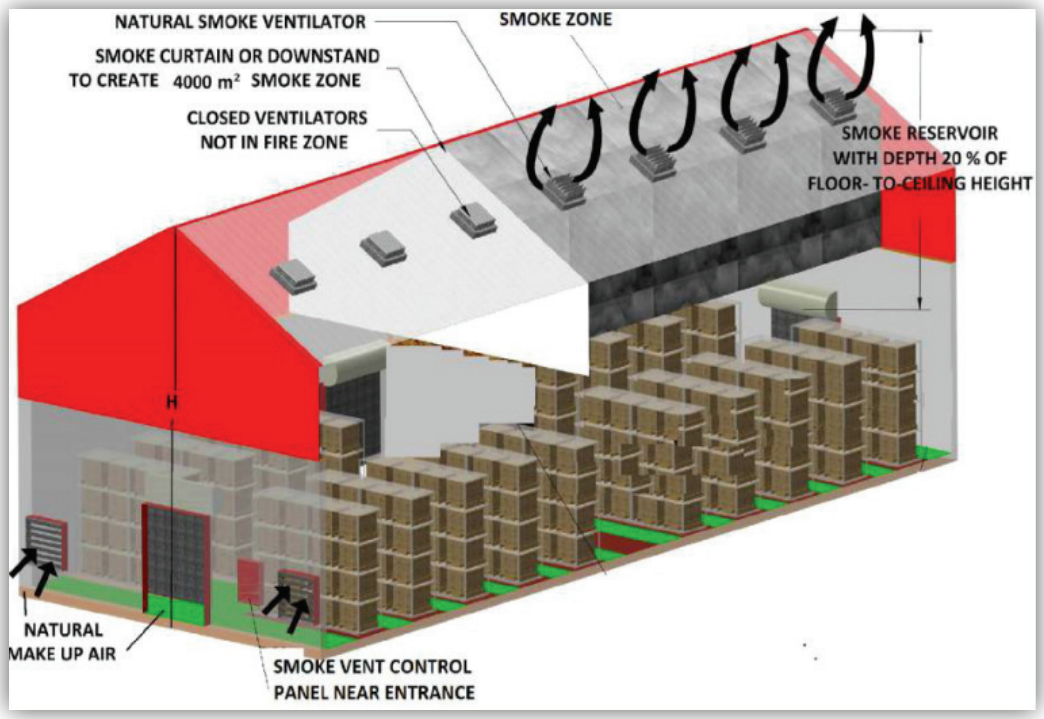
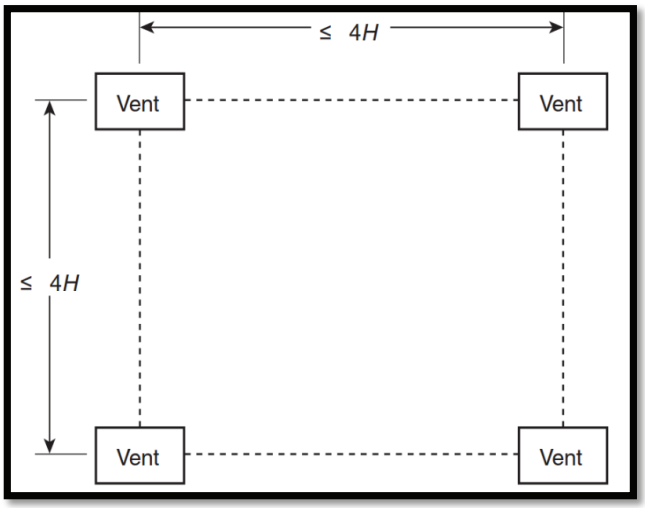


Figure:- E.06-F 11: Typical Natural Smoke Vent System arrangement



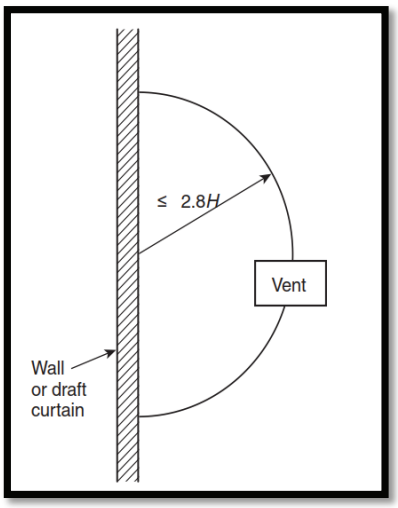


Figure:- E.06-F 12: Vent Spacing in Rectangular Matrix (plan view).

Figure:- E.06-F 13: Vent Location near a Wall or Draft Curtain (plan view).

6.11 Smoke Venting System Using Mechanical Exhaust Fans for Factories and Warehouses

Smoke venting systems using mechanical exhaust fans shall comply with the relevant general requirements for smoke control systems as per **Table:- E.06-T 11.**

Table:- E.06-T 10: Smoke Venting System Using Mech. Exhaust Fans for Factories and Warehouses

SI.NO	ITEMS	REQUIREMENTS
1	**DESIGN CRITERIA**	a) The mechanical smoke exhaust fans shall be designed to achieve 6 air changes per hour. b) Make-up air shall not exceed an inlet velocity of 5 m/s. c) Makeup air shall be provided by either fan, openings to the outside leakage paths, or the combination thereof. d) Where mechanical make-up air is supplied, the supply points for the makeup air shall be located beneath the smoke layer interface. e) Listed and permitted smoke curtains should be provided to enhance the performance of the natural smoke vents, where floor area exceeds 4000 m^2. f) Smoke exhaust fans shall be located on the roof, where smoke plume and reservoir is available vertically above the fire loads.

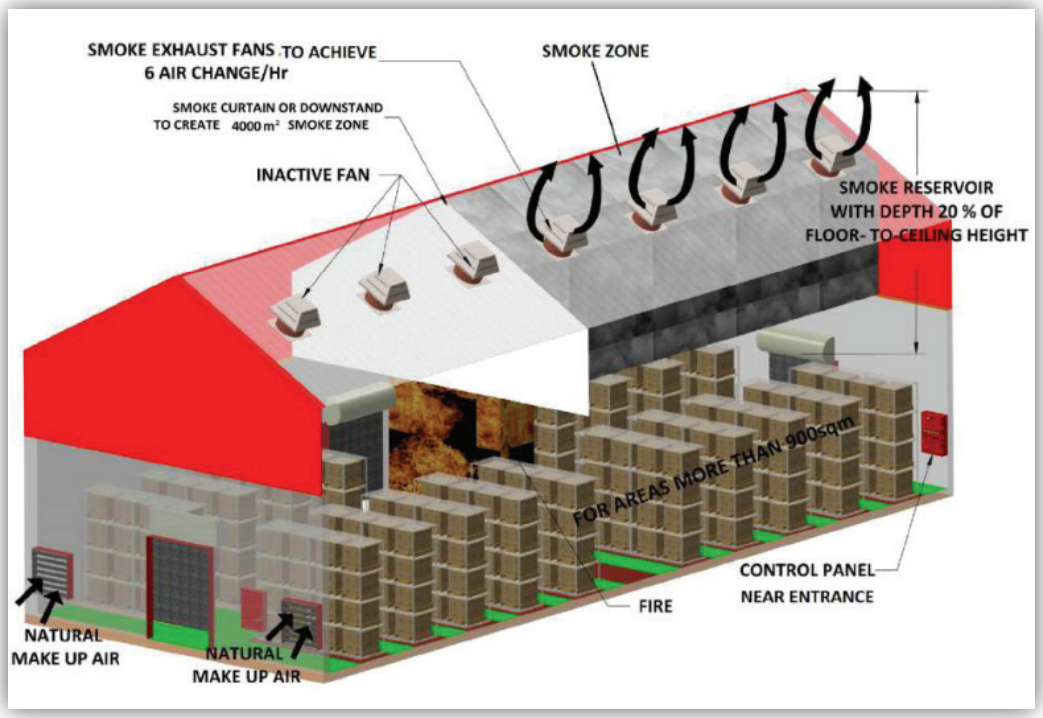


Figure:- E.06-F 14:Typical Mechanical Smoke Exhaust Fan System Arrangement

7.0 Application of Smoke Control and Smoke Management Systems

Smoke Control System Requirements at Various locations and occupancies are explained below.

7.1 Theater / Cinema area Smoke Management System

Theaters with legitimate stages shall comply with the relevant general requirements for smoke control systems as per **Table:- E.07-T1.**

Table:- E.07-T 1 Theater Smoke Management System Requirements		
SI.NO	**ITEMS**	**REQUIREMENTS**
1	**DESIGN CRITERIA**	a) Theaters with regular stages with area greater than 93 m² and legitimate stages shall be provided with an automatic smoke management system to provide a means of removing smoke and combustion gases directly to the outside in the event of a fire. b) The system equipment, fan wiring and ducts shall be located and protected to ensure a minimum of 20 minutes of operation in the event of activation. c) The smoke control system shall be designed to maintain the smoke level at not less than 1830 mm above the highest level of the theater seating or above the top of the proscenium opening where a proscenium wall and opening protection are provided. d) Mechanical air supply inlets shall achieve a minimum of 85% airflow rate of the extract. e) The makeup air velocity shall not exceed 1.02 m/s where the makeup air could come into contact with the plume unless a higher makeup air velocity is supported by an engineering analysis. f) The supply points for the makeup air shall be located beneath the smoke layer interface.
2	**GENERAL**	e) Regular stages with area greater than 93 m² and legitimate stages shall be provided with a fire curtain permitted and listed for 1-hour fire rating to separate the stages from rest of the seating area, during fire. f) Such fire curtain shall be activated by the sprinkler operation or the smoke detection from the stage zone.

7.2 Mall Smoke Management System

Mall smoke management shall comply with the relevant general requirements for smoke control systems as per **Table:- E.07-T2.**

Table:- E.07-T2: Mall Smoke Management System Requirements		
SI.NO	**ITEMS**	**REQUIREMENTS**
1	**GENERAL**	i. The mall shall incorporate a smoke management system designed to maintain tenable conditions, specifically ensuring that the smoke interface layer remains at a minimum height of 1830 mm above the highest walking surface open to the atrium or floor used as part of the means of egress. This requirement must be sustained for a duration of 20 minutes or 1.5 times the calculated egress time, whichever is longer. ii. In areas where atriums or large volumes are present within the mall, the smoke management system shall be designed in accordance with Section 6.2. iii. The minimum depth of the smoke layer shall be 20% of the floor-to-ceiling height, unless an engineering analysis utilizing full-scale data, scale modeling, or Computational Fluid Dynamics (CFD) modeling indicates otherwise. iv. The engineering analysis for the mall's smoke management system should encompass the following elements: a. Fire dynamics b. Size and location of the fire c. Combustible materials involved d. Geometry of the fire plume e. Impact of the fire plume or smoke layer on means of egress f. Tenability conditions throughout the occupant egress period g. Response and performance of building systems, including passive barriers, automatic detection, automatic suppression, and smoke control. h. Occupant response time to reach mall exits, accounting for any necessary passage through atriums or large volumes.
2	**DESIGN CRITERIA**	**i. MALL CIRCULATION AREA** a) Automatic smoke curtains or permanent down stands shall be installed strategically in open circulation areas as per the engineering analysis but not more than 122 m of travel distance. **ii. ATRIUM** a) The atrium shall be provided with an atrium smoke control in accordance with Section 6.2. **iii. ENCLOSED SERVICE CORRIDORS** a) Enclosed service corridors shall be provided with a corridor Smoke management in accordance with Section 6.3. **iv. ANCHOR STORES, HYPERMARKETS AND TENANT SPACES HAVING FLOOR AREA LARGER THAN 1000 m^2.** a) Tenant spaces having an area more than 1000 m^2 shall be provided with an independent and dedicated smoke management in accordance with Section 6.3.

		b) Such a smoke management system with 6 ACH, shall be restricted to a maximum zone areas of 2000 m^2. c) Such zoning of 2000 m^2 shall be permitted to be achieved by listed smoke curtains and/or permanent down stands, complying with 20% of the hazard height. d) Make-up air shall be permitted to be withdrawn from the mall. e) Listed and permitted smoke curtains shall be provided to isolate the tenant space from the mall during fire scenario in the tenant space as well as the mall. **v. COMMUNICATING SPACES** a) Communicating spaces shall not be required to have dedicated smoke control systems. However, a smoke containment approach shall be implemented in accordance with section 6.2. **vi. LIFT & STAIR PRESSURIZATION** **Staircase and lift shafts to be pressurized as per section 6.1 & 6.4**

7.3 Tunnels

Tunnels shall be provided with smoke control systems in accordance with NFPA 92, NFPA 409, NFPA 130, NFPA 502, ASHRAE, SFPE guidelines etc.

Table:- E.07-T3 Tunnel Smoke Management System Requirements		
SI.NO	**ITEMS**	**REQUIREMENTS**
1	**DESIGN CRITERIA**	a) A jet fan system OR a mechanical smoke purging system using dedicated ducting OR other systems or combinations of systems shall be permitted, where justified by an engineering analysis and CFD modeling based on the actual fire load consideration. b) Natural ventilation in shall be acceptable, Fire safety engineering analysis conducted to demonstrate that the natural smoke ventilation system is effective to maintain tenable conditions for evacuation as stipulated in NFPA 502, NFPA 130. c) Natural smoke ventilation concept developed using CFD modelling and evacuation simulation based on the strategic natural louvre openings and the exit/entry points of tunnel to facilitate the smoke exhaust. d) Cross passage shall be pressurized as per section 6.1. e) Critical velocity shall be maintained to avoid improper extraction and to avoid back layering of smoke. f) Jet fan shall be reversible type. g) Longitudinal ventilation using jet fan should consider 10% redundancy or 2 jet fans whichever is the greater. h) Assumed destruction of fans due to fire.

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<tr><th>Fire Size (MW)</th><th>Distance Upstream of Fire (m)</th><th>Distance Downstream of Fire (m)</th></tr>
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<td>ROAD TUNNEL</td>
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i. GENERAL
a) Ventilation is necessary in most road tunnels to limit the concentrations of contaminants to acceptable levels within the traveled roadway.
b) Ventilation systems can also be used to control smoke and heated gases that are generated during a tunnel fire emergency.
c) The intent of the Tunnel Smoke control shall be to provide an evacuation path for motorists who are exiting from the tunnel and to facilitate fire-fighting operations.
d) Smoke management Systems, other than using jet fan systems, shall be installed through a fire engineering analysis, demonstrating the efficiency and fulfillment of the above-mentioned intent.

ii. TUNNELS WITH BIDIRECTIONAL TRAFFIC
a) In tunnels with bidirectional traffic, where motorists can be on both sides of the fire site, the following objectives shall be met.
b) Smoke stratification shall not be disturbed.
c) The longitudinal air velocity shall be kept at low magnitudes.
d) Smoke extraction through ceiling openings or high openings along the tunnel wall.
e) (s) is effective and shall be considered.

iii. TUNNELS WITH UNIDIRECTIONAL TRAFFIC
In tunnels with unidirectional traffic, where motorists are likely to be located upstream of the fire site, the following objectives shall be met.
a) Prevent a backlayering by producing a longitudinal air velocity that is greater than the critical velocity in the direction of the traffic flow.
b) Avoid disruption of the smoke layer initially by not operating jet fans that are located near the fire site. Operate fans that are farthest away from the site first.
c) Maximize the exhaust rate in the ventilation zone that contains the fire and minimize the amount of outside air that is introduced by a transverse system.
d) Create a longitudinal airflow in the direction of traffic flow by operating the upstream ventilation zone(s) in maximum supply and the downstream ventilation zone (s) in maximum exhaust.
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		iv. ROAD TUNNELS HAVING TOTAL LENGTH OF LESS THAN 90 m. a) Natural ventilation in accordance with either Section 6.10. OR Section 6.7. shall be acceptable. b) Natural ventilation utilizing the tunnel openings shall be acceptable. c) A jet fan system shall not be mandatory. **v. ROAD TUNNELS HAVING TOTAL LENGTH OF MORE THAN 90 m.** a) A jet fan system, shall be provided for the entire tunnel. Other systems or combinations of systems shall be permitted, where justified by an engineering analysis and CFD modeling.
3	**RAIL TUNNEL**	**i. RAIL TUNNELS HAVING TOTAL LENGTH OF LESS THAN 90 m** a) Natural ventilation in accordance with either Section 6.10. OR Section 6.7. shall be acceptable. b) Natural ventilation utilizing the tunnel openings shall be acceptable. c) A jet fan system shall not be mandatory. **ii. RAIL TUNNELS HAVING TOTAL LENGTH OF MORE THAN 90 m.** a) A jet fan system shall be provided for the entire tunnel. OR a mechanical smoke purging system using dedicated ducting shall be provided. b) Other systems or combinations of systems shall be permitted, where justified by an engineering analysis and CFD modeling.
4	**SERVICE TUNNEL**	**i. SERVICE OR CABLE TUNNELS OF ANY LENGTH.** a) A mechanical ventilation system in accordance with Section 6.8., shall be provided. b) Natural ventilation utilizing the tunnel openings shall be acceptable, where the tunnel length is less than 90 m. c) A jet fan system OR a mechanical smoke purging system using dedicated ducting OR other systems or combinations of systems shall be permitted, where justified by an engineering analysis and CFD modeling.

7.4 One Unit Responsibility

Under One Unit Responsibility permitted, Smoke Management System Specialist Contractor shall supply complete equipment's involved, and accomplish the installation. The Specialist Contractor responsibility to deliver Undertaking to General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain as part of documentation during system commissioning and acceptance.

This "smoke management system Unit Performance" shall be declared by a single entity as having the "Unit Responsibility". General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain designates the permitted Smoke Management System Specialist Contractor as such "Unit Responsibility Holder" and the Smoke Management System Specialist Contractor shall declare such unit responsibility in an undertaking and shall

be submitted to General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain as part of documentation during system commissioning and acceptance.

All the smoke management design drawings to be stamped by unit responsibly contractor prior to the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain submission. Such unit responsibly contractor shall have General Directorate of civil defense approval for supply and installation of smoke management equipment's.

One-unit responsibility offers several benefits:

Table:- E.07-T4 Unit Responsibility Benefits

SI.NO	ITEMS	
1	**ONE UNIT RESPONSIBILITY**	a) **Clear Accountability:** Having one unit responsible for the smoke ventilation system ensures clear accountability. This unit can oversee the design, installation, commissioning, and maintenance of the system, reducing the likelihood of misunderstandings or gaps in responsibility. b) **Efficient Decision**: Making for system sequence of operation: Centralizing responsibility allows for more efficient decision-making processes. Decisions related to system design, equipment selection and scheduling can be made promptly by the responsible unit, avoiding delays and conflicts that may arise from multiple parties. c) **Consistency and Standardization:** A unified approach to smoke ventilation ensures consistency and standardization across all aspects of the system. This includes design criteria, performance specifications, installation practices, and maintenance procedures, promoting reliability and effectiveness. d) **Comprehensive System Integration:** When one unit oversees the entire smoke ventilation system, it can better ensure comprehensive integration with other building systems, such as fire detection, alarm, and suppression systems. This integration enhances overall safety and functionality. e) **Quality Assurance:** The responsible unit can implement quality assurance measures throughout the project lifecycle, including design reviews, inspections, testing, and documentation. This helps ensure that the smoke ventilation system meets regulatory requirements, industry standards, and performance expectations. f) **Single Point of Contact for Maintenance and Support:** After installation, having one unit responsible for ongoing maintenance and support simplifies the process for building owners or facility managers. They have a single point of contact to address any issues, schedule routine inspections, and obtain technical assistance as needed.

Overall, assigning one-unit responsibility for the smoke ventilation system promotes efficiency, accountability, and effectiveness throughout the project lifecycle, from design and installation to operation and maintenance.

7.4.1 Smoke Control System Requirements at Various other Occupancies in accordance with **Table:- E.07-T5.**

Table:- E.07-T5 Smoke Control systems requirements at various occupancies

Smoke Control System Requirement at Various Occupancies													
Occupancy Classification		Building Configuration		Ventilation System in Smoke proof Enclosure		Mechanical Ventilation, Smoke – Heat Ventilation Exhaust System							
		Max Area (Sqm)	Building height from the fire access level Height (m)	Stair pressurization	Elevator pressurization	Carpark Ventilation	Fire pump Room	Generator Room	Fire Command Center	Atrium, Communicating Space	Exit Corridors / Service Corridor	Remark
Residential, Commercial, Hotel, Labor Accommodation, Business etc	Low & Mid Rise Buildings	NA	≤ 23 M	NR	NR	R	R	R	NA	NR	NR	Refer Note -1
	Highrise Buildings	NA	≥23m & ≤ 90m	R	R	R	R	R	R	R	R	
	Super Highrise Buildings	NA	≥ 90m	R	R	R	R	R	R	R	R	Refer Note -2
School		NA	Any Height	R	R	R	R	R	R	R	R	Refer Note -3
Hospital		NA	Any Height	R	R	R	R	R	R	R	R	Refer Note -4
Malls		NA	Any Height	R	R	R	R	R	R	R	R	
Open Office		NA	Any Height	Open plan office spaces shall not be required to have smoke control systems. However, where exterior façade is accessible, an automatic openable ventilation panel system in accordance with Section 6.7. shall be provided for smoke clearance. Such windows shall be clearly marked as “smoke clearance openable windows”.								

Exhibition Center, Assembly Halls, Sports Halls, Auditorium, Indoor Stadium	≥ 2000 m^2	Any Height	A dedicated mechanical smoke purge system shall be provided. The smoke purge system shall be permitted to provide 6 air changes per hour. Where exterior façade or roof is accessible and justified by an engineering analysis, a natural ventilation system, in accordance with Section 6.7 shall be permitted.	
Factories and Warehouses	< 230 m^2	Any Height	Roof Ventilation system in accordance with Section 6.10. shall be provided. Fresh air from the unit entrances and openings shall be sufficient for the make-up or replacement air.	
	≥230 m^2 & ≤ 900 m^2	Any Height	Roof Ventilation system in accordance with Section 6.10. shall be provided. In addition to the fresh air from the unit entrances and openings, make-up air fans shall be provided. OR the sufficient replacement air opening area to the exterior of the perimeter of the facility shall be provided.	
	≥901 m^2 & ≤ 2000 m^2	Any Height	Roof Ventilation system in accordance with Section 6.10. shall be provided. OR Mechanical roof exhaust fans in accordance with Section 6.11 shall be designed to achieve 6 air change per hour shall be provided. In addition to the fresh air from the unit entrances and openings, make-up air fans shall be provided. OR the sufficient replacement air opening area to the exterior of the perimeter of the facility shall be provided.	
	> 2000 m^2	Any Height	Roof Ventilation system in accordance with Section 6.10. shall be acceptable where justified by the engineering analysis of wind and temperature effects on the proposed system. OR Mechanical roof exhaust fans in accordance with Section 6.11. shall be provided. In addition to the fresh air from the unit entrances and openings, make-up air fans shall be provided. OR the sufficient replacement air opening area to the exterior of the perimeter of the facility shall be provided.	

Aircraft Hangers	NA	Any Height	Aircraft Hangers shall follow the ventilation requirements in accordance with NFPA 409. Draft curtains shall be required in Group I hangers. Draft curtains shall be required in Group II hangers, only where foam – water deluge sprinkler systems are provided. Draft curtain areas shall be around each roof / ceiling fire suppression system and subdivided such that a single draft curtain area shall not exceed 697 m^2 (7500 ft^2). Where provided, draft curtain shall be extended down from the roof or ceiling of aircraft storage and servicing areas not less than one – eighth of the height from the floor to the roof or ceiling. Under curved or sloping roofs extending to grade level or close to grade level, draft curtains need not be continued below 4.8m (16 ft) from the floor.	
Cold store	NA	Any Height	The cold store void area must have a roof ventilation system in accordance with Section 6.10 . OR Mechanical roof exhaust fans in accordance with Section 6.11 shall be designed to achieve 6 air change per hour. However, no smoke management system is required inside the cold store.	
Hot kitchen	NA	Any Height	Ventilation requirements specified in **Section 6.9** must be followed.	
Hazardous and Flammable Materials (Hazmat)	NA	Any Height	Ventilation requirements specified in **Section F, Chapter 01 of the Preventive Requirements for Hazardous Materials** must be followed.	

Note -1 : Enclosed corridors in lowrise and midrise buildings, having a circulation length of excess of 60 m such as in covered mercantile spaces, staff accommodations, labour accommodations, residential buildings, office buildings and where exterior façade or roof is accessible, natural ventilation in accordance with Section 6.7 shall be provided. However, fire rating of the walls shall be ensured.

Note -2: Ventilation System in the building shall be divided into sections where stair shafts separated.

Note -3: Enclosed sports hall and auditoriums with legitimate stage or having more than 2000 m^2 , dedicated smoke purging system with 6 air change per hour extract and 85% make up shall be required.

Note -4: Every hospital floor shall have a minimum of two smoke partitions.

Note -5: Lift hoistway pressurization shall not be required if enclosed with smoke partitions.

Abbreviations : -

ACH : - Air change per hour
R : - Required
NR :- Not Required
NA :- Not Applicable

8.0 Design, Installation, Inspection, Acceptance and Maintenance of Smoke Control Systems

8.1 Design/Specification and Submittals

8.1.1. Design, Specifications and Submittals to General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain for permitted shall be the main consultant's responsibility. The consultant shall have competent and knowledgeable personnel to understand the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain requirements and codes and standards.

8.1.2. It is the consultant's responsibility to appropriately select the smoke control, smoke containment or smoke management systems, suitable for the building, life safety and property protection.

8.1.3. Design submittals shall be complete with design criteria, design objective, calculations, engineering analysis, equipment specifications and riser diagrams with layouts and schematics in compliance with this chapter.

8.1.3. Design submittals shall be complete with design criteria, design objective, calculations, engineering analysis, equipment specifications and riser diagrams with layouts and schematics in compliance with this chapter.

8.1.4. Under One Unit Responsibility Permitted Smoke Management System Specialist Contractor shall supply complete equipment's involved, and accomplish the installation. The Specialist Contractor responsibility to deliver Undertaking to General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain as part of documentation during system commissioning and acceptance.

8.1.5. This "smoke management system Unit Performance" shall be declared by a single entity as having the "Unit Responsibility". General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain designates the permitted Smoke Management System Specialist Contractor as such "Unit Responsibility Holder" and the Smoke Management System Specialist Contractor shall declare such unit responsibility in an undertaking and shall be submitted to General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain as part of documentation during system commissioning and acceptance.

8.1.6. All the smoke management design drawings to be stamped by unit responsibly contractor prior to the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain submission. Such unit responsibly contractor shall have civil defense approval for supply and installation of smoke management equipment's.

8.2 Installation

8.2.1. The installation of smoke control systems shall be carried out by the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted smoke control contractors under the supervision of Consultant.

8.2.2. The installation contractor shall not commence work on site without receiving General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain stamped and permitted drawings from the Consultant.

8.2.3. It is contractor's responsibility to adhere to consultant's General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted drawings and the manufacturer's installation guidelines and specifications.

8.2.4. The consultant shall ensure that the smoke control system installation complies with the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted drawings and specifications.

8.3 Inspection and Acceptance

8.3.1. Inspection and acceptance shall be the main consultant's responsibility.

8.3.2. Ducting shall be inspected and certified by the ducting manufacturer or supplier. The consultant shall sign off the ducting installation based on the manufacturer or supplier's onsite ducting certification.

8.3.3. The main consultant shall inspect the contractor's work during installations and ensure that intended pressure differences, door opening forces, air velocities, make-up air velocities, extract rate, duct routing, clear head rooms etc. follow this chapter and the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted drawings.

8.4 Inspection and Maintenance

8.4.1. The building owner, his appointed representative and the facility management shall be responsible to ensure that the facility smoke management system performs as intended, in compliance with this chapter. The consultant, the contractor and the owner representative shall jointly sign off the acceptance of the system.

8.4.2. It is the owner's responsibility to ensure that the smoke control systems are inspected regularly and maintained in accordance with **Sub Section 8** of this chapter.

9.0 Acceptance and Maintenance of Smoke Control Systems

9.1 Pressurization Systems - Acceptance Test and Maintenance

9.1.1 Pressurization systems for Stairs, lift hoist way lobbies, vestibules, corridor etc. shall be tested and maintained in accordance with **Table:- E.09-T1** for acceptance.

Table:- E.09-T1 Acceptance Test for Stair Pressurization Systems

SI.NO	ITEMS	REQUIREMENTS
1	**ACCEPTANCE TEST**	**i. GENERAL** i. The pressurization System acceptance testing shall demonstrate that the final integrated smoke-control system installation complies with the specific design and is functioning as intended and that its operating parameters comply with the design objectives defining pressure differences, air velocities and door opening force. ii. Pressurization systems shall prove that the system can be activated either manually or automatically, where applicable, by the building fire alarm system, that all components are placed in the appropriate operating modes in accordance with the control matrix and that the design objectives are met. iii. In addition, the acceptance testing shall enable to evaluate potential interactions that can take place between different smoke-control systems and components installed in the buildings. iv. Prior to the acceptance testing, all building equipment shall be placed in the normal operating mode, including equipment that is not used to implement smoke control. v. The following four acceptance tests shall be carried out. a. Activation of pressurization system b. Pressure difference test c. Air velocity test d. Door opening force test **ii. ACTIVATION OF PRESSURIZATION SYSTEM** i. Regardless of the activation methods mentioned below, these tests shall demonstrate that the pressurization system can be activated in case of a fire and is capable to operate in accordance with the specific building design. a. Activation by the building Fire Detection and Alarm System: This test shall be to operate the automatic fire detection system (smoke detector) by introducing smoke into the

		detector head. This shall in turn operate the central fire alarm panel, thus activating the pressurization system. b. Activation by Manual Switches: This test shall be to activate pressurization system by means of manual switch at the Smoke Control Panel (SCP). **iii. PRESSURE DIFFERENCE TEST** i. This acceptance test shall measure pressure differences across the closed door separating a pressurized and an unpressurized space and to determine the pressure distribution (field) within the pressurized space. The test(s) shall be carried out as follows. a. Initiate the pressurization system either automatically or manually. b. Close all relevant doors. c. Measure pressure differences across the closed door separating a pressurized and an unpressurized space on at least 3 lowest and 3 top floors of the building. If the vertical distance between floors where measurements were carried out exceeds 6 floors, additional measurement on one of the middle floors shall be carried out. d. Additional pressure difference measurements shall be carried out on floors with different air release paths. These readings shall be taken using a calibrated manometer, with the appropriate tube connections. ii. The calibration of all test equipment shall be such that the measurements are accurate to at least 5 %. iii. Each pressure difference reading shall be continuously taken and logged for at least 10 seconds. iv. Pressure differences measured relative to this acceptance test shall comply with specific design pressure differences. v. The design objective requirement is considered to be fulfilled if the measured values of pressure differences deviate less than 10 % of the design value. vi. For the super high-rise buildings it is recommended to carry out pressure differences measurements on all building floors. **iv. AIR VELOCITY TEST** i. This acceptance test shall measure the air velocity through an open door separating a pressurized and an unpressurized space. The measurement of the flow velocity through the relevant doors shall be taken with all other doors open or closed in accordance with the specific design assumptions. ii. The test(s) shall be carried out as follows,

		a. Initiate the pressurization system either manually or automatically. b. Open or close all relevant doors. c. Measure air velocity through the relevant door. d. For each door, at least 8 measurements shall be taken, uniformly distributed over the doorway, to establish an accurate air velocity. Calculate the mean of these measurements or alternatively move an appropriate measuring device steadily over the cross section of the open door and record the average air velocity. iii. These measurements shall be taken with an open-air release path consequently on following floors, in order to determine if the air release system has been properly designed and balanced. iv. These readings shall be taken using a calibrated anemometer. v. The calibration of all test equipment shall be such that the measurements are accurate to at least 5 %. vi. Air velocities measured relative to this acceptance test shall comply with specific design air velocities. vii. The design objective requirement is considered to be fulfilled if an average value of air velocity is not less than 90 % of the design value. viii. For super high-rise buildings it is recommended to carry out air velocity measurements on all building floors. **v. DOOR OPENING FORCE TEST** i. This acceptance test is to measure the door opening force on the doors between the pressurized and unpressurized spaces. ii. The test(s) shall be carried out as follows. a. Measure door-opening force without the pressurization system operating. b. Close all relevant doors c. Initiate the pressurization system operation either manually or automatically. d. Actuate the pressure differential system. e. Fasten the end of the force-measuring device (e.g. a spring balance) to the door handle, on the side of the door in the direction of opening, release any latching mechanism, if necessary holding it open. f. Pull on the free end of the force-measuring device, noting the highest value of force measured as the door opens. g. Measure door-opening force at all doors located within the escape route. h. For each door take at least 3 measurements and calculate the mean of these measurements.

		iii. These readings shall be taken using a calibrated dynamometer. iv. The calibration of all test equipment shall be such that the measurements are accurate to at least 5 %. Door opening forces measured relative to this acceptance test shall comply with specific design door opening forces and in particular shall not exceed the maximum allowable door opening force of 133 N The door opening force measurements shall be taken for all doors located **within the** escape routes
2	**MAINTENANCE OF PRESSURIZATI-ON SYSTEMS**	**1. GENERAL** I. Maintenance is a combination of all technical, administrative and managerial actions taken with the objective of ensuring the specified function of the pressurization system. II. Pressurization systems, including the smoke detection system or any other type of fire alarm system used, the Smoke Control Panel (SCP), the fans, the equipment power supply arrangements and the automatically operated ventilation equipment, shall be subject to a regular maintenance and functional testing procedure. III. The consultant shall be responsible for the design of the system and shall provide the Owner and the facility management with a maintenance check list. Records shall be kept of all maintenance and functional testing by the facility management. IV. The entire pressurization system shall be properly inspected, serviced and if necessary repaired strictly in accordance with the manufacturer's and supplier's instructions. V. The equipment shall be included in the Building Services maintenance schedule. VI. A maintenance and functional test schedule shall be prepared. VII. All unsatisfactory findings or defects found regarding the maintenance of the equipment shall be recorded in the log book and reported to the facility management. VIII. Maintenance of equipment shall be in accordance with the manufacturer's instructions. IX. Records shall indicate all reports regarding repeated faults that can be deemed design faults.
3	**MAINTENANCE TEST SCHEDULE**	**1. WEEKLY TESTS** I. The smoke Control Panel (SCP) shall be visually inspected for abnormal conditions, faults and availability of normal power. Each week the pressure differential system shall be actuated. While the system is operating, checks shall be made that the fans are running satisfactorily and that all components essential to supply air to pressurized spaces, to control pressure differences and to achieve air velocities are working properly.

		II. Each week the fuel level for the secondary power supply shall be checked so that there is sufficient fuel to run the generator for the required time, if the secondary power supply is a generator. The entire pressurization system shall be re-tested in accordance with Section 8, following any modification to the building such as alterations to internal partitions, extensions and alterations to the pressurization system that could affect the pressurization system. **2. MONTHLY TESTS** I. In addition to Weekly tests, the following tests shall be conducted monthly. II. A failure of the primary power supply shall be simulated and ensure that the system has switched automatically to the secondary power supply. If the secondary power supply is provided by a diesel generator it shall energize the system for a minimum of 1 hour. III. A zero-airflow condition shall be simulated and checked that the stand-by fans are running if they are provided. **3. YEARLY TESTS** Every 12 months, in addition to the manufacturer's recommendation and monthly tests, the entire pressurization system shall be tested by following the acceptance test procedures detailed in **Section 8**. **4. MODIFICATIONS** The entire pressurization system shall be re-tested in accordance with **Section 8**, following any modification to the building such as alterations to internal partitions, extensions and alterations to the pressurization system that could affect the pressurization system.

9.2 Kitchen Hood Ventilation Systems

Kitchen Hood Ventilation Systems shall be tested and maintained in accordance with **Table:- E.09-T2** for acceptance.

Table:- E.09-T2: Kitchen Hood Testing and Maintenance

SI.NO	ITEMS	REQUIREMENTS
1	**INSPECTION AND MAINTENANCE**	**1. GENERAL** i. The entire exhaust system shall be inspected for a grease buildup by a properly trained, qualified, and General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain listed company (Maintenance Contractor). ii. The cooking equipment that collects grease below the surface, behind the equipment, or in the cooking equipment flue gas exhaust, such as griddles or char broilers, shall be inspected and, if found with grease accumulation, shall be cleaned.

		iii. Hoods, grease removal devices, fans, ducts, and other appurtenances shall be cleaned to remove combustible contaminants prior to surfaces becoming heavily contaminated with grease or oily sludge. iv. Grease filters shall be inspected and cleaned. v. Where disposable filters are used, they shall be replaced periodically as per manufacturer's specifications. **2. MONTHLY INSPECTION** i. Systems serving solid fuel cooking operations shall be inspected for grease accumulation. **3. QUARTERLY INSPECTION** i. Systems serving high-volume cooking operations, such as 24-hour cooking, charbroiling, or wok cooking, at commercial kitchens, hotel and hospital kitchens. **4. SEMIANNUAL INSPECTION** i. Systems serving moderate-volume cooking operations such as restaurants, labor accommodations and staff accommodations shall be inspected for grease accumulation and ventilation system operation. **5. ANNUAL INSPECTION** i. Systems serving low-volume cooking operations, such as residential, day camps, seasonal businesses, or event centers shall be inspected for grease accumulation. ii. The hood ventilation system of all kitchens shall be annually inspected. All cooking equipment shall be inspected and serviced for proper functioning.

10.0 Smoke Control System Material Test Standards and Approval.

10.1 Acceptable Test Standards and criteria

10.1.1. All the Materials, Systems, Assemblies, Control Systems, Ducts, Fans, Insulation, Pipes and fittings, equipment, Products and Accessories, referred to in this chapter shall be Listed, Permitted and Registered by the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain **Material Approval Department.**

10.1.2. There is no year of edition mentioned against any test standards. It is the intent of General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain to invite the customers seeking laboratory tests and the test laboratories to follow the "LATEST EDITION OF THE TEST STANDARD, AS AND WHEN THEY ARE UPGRADED/REVISED/AMENDED, TO THE DATE."

10.1.3. Smoke Damper

i. ANSI/UL 555S, Standard for Smoke Dampers.
i. EN 12101-8: Smoke and heat control systems—Smoke control dampers.
ii. ISO 21927-8: Smoke and heat control systems — Specification for smoke control dampers.
iii. EN 1366-10 Fire resistance tests for service installations. Smoke control dampers.

10.1.4. Fire Damper (90 minutes and 3-hour fire rated)

i. ANSI/UL 555, Standard for Fire Dampers.
ii. EN 1366-2 Fire resistance tests for service installations. Fire dampers.
iii. EN 13501-3: Fire classification of construction products and building elements - Part 3: Classification using data from fire resistance tests on products and elements used in building service installations: fire resisting ducts and fire dampers

10.1.5. Combination (Fire/Smoke) Damper (90 minutes and 3-hour fire rated)

i. ANSI/UL 555, Standard for Fire Dampers, and ANSI/UL 555S, Standard for Smoke Dampers.
ii. EN 1366-2 Fire resistance tests for service installations. Fire dampers.
iii. EN 1366-10 Fire resistance tests for service installations. Smoke control dampers.
iv. EN 13501-3: Fire classification of construction products and building elements - Part 3: Classification using data from fire resistance tests on products and elements used in building service installations: fire resisting ducts and fire dampers.

10.1.6. Smoke Control Panel (SCP) and Power Supply (With 3 hour battery backup, enclosure rating of UL 864, IP 65 or above)

i. ANSI/UL 864, Standard for Control Units and Accessories for Fire Alarm Systems, category UUKL, for their intended purpose.
ii. ISO 21927-9: Smoke and heat control systems — Specification for control equipment.
iii. ISO 21927-10: Smoke and heat control systems — Specification for power output devices.
iv. EN 12101-10: Smoke and heat control systems. Power supplies.

10.1.7. Smoke Curtains or Draft Curtains (Rated at 600°C for 2 hours)

i. ISO 21927-1: Smoke and heat control systems, Specification for smoke barriers.
ii. EN 12101-1: Smoke and heat control systems. Specification for smoke barriers.

10.1.8. Fire Curtains (Rated at 1100°C for 2 hours)

i. UL 10D. Standard for Fire Curtains.
ii. BS 476; part 22, Fire Resistance Test to Building Material
iii. BS 8524-1: Active fire curtain barrier assemblies Part 1 - Specification
iv. BS EN 1634-1, Fire resistance and smoke control tests for door and shutter assemblies

10.1.9. Natural Smoke and Heat Vents (Rated at 300°C for 30 minutes)

i. ISO 21927-2: Smoke and heat control systems — Specification for natural smoke and heat exhaust ventilators.
ii. FM 4430, Heat and Smoke Vents.
iii. UL 793, Standard for Automatically Operated Roof Vents for Smoke and Heat
iv. EN 12101-2: Smoke and heat control systems. Specification for natural smoke and heat exhaust ventilators.

10.1.10. Mechanical Extract Fans and Jet Fans (Rated at 400°C for 2 hours)

i. EN-12101-3: Smoke and heat control systems. Specification for powered smoke and heat exhaust ventilators.
ii. UL 705, Standard for Power Ventilators.
iii. EN 13501-4: Fire classification of construction products and building elements - Part 4: Classification using data from fire resistance tests on components of smoke control systems.

10.1.11. Powered Smoke and Heat Exhaust Ventilators (Rated at 400°C for 2 hours)

i. EN 12101-3: Smoke and heat control systems. Specification for powered smoke and heat exhaust ventilators.
ii. EN ISO 13350: Industrial fans. Performance testing of jet fans.
iii. EN 13501-4: Fire classification of construction products and building elements - Part 4: Classification using data from fire resistance tests on components of smoke control systems

10.1.12. Ducts for Smoke control systems (Type A, Rated for both fire outside and Type B, fire outside and inside, 1 hour and 2 hour fire rated, tested and permitted for fire rating, stability, integrity)

i. BS 476, Part 24, Fire tests on building materials and structures. Method for determination of the fire resistance of ventilation ducts.
ii. ISO 21927-7: Smoke and heat control systems—Smoke control Ducts.
iii. Class 0 or Class 1 in accordance with ANSI/UL 181.
iv. ASTM E2816-12: HVAC ducts fire resistance
v. EN 1366-1: Fire resistance test for service installations. PART 1: DUCTS.
vi. EN 1366-8: Fire resistance tests for service installations - Part 8: Smoke extraction ducts

vii. UNE-EN 1366-9: Fire resistance tests for service installations - Part 9: Single compartment smoke extraction ducts
viii. EN 13501-4: Fire classification of construction products and building elements - Part 4: Classification using data from fire resistance tests on components of smoke control systems.
ix. EN 12101-7: Smoke and Heat control Systems. Smoke duct sections.

10.1.13. Duct and Pipe Insulation as assembly including Pipe and Duct insulation, coverings, linings fasteners, adhesives.

i. NFPA 274– Standard test method to evaluate fire performance characteristics of pipe insulation (Pass with full acceptance criteria of NFPA 274)
ii. FM 4924– Pipe and Duct Insulation

10.1.14. Air cleaners

i. ANSI/UL 867 Standard for Electrostatic Air Cleaners.

10.1.15. Air Filters

i. Class 1 or Class 2 in accordance with ANSI/UL 900.
ii. ANSI/UL 867

10.1.16. Grease Filters

i. UL 1046, Standard for Grease Filters for Exhaust Ducts.

10.1.1.17. Fire rated Cable, Certified for 120 minutes fire rating

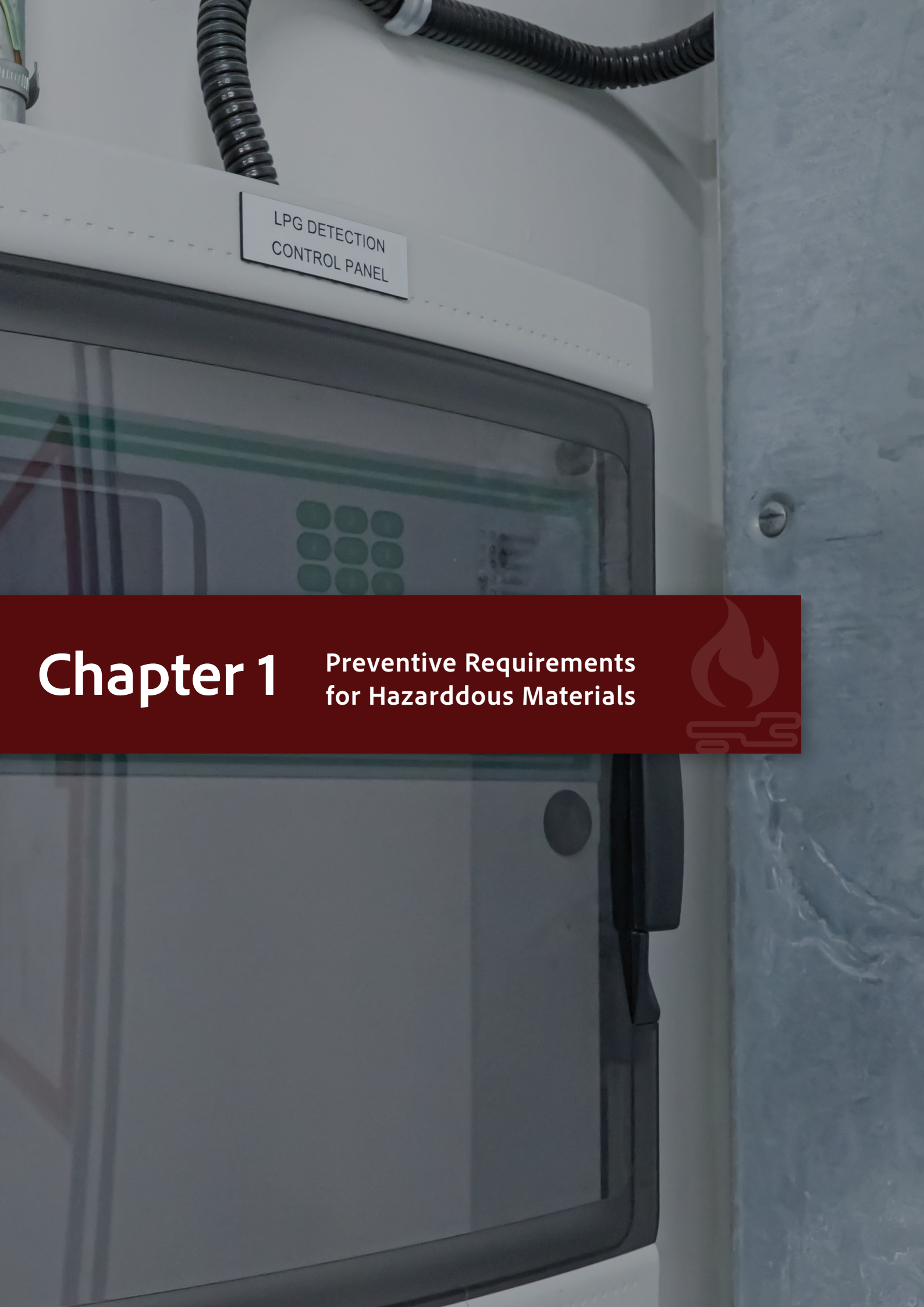
i. EN 50200, Method of test for resistance to fire of unprotected small cables for use in emergency circuits.
ii. UL- 2196, Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control, and Data Cables.
iii. BS 8434-2, Methods of test for assessment of the fire integrity of electric cables. Test for unprotected small cables for use in emergency circuits. BS EN 50200 with a 930° flame and with water spray.
iv. BS 7629-1, Electric cables. Specification for 300/500 V fire resistant screened cables having low emission of smoke and corrosive gases when affected by fire. Multicore and multipair cables.
v. BS 6387, Test method for resistance to fire of cables required to maintain circuit integrity under fire conditions.
vi. IEC 60331-1, Tests for electric cables under fire conditions.
vii. IEC 60331-2, Tests for electric cables under fire conditions. viii. IEC 60332-2-2, Tests on electric and optical fiber cables under fire conditions.
viii. IEC 60332-3-10, Tests on electric and optical fiber cables under fire conditions.
ix. IEC 60331-2, Tests for electric cables under fire conditions.
x. UL 1724, Outline of Investigation for Fire Tests for Electrical Circuit Protective Systems.

xi. UL 1685, Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical Fiber Cables.

UL 1666, UL 1666 Test for Flame Propagation Height of Electrical and Optical Fiber Cables Installed Vertically in Shafts.

11.0 General Schematics Arrangements

11.1 Annexure – 01 (High Rise Building Upto 30.5m)



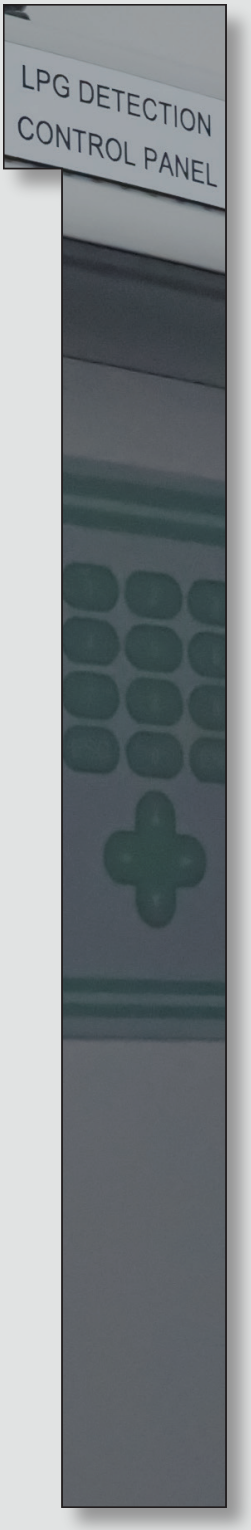
Chapter 1

Preventive Requirements for Hazarddous Materials

Section F

Chapter

Preventive Requirements for Hazarddous Materials



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1. Scope

1.1. To provide guidelines to designers, users, producers, distributors and those involved with the safe handling, storage and use of Hazardous Materials.

1.2. To restrict Hazardous Materials to maximum allowed quantities occupancy wise.

1.3. Minimum required separation distances from Hazardous Materials storage.

1.4. To ensure material and equipment involved in Hazardous Materials are tested and comply to international standards.

2. Definitions and Terminology

2.1. Competent Authority

They are the official (governmental) bodies authorized - or their representatives - that are legally responsible for issuing regulatory decisions, imposing technical requirements and requirements, and issuing licenses (permits) for establishing establishments for various activities, and then issuing the professional license (permit) after establishing the entity - to practice the activity allocated and authorized in licensing the entity. The General Directorate of Civil Defense is considered one of these competent authorities in addition to the ministries and other relevant government bodies.

2.2. Flammable Liquid

A liquid with a Flash Point below 60°C and a vapor pressure exceeding 2.76 bar at 37.8°C. The degree of danger of the flammable fluid increases when its flash point decreases.

2.3. Combustible Liquid

A liquid with a Flash Point above 37.8°C and below 93.3°C.

2.4. Flash Point

Represents the lowest temperature at which the liquid releases enough vapors to combine with the air and form a flammable mixture to cause a flash when the mixture is exposed to a flammable source.

2.5. Fixed Tanks

Non- movable and non-movable Tanks, fixed in position.

2.6. Earthing

Direct electrical connection of any conductor to the ground with good conductive media (Electrode). An object (equipment) is said to be grounded when it is electrically attached to an electrode installed in the ground without a fuse, switch, circuit breaker, etc.

2.7. Cathodic Protection

Technology to control (or force the electric current to prevent (for example) the corrosion of the metal surface of an oil buried Tank by making it a Cathode (negative pole), by connecting (linking) the metal to be protected (i.e. the Tank) to another metal that is easy to corrode to act as an anode (positive pole). (Caution: The concept of corrosion is different from the concept of rust).

2.8. Unstable Liquid

A liquid that in its pure state violently polymerizes, decomposes, or undergoes other violent chemical changes, or becomes self- reactive under conditions of shock, pressure, or heat.

2.9. Incompatible Materials

Materials posing a risk of hazardous reactions with other Materials in the same storage site, especially in circumstances where they may be exposed to accidental or intentional proximity, convergence, or mixing, resulting in hazardous reactions that may lead to combustion, explosion, the generation of toxic gases, or the production of other hazardous Materials.

2.10. Gas Detector

A device integrated with the Sensor that senses and measures the proportion of gas - designed and assigned to it, in the pit of the location where it is installed. For the record, each gas has its own sensor and cannot be used for other gases.

2.11. Sensor

A sensor that is installed with a gas detector, especially for a specific gas. Some gas detectors have a multi- detection feature (for more than one gas), because they contain more than one Sensor. Others have a Sensor replacement feature – to detect multiple gases.

2.12. Solenoid Valve

An electromechanical valve (electrical part that moves a mechanical part) attached to a control device (panel), used for gas or liquid, that stops the flow of gas or liquid if it receives an electrical signal from the control device.

2.13. Normally Close Valve

An electromechanical valve that remains closed if the electrical current is disconnected from it.

2.14. Normally Open Valve

An electromechanical valve that stays open if the current is disconnected.

2.15. Regulator Valve

A pre-set valve that does not allow the passage of gas at a pressure higher than the pressure calibrated thereon.

2.16. Safety Relieve Valve

A valve to relieve (by draining) excess pressure - automatically opens and closes when the designed pressure is exceeded, to maintain the internal pressure of the container on which the valve is installed.

2.17. Non-Return Valve

A valve that allows one- way flow of gas or liquid and the opposite is prevented, also called a Check Valve.

2.18. Vaporizer

An Vaporizer using heat-receives the gas in its liquefied state and adds enough heat to convert it to the gaseous state - as a prelude to utilizing the gas in general uses such as heating, cooking, etc.

2.19. Pit

A pit to accommodate anticipated spills of liquids, below ground level with brick or cement walls, with a hermetically sealed lid and in a suitable location - inside or outside the storage area.

2.20. Abbreviated Units of Measure

cm = centimeter, mm = millimeter, km = kilometer, s = second, M = minute °C = degree Celsius.

3. Activities related to the storage, handling and transportation of hazardous Materials

3.1 Flammable Liquids

Introductory Definitions:

Flammable Liquid: Any Flash Point less than 60 °C.

Combustible Liquid: Any fluid whose flash point is higher than 37.8 °C and lower than 93.3 °C.

Flash Point: Represents the lowest temperature at which the liquid releases enough vapors to combine with the air and form a flammable mixture to cause a flash when the mixture is exposed to a flammable source. The degree of danger of the flammable fluid increases when its flash point decreases. (Flash: It is a sudden and transient flammable flare).

Note: The general concept of “flammable liquids” or “liquid” is used in this Part to refer to both flammable and/or combustible liquids- unless otherwise specified in the terms of Part.

Intermediate Storage Tank: A Tank used for progressive refueling (fixed or moveable) and located between the main fuel supply Tank and the fuel consuming equipment (in the operations of the existing activity or work).

3.1.1 Preamble and General Requirements

3.1.1.1 Categories of flammable liquids are classified according to the following table:

Table:- F.1-T1: Categories of flammable liquids

Category	Flash Point (°C)	Boiling Point (°C)
1.a.	Less than 22.8	Below 37.8
1.b.	Below 22.8	Equal to or above 37.8
1.c.	Equal to or above 22.8 and below 37.8	
2.	Equal to or above 37.8 and below 60.0	
3.a.	Equal to or above 60.0 and below 93.0	
3.b	Equal to or above 93.0	

3.1.1.2 A license shall be obtained from the General director of civil defence Hazardous Materials Section before engaging in the following activities: -

1. Storage or use of Class I or II flammable liquids – in the following cases:
   (a) If the quantity exceeds 40 liters inside any housing unit.
   (b) If the quantity exceeds 230 liters inside any building.
   (c) If the quantity exceeds 2500 liters outside the building.

   * Excluding dyes that are kept for use on the work location (to paint the building or part thereof) for a period of no more than 30 days, and fuel in the Tanks of vehicles, boats and the like.

3.1.1.3 Storage or use of Class III flammable liquids – in the following cases:
   (a) If the quantity exceeds 230 liters inside any building.
   (b) If the quantity exceeds 2500 liters outside the building.

3.1.1.4 Means of transport (vehicles) of flammable liquids – whether in the form of Tanks or movable containers.

1. Liquids that do not have a flash point and that can combust in special circumstances, such as some halogenated hydrocarbons - or whose mixture can combust with some flammable liquids that are not subject to the conditions mentioned in this chapter.
2. Unstable liquids shall be treated as Class 1- A.

3.1.2 Storage of flammable liquid containers in a secluded Warehouse

3.1.2.1. Containers: Sealed containers (with specified capacities) usually used to keep flammable liquids from leaking, spilling, or volatilizing their vapors out.
The requirements for storing flammable liquid containers shall apply to the following cases:
   (a) Container with a capacity of no more than 450 liters.
   (b) Portable Tanks with a capacity of no more than 2500 liters.
   (c) An intermediate Tank with a capacity of no more than 3000 liters.

3.1.2.2 Containers used in the storage and handling of flammable liquids shall be manufactured according to the approved international standards and according to the following table:

Table:- F.1-T2: Maximum permissible capacity (in litres) for the types of containers and categories of flammable liquids

Container type	Flammable Fluid Class				
	1.a	1.b	1.c	2.	3.a
Glass bottles	0.5	1	5	5	20
Approved metal or plastic container	5	20	20	20	20
Special purpose safe containers	10	20	20	20	20
Metal drum	450	450	450	450	450
Approved Metal Portable Tank	3000	3000	3000	3000	3000
Polyethylene or approved fiber	5	20	20	450	450

3.1.2.3 Location Requirements:

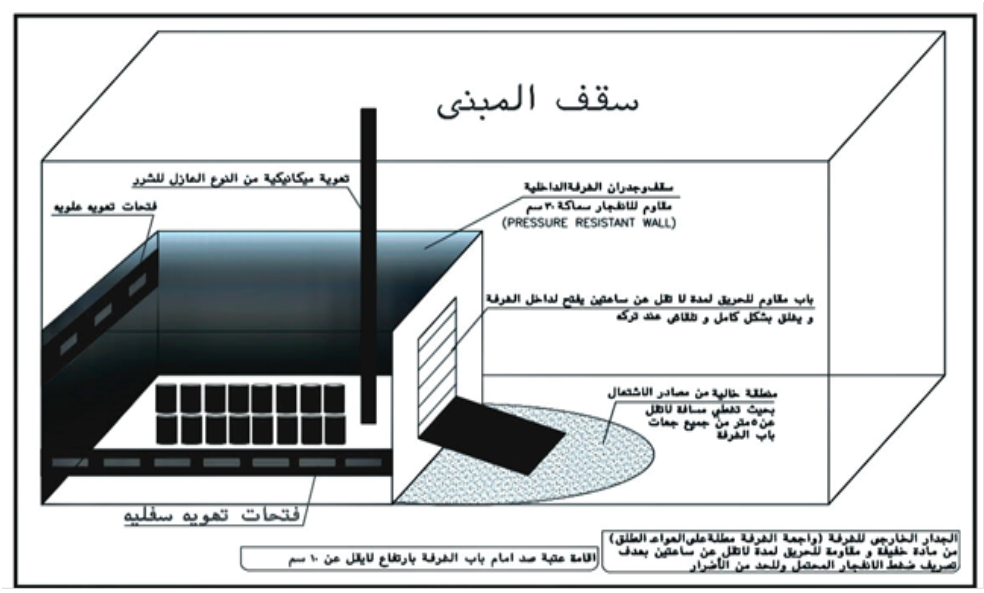
3.2.3.1 Flammable liquid containers (packages) shall be warehoused in special Warehouses in accordance with the precautionary conditions in the storage buildings mentioned in Part (1) and in suitable locations to be located according to the types and quantities of liquids to be warehoused.

3.2.3.2 The distance between the flammable liquid storage site and adjacent buildings shall not be less than 6 m.

3.1.2.4 Requirements for storing flammable liquids inside the building:

3.1.2.4.1 Construction elements and Specifications of Warehouse.

1) The storage building shall be of one ground floor only (separate isolated Warehouse).
2) All fire- resistant walls shall be constructed for a period of not less than 4 hours for the Warehouse building and the ceiling of the Warehouse shall be made of light a and fire-resistant Material in order to discharge the potential explosion pressure and to reduce the damage. The separation distance of the flammable liquids warehouse from neighboring buildings shall be from 6 m to 3m as a minimum. In this case, all the walls of the Warehouse shall be Pressure Resistant Walls with a thickness of not less than 30 cm and the ceiling of the room shall be made of light and fire-resistant Material in order to discharge the potential explosion pressure and to reduce the damage.
3) A room is allowed to Warehouse flammable liquids within a building with an area of not more than 50 square meters. In this case, all internal walls and the ceiling of the room within the building shall be Pressure- Resistant Walls with a thickness of not less than 30 cm, provided that the external wall (the room's front is open- air view of a light and fire-



resistant Material in order to discharge the potential explosion pressure and to reduce damage while applying all other Requirements for the Separate Warehouse building.

Building Roof
Roof and walls of the inner room is explosion-proof thickness 30 cm (pressure resistant wall)
Spark Insulation Type Mechanical Ventilation
Overhead vents
A fire-resistant door for a period of not less than two hours that opens inside the room and is fully and automatically fired when left
An area that is free of sources of flammability so that it covers a distance of not less than 5 meters from all the door of the room
Bottom Vents
The external wall of the room (the front of the room overlooking the open air) of light and fire-resistant material for a period of not less than two hours in order to discharge the potential explosion pressure and to limit the damage
Setting up a buffer threshold in front of the door of the room with a height of not less than 10 cm

4) The floor of the storage building shall be made of concrete, and resistant to flammable fluid leaks, especially at the angles of its connection to the walls.
5) Buffer sills shall be erected in front of the doors of the storage building with a height of not less than 10 cm in order to stop possible leaks and spills of flammable liquids outside the Warehouse or (as an alternative option) reduce the storage floor from the level of the floor surrounding the storage building by at least 10cm.
6) The storage floor shall be made with a calculated inclination for the purposes of draining accidental leaks and spills of liquids.
7) A separate drainage network shall be made for the storage floor to secure the diversion and drainage of liquid leaks to a special external collection pit for the purpose.
8) An appropriate number of exits shall be provided in the storage building for emergency evacuation purposes in accordance with the Requirements for Chapter 3.1.
9) The exits of the storage building shall be completely free of obstacles to emergency evacuation.
10) The doors of the storage building shall be fire resistant for at least two hours, and easy and free to open towards the outside and close automatically when left.

3.1.2.4.2 Ventilation Requirements for Storage Building:

1. Natural ventilation shall be provided to refresh the air at least 6 times per hour by making upper and lower ventilation windows for the storage building.
2. In the event that mechanical ventilation is installed to refresh the air of the Warehouse at least 6 times per hour from flammable liquids vapors, this mechanical ventilation shall work continuously and be of spark insulation type and be connected with the alarm system of the building (the main alarm panel of the building).
3. Mechanical ventilation shall be connected to a lower ventilation duct, the opening of which shall be at a height of 30 cm (as a maximum) from the floor of the storage building, because the flammable vapors are heavier than air.

3.1.2.4.3 Requirements for Electrical Installations in the Storage Building:

1. Electrical wiring and installations shall be installed on the walls at a safe height of not less than 2 m from the floor of the storage building.
2. Electrical wiring fixtures and installations for the Warehouses of the first and second categories of flammable liquids shall be of the spark insulation type, or the wiring shall be in galvanized iron pipes.
3. The amount of lighting shall be suitable for the size of the storage building and the light bulbs used for lighting shall be of the types that do not overheat (insignificant heat release).
4. Light bulbs shall be installed in the ceiling of the storage building or on the upper places of the walls, while the bulbs shall be equipped with caps that are resistant to sparks, shocks and ambient conditions.

3.1.2.4.4 Fire Protection Requirements for Storage Building:

1. The storage building shall be equipped with manual dry powder fire extinguishers according to the numbers and capacities specified by the General Directorate of Civil Defence.
2. The General Directorate of Civil Defence has the right to request what it deems appropriate to provide (automatic and manual) automatic, manual or various fixed control systems, depending on the danger of the Materials and their quantity.

3.1.2.4.5 Storage Conditions:

1. The storage height shall not exceed 2 m, provided that such height does not conflict with the "stacking tolerance" height allowed for the quality of each package.
2. The width of the corridors (between the stock rows) shall not be less than 1 m.
3. The distance between the stock rows and the walls shall not be less than 1 m.
4. Flammable fluid containers (storage) shall be placed on pallets with a height of not less than 15cm.
5. Signs and billboard shall be placed to determine the quality of the stock and its severity aspects.
6. The containers shall be kept in their normal standing position and tightly closed.
7. The tools used to open the containers shall be of a type that does not cause sparks.
8. Smoking is prohibited inside the flammable liquids storage building.
9. Open flames, heating equipment, or any other heat sources may not be used inside the building. It is also prohibited to bring heat sources closer from the outside to less than 6 m from the storage building.
10. Flammable liquids shall be separated from incompatible Materials as follows:
    a) Flammable liquids shall be separated from incompatible Materials for a distance of not less than 8 m. Incompatible materials include products containing more than 5% by weight acids, alkalis or oxidizers.
    b) Water- react Warehouse Materials shall not be Warehoused in the same storage area as flammable liquids.
11. The following Alarm signs shall be placed: No Smoking, Danger, and Flammable Liquids.
12. Non- specialists shall not access to flammable liquid storage buildings.

3.1.2.5 External storage of flammable liquids:

Outdoor (off premises) storage: Storage on a walled vacant plot of land with tiled floor (or constructed of concrete), normally used for storage purposes.

3.1.2.5.1 External Storage Requirements and Conditions:

1. External storage shall be limited to containers of 100 liters or more.
2. The floor of the external storage shall be surrounded by a buffer threshold with a height of not less than 15 cm, with the work of a separate drainage network to collect leaks and spills of flammable liquids in a special external pit for the purpose.
3. A fence of metal mesh shall be constructed around the external Warehouse, provided that its openings shall not exceed 12 cm2 and its height shall not be less than 3 m.
4. More than one exit shall be provided in the external Warehouse fence so that the width of one exit is not less than 3 m.
5. The external Warehouse shall be shaded with light and fire- resistant Materials to protect the stock from the effects of the sun's heat.
6. The distance between the stock and the outer wall of the Warehouse shall not be less than 1 m.
7. The external Warehouse and its surroundings shall be free of weeds, grasses or any other flammable Materials.

3.1.2.5.2 Electrical wiring and installation for external storage:

1. Electrical fixtures, installations and installations in the Warehouse containing flammable liquids shall be of the first and second class of the spark insulation type, or the electrical installations shall be within galvanized iron pipes.
2. The lighting of the Warehouse shall be suitable for its size. The lamps shall be with shatter-proof caps and protected from climate influences.

3.1.3 Fixed Tanks for flammable liquids.

Fixed Tanks: Tanks installed in their location and in their stable position and are not mobile and are not moveable from their location.

3.1.3.1 General Requirements for Fixed Tanks:

3.1.3.1.1 The flammable fluid Tank certificate issued by the manufacturer shall be submitted showing the capacity and static pressure test on the Tank up to 10lbs/ sq. in. at least and remain under the same pressure for at least 24 hours. The Tank was manufactured according to the international standards approved for General Directorate of Civil Defense, while indicating the standard number.

3.1.3.1.2 The Tank made of steel and the Tank made of fiberglass reinforced plastic - fiberglass (FRP/ GRP) may be used as underground fuel Tanks.

3.1.3.1.3 An executive engineering plan shall be submitted for the location of the Tank in relation to the general location of the facility, including the details of the underground fuel Tank made of steel in the Tank (Figure (F.1.T1), including the rest of the pipelines and fuel works to be studied and approved by the General Directorate of Civil Defence.

3.1.3.1.4 An executive engineering plan shall be submitted for the location of the Tank in relation to the general location of the facility, including details of the fuel Tank above the cylindrical and steel ground (Figure (F.1.T2) including the rest of the pipelines and Fuel works, to be studied and approval by the General Directorate of Civil Defence

3.1.3.1.5 An executive engineering plan shall be submitted for the location of the Tank in relation to the general location of the facility, including details of the fuel Tank above the existing vertical ground and made of steel, including the rest of the pipelines and fuel works, to be studied and approval by the General Directorate of Civil Defence.

3.1.3.1.6 The General Directorate of Civil Defence shall be reviewed after the completion of the installation of the Tank to obtain the final license necessary to fill the Tank, after ensuring compliance with the approved plans and preventive requirements. The license shall be renewed periodically with the availability of the preventive requirements.

3.1.3.2 Special Requirements for Underground Horizontal Cylindrical Tank:

The Tank that is placed below the surface of the earth and has a cylindrical shape and is fixed in the horizontal position.

3.1.3.2.1 Liquid Tank, if cylindrical and horizontal in design, shall be buried underground in permanent installations.

3.1.3.2.2 Tank Specifications:

1. The Tank shall be designed and manufactured in accordance with the approved international standards and in a manner that ensures the desired safety and durability of its use, including the durability of pipes and connections in preventing the release of fluid and flammable vapor from it.
2. Shape of the Tank shall be cylindrical.
3. No openings shall be made in the Tank, excluding the openings originally designed for the purposes of filling, venting, and discharge and measuring the intake of liquid.
4. The Tank manufactured and designed as an underground Tank shall not be placed above the ground.

3.1.3.2.3 Tank Protective Requirements:

1. The Tank body shall be protected from rust by coating it with sufficient layers of insulating dye and bitumen.
2. The Tank shall be placed in an underground room built of reinforced concrete so that the thickness of the walls and floor is not less than 25 cm as shown in Figure (F.1.T1) complying with all the details shown in the figure). The size of the room shall not be less than 110% of the volume of the Tank to ensure that it can accommodate the full capacity in the event of release.
3. The perimeter of the Tank shall be backfilled after placing it in the room designated for it with clean dry sand or gravel, depending on the type of Tank and the manufacturer's recommendations in this regard, in order to accommodate any potential flammable vapors resulting from petroleum materials in the Tank.
4. The Tank manhole shall be surrounded by a reinforced concrete wall not less than 20 cm thick and slightly above ground level to prevent water from leaking inside and have a suitable cap.
5. In the event that the Tank room is exposed to the passage of cars, structural considerations shall be calculated that ensure that the room's roof is durable and withstands traffic burdens, by applying one of the following options above the Tank room:
   a) Laying a layer of sand at least 1 meter thick.
   b) Laying a layer of sand with a thickness of 50cm, topped with a layer of reinforced cement with a thickness of 15 cm, extending horizontally by at least 30 cm from the ends of the walls of the room and from all sides.
   c) Applying a layer of sand with a thickness of 50cm topped with a layer of asphalt reinforced cement with a thickness of 20 cm.
6. The horizontal distance between the end of the Tank room and adjacent facilities shall not be less than 1 m.

7. If submerged pumps in the Tank to withdraw the liquid are used, the gabs in the manhole around the electrical connections between the pump and the current source shall be sealed with an insulating Material.
8. A sealed cap shall be installed for the liquid level gauge opening.

3.1.3.2.4 Requirements for Tank fill pipe:

1. The diameter of the filling pipe shall be proportional to the diameter of the vacuum hose from the fuel tanker.
2. The filling pipe shall pass through the roof of the Tank and extend down into the Tank until it reaches a depth of 15cm from its base.
3. The Tank filling pipe shall be away from potential places of fire hazards - or from pits and tunnels exposed to the accumulation of flammable vapors and liquids.
4. The filling point shall be marked with indicative signs clearly indicating the type of liquid and the words: Danger - Fuel Tank Discharge Point.
5. All visible pipes of the Tank shall be painted in colors that distinguish the quality of the liquid used as follows: Yellow (for diesel), Blue (for kerosene), Red (for premium gasoline), Gold (for special gasoline) or any other approved colors.
6. A 5 cm width and 6 mm thickness copper or aluminum ruler shall be provided to measure the level of the flammable liquid in the Tank.

3.1.3.2.5 Tank Vent Pipe Requirements:

1. The diameter of the air duct shall not be less than 50 mm and shall be suitable for the maximum rate expected for filling and discharge the Tank.
2. The height of the air duct shall not be less than 4.5 m above the ground. In the event that the air duct is installed on the walls of the building, the height of the pipe shall not be less than 1 m from the roof of the building.
3. The Tank vent pipe shall be kept at a distance of not less than 7 m from its filling point or any heat source.
4. The Tank air duct shall be in the roof of the Tank and to a depth of not more than 2 cm.
5. The direction of the air duct opening shall be upward.
6. The end of the Tank air duct shall be provided with a suitable cap to prevent its blockage, prevent the entry of dust and water inside it, and reduce the chances of vapors rising from it.
7. The Tank air duct shall be in sight from the location of the filling point, if possible, so that it can be seen in the event of overflow of the Tank and the flammable liquid flows out and then stop the discharge process immediately.

3.1.3.2.6 Requirements for intake pumps from the Tank:

1. Intake pumps shall be of approved type for flammable liquids.
2. Intake pumps shall not be more than 25 m away from the Tank.
3. The intake pumps shall be connected to the grounding cable.
4. A non- return valve shall be installed on the intake line.

3.1.3.2.7 Precautionary Requirements for Tank Filling Process:

1. A separate grounding point shall be made to discharge static electricity charges from the Tank at the filling point, as shown in Figure (F.1.T1) so that the grounding cable is 5 m long and equipped with the grounding clamp.
2. An automatic system shall be installed to measure the liquid level in the Tank so that it gives an alarm in two stages:

a) Before the liquid reaches the permissible filling level of the Tank; and
b) When it reaches that level – provided that the alarm means is near the filling point.

3.1.3.2.8 Fire Protection Requirements:

1. The following Alarm signs shall be placed in the Tank area and adjacent to the filling point: No Smoking, Danger, and Flammable Liquids.
2. Dry Powder type manual fire extinguishers with a capacity of 25 kg shall be provided for each underground fuel Tank.

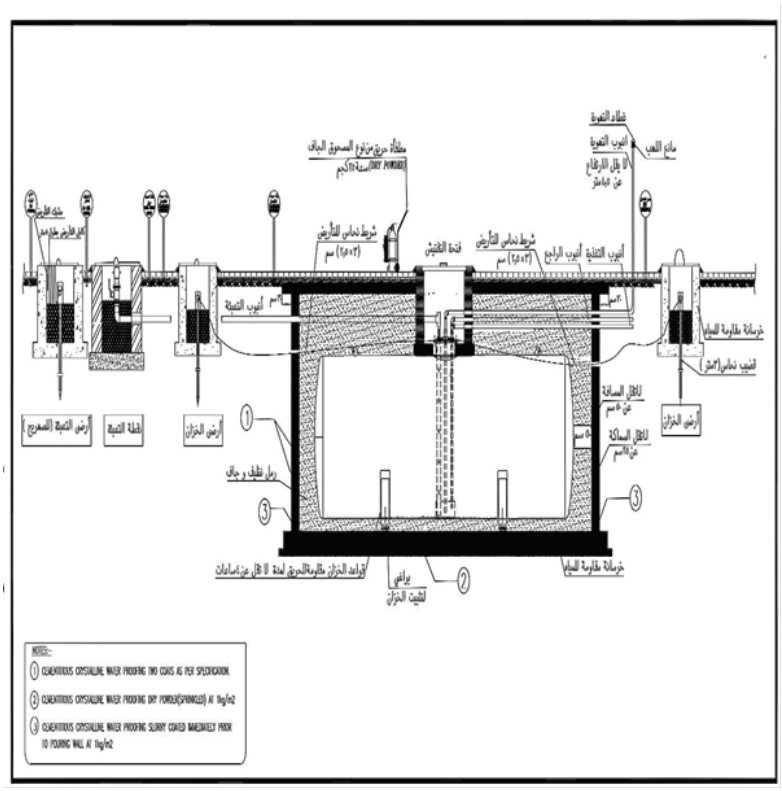


Figure:- F.1- F1 Cylindrical underground fuel Tank made of steel

Vent cap
Flame retardant
Ventilation pipe
Height not less than 4.5m
Dry powder fire extinguisher 25kg
Grounding copper tape (3x2.5) cm
Manhole
Feeding pipe
Return pipe
Grounding copper tape (3x2.5) cm
34 cm packing pipe

Waterproof Concrete
Copper bar (3m)
Ground of the tank
The distance shall not be less than 50 cm
Thickness shall not be less than 25 cm
Waterproof Concrete
Tank anchor bolts
Clean and dry sand
Tank floor
The tank bases are fire resistant for a minimum of 4 hours
Earthing Clamp
Full earthing with a length of 5 meters
Filling point
Filling ground (tanker)
Notes
1. CEMENTTIOUS CRYSTALLINE WATER PROOFING TWO COATS AS PER SPECIFICATION.
2. CEMENITIIOUS CRYSTALLINE WATER PROOFING DRY POWDER(SPRINKLED) AT 1kg/m2
3. CEMENTTIOUS CRYSTALLINE WATER PROOFING SLURRY COATED IMMEDIATELY PRIOR TO POURING WALL AT 1kg/m2

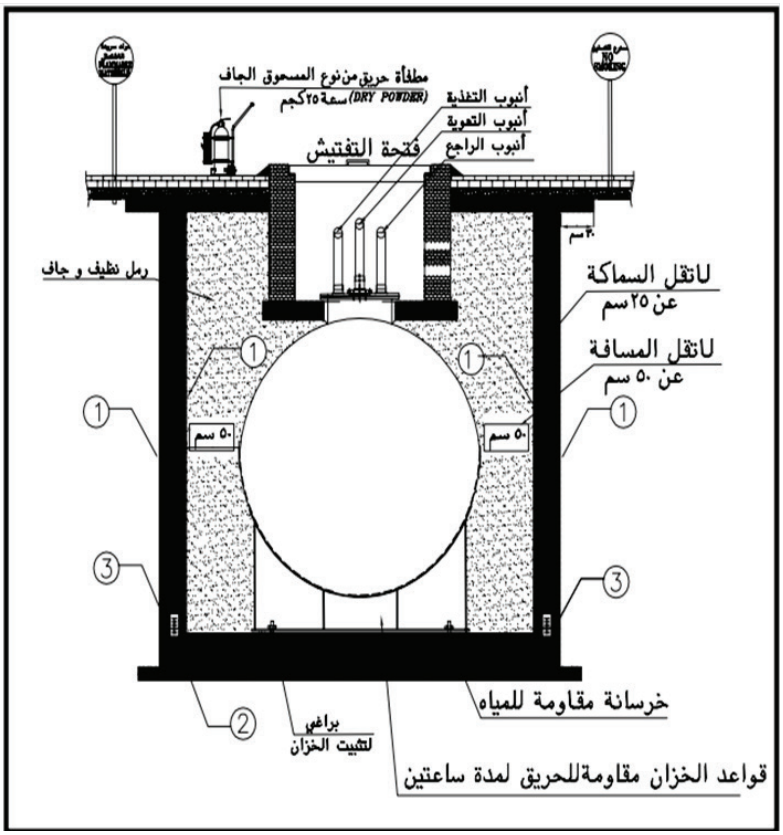


Figure:- F.1-F2 Cylindrical underground fuel Tank made of steel

25Kg dry powder type fire extinguisher
Feeding pipe
Ventilation pipe
Return pipe
Waterproof Concrete
Tank anchor bolts
2 Hour Fire Resistant Tank Bases
Thickness shall not be less than 25 cm
The distance shall not be less than 50 cm
Clean and dry sand
Manhole

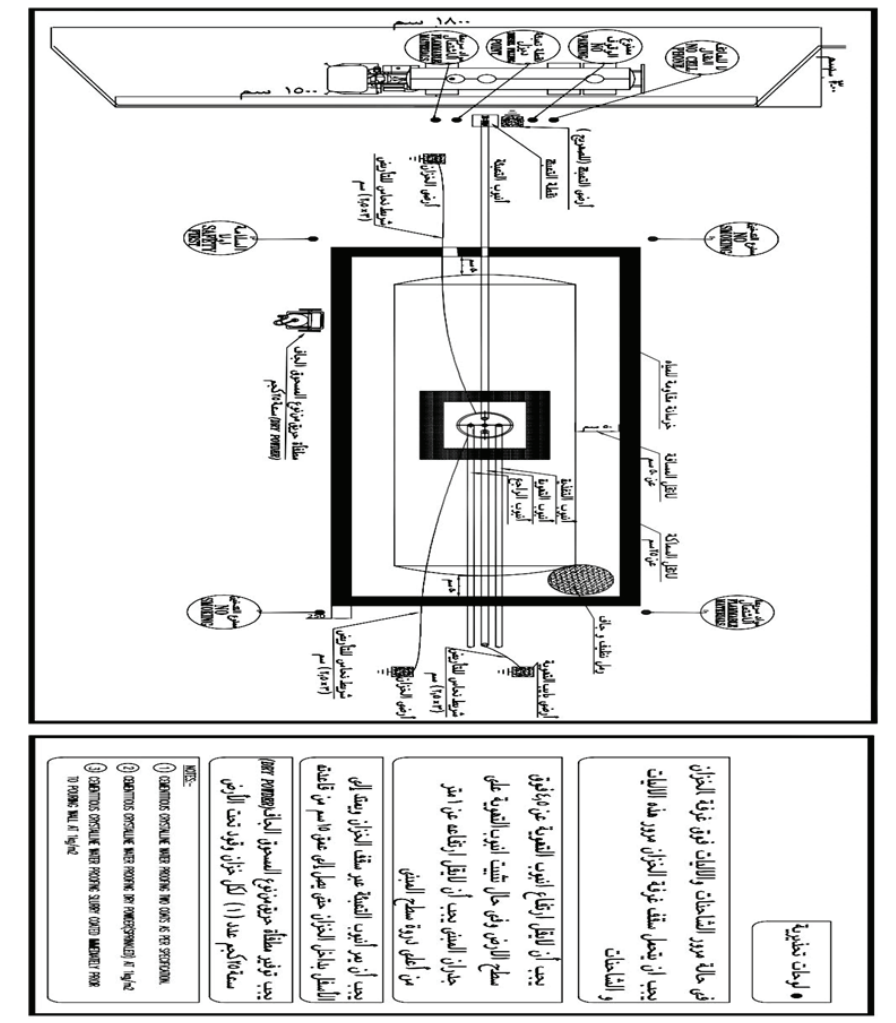


Figure:- F.1-F3 Cylindrical underground fuel Tank made of steel

Quick-acting materials
Clean and dry sand
Dry powder fire extinguisher 25kg
Feeding pipe
Ventilation pipe
Return pipe
Thickness shall not be less than 25 cm
The distance shall not be less than 50 cm
Waterproof Concrete
Flammables
No Smoking
Safety first
No Mobile
No Parking
Diesel filling point
• Warning plates

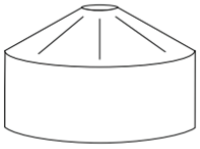
In the event that trucks and vehicles pass over the tank room, the roof of the tank room shall withstand the passage of these vehicles and trucks
The height of the ventilation pipe must not be less than 4.5 m above the ground. In the event that the ventilation pipe is installed on the walls of the building, the height of the pipe must not be less than 1 m from the roof of the building.
The filling pipe must pass through the roof of the tank and extend down into the tank until it reaches a depth of 15cm from its base .
A dry powder fire extinguisher shall be provided with a capacity of 25 kg, number 1 for each above-ground fuel tank.

3.1.3.3 Ground Tanks:

3.1.3.3.1

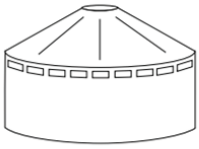
١- خزان أرضي رأسي (قائم) ذو سقف ثابت

(دائري قائم الوضع بسقف ملحوم)

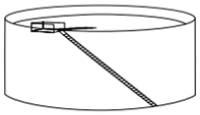


٢- خزان أرضي رأسي (قائم) ذو سقف متحرك

(دائري قائم الوضع بسقف عائم على سطح السائل ويتحرك عمودياً تبعاً لمستوى السائل)

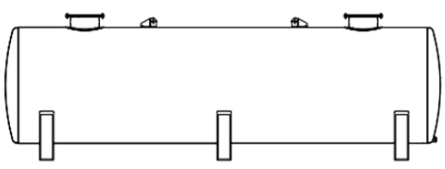


شكل (ب) السقف العائم المتحرك يعلوه سقف ثابت



شكل (أ) السقف العائم المتحرك مكشوف للهواء

G round Tanks means the Tanks that are placed and installed above the surface of the earth.

Vertical (standing) floor tank with fixed roof
(Round standing with welded roof)
2. Vertical (standing) floor tank with movable roof
(circular standing with a floating roof on the liquid surface, moving vertically according to the liquid level)
Figure (A) The open air floating movable roof
Figure (B) Floating movable roof topped with fixed roof
3. Horizontal Ground cylinder tank
٣- خزان أسطواني أرضي أفقي الوضع 

3- Horizontal ground cylinder tank

3.1.3.3.2 Ground Tanks Specifications:

1. The Tank shall be made of steel in accordance with the approved international standards to ensure the desired safety and endurance of its use, including the safety and security of pipes and connections in preventing the release of liquid or combusted vapor from it.
2. No openings shall be made in the Tank other than the openings designed mainly for the purposes of filling, venting, and discharge and measuring the amount of liquid.
3. The Tank shall have a suitable metal ladder leading to its surface with the availability of a suitable walkway protected by a fence to inspect the surface of the Tank in a safe manner.
4. The Tank manufactured and designed as an above-ground Tank is prohibited from being placed underground.

3.1.3.3.3 Locations of ground Tanks relative to surrounding facilities:

1. The dimension of Tanks containing stable flammable liquids shall be of Class I, II and III -A- and with an internal pressure of no more than 0.17 bar, from the adjacent building according to **Table:- F.1-T3** and **F.1-T4**

Table:- F.1-T3: Minimum distance between Tanks and any adjacent building or facility - as per item 1 above

Tank Type	Fire station for the facility	Distance*
Sliding Ceiling	Applicable	1x Tank Diameter
	Not applicable	2x Tank Diameter
Fixed Roof vertical Tank	Applicable	1.5x Tank Diameter
	Not applicable	3x Tank Diameter
Horizontal or vertical Tank with a breathing valve to reduce pressure by no more than 0.17 bar	Applicable	1.5x Parameter in Table (1-1- 4)
	Not applicable	3x Parameter in Table (1- 1- 4)

Distance: The minimum distance that shall be available between the flammable fluid Tank and the nearest adjacent building or facility on the location, excluding (building or facility) monitoring or control stations for the Tanks.

Table:- F.1-T4 Reference to tables (1-1-3,5,6)

Tank capacity (liters)	Distance coefficient (meters)
3000 – 5000	2
5001 – 10000	5
10001 – 45000	6
45001 – 114000	8
114001 – 190000	12
190001 – 380000	17
380001 – 1900000	30
1900001 – 3800000	40
3800001 – 7600000	45
Over 7600000	50

2. In all cases, the distance between the Tank and any adjacent building or facility or location that constitutes a fire hazard – shall not be less than 6m.

Table:- F.1-T5 Minimum distance between Class III- B fluid Tanks and any adjacent building or facility

Tank Capacity (L)	Distance (m)
45,000 and below	6
45001 – 114000	10
114001 – 190000	15
190001 – 380000	20
Over 380000	25

3.1.3.3.4. Distances between ground Tanks:

1. Stable fluid Tanks, Class I, Class II or Class III- A shall be separated from each other according to the distances mentioned in Table (F- 1- T6) below

Table:- F.1-T6 Distance between fluid Tanks

Tank Diameter	Sliding Roof Tank	Horizontal Tank or fixed roof Tank	
		Category I or II	Category 3.(a):
The largest diameter of a Tank shall not exceed 45m	*4.1 The total diameters of the Tanks, provided that they are not less than 1m	4.1 The total diameters of the Tanks, provided that they are not less than 1m	4.1 The total diameters of the Tanks, provided that they are not less than 1m
Tanks with diameters of more than 45m Spills are collected away from the Tanks	4.1 Total Tank diameters	3.1 Total Tank diameters	4.1 Total Tank diameters
Spills are collected around the Tanks	3.1 Total Tank diameters	2.1 Total Tank diameters	3.1 Total Tank diameters

*Total Tank diameters: The sum of the diameters of adjacent Tanks only.

2. If the categories of flammable liquids vary in the group of Tanks, the distance shall be calculated for the category with the lowest flash point (i.e. the most dangerous and fastest flammable).
3. In all cases, the distance between the Tanks of flammable liquids shall not be less than 1m in the same area if they are all of the third category - b. However, if the area contains Tanks for Class I or II flammable liquids, the Tank containing Class III B of flammable liquids shall be treated as Class III A according to the distances mentioned in **Table:- F.1-T6** above.
4. The distance between a Tank containing an unstable liquid and another Tank containing an unstable liquid or a liquid of the first, second or third category shall not be less than half of the total diameters of the Tanks.
5. The distance between a ground Tank of a flammable liquid and another of a liquefied petroleum gas erected above the ground shall not be less than 7m.
6. The distance between the ground Tank of a flammable liquid and another of a liquefied natural gas erected above the ground shall not be less than 15m.

3.1.3.3.5. Fire Prevention for Ground Tanks:

1. Clause (3.1.3.2.7) on the auxiliary Requirements for underground Tank filling operation shall be adhered to.

2. The area around the Tank shall be free of weeds, woods and flammable Materials.

3. The following Alarm signs shall be placed on the Tanks: No smoking, Danger, flammable liquids.

4. Plates shall be placed on the Tanks to characterize the liquid and its specific degree of danger.

5. The outer surface of the Tank shall be protected from rust and weather with a special (silver or white) paint to reflect sunlight and limit its heat on the Tank.

6. A dry powder fire extinguisher shall be provided with a capacity of 15 kg, number 2 for each above- ground fuel Tank.

7. Clause (3.1.3.3.7) shall be adhered to in accordance with the request of the General Directorate of Civil Defense.

3.1.3.3.6. Ground Tank Leak Containment Requirements:

Facilities adjacent to Tanks shall be protected from spills and emergency leaks of flammable liquids from the Tank in order to avoid the expansion of the risk area and to protect other environmental elements such as soil, groundwater and public drainage networks by absorbing these spills in one of the following ways:

1. Making a special pothole to collect potential leaks and spills of Tanks and drain them away from the perimeter of the Tank - with the following specifications:

    a) The inclination of the drainage line shall not be less than 1%, and the Tank shall be kept at a distance of not less than 15m.

    b) The capacity of the collection pit shall not be less than 10% of the capacity of the largest Tank in which it is poured. In the event that this capacity cannot be provided, the remaining capacity can be replaced by the provision of a basin around the Tank as in Clause (3.1.3.3.6- 2).

    c) No packages for any Materials may be stored inside the pit, whether the packages are empty or full.

    d) General Directorate of Civil Defense shall determine the protection or control system it deems appropriate for the pit.

2. Constructing a basin around the Tank to collect leaks of flammable liquids from the Tank with the following specifications:

a) The floor of the basin shall have slopes of not less than 1%, which shall be lowered from the Tank towards the wall of the basin.

b) The capacity of the basin shall not be less than 110% of the capacity of the largest Tank surrounding it.

c) A wall of fire- resistant and leak- proof Materials shall be constructed to withstand the hydrostatic pressure of the flammable liquid if the basin is fully filled of such flammable liquid.

d) A fixed and safe means shall be provided on the walls to enable maintenance personnel to cross them to enter the basin (stairs and bridges to cross) for detection and maintenance procedures. It shall be in more than one location, depending on the size of the basin.

e) A secondary basin shall be made whose walls are at least 50cm high if the basin contains more than one Tank, in order to avoid minor leaks to adjacent Tanks in the same basin.

f) In the event that a means of discharging water from the basin is operated, it shall ensure that flammable liquids do not reach the water drains.

g) The main filling and discharge lines of the Tank shall be provided with isolation valves located outside the basin, in order to stop the filling process and to drain the liquid to another Tank in emergency cases.

h) No packages for any Materials may be stored inside the basin, whether the packages are empty or full.

i) The General Directorate of Civil Defense shall determine the protection or control system it deems appropriate for the basin.

3.1.3.3.7. Fire Alarm and Fire Fighting Systems for Ground Tanks:

1. Alarm systems: The types and functions of alarm systems for ground Tanks vary according to their purposes, some of which are used to warn and alert those present of the danger, and some of which are used to operate other systems such as control and cooling. The most important types of alarm systems are:

   a) Manual Alarm: Through hand alarms distributed at the location and in accordance with the Requirements for Chapter 3.8.

   b) Automatic Alarm: Through heat detectors and flame detectors distributed at the location and in accordance with the Requirements for Chapter 3.8.

2. Control and cooling systems: The types of systems for dealing with ground Tank fires and their functions vary according to their purposes, including fire foam systems that are suppressed by pushing the foams to the surface of the combusted liquid in the Tank, or the surrounding basin - to cap it completely, including cooling systems for the entire outer body of the Tank in order to protect it from the potential heat of a neighboring Tank fire, etc. These types of systems include the following:

a) Foam extinguishing system inside the Tank (foam injection).
b) Foam pouring system to the surface of the liquid - whether in the pit or the collection basin of leaks and spills.
c) A (fixed or mobile) foam launcher system for control or water for remote cooling.
d) Water immersion cooling system for the entire outer body of the Tank.

3. Refer to the Appendix to the Table of Fire Protection Requirements for Above Ground Flammable Fluid Tanks in Industrial Areas.
4. The requirements contained in Chapter 3.8 on fire alarm systems, emergency management and exits, and Chapter 4.99 on firefighting systems shall be adhered to.

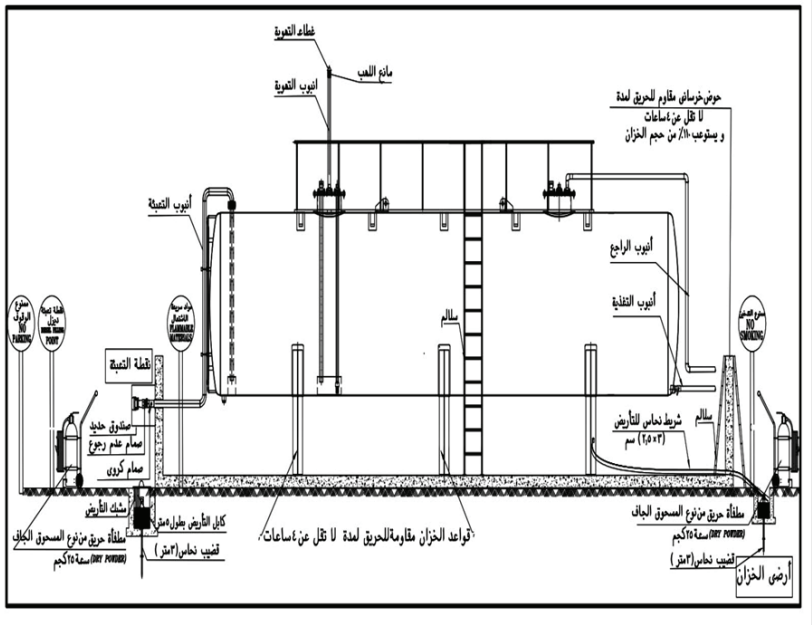


Figure:- F.1- F4 Cylindrical underground fuel Tank made of steel

Fire-resistant concrete basin for a period of not less than 4 hours and can accommodate 110 of the volume of the tank
Return pipe
Feeding pipe
No Smoking
Stairs
Dry powder fire extinguisher 25kg
Copper bar (3m)
Tank floor
Flame Retardant
Vent cap
Ventilation pipe
Filling pipe
Flammables
Diesel filling point
No Parking
Iron Box

ball valve
Earthing Clamp
Dry powder fire extinguisher 25kg
5m Earthing Cable
Copper bar (3m)
Check valve

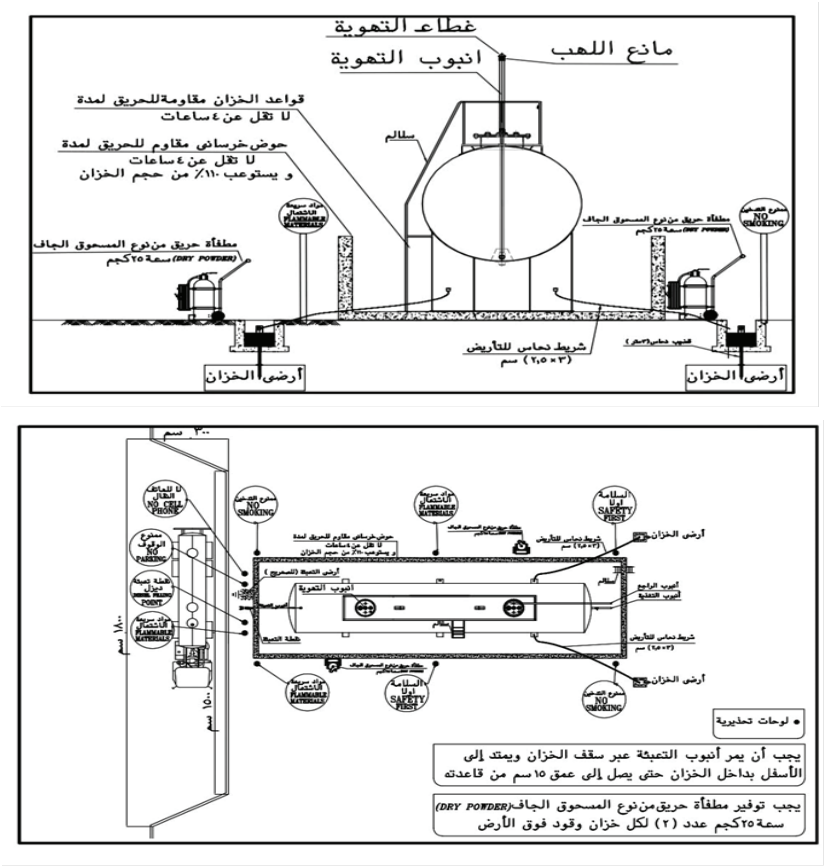


Figure:- F.1-F5 A cylindrical above- ground fuel Tank made of steel

Flame Retardant
Vent cap
Ventilation pipe
No Smoking
Dry Powder Fire Extinguisher 25kg
Tank floor
Stairs
The tank bases are fire resistant for a minimum of 4 hours
Fire-resistant concrete basin for a period of not less than 4 hours and can accommodate 110 of the volume of the tank
Flammables
Dry powder fire extinguisher 25kg
Grounding copper tape (3x2.5) cm
Tank floor

Tank floor
Safety First!
Return pipe
Feeding pipe
Grounding copper tape (3x2.5) cm
Flammables
No Smoking
Fire-resistant concrete basin for a period of not less than 4 hours and can accommodate 110% of the volume of the tank
No Smoking
Filling ground (tanker)
Dry powder fire extinguisher
Warning plates
The filling pipe must pass through the roof of the tank and extend down into the tank until it reaches a depth of 15cm from its base.
A dry powder fire extinguisher shall be provided with a capacity of 25 kg, number 2 for each above-ground fuel tank.

3.1.3.4 Special Requirements for Daily Consumption Tank:

Definition of Daily Consumption Tank: A secondary fuel Tank that is usually near fuel-consuming operating equipment (such as power generation engines, furnaces and central boilers to heat building water... Etc.). The daily consumption Tank is often supplied from another main fuel Tank.

3.1.3.4.1 The daily consumption Tank shall be in a room separate from the building and at Ground Level No. (1) As specified in Figure (F-1-T3) for all commercial, industrial, educational and residential complexes purposes.

3.1.3.4.2 It is allowed to exploit the patterns of the other rooms of the daily consumption Tank mentioned below (2, 3 and 4) as specified in Figure (F-1-T3) in the event that daily consumption Tank rooms separated from the building may not be provided.

3.1.3.4.3 A daily consumption Tank room shall be allowed on the roofs of buildings (ground floor surface and mezzanine surface) No. (5, 6 and 7) and not exceeding the second mezzanine surface as shown in Figure (F- 1- T4) in the event that the daily consumption Tank room is not available at the ground level.

3.1.3.4.4 A room for the daily consumption Tank below the ground floor level (first tunnel only) is allowed in the event that the daily consumption Tank room is not available at both the ground level and the roofs of the building.

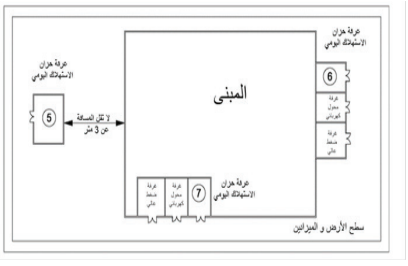


Figure:- F.1-F6 : Patterns and locations of daily consumption Tank rooms in the ground

Building
Daily Consumption Tank Room 1
Daily Consumption Tank Room 2
Daily Consumption Tank Room 3
Daily Consumption Tank Room 4
Daily Consumption Tank Room 4a
Daily Consumption Tank Room 4b
The distance shall not be less than 5 cm
Electrical Transformer Room
Distance not less than 5m
High pressure room.

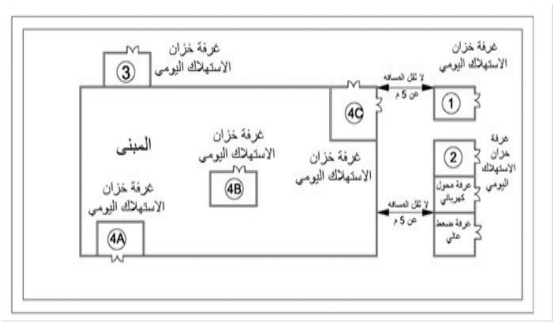


Figure:- F.1-F7 Patterns and locations of daily consumption Tank rooms on the roofs of buildings

Building
Daily Consumption Room 5
Daily Consumption Room 6
Electrical Transformer Room
High pressure room.
Daily Consumption Room 7
Electrical Transformer Room
High pressure room.
Ground surface and mezzanine

3.1.3.4.5 The storage of the uses of the daily consumption Tank shall be limited to diesel fuel only.

3.1.3.4.6 The volume of the Tank shall not exceed 3000 liters.

3.1.3.4.7 If there is more than one Tank, the total capacity of the Tanks shall not exceed 3000 liters in the single fire area predetermined in accordance with Chapter Eleven (Architectural Requirements and Ways of Escape).

3.1.3.4.8 A basin shall be constructed around the Tank to accommodate 110% of the Tank capacity with a height not exceeding 1m as shown in **Figure:- F.1-F8**

3.1.3.4.9 The roofs, floors and walls of the Tank room shall be fire resistant for a minimum of 4 hours and the doors of the Tank room shall be fire resistant for a minimum of 2 hours.

3.1.3.4.10 A buffer threshold shall be erected in front of the doors of the daily consumption Tank room with a height of not less than 15 cm.

3.1.3.4.11 All Electrical Installations and connections close to the Tank shall be of spark insulation type.

3.1.3.4.12 An automatic control device shall be installed to adjust the liquid level inside the Tank, usually a control panel linked to Tank liquid level gauge and fuel pump.

3.1.3.4.13 An air duct extending from the Tank to the outside of the building shall be installed, so that the height of the air duct is not less than 1 m from the top of the roof of the room.

3.1.3.4.14 Concrete shall be tied to the grounding cable to discharge the accumulation of static electric charges.

3.1.3.4.15 The Tank shall be securely fixed to the ground.

3.1.3.4.16 Natural ventilation shall be provided to refresh the room air at least 6 times per hour or install mechanical ventilation to refresh the air of the room at least 6 times per hour, provided that this mechanical ventilation works continually and be of spark insulation type and be connected with the building alarm system (the main alarm panel of the building).

3.1.3.4.17 The following Alarm signs shall be placed on the Tanks: No smoking, Danger, flammable liquids.

3.1.3.4.18 A dry powder type extinguisher with a capacity of 25 kg shall be provided for the following daily consumption rooms:

a) Daily consumption Tank rooms at the ground level separated from the building (Figure 1).
b) Daily consumption Tank rooms at the ground level within the service building separated from the building (Figure 2).
c) Daily consumption Tank rooms at the ground level within the building, Building utilities, or attached to the external wall of the building, which have an exit leading directly outside the building with a Tank capacity of no more than 2000 liters (Fig. 4A)Fig. 4C (Fig. 3).
d) Separate daily consumption Tank rooms at the level of the ground floor level and the mezzanine floor surface (Figure 5).

3.1.3.4.19 Foam system with 6 kg dry powder extinguisher shall be provided for the following daily consumption rooms:

a) Daily consumption Tank rooms at the ground level within the building, building utilities that do not have an exit that leads directly outside the building (Figure 4C).
b) Daily consumption Tank rooms at the ground level within the building, building utilities or attached to the external wall of the building with a Tank capacity of more than 2000 liters (Figure 4A) (Figure 4C).
c) Daily consumption Tank rooms at the level of the ground floor and the level of the mezzanine floors (first and second) within the service building of the building (Figure 6) and (Figure 7) with a capacity of the Tank exceeding 1000 liters.
d) Daily consumption Tank rooms below the ground floor level (first tunnel).

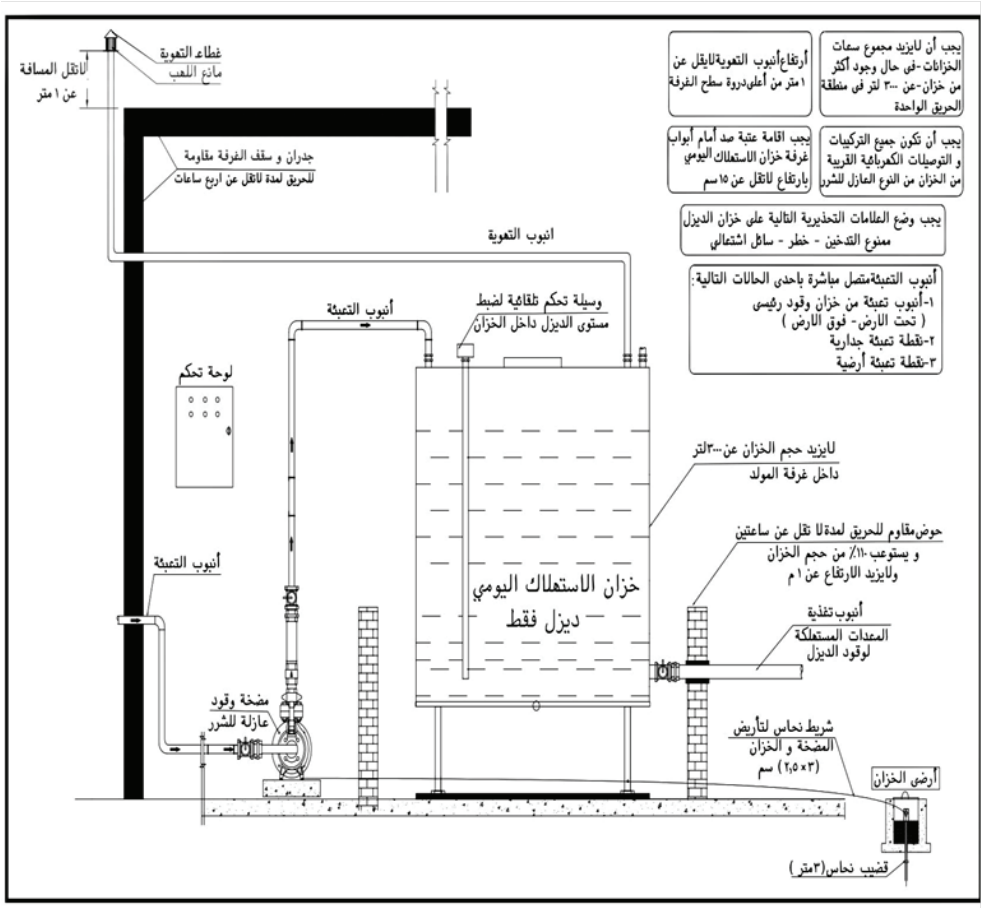


Figure:- F.1-F8 : Daily Consumption Tank

If there is more than one tank, the total capacity of the tanks should not exceed 3 liters in one fire area.
The height of the ventilation pipe is at least 1 meter from the highest peak of the room surface
All electrical installations and connections close to the tank shall be spark insulation type.
A buffer threshold shall be erected in front of the doors of the daily consumption room with a height of not less than 15 cm.
The following warning signs shall be placed on the diesel tank (No Smoking – Danger – Flammable Liquid)
The filling pipe is directly connected to one of the following conditions: 1- A filling pipe from a main fuel tank (underground – above ground), 2. Wall filling point, 3. Ground filling point
Ventilation cover, flame retardant
Distance is not less than 1m.
The walls and ceiling of the room are fire resistant for at least four hours
Ventilation pipe
Automatic control device to adjust the diesel level inside the tank
Filling pipe
Control panel
The size of the tank shall not exceed 3000 liters inside the generator room

A basin that is fire-resistant for a period of not less than two hours and accommodates 110% of the volume of the tank and the height is not more than 1 m
Diesel fuel consuming equipment feed pipe
Copper tape for pump and tank earthing (3x2.5) cm
Tank floor
Copper bar (3m)
Daily Consumption Tank – Diesel Only
Filling pipe
Spark-proof fuel pump

3.1.4 Flammable liquid transport tankers.

3.1.4.1. Tanker of Flammable Liquid Transport:

A vehicle designated in terms of design and integrated (installed) with a Tank to transport flammable liquids or asphalt (bitumen).
Note: The term "tanker" in this clause is used to refer to both the (individually) transported Tank and the vehicle integrated into the Tank.

3.1.4.2. Requirements for flammable liquid transport tankers:

3.1.4.2.1 Tanker Design:

1. The tanker shall be designed and manufactured in accordance with the approved international standards, so that the Tank bears the weight of the liquid and resists the expansion (pressure) resulting from flammable liquids vapors and their decomposition products, and resists the corrosion property of potential impurities with the liquid.
2. All fixtures and equipment in the tanker shall be of types resistant to petroleum products and comply with the approved international standards.
3. A manufacturing certificate shall be submitted for the tanker, provided that the design, manufacture and test have been carried out in accordance with the approved international standards.
4. The static pressure on the tanker vessel shall be tested by water at a height of 3 m from the tanker for a period of 3 hours.
5. The Tank body shall be cylindrical and shall be made of Materials not less durable than steel (known as black steel) and the capacity of the tanker shall correspond to the thickness of its wall according to the following table:

Table:- F.1-T6 : Minimum thickness of the tanker vessel according to its capacity

Capacity (L)	Thickness (mm)
Up to 9000	4, and at the bottom of tanker 5
More than 9000	4, and at the bottom of tanker 6

* Lower thicknesses than those mentioned in the table shall be adopted if they conform to the approved high specifications.

6. The steel used shall conform to the approved international standards.
7. It shall include an upper space (above the liquid) to accommodate flammable liquids vapors, provided that this space is not less than 5% of the total capacity of the Tank.
8. The surface of the tanker body shall be intact and free from defects, and it is strictly prohibited to hide scratches and cracks in the tanker using car tinning pastes, etc.

9. A corrosion- resistant metal plate shall be installed on the base of the Tank near the front of the car on the right side bearing the following data:
   a) Name of Tank manufacturer.
   b) Date of manufacturing the Tank.
   c) The permitted Material and the total capacity of the Tank.
   d) The designed pressure of the Tank and the date of its testing.
   e) The type of metal used to manufacture the Tank and the type of liner used.
10. The Tank shall be equipped with internal partitions with equal distances and openings so that:
   a) The distance between each incisor shall not exceed 1.5 m and not be less than 90 cm.
   b) The thickness of the cutter is not less than the thickness of the metal used to manufacture the Tank itself.
   c) The area of the openings in the cutter shall not be less than 20% of the total area of the cutter.
11. The Tank shall be provided with an upper opening with a hinged cap, and equipped with openings that open automatically in the event of an increase in the internal pressure of the Tank in order to discharge the excess pressure.
   a) If the Tank is designed with sections to fill more than one product, a separate filling opening shall be made for each section.
   b) The perimeter of the Tank cap shall be provided with an insulating Material for the release of flammable liquids.
   c) The Tank cap shall be equipped with four openings, two of which shall be used to discharge the excess pressure of the flammable fluid vapor, one for ventilation, and one for measuring the level of the flammable fluid in the Tank.
12. The tanker shall be provided with a rear or side ladder that connects to the surface of the Tank for the purposes of inspecting and inspecting the tanker.
13. Front and rear bumpers shall be installed, painted with red and yellow phosphor lines, alternating and oblique, for ease of view.
14. The flammable liquid transport tanker shall be equipped with a clear and safe measurement device indicating the level of liquid in the Tank.

3.1.4.2.2. Discharge and Filling the Tanker:

1. The tanker shall be equipped with a gravity discharge pipe with a valve at its end.
2. The pumping rate shall not be less than 700 (liters/ Min).
3. When the need arises to install and use a pump for the liquid, it shall be of the approved and special type of the liquid itself.
4. The discharge pipe shall be provided with a metal cap with tight sealing.
5. The rear bumper shall protrude at a distance of not less than 20 cm from the discharge valve.
6. The tanker shall be provided with durable wooden pieces (crammed under the tires) to limit the movement of the vehicle during filling and discharge.
7. The base of the Tank shall be equipped on both sides with a copper angle with a thickness of not less than 6 mm for earthing purposes.
8. The earthing cable shall be tied adjacent to the filling point (Fig. F- 1- F2) with the copper corner fixed to the tanker structure during the filling and discharge process.
9. The tanker shall be stopped during the process of filling in the open air and in a place free of traffic, traffic of vehicles and individuals, and other obstacles that may hinder its rapid removal from its location in emergency situations.

10. The tanker engine shall be stopped during the filling and discharging of flammable liquids. All valves and connections of the tanker shall be completely closed and returned to their safe position. The ground Tank filling point shall be closed, before restarting the engine.
11. The driver may not stay inside the cockpit during filling and discharge of the tanker and even he shall be near the tanker to inspect the proper, safe and secure functioning of the operations.
12. Make sure of the type of liquid to be filled or discharged from the tanker before starting the discharge or filling process.
13. The process of discharge or filling shall be stopped immediately after the occurrence of a spill or an emergency rash of the flammable liquid. The fire extinguishers shall be prepared for the possible need, and the leaking liquid shall be immediately caped with sand, in preparation for its subsequent disinfection.

3.1.4.2.3. Precautionary Measures to Prevent Release:

1. A manual switch shall be installed to disconnect the electricity from the vacuum pump so that the switch is outside the tanker and accessible and to be used in emergency situations.
2. The connections from the tanker to the discharge hose (or any other valves) shall be durable and approved to ensure and confirm that they are free from possible leaks.
3. Discharge hoses shall be of types resistant to corrosion due to the effects of petroleum liquids and their lengths shall be approved.
4. Discharge hoses shall be equipped with easy- to- disassemble and easy- to- install couplings and ties.
5. Discharge hoses shall be kept intact and in special cabinets for the purpose or in special storage channels installed on both sides of the tanker.
6. There shall be a barrier (basin) around the filling opening, on the surface of the external Tank, to drain the liquid flowing around the filling openings in a safe manner. It shall be welded on the back of the Tank with a height of 10 cm ending with two drain pipes with a diameter of not less than 12 mm and extending to the bottom of the tanker from the back with two valves installed behind the rear bumper.

3.1.4.2.4. Fire Protection Requirements:

1. The Exhaust outlet of the flammable fluid transport Tanks shall be fixed downward and extended to the front of the vehicle and shall not exceed it and shall be equipped with a Spark Arrester.
2. A metal plate shall be installed behind the cockpit at a height of 25 cm from the ground to avoid leaks or the flow of flammable liquids on the exhaust pipe.
3. The tanker batteries shall be kept outside the engine,. They are allowed to be installed behind the cockpit (so that its driver can access them) and provided that they are in a ventilated, non- conductive box and from Materials resistant to flammable liquids.
4. The tanker shall be equipped with a manual disconnect breaker so that the driver can cut off the electrical circuit of the tanker (in addition to the automatic breaker).
5. All Electrical Installations (behind the tanker's cockpit) shall be in copper or galvanized iron pipes.
6. No electric cigarette lighter in the cockpit.
7. The tanker shall be painted white with a strip of 20 cm width painted red in the middle on the perimeter of the Tank with Alarm signs: Flammable - Danger, in white, in Arabic and English. The international Alarm sign for the portable flammable liquid shall be affixed to the tanker, provided that it is at least 15 cm high.
8. The HazChem poster shall be placed on the sides of the Tank and in the back and shall be at a level and position that is clearly visible from a distance.

9. It is prohibited to transport any Material in the tanker other than the Material authorized to be transported.
10. Tanks intended for the transport of one group of liquids shall not be used for the transport of another group until it has been ascertained that the Tank and all its pipelines and connections are completely empty from the first group.
11. The tanker shall be provided with 2 dry powder extinguishers of a capacity of 9 kg, taking into account the following:
    a) Placing extinguishers in a visible place behind the cockpit on the sides, or placing them on the structure under the tanker so that they are easy to bring, when needed.
    b) The driver shall be trained in the use of extinguishers.
12. Smoking is prohibited while driving (or filling or discharge) flammable liquids Tanks.
13. In the event that the tanker is parked on public streets, it shall be at least 15 meters away from any building or facility except the building designated for transporting liquids to it.
14. The tanker commander shall adhere to the minimum speed limits specified for the roads he takes so that the speed of the tanker is not less than it and does not increase with the installation of plates behind the tanker indicating the minimum speeds of the roads he takes.

3.1.4.2.5. Inspection and Maintenance of Tanks:

1. The tanker engine shall be apparently intact and free from any fuel leaks.
2. The tanker shall be subjected to periodic mechanical maintenance, so that it always works properly and safely.
3. The technical inspection of the tanker brake system shall be checked periodically. A permanent reference record shall be kept for its work, distances travelled, maintenance work and repairs, to be submitted to the competent authorities upon request.
4. Any maintenance operations of flammable liquids transport Tanks in closed places are prohibited.
5. It is prohibited to use open flames and any other sources of flammable in and during maintenance operations of flammable liquid transport Tanks.
6. The use of the tanker is allowed only after ensuring that it is safe, clean, free of flammable greases and oils, and that it is safe from flammable fluid leaks.
7. The tanker operator shall be familiar with the security and safety procedures related to the transport of flammable liquids, identify the nature of their dangers, ways to deal with them, and call emergency services in cases of fire.
8. The flammable liquids transport tanker shall be kept clean and washed daily properly and safely in accordance with the principles followed for the purpose.

3.1.4.3. Fire Protection Requirements for Bitumen Asphalt Transport Tanks:

3.1.4.3.1. The provisions of Clause (3.1.4.2) shall be adhered to when designing asphalt transport tankers and the color of the tanker may be gray or black.

3.1.4.3.2. If the tanker is used for asphalt spraying, the asphalt carried shall be liquefied by a liquid or gas Tank burner.

3.1.4.3.3. The basic components of an asphalt tanker burner include:
    a) Fuel Tank and fuel delivery pipes.
    b) Controls for regulating and stopping flammable.
    c) Ventilation means and burner gas discharge.

3.1.4.3.4. The General Directorate of Civil Defense shall be consulted to obtain the necessary license to operate the burner before starting its use.

3.1.4.3.5. The necessary periodic maintenance of the burner shall be carried out.

3.1.4.3.6. The surrounding of the burner shall always be kept clean and the accumulation of trash and flammable Materials shall not be allowed.

3.2 Liquefied Natural Gas (LNG)

Introductory Definitions:

Natural Gas: It is located above the petroleum layer in underground oil warehouses and is produced by its natural pressure that pushes it to the surface by accompanying oil in drilling operations. It consists of 85% methane, 10% ethane, 3% propane and other gases in very small proportions. It is lighter than air and is colorless and odorless unless an odor is added to it for alerting purposes. Its flammable concentration (in the air) ranged from 3.8% to 17%. It is used as a cooking fuel and in the manufacture of ammonia and in many petrochemical industries.

Liquefied Natural Gas (LNG): It is natural gas in its liquid state, and it is liquefied by extreme cooling to very low temperatures - below zero Celsius.

Tank: In this chapter, each Tank, cylinder, or container is called an LNG storage Tank.
Fixed Tanks: Non- movable Tanks, fixed in position.

Gas Detector: A device integrated with the sensor that senses and measures the proportion of gas, designed and assigned to it, around the location where it is installed. For the record, each gas has its own sensor and cannot be used for other gases.

Sensor: A sensor installed with a gas detector, especially for a specific gas. Some gas detectors have a multi- detection feature (of more than one gas) - because they contain more than one sensor. Others have a Sensor replacement feature – to detect multiple gases.

Solenoid Valve: An electromechanical valve (electrical part that moves a mechanical part) attached to a control device (panel) - used for gas or liquid - that stops the flow of gas or liquid if it receives an electrical signal from the control device.

Normally Close Valve: An electromechanical valve that remains closed if the electrical current is disconnected from it.

Normally Open Valve: An electromechanical valve that stays open if the current is disconnected.
Regulator Valve: A pre- set valve that does not allow the passage of gas at a pressure higher than the pressure calibrated thereon.

Safety Relieve Valve: A valve to relieve (by draining) excess pressure - automatically opens and closes when the designed pressure is exceeded - to maintain the internal pressure of the container on which the valve is installed.

Non- Return Valve: A valve that allows one- way flow of gas or fluid and the opposite is prevented.

Vaporizer: An Vaporizer using heat - receives the gas in its liquefied state and adds enough heat to convert it to the gaseous state - as a prelude to utilizing the gas in general uses such as heating, cooking, etc.

Cathodic Protection: Technology to control (or force the electric current to prevent (for example) the corrosion of the metal surface of an buried tank by making it a Cathode, by connecting (linking) the metal to be protected (i.e. the tank) to another metal that is easy to corrode to act as an anode. (Caution: The concept of corrosion is different from the concept of rust).

3.2.1 Preamble and General Requirements.

3.2.1.1 These Conditions are concerned with activities relating to the transport, handling, storage or handling of LNG within fixed Tanks or portable Tanks or through an extension network.

3.2.2 Fixed Tanks:

3.2.2.1 Storage site Requirements.

3.2.2.1.1 Tanks, cylinders and regulating equipment, used for storing gas or used in distribution facilities, shall be installed outside the building.

3.2.2.1.2 The intervals for LNG Tanks and cylinders shall be as per **Table:- F.1-T7** below:
Table:- F.1-T7: Interval for LNG Tanks

Minimum distance between adjacent gas Tanks (m)	Minimum distance between gas Tank and adjacent installations (m)	Water Capacity of Gas Container (L)
-	-	Less Than 500
1	3	500 – 2000
1.5	5	2001 – 7500
1.5	8	7501 – 63000
1.5	15	63001– 114000
¼ The sum of the diameters of adjacent containers and not less than 1.5 m	23	114001– 256000
	0.7 of Container Diameter and not less than 30.5 m	Over 256000

3.2.2.1.3 The distance between the Tank and any door, grill or vent of the adjacent building shall not be less than 3 m.

3.2.2.1.4 If the diameters of the Tanks exceed 3 m each, the distance between each two of them shall not be less than ½ of the total two diameters.

3.2.2.1.5 It is not permissible to install any natural gas Tank closer than 3 m from the nearest street or sidewalk. It is not permissible to install it closer than 15 m from the nearest railway main line.

3.2.2.1.6 The distance between the underground gas Tank and any adjacent structures shall not be less than 3 m.

3.2.2.1.7 The distance between the location of the gas Tank and the location of an above- ground Tank for a flammable liquid shall not be less than 15 m.

3.2.2.1.8 Gas network pipelines are not permitted to be erected under, or near, electrical line pipelines.

3.2.2.1.9 A concrete brick or metal mesh fence shall be erected around the gas ground Tanks, at a height of not less than 1.5 m.

3.2.2.2 Types of Tanks:

3.2.2.2.1 The types of natural gas storage Tanks relative to the installation location are divided as follows:

a) Ground Tanks (above ground).
b) UG Tanks

3.2.2.3 Main components of the Tank:

a) Body of Tank (Containing Gas).
b) Feeding and filling pipelines.
c) Valves.
d) Gas flow regulators.
e) Liquefied Gas Vaporizers.

3.2.2.4 Tank Specifications:

3.2.2.4.1 The gas Tank shall be designed and manufactured in accordance with the approved international standards.
3.2.2.4.2 The Tank shall be equipped with openings for all devices such as pressure gauge, safety valve in case of pressure increase and other necessary devices.
3.2.2.4.3 The Tank shall be coated with Materials resistant to gas reactions. If the stranded wire is used to protect the hose, it shall be of stainless steel.
3.2.2.4.4 The design pressure of the Tank shall not be less than the vapour pressure of the liquefied gas at its highest possible temperature. The design pressure of the safety valve shall be equal to 120% of the working pressure of the Tank.
3.2.2.4.5 A printed plate with the following data shall be affixed on the Tank:
a) The standard number on which the Tank is manufactured.
b) Tank capacity
c) Maximum pressure to withstand the Tank design (kg/ cm2).
3.2.2.4.6 The ground Tank shall be protected by a manually operated submersion cooling system by means of a valve near the Tank area, and automatically by heat detectors that operate the system when the temperature of the atmosphere surrounding the Tank increases to 50 °C, and the system operates for a period of not less than 50 minutes.
3.2.2.4.7 The Tank shall be equipped with a suitable earthing cable to discharge static electrical charges.

3.2.2.5 Design of LNG Tanks and containers:

3.2.2.5.1 All LNG containers shall be designed and made of the steel as per approved international standards.
3.2.2.5.2 The design of the supports (ground bases) of the LNG Tanks shall withstand the low heat effects usually caused by gas spills.
3.2.2.5.3 The external wall of double wall Tanks shall be designed to withstand the effects of pressure and discharge. The appropriate insulation Material shall be selected for the purpose.
3.2.2.5.4 In the event of the use of metal structural supports (ground bases), they shall be encapsulated with concrete or fire- resistant Material for a period of not less than two hours.
3.2.2.5.5 Fire rated bases of Tanks shall be constructed and fixed on concrete foundations.
3.2.2.5.6 The internal walls of the building containing the natural gas extension network shall be fire resistant for a minimum of two hours, and one of its walls shall be overlooking the outside.
3.2.2.5.7 Electrical devices installed on location, such as operating machines and switches shall be in accordance with British Standard BS4683 or its equivalent approved standards. Such devices shall be secured against the effects of weather factors.
3.2.2.5.8 The pipelines and Tanks shall be protected from damage that may arise from accidents of falling objects and omissions as a result of the construction and other works taking place in the area.

3.2.2.5.9 Gas Tanks and their pipelines shall be protected with anti- corrosion Materials.

3.2.2.5.10 It is not permitted to use cast iron, ductile iron or plastic in any of the natural gas pipelines. It is not permitted to use copper alloys, in which the percentage of copper exceeds 70% for the same purpose.

3.2.2.5.11 If any hoses are used for gas applications, their operational pressure shall be four times the gas explosion pressure. These hoses shall be made of Materials resistant to the effects of gas on them.

3.2.12.5.12 Safety valve assemblies and connections shall be of appropriate sizes to ensure that the required flow rate is provided from the Tanks equipped with such valve assemblies.

3.2.13.5.13 In the event that the Tank is exposed to high temperature, the rate of overpressure discharge shall be sufficient to ensure that the internal pressure of the Tank does not exceed 120% of the working pressure of the Tank.

3.2.2.6 Technical Installation Requirements for Tanks:

3.2.2.6.1 Tanks shall be installed on concrete bases and securely fastened.

3.2.2.6.2 LNG Tanks shall be installed in one assembly so that 90% of the external level (or top rooftops of the Tanks) shall be in one horizontal plane.

3.2.2.6.3 Tanks, regulators and valves shall not be buried underground unless a license is obtained from the General Directorate of Civil Defense.

3.2.2.6.4 A panel with the following data shall be installed on the Tank body:

1. Content identification tags.
2. Empty Tank weight - kg.
3. Water capacity of the Tank - liter.
4. The maximum filling of the Tank - liter.
5. Max filling pressure - bar
6. Gas condensate- kg/ m3.
7. Minimum Celsius temperature in design calculations.

3.2.2.6.5 All pipelines shall be painted in the distinctive colors of both liquid pipelines and gas pipelines.

3.2.2.6.6 Underground buried pipelines shall be protected with corrosion resistant Materials.

3.2.2.6.7 All vertical pipelines shall be tied with tight and suitable fixing means.

3.2.2.6.8 Threaded flanged connections shall be used as minimal as possible. Welded connections are preferred.

3.2.2.6.9 Pumps and regulators shall be suitable for use in gas circulation under conditions designed, for pressure and temperature.

3.2.2.6.10 The Tank and all its pipelines shall be connected to the grounding line.

3.2.2.6 Gas Extension Valves:

3.2.2.7.1 Gas pipe pipelines larger than 25 mm in diameter shall be equipped with the following:

1. Solenoid Valve of the Normally Close type to stop the gas in the event of a fire, and is attached to the main alarm panel of the building and the alarm panel of the gas detector system.
2. Non- Return Valve:
3. Manual Ball Valve close to the Tank for emergency use.

3.2.2.7.2 The Regulator Valve gas flow regulators used shall have drain openings equipped with protective covers, to cover the drain openings - to prevent them from clogging from dust.

3.2.2.7.3 The Safety Relieve Valve shall be installed to discharge the potential overpressure at the top of the Tank, so as not to exceed the internal design pressure of the Tank on the

overpressure is discharged towards the top, and at a height of 1 m from the surface of the Tank.

3.2.2.7.4 The ends of the gas discharge means (such as the discharge of the regulators and the safety valve) shall be placed to ensure their protection from accidental damage.

3.2.2.7.5 For overpressure discharge, safety valves shall be directly connected and permeable at all times with the gas compartment within the Tank.

3.2.2.7.6 The valves shall be placed in suitable locations to minimize the possibility of tampering with them.

3.2.2.7.7 It is prohibited to install any shut- off valves between the safety valves and the Tank.

3.2.3 Vaporizers:

3.2.3.1 Location Requirements.

3.2.3.1.1 The design of the Vaporizer shall be in accordance with the approved international standards, with the need to submit certificates of proof from the accrediting bodies.

3.2.3.1.2 The Vaporizer shall be designed to operate at an operating pressure not less than the higher discharge pressure of the LPG pump or the pressure of the Tank supplied to them, whichever is higher.

3.2.3.1.3 Vaporizers with a capacity of more than 4 liters shall be provided with a safety valve, at least one, suitable for use with natural gas, so that it opens at a pressure not less than the upper limit of the operating pressure and not more than 10% above it.

3.2.3.1.4 The safety valve discharge opening shall end outside the Vaporizer building in a vertical upward direction.

3.2.3.1.5 No electrical (exothermic) means shall be installed to vaporize LNG inside the Tank.

3.2.3.2 Vaporizer Location Requirements.

3.2.3.2.1 The distance between the direct flame Vaporizer and the location of the Tanks or any other hazardous Materials shall not be less than 15 m.

3.2.3.2.2 The location of the Vaporizers, which are not operated by direct flame, shall be chosen so that they are far from the nearest facility or assembly according to **Table:- F.1-T8** below:

Table:- F.1-T8 : Spaces between LNG Vaporizers and the nearest facility or combination

Minimum distance between the Vaporizer and the nearest facility or complex (m)	Vaporizer's Power (KG/ Hr)
3	Up to 40
7.5	40 to 230
15	More than 230

3.2.3.2.3 Immediately flamed Vaporizers shall be kept at least 15m away from gas storage containers.

3.2.3.2.4 Any direct flame- operated Vaporizers shall not be connected to a Tank having a storage capacity less than ten times the evaporation capacity per hour.

3.2.3.3 Vaporizers Building Requirements.

3.2.3.3.1 Construction elements and Specifications.

1. Ceilings, walls and floor shall be constructed of fire- resistant Materials for a period of not less than 4 hours.
2. Openings shall be made to discharge the potential pressure of any gas explosion, in one of the walls or roof of the building, so that these openings are constructed in the area that poses the least possible danger.
3. The floor of the Vaporizers building shall be free of any openings for liquid drainage and succession.

3.2.3.3.2 Ventilation of Vaporizers Buildings.

1. Upper and lower natural ventilation shall be provided to refresh the air of the storage building at least 6 times per hour.
2. The distance between the lower air vents and the floor of the building shall not be less than 15 cm and not more than 1m.
3. The distance between any two adjacent air vents shall not be less than 1.5 m.
4. In the event that natural ventilation is not possible or natural ventilation is insufficient at the above required rate, separate mechanical ventilation shall be installed to refresh the air of the warehouse building at least 6 times per hour, provided that this mechanical ventilation works continuously and that it is of spark insulation type and that this ventilation is linked to the alarm system of the building (the main alarm panel of the building).

3.2.3.3.3 Electrical Installations of Vaporizers Buildings.

1. All electrical equipment shall be of spark insulation type.
2. The light bulbs shall be of the type that does not radiate heat.
3. The light bulbs shall be installed in the ceilings or on the upper areas of the walls.
4. Light bulbs shall be protected with protective covers against breakage and from climate influences.

3.2.4 Transportation and filling of liquefied natural gas:

3.2.4.4.1 Natural gas shall not be packed in any Tank unless approved Materials with a characteristic odor are added to it, so that it is inferred from the gas when it is an emergency leak at a concentration of 25% of the minimum combustion in air.

3.2.4.4.2 The new Tank shall be dried before filling it, by passing dry nitrogen gas in it and then ensuring (using gas detectors) that the concentration of hydrocarbon vapors in it has decreased to less than 25% of its minimum combustion, with the need to subject the Tank to the highest designed static pressure before filling and using it.

3.2.4.4.3 A Tanker in which release is detected at the filling location may not be filled. It shall be immediately withdrawn to a safe place (in accordance with the procedures for this) with the evacuation of the area and the summoning of the owner and the General Directorate of Civil Defense.

3.2.4.4.4 The area of LNG release can be distinguished by the vapor cloud caused by the condensation of water vapor in air.

3.2.4.4.5 The natural gas Tank may not be filled with more than 90% of its capacity.

3.2.4.4.6 Indicative and warning signs shall be placed at the filling point of the LNG Tank and include the following statements: Danger, NO SMOKING, LPG Filling Point.

3.2.4.4.7 The tanker shall be connected to the grounding cable before and during the LNG discharge and filling process.

3.2.5 Fire prevention:

3.2.5.5.1 The Tanks' area and gas consumption areas shall be provided with a gas alarm system, so that the system alarms those on location and gives a signal for the automatic shut- off valve to work when the concentration of gas released into the air reaches 25% of the minimum gas explosion. The gas alarm system consists of a control panel and gas detectors. This equipment and all items connected to it and works through it shall be manufactured according to the approved international standards.

3.2.5.5.2 Warning signs shall be placed in the Tank area with the following statements: LNG, No Smoking, No Open Flame, No Heating Equipment, and No Soldering Equipment.

3.2.5.5.3 Smoking, open flames, the use of heating and welding equipment to the nearest 3 m from any natural gas Tank shall be prohibited during the filling process.

3.2.5.5.5 No employer or worker shall fill natural gas in any Tank or cylinder that is not intended or designed for natural gas purposes.

3.2.5.5.6 At least one competent person with sufficient experience in this field shall be present during the process of filling or transporting natural gas.

3.2.5.5.7 The location shall be provided with suitable hand extinguishers during the transportation and filling of natural gas in accordance with the General Directorate of Civil Defense requirements.

3.2.5.5.8 HazChem shall be applied to natural gas Tanks.

3.2.6 Maintenance:

3.2.6.6.1 All pressure Tanks and their accessories, natural gas piping networks, Vaporizers, damage controls, etc., shall be maintained and always ensured that they are intact and functioning properly.

3.2.6.6.2 The necessary periodic maintenance of the Tanks, valves and electrical devices belonging to their uses, shall be carried out by a specialized technical body.

3.2.6.6.3 Periodic maintenance of Tanks, pipelines, valves and Vaporizers shall be carried out in accordance with the manufacturer's instructions to ensure the safety of this equipment. Records of periodic maintenance work shall be prepared and always provided to inform the General Directorate of Civil Defense upon request.

3.2.6.6.4 All the above mentioned LNG conditions shall be applied as per the activity.

3.3 Liquefied Petroleum Gas (LPG)

Introductory Definitions:

Liquefied Petroleum Gas (LPG): A petroleum product generally consisting of a mixture of 20 or 25% propane and 80 or 75% butane. A heavier- than- air, colorless, non- toxic gas with a flash point of - 37.8 °C and a flash point ranging from 426.7 °C to 537.8 °C. Produced as a secondary component in petroleum refining operations. It is pressurized at normal temperatures and stored in cylinders and containers for use in cooking, lighting and heating, and as fuel for some internal combustion engines.

Gas Exploitation Location: the place where the pipelines of the gas network end, such as kitchens and manufacturing halls in factories, laboratories and the like, in which gas is exploited by combusting it in cooking equipment, furnaces or combustion devices.

Gas Detector: A device integrated with the sensor that senses and measures the proportion of gas, designed and assigned to it, around the location where it is installed. For the record, each gas has its own sensor and cannot be used for other gases.

Sensor: A sensor installed with a gas detector, especially for a specific gas. Some gas detectors have a multi- detection feature (of more than one gas) - because they contain more than one sensor. Others have a Sensor replacement feature – to detect multiple gases.

Solenoid Valve: An electromechanical valve (electrical part that moves a mechanical part) attached to a control device (panel) - used for gas or liquid - that stops the flow of gas or liquid if it receives an electrical signal from the control device.

Normally Close Valve: An electromechanical valve that remains closed if the electrical current is disconnected from it.

Normally Open Valve: An electromechanical valve that stays open if the current is disconnected.

Pressure Regulator Valve: A pre- set valve that does not allow the passage of gas at a pressure higher than the pressure calibrated thereon.

First Stage Regulator: First Stage Regulator placed on the gas main feed pipe.

Second Stage Regulator: Second Stage Regulator to be placed on the gas pipelines and after the initial pressure regulator.

Final Stage Regulator: Final Stage Regulator is a regulator to be placed on gas pipelines and just before the gas exploitation equipment.

Safety Relieve Valve: A valve to relieve (by draining) excess pressure - automatically opens and closes when the designed pressure is exceeded - to maintain the internal pressure of the container on which the valve is installed.

Non- Return Valve: A valve that allows one- way flow of gas or liquid and the opposite is prevented, also called a Check Valve.

Vaporizer: A Vaporizer using heat, receives the gas in its liquefied state and adds enough heat to convert it to the gaseous state, in preparation for utilizing the gas in general uses such as heating, cooking, etc.

Cathodic Protection: Technology to control (or force the electric current to prevent (for example) the corrosion of the metal surface of an oil buried tank by making it a Cathode (negative pole), by connecting (linking) the metal to be protected (i.e. the tank) to another metal that is easy to corrode to act as an anode (positive pole). (Caution: The concept of corrosion is different from the concept of rust).

3.3.1 Preamble and General Requirements.

3.3.1.1 This chapter is concerned with the conditions to be met and the appropriate precautions for fire protection regarding the transport, circulation or storage of liquefied petroleum gas before obtaining the required approval from the General Directorate of Civil Defense.

3.3.1.2 The application of the approved standard for the conditions of workers in the field of liquefied petroleum gas shall be adhered to.

3.3.1.3 Any activities or works related to the storage, transportation or distribution of LPG cylinders may be carried out without obtaining the prior approval of the General Directorate of Civil Defense.

3.3.1.4 All liquefied petroleum gas Tanks and cylinders and their accessories used in the circulation of gas shall be in accordance with the approved international standards.

3.3.1.5 Handled gas cylinders shall conform to the approved standards.

3.3.1.6 Only one gas cylinder with a smile not exceeding 13 kg shall be allowed for each kitchen in residential buildings up to the twentieth floor only, and for the higher floors, the rest of the floors. The cylinders shall be replaced by a central gas network or electrically operated cooking equipment.

3.3.1.7 Licensed Activities:

1. Storing gas in fixed Tanks.
2. Storing LPG cylinders in the main warehouses and distribution places.
3. Storing small gas cylinders and containers or offering them for sale.
4. Gas transport vehicles with cylinders or movable containers.
5. Gas transport tankers.
6. Gas cylinder refilling and maintenance plants.
7. Gas transmission lines and networks, except for what falls within the scope of the Law on the Preservation of Petroleum Wealth.

3.3.2 Stores of liquefied petroleum gas cylinders (gas sections).

3.3.2.1 The following requirements apply to liquefied petroleum gas (LPG) cylinder stores and the locations, on which they are located, in addition to the elements and specifications of construction, electrical wirings, ventilation and lighting, and the storage requirements to be met in these stores.

3.3.2.2 Storage site requirements.

3.3.2.2.1 The storage site shall be at a distance of not less than 15 m from neighboring buildings, public places and parking lots.

3.3.2.2.2 The storage site shall be at least 25 m away from hospitals, schools and gas stations. Neighborhood storage is not permitted.

3.3.2.2.3 The external yards of the storage site shall be paved and free from weeds and objects that obstruct access to the location and the ease of removing cylinders from it.

3.3.2.3 Storage Building Requirements:

3.3.2.3.1 Construction elements and Specifications:

1. The building shall be constructed of one floor (ground floor only) and shall have regularly distributed doors, ventilation windows and natural lighting.
2. All walls and floor shall be made of Materials with a fire resistance of not less than two hours.
3. The location shall be on at least one street.
4. The design of the building shall take into account the possibility of making pressure discharge openings for any potential explosion in the direction that constitutes the

least possible danger to the storage building. The roof shall be made of light fire-resistant Materials to discharge the potential explosion pressure.

5. The height of the walls of the building shall not be less than 4 m.
6. The width and height of the main entrance shall not be less than 4 m.
7. The floor of the building shall be constructed of concrete or asphalt with a thickness of not less than 15 cm and with a soft, shockproof and fire resistant finish. The floor shall be free of any drainage openings and the like.
8. The level of the floor of the building shall be equal to the level of the floor of the front yard.
9. A room for the warehouse official can be added within the building with an area of no more than 6 m2, provided that it is isolated from the rest of the building and has windows that look directly outside.
10. At least one emergency exit shall be provided to the storage building, so that it is on a different side than the main entrance.

3.3.2.3.2 Ventilation Requirements:

1. Upper and lower natural ventilation shall be provided with permanent openings to refresh the air of the storage building at least 6 times per hour.
2. The height of the upper and lower ventilation window bases shall not be less than 2.5 m and less than 15 cm from the floor of the warehouse.
3. The distance between any two adjacent air vents shall not be less than 1.5 m and not more than 2 m.
4. In the event that natural ventilation is not possible or natural ventilation is insufficient at the above required rate, separate mechanical ventilation shall be installed to refresh the air of the warehouse building at least 6 times per hour, provided that this mechanical ventilation works continuously and that it is of spark insulation type and that this ventilation is linked to the alarm system of the building (the main alarm panel of the building).

3.3.2.3.3 Requirements for Electrical Installations for Gas Cylinder Storage Building:

1. The height of the electrical wiring and installations shall not be less than 2 m from the floor of the warehouse, and the keyboard shall be outside the warehouse and shall be of the tightly closed type.
2. Electrical fixtures, installations and lamps shall be of the type conforming to the approved and special standards for areas with hazardous atmospheres containing explosive gases and shall be spark- proof and not radiate heat.
3. The light bulbs shall be of durable types and shall have protective covers against breakage, gas release, etc.. The light bulbs shall be installed in the ceiling or on the upper areas of the walls.

3.3.2.4 Cylinder Storage Requirements:

3.3.2.4.1 Cylinders shall be stored on top of each other according to the number allowed by the manufacturer inside cages (cylinder container) equipped for the purpose, so that they are in an vertical position (upward valve).

3.3.2.4.2 A fire- resistant partition wall (concrete bricks) shall be erected between the cylinders, so that they are distributed into groups as specified in **Figure:- F.1-F7** if the size of one cylinder exceeds 50 kg and its number is 100 cylinders or more. The dimensions increase directly with the increase in the number of cylinders.

3.3.2.4.3 The storage height shall not exceed 3 m.

3.3.2.4.4 Corridors shall be made between storage rows with a width of not less than 1 m where each cage is considered as a separate storage row by itself.

3.3.2.4.5 The distance between the walls and the storage rows shall not be less than 1 m.

3.3.2.4.6 Empty cylinders shall be stored in the same manner as filled cylinders.

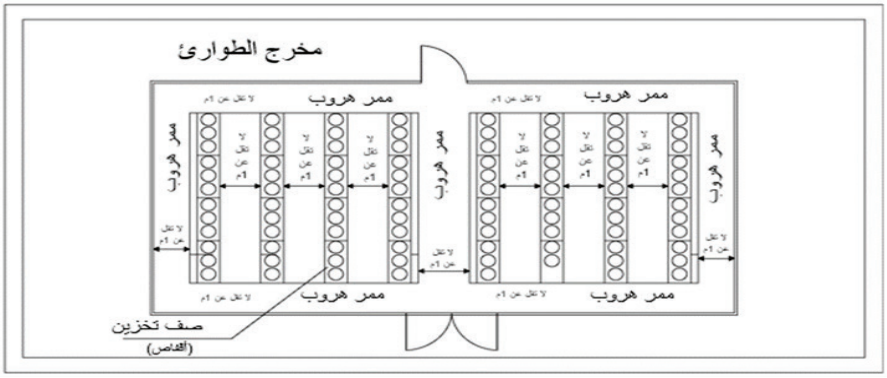
3.3.2.4.7 A part of the building shall be allocated for storage of empty cylinders. Signs showing and distinguishing the filled cylinders from the empty ones, shall be placed.

3.3.2.4.8 If small gas cylinders are stored, they shall be placed on specially equipped metal shelves.

3.3.2.4.9 It is prohibited to contain any other flammable Materials in the storage building. It is also prohibited to use cooking burners, heaters, or any other heat sources inside it.

3.3.2.4.10 In all cases, it is prohibited to make any attempts to fill or discharged between gas cylinders inside the warehouse, designated for storage only.

3.3.2.4.11 In all cases, it is prohibited to store gas cylinders outside the locations and buildings designated for this purpose. It is also prohibited to place them on street sidewalks, in places lower than ground level, or near sewer openings, even if for a short period.



Emergency exit, fire escape
Escape corridor
Storage Row (Cages)
not less than 1 m

3.3.2.4.12 General Precautionary Conditions:

1. The warehouse shall be equipped with dry powder type manual fire extinguishers. Their numbers are determined before the General Directorate of Civil Defense according to the area of the warehouse.
2. The warehouse shall be equipped with a manual or automatic alarm system that is carried out in accordance with the recommendations of the General Directorate of Civil Defense.
3. The use of furniture and flammable Materials in the room of the warehouse official shall be minimized as much as possible.
4. The warehouse shall be equipped with warning signs, to be placed in suitable places, as follows: No smoking, Danger, liquefied petroleum gas, no entry for non-specialists, provided that they are in Arabic and English and in letters not less than 10 cm high.
5. A clearly visible signboard shall be placed, so that it is easy and quick to observe and understand, indicating the procedures to be followed in the event of an emergency.

3.3.3 Fixed Tanks for liquefied petroleum gas.
Introductory Definitions:

Fixed Tanks: They are pressure Tanks installed in place and in situ with different capacities designed to store LPG in its liquid and gaseous state at normal temperature.

3.3.3.1 This clause is concerned with the precautions and fire requirements to be met regarding ground and underground LPG Tanks for the supply of gas to industrial, commercial and residential locations, to use it for public purposes and uses.

3.3.3.2 LPG Tank Location Requirements:

3.3.3.2.1 The General Directorate of Civil Defense approval in addition to the approvals of other relevant authorities, regarding the chosen location for the LPG Tank, shall be obtained.

3.3.3.2.2 The location of the Tanks shall be away from populated places.

3.3.3.2.3 It is prohibited to place or use LPG Tanks in tunnels (underground) or in open pits.

3.3.3.2.4 The Tank shall be buried if it is constructed underground with dry and clean sand as shown in **Figure:- F.1-F8.**

3.3.3.2.5 Excavations or dips in the direct floor of Tank locations and associated connections shall be avoided.

3.3.3.2.6 The minimum intervals for the Tanks shall be as shown in **Table:- F.1- T9.**

3.3.3.2.7 When installing multiple Tanks on location, they shall be of identical dimensions (sizes) and on one level.

3.3.3.2.8 It is prohibited to erect Tanks on top of each other.

3.3.3.2.9 The number of Tanks in one set shall not exceed six Tanks.

3.3.3.2.10 The distance between one group of Tanks and other groups shall not be less than 8 m except in cases where the Tanks have special protection reasons for its purpose, such as separation concrete protection walls or water curtain system * Water Curtain. This protection shall be approved by the General Directorate of Civil Defense.

3.3.3.2.11 The distance between the ground Tank of liquefied petroleum gas and the ground Tank of a flammable liquid shall not be less than 6m. The distance between the gas Tank and the protective wall (basin) around the flammable or combustible liquid Tank shall not be less than 3 m.

3.3.3.2.12 The distance between the LPG Tank and an oxygen Tank with a volume of 566 m3 (or less) shall not be less than 6m. This distance shall not be less than 15 m if the volume of the oxygen Tank is greater than 566 m3.

3.3.3.2.13 The distance between the LPG Tank and the hydrogen gas Tank with a volume of 85 m3 (or less) shall not be less than 7.6 m. This distance shall not be less than 15 m if the volume of the hydrogen gas Tank is greater than 85 m3.

3.3.3.2.14 The distance between the tank wall and the nearest combustion point or highway shall not be less than 6 m.

3.3.3.2.15 The distance between the Tank installations and the unprotected floor openings (tightly closed) shall not be less than 3 m.

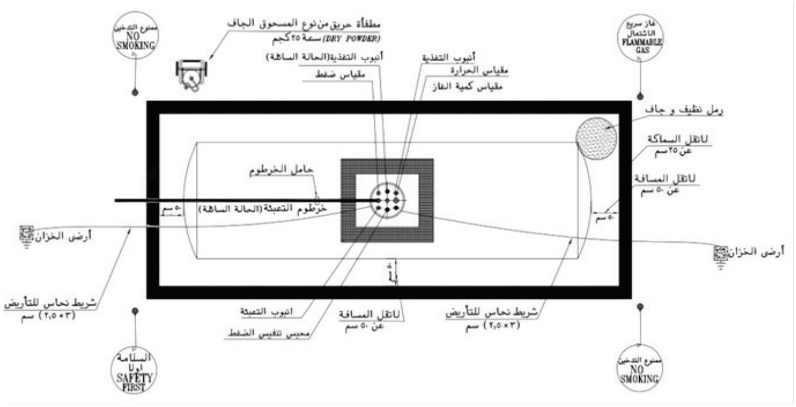
3.3.3.2.16 The distance between the Tank installations and the intake and ejection fans or air conditioning equipment shall not be less than 6 m.

3.3.3.2.17 It is prohibited to construct a liquefied petroleum gas Tank within a fence containing flammable liquid Tanks.

3.3.3.2.18 The area around the Tanks shall be free of weeds or any flammable Materials for a distance of not less than 6 m. It is also prohibited to use insecticides, especially sodium chlorate, in the area around the Tank.

3.3.3.2.19 A metal wire fence shall be constructed with openings not exceeding 12 cm2. Its height shall not be less than 3 m. The fence shall have more than one exit, provided that the width of the exit shall not be less than 3 m.

Waterproof Concrete
Copper bar (3m)
Tank floor
Dry powder fire extinguisher 25kg
Grounding copper tape (3x2.5) cm
The distance shall not be less than 50 cm
Thickness shall not be less than 25 cm
Vent cap
pressure gauge
Feeding pipe (liquid state)
thermometer
Feeding pipe
Gas Quantity Meter
Manhole
Pressure relief valve
Filling pipe
Hose holder
Filling hose (liquid state)
Earth Clamp
5m Earthing Cable
Filling ground (tanker)
Clean and dry sand
The tank bases are fire resistant for a minimum of 4 hours
Tank anchor bolts
Waterproof Concrete



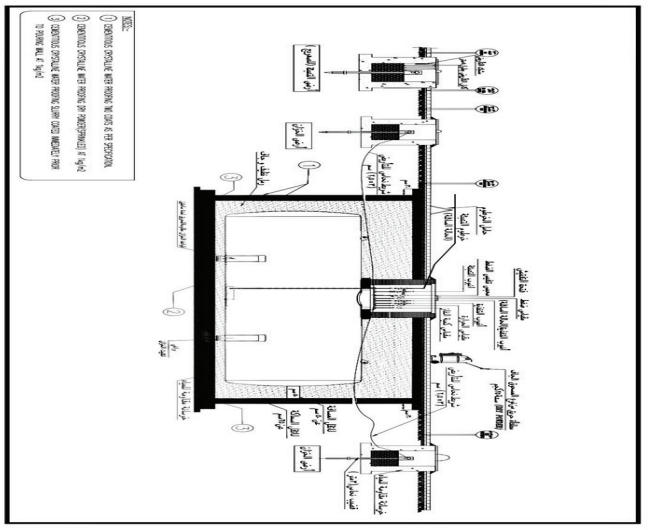
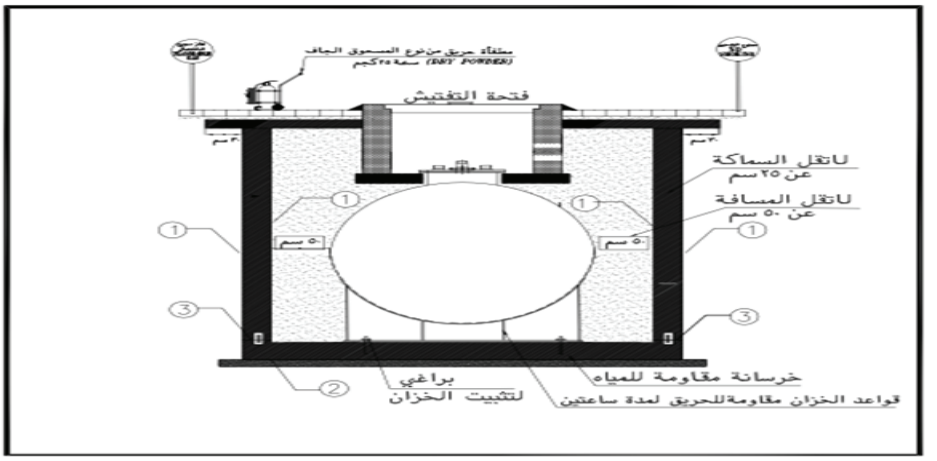


Figure:- F.1-F7: LPG Steel Underground Tank

Figure:- F.1-F8: Underground Tank of solid iron for liquefied petroleum gas

Flammable gas
Clean and dry sand
Thickness shall not be less than 25 cm
The distance shall not be less than 50 cm
Tank floor
Dry Powder Fire Extinguisher 25kg
Feeding pipe (liquid state)
pressure gauge
No Smoking
Hose holder
Filling hose (liquid state)
Tank floor
Grounding copper tape (3x2.5) cm
The distance shall not be less than 50 cm
Filling pipe
Pressure relief valve



Dry Powder Fire Extinguisher 25kg
Manhole
Thickness shall not be less than 25 cm
The distance shall not be less than 50 cm
Waterproof Concrete
Tank anchor bolts
Tank Bases for 2 Hour Fire Resistance

Table:- F.1-T9: Minimum intervals between Tanks and adjacent buildings and installations

Tank Water Capacity (m^3)	Tank water capacity (gallons)	Underground or Telly Tank (m)	Ground Tank (m)	Distances between tanks in one group (meters)
≤ 1.0	≤250	3	3	0
+1.0 – 1.9	+250 – 500	3	3	1
+1.9 – 7.6	501 – 2.000	3	7.6	1
+7.6 – 114	2.001 – 2.000	15	15	1.5
+114 – 265	30.001 – 70.000	15	23	1/4 sum of the diameters of the total adjacent tanks
+265 – 341	70.001 – 90.000	15	30	
+341-454	90.001 – 120.000	15	38	
+454 – 757	200.000 - 120.001	15	61	
3785 - +757	200.001 - 1,000.000	15	91	
>3785	>1,000.000	15	122	

Note: These distances are calculated to protect the Tanks from the radiation heat of any neighboring fire that may break out and also ensure the full spread and dissipation of the gas in the event of release.

3.3.3.3 Types of Fixed LPG Tanks.

1. Ground Tank It is constructed above ground.
2. UG Tanks: It is constructed underground.
3. Mounded Tank: The Tank of its lower half is buried (completely buried in sand below the surface of the earth) while its upper half is completely covered in sand and visible as a hill above the surface of the earth - due to its little exposure to sunlight.

3.3.3.4 Components of LPG Tanks:

The Tank consists of (1) the Tank body,(2) gas evaporation devices (to convert it from its liquid to gaseous state, in preparation for benefiting from its uses), and (3) pipelines and valves.

3.3.3.5 Fixed tank Requirements:

3.3.3.5.1 Gas Tanks shall be designed, manufactured and tested in accordance with the approved international standards, provided that their testing takes into account the maximum temperature, to which the Tank body may be exposed in emergency cases.

3.3.3.5.2 The installation of the Tanks shall be carried out by companies specialized in liquefied petroleum gas works, provided that these companies are registered and approved by the competent authorities.

3.3.3.5.3 The Tank shall be equipped with all its openings, designated for Pressure Gauge, Safety Relief Valve, and Tank Content Meter.

3.3.3.5.4 The Tank shall be coated with Materials resistant to the effects of gas on the Tank. If the stranded wire is used to protect the filling hose (or any hose in the gas network), the wire shall be stainless steel.

3.3.3.5.5 The design pressure of the Tank shall not be less than the vapor pressure of the liquefied gas at the highest possible temperature to which the Tank may be exposed. The safety valve shall be designed at 120% of the working pressure allowed for the Tank.

3.3.3.5.6 A guide plate for the Tank shall be installed with the following data:

1. Type and number of Tank design specification.
2. The name of the manufacturer, the serial number of the Tank, and the year of manufacture.
3. Operating pressure and maximum design pressure of the Tank.
4. Tank capacity

3.3.3.5.7 The Tank shall be equipped with two brackets used for installation purposes.

3.3.3.5.8 The Tank shall be equipped with a suitable earthing cable to discharge static electrical charges.

3.3.3.6 Technical Installations for Fixed Tank installations:

3.3.3.6.1 Requirements for Ground Tank installations:

1. Tanks shall be installed on steel (rust- proof) or concrete bases not higher than 10cm above the surface of the concrete base constructed under the Tank.
2. Bases shall be non- expandable and non- shrinkable but allow expansion and contraction of the Tank as a result of normal changes in normal temperatures, and in a location that allows the minimum torque and deviations to be given to the Tank body.
3. In the event that the bases of the Tank are within the body of the horizontal Tank, whose water capacity exceeds 5000 liters, the Tank shall be provided with a means of fixation from one end and keep the other end free to allow the expansion and contraction of the Tank as a result of normal temperature changes, and that the pipe

installations transporting liquefied gas and vapors at the fixed end of the Tank,. When the substrates are not welded to the body of the Tank, they shall be formed so as to fit the body of the Tank.

4. The Tank bases shall be designed to allow the drainage of potential pools of water under the Tank.
5. The movement of the Tank against the floods shall be secured, whether by installing it or by raising the Tank bases to the level that achieves the purpose.
6. The Tank shall be chemically treated to resist rust, in addition to painting it from the outside with reflective colors of sunlight, preferably white.
7. The Tank shall be protected by a manually operated submersion cooling system by means of a valve near the Tank area, and automatically by heat detectors that operate the system when the temperature of the atmosphere surrounding the Tank increases to 50°C, and the system operates for a period of not less than 50 minutes.

3.3.3.6.2 Requirements for underground Tank installations:

1. The Tank shall be placed in a concrete room that is waterproofed **Figure:- F.1-F7.** The Tank shall also be coated with a rust- resistant layer and provided with Cathodic Protection.
2. The Tank shall be buried with clean and dry sand.
3. The diameter of the manhole shall not be less than 55 cm.

3.3.3.7 Requirements for pipelines and connections:

3.3.3.7.1 Liquefied gas (LNG) installations and connections shall be made of copper, steel iron or polyethylene, including carbon steel or brass in accordance with approved international standards. It is prohibited to use cast iron in its manufacture.

3.3.3.7.2 The Tank filling hose pipe(s) shall be approved for its purpose and provided with a safety valve for overpressure discharge and an automatic isolation valve. The filling pipe closes when accidentally separated from the gas transfer Tank during filling.

3.3.3.7.3 Seamless carbon steel gas pipes shall be of a size not less than 40. Sch) in accordance with the specifications (36.10 ASTM A3, ASTM A106, ASME) or equivalent Materials manufactured according to the approved international standards.

3.3.3.7.4 Metallic gas lines shall be connected according to **Table:- F.1-T10**

3.3.3.7.5 In populated areas, the gas filling point shall be contained within an airtight metal box protected from tampering and 1.8 m above the ground.

3.3.3.7.6 The gas pressure shall not exceed 2 bar when polyethylene pipes are used and the gas is in its gaseous state. The pipelines are allowed to be outside the building only and buried underground.

3.3.3.7.7 In the event that gas pipelines enter any building, the gas pressure shall not exceed 1.38 bar and shall be in its gaseous state only. The competent authority may allow an increase in pressure in industrial facilities.

3.3.3.7.8 Metallic gas lines shall be connected according to the following table:

Table:- F.1-T10: LPG Metallic Wiring Connection Methods

Gas Condition	*Schedule* 40	*Schedule* 80
Liquid	Welding	Welding or Threaded
Gas with pressure < 9 bar	Welding or Threaded	Welding or Threaded
Gas with pressure ≥9 bar	Welding	Welding or Threaded

3.3.3.7.9 The melting point of the Gasket (for gas release insulation between joints) shall be above 815°C.

3.3.3.7.10 pipelines shall be installed on special brackets on (or near) walls for a distance not exceeding 50 cm (to protect them from damage) and marked with yellow color, and shall be at the maximum possible distance from other service lines.

3.3.3.7.11 In the event that the competent authority requires that gas pipes be placed under floors or within walls, they shall be protected against corrosion and rust, and the pipes shall be without connections, except in cases where the installation of these connections cannot be avoided, as this shall be only with the approval of specialists.

3.3.3.7.12 Flexible connections (hoses), used for burner installations - shall be made of heat- resistant Materials and the effects of petroleum gases. In the event that a strand of braided wire is used to strengthen the gas carrier hose, it shall be made of stainless steel.

3.3.3.7.13 In all cases, it shall be ensured that air does not enter the gas line.

3.3.3.7.14 The underground Tank pipelines from the upper surface of the Tank shall be as specified in **Figure:- F.1-F8.**

3.3.3.7.15 The readiness of gas pipelines shall be tested before use by compressing them to 150% of their operational pressure.

3.3.3.7.16 Gas lines shall be tied to the earthing cable.

3.3.3.8 LPG Tank Valves and Regulators Requirements:

3.3.3.8.1 The installations shall be provided with automatic shut- off valves in the event that the gas flow is higher than its rate, as well as check valves and safety valves to discharge the excess pressure, Safety Relief Valve on the main line to supply gas in accordance with the General Directorate of Civil Defense Requirements.

3.3.3.8.2 The gas main line shall be provided with a solenoid valve for automatic shut- off connected to the emergency gas alarm panel.

3.3.3.8.3 The main line (near the gas source), gas Section lines feeding more than one burner (or gas-powered equipment) and their Separate lines shall be provided with manual shut- off valves.

3.3.3.8.4 A safety valve shall be installed to discharge the excess pressure at the top of the Tank so that the working pressure does not exceed the maximum design pressure of the Tank so that it works at a pressure of 120% of the working pressure of the Tank, provided that the direction of the drain pipe opening is upward and that the pipe is visible outside to the open air and at a height of not less than 1 m above the ground.

3.3.3.8.5 The placement of the ends of the discharge means and equipment shall be secured to ensure their protection from damage.

3.8.6 The placement of the valves shall be arranged in such a way as to prevent them from being tampered with.

3.3.3.8.7 It is prohibited to install shut- off valves between the relief valves and the Tank.

3.3.3.8.8 The drainage openings of the regulators used shall have covers that protect them from blockage.

3.3.3.8.9 Excess pressure relief valves shall at all times be in direct contact with the gas compartment within the Tank.

3.3.3.9 Vaporizers (Gas Vaporizers) Requirements:

3.3.3.9.1 General Conditions:

1. Vaporizers with a capacity of more than 4 liters shall be provided with a safety valve, at least one, suitable for use with liquefied petroleum gas, so that it opens at a pressure not less than the upper limit of the operating pressure and not more than 10%.

2. The outputs of the safety valve shall be discharged, vertically upwards - to the outside of the Vaporizer building.
3. It is prohibited to install any electrical device that emits heat to evaporate the gas inside the Tank.

3.3.3.9.2 Vaporizers Locations:

1. The selected location, for a Vaporizer operated with a direct flame, shall not approach more than 15 m from the location of the gas Tank.
2. For vaporizers operated by indirect flame, the distance between the chosen location and the nearest installation or collection shall be determined according to the following table:

Table:- F.1- T11: Indirect flame operated Vaporizer intervals (depending on capacity) to the nearest facility

Vaporizer power (kg/ Hr)	Minimum distance allowed between Vaporizer and nearest building or complex (m)
Less Than 40	3
40 – 230	7.5
Over 230	15

3. The distance between vaporizers operated with direct flame shall not be less than 15 m from any gas storage Tanks.
4. Any direct flame- operated Vaporizers shall not be connected to a Tank having a storage capacity less than ten times the evaporation capacity per hour.

3.3.3.9.3 Vaporizers Building:

1. All ceilings, walls and floor of the Vaporizers building shall be constructed of fire-resistant Materials, so that this resistance is not less than 4 hours.
2. Openings shall be made to discharge the potential pressure of any gas explosion, in one of the walls or roof of the building, so that these openings are constructed in the area that poses the least possible danger.
3. The floor of the building shall be free of any drainage openings.

3.3.3.9.4 Ventilation of Vaporizers Building:

1. The design of the Vaporizers building shall take into account the construction of upper and lower natural air vents to refresh the air of the Vaporizers building at least 6 times per hour.

2. The bases of the lower ventilation windows shall be 15 cm above the floor of the building, and the distance between any two adjacent openings shall be within 1.5 m to 2 m.
3. In the event that natural ventilation is not possible or natural ventilation is insufficient at the above required rate, separate mechanical ventilation shall be installed to refresh the air of the warehouse building at least 6 times per hour, provided that this mechanical ventilation works continuously and that it is of spark insulation type and that this ventilation is linked to the alarm system of the building (the main alarm panel of the building).

3.3.3.9.5 Electrical wirings for Vaporizers Building:

1. The electrical fixtures, installations and lamps of the Vaporizers building shall be of the type conforming to the approved standards for the atmosphere surrounded by explosive gases and shall be of spark insulation from and shall not radiate heat.
2. The light bulbs shall be strong, have protective covers, and be installed in the ceiling or above the walls.

3.3.3.10 General Preventive Requirements for LPG Tanks:

3.3.3.10.1 Warning signs shall be placed around the Tank area on which shall be written No Smoking, No Use of Open Flame, Combustion Gas - in Arabic and English, so that they are clear and of appropriate measurements.

3.3.3.10.2 All installations, devices and LPG shut- off valves shall be marked in yellow.

3.3.3.10.3 LPG detectors shall be installed throughout the LPG buildings and in the necessary locations, as requested by the General Directorate of Civil Defense.

3.3.3.10.4 The pipelines of the Tank may not be used in the grounding process.

3.3.3.10.5 No sources of heat generation, combustion, welding and cutting can be used around the Tank area.

3.3.3.10.6 Basic firefighting equipment required for LPG Tanks shall be provided in accordance with the General Directorate of Civil Defense Requirements, such as:

1. Adequate and continuous water source.
2. Adequate external fire nozzles in the Tank area.
3. Adequate rubber water hoses throughout the Tank area.
4. Dry powder manual fire extinguishers whose number and capacity are commensurate with the capacity of the Tank.

3.3.3.10.7 A flood cooling system shall be provided on the LPG Tank parking location during filling and discharge while providing the necessary sheds to shade the Tank parking location.

3.3.3.10.8 Paved roads shall be provided for the arrival of General Directorate of Civil Defense vehicles to the Tank locations.

3.3.3.10.9 Adequate exits shall be provided in the Tank area for emergencies.

3.3.3.10.10 The system of international symbols and signs shall be applied to the Tanks and surrounding areas.

3.3.3.11 Maintenance Requirements for LPG Tanks:

Systematic tests and maintenance of the Tanks shall be carried out by (and with the knowledge of) specialized technical bodies Permitted by the General Directorate of Civil Defense in accordance with the following maintenance programs:

3.3.3.11.1 General maintenance every three months that includes and requires:

1. Checking if there are anti- smoking signs in the areas of liquefied petroleum gas Tanks and the devices and equipment used within the procedures for dealing with emergency cases, provided that such equipment is in the places specified for it and in good condition.
2. Verifying that the Tank area and its surrounding lands are completely free of any flammable Materials or weeds and crops for a distance of not less than 6 m, with the prohibition of using potassium chlorate for disposal of weeds.
3. Checking the validity and durability of the fence surrounding the Tank.
4. Verifying that there are no changes in the location of the Tank other than as set out in the drawings approved by the General Directorate of Civil Defense.

5. Externally inspecting the condition of the Tank, including paints, gas- carrying pipes, valves and other accessories.
6. Checking the grounding arrangements and means * of the Tank and pumping systems.
7. Inspecting all cement supports and Tank- bearing supports and verifying that they do not have any defects, such as cracks, the prominent appearance of gravel quantities on the concrete due to damage to the external cement cladding, the dissipation of the external paints of the concrete and the appearance of brown colors of rust (and corrosion of salts) on the surface, etc.
8. Checking all gas connections for gas leaks, using soapy water solution on top to detect potential leak bubbles.
9. Checking the condition of the gas pipes and testing the valves to verify that they are easy to operate and free from tamper or natural damage.
10. Visually inspecting the pressure gauges and their contents to verify that they are working well, and that the safety valves are free of rust and the discharge openings are free of impurities.
11. Checking the cooling and protection systems installed on the Tanks and in the position of the gas Tank.

3.3.3.11.2 A thorough annual field inspection of the Tank shall be carried out to inspect the Tank body, Tank bearing supports and Tank pipelines to verify that the Tank and its accessories are free from corrosion or rust and salt deposits, or any abnormal observations that may appear from the inspection process.

3.3.3.11.3 An examination shall be carried out every five years comprising the following:

1. Conduct an ultrasound examination on the body of the Tank.
2. A comparative test of the pressure gauge with another gauge to verify that the original gauge is working properly.

3.3.4 LPG Cylinder Feed System Requirements

LPG Cylinder Network Feeding System: LPG supply system by a set of cylinders connected to a Manifold to deliver gas to the gas exploitation location for commercial, industrial, educational and residential purposes.

3.3.4.1 Location Requirements:

3.3.4.1.1 All LPG cylinders shall be in separate rooms outside the building and at the ground level as per Figure (1- A) for all commercial, industrial, educational and residential complexes purposes. The room types mentioned below in Figure (F- 1- F9) are allowed to be exploited, in the event that it is not possible to have separate rooms outside the building, which are arranged in order of priority as follows:

1. A gas cylinder room within the building as shown in Figure 1 (b).
2. A room in the form of a cage, gas cylinders attached to an external wall of the building as it is in Figure (1- C), and it is called a “CAGE” for short.

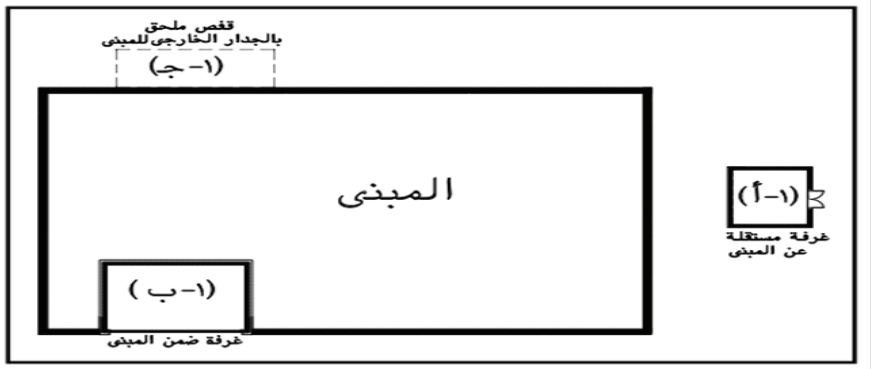


Figure:- F.1-F9: Patterns of LPG networks cylinder rooms in the ground.

Building
Separate room (1A)
Room within building (1-B)
Cage attached to the external wall of the building (1-c)

3. A room of gas cylinders on the roofs of buildings as shown in **Figure:- F.1- F9** so that the room is on the surface of the ground floor or the surface of the mezzanine and does not exceed the height of the surface of the second mezzanine



Figure:- F.1-F10: Locations of LPG networks cylinder rooms on rooftops

Building
Roof of Mezzanine II
Roof of Mezzanine I
Ground floor roof
Ground floor

3.3.4.1.2 It is strictly prohibited for the LPG cylinder room to be below the ground floor level.
3.3.4.1.3 The gas cylinder room shall be at least 10m away from the nearest external fire nozzle.

3.3.4.2 Requirements for building- separate LPG cylinder rooms:

3.3.4.2.1 Location

1. The room shall be at the ground floor level.
2. The location of the room shall be at a distance of not less than 3 m from the outer fence of the facility borders and the sewage manholes.
3. The location of the room shall be at a distance of not less than 6 m from neighboring buildings, works, mechanical and electrical devices, and any location containing hazardous Materials.
4. The location of the room shall be at a distance of not less than 6 m from the parking lots of all parties as specified in **Figure:- F.1-F11**. It shall be protected by iron barriers in the event that the room is within the scope of vehicle traffic.

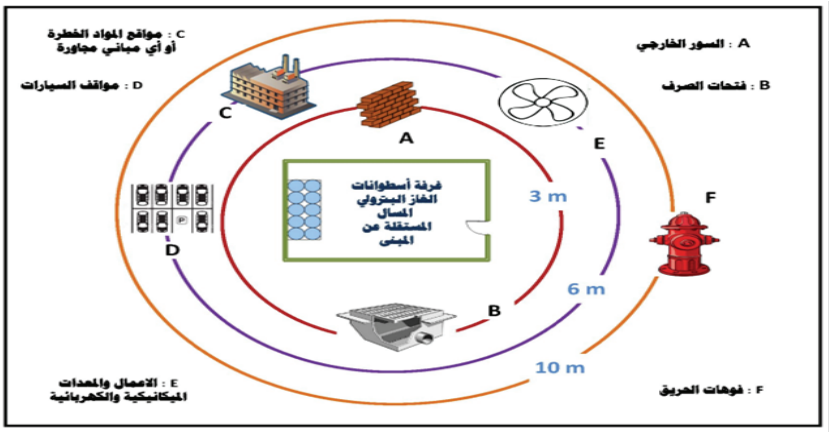
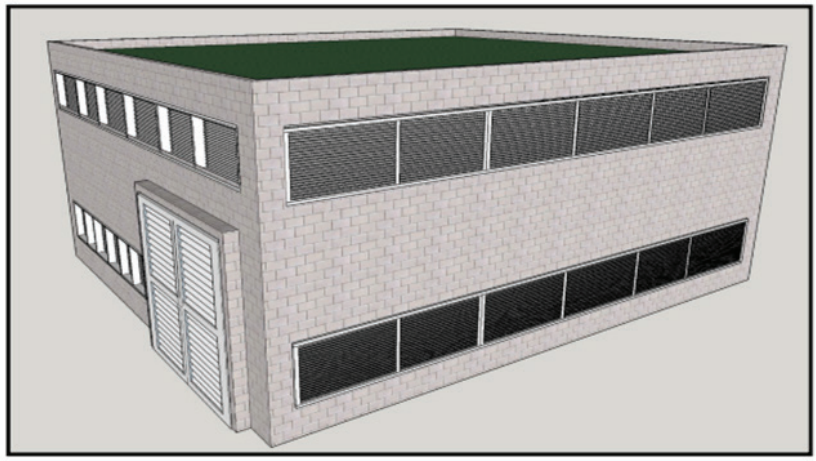


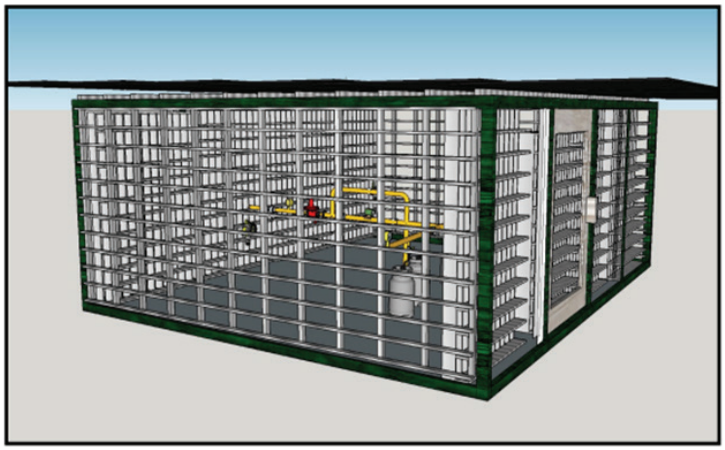
Figure:- F.1- F11 Minimum distances between cylinder rooms, installations and adjacent works

Building-separate LPG cylinder room
Fire Nozzles
Mechanical and Electrical Works and Equipment
Outer wall
Drainage manholes
Hazardous materials locations or any adjacent buildings
Parking

3.3.4.2.2 Construction elements and Specifications

1. The room shall be constructed of fire- resistant bricks for a period of not less than two hours or of a steel cage with a thickness of not less than 2.66 mm.





2. The ceiling of the room shall be of non- flammable and light Materials to discharge the explosion pressure.
3. The floor of the room shall be solid concrete and free of any drainage openings.
4. The room shall have at least one sealed and non- flammable door, provided that its size is commensurate with the size of the room and the number of cylinders to ensure safe and easy handling of cylinders.

3.3.4.2.3 Ventilation Requirements:

1. Natural ventilation shall be provided for the gas cylinder room of bricks with permanent upper and lower openings to refresh the air of the room at least 3 times per hour.
2. The height of the bases of the lower air vents shall be 15 cm from the floor level of the room.

3.3.4.2.4 The amount of gas allowed for gas cylinder rooms separated from the building depending on the nature of the exploitation.

1. **Commercial purposes and residential complexes**

The amount of gas in the Separate room shall not exceed 500 kg distributed over two (optional) sets of cylinders for one Manifold main feed pipe as specified in **Figure:- F.1-F16**. In the event that an increase in the amount of gas is required, other Separate rooms shall be built so that the distance between the room and the other is not less than 6 m. The distance

may be less than 6 m to 3 m as a minimum. In this case, all rooms shall be constructed of pressure- resistant walls with a thickness of not less than 30 cm.

2. **Industrial purposes**

(a) The amount of gas in the Separate room shall not exceed 500 kg distributed over two (optional) sets of cylinders for one Manifold. In the event that an increase in the amount of gas is required, other separate rooms shall be built so that the distance between one room and another is not less than 6 m. The distance may be less than 66 m to a minimum of 3 m. In this case, all rooms shall be constructed of pressure- resistant walls with a thickness of not less than 30 cm.

(b) The total quantity of one gaseous plant shall not exceed 1500 kg

3. **Educational and laboratories purposes (excluding public and private schools).**

A- The amount of gas in the room that is separate from the building shall not exceed 250kg distributed over two (optional) sets of cylinders for one Manifold. In the event that an increase in the amount of gas is required, other Separate rooms shall be built so that the distance between one room and another is not less than 6 m. The distance may be less than 6 m and up to a minimum of 3 m. In this case, all rooms shall be constructed of pressure-resistant walls with a thickness of not less than 30 cm.

(b) The total amount of gas for a single building for separation shall not exceed 500 kg.

3.3.4.3 Requirements for LPG Cylinder Rooms within a Building:

3.3.4.3.1 Location

1. The room shall be at the ground floor level.
2. The location of the room shall be at a distance of not less than 3 m from the outer fence of the facility borders and the sewage manholes.
3. The location of the room shall be at a distance of not less than 6 m from any location containing hazardous Materials.
4. The location of the rooms shall be at least 6m away from any neighboring building.
5. The room shall be far from the mechanical and electrical works and devices and parking lots at a distance of not less than 3m as specified in **Figure:-F.1-F12**.
6. The room shall be at least 3m away from the exits, entrances, stairs and escape corridors of the building.

3.3.4.3.2 Construction elements and Specifications

1. The room shall have at least one external facade. The facade shall be made of light non- flammable Materials in order to discharge the explosion pressure.
2. All internal walls and ceiling of the room shall be made of fire- resistant Materials for a period of 4 hours and shall not contain any openings or outlets leading to the inside of the building.
3. The floor of the gas room shall be solid concrete and free of any drainage openings.

3.3.4.3.3 Ventilation Requirements:

1. The length of the open exterior façade (A), for a room with one exterior façade, shall be twice the depth of room (B) as specified in **Figure:-F.1-F12**. In the event that the dimensions of this room are not available, natural ventilation shall be replaced by a spark- proof mechanical ventilation system to refresh the air at least 6 times per hour and connect the mechanical ventilation system to the main control panel of the building.
2. The external facade shall be fully ventilated (A) Louver and sealed to prevent tampering with cylinders.

شكل(١-٣-٥): مسافات الأمان الدنيا لغرف أسطوانات الغاز ضمن مبنى.

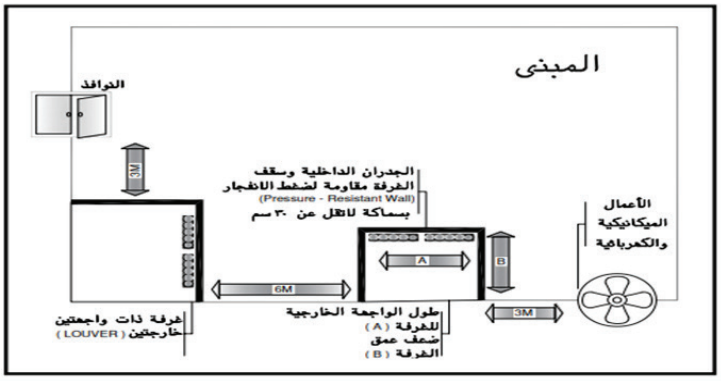


Figure:-F.1-F12: Minimum safety distances for gas cylinder rooms within a building
Building
MECHANICAL & ELECTRICAL Works
Throughout the exterior of the room (A) double the room (B)
Room with two exterior facades (Louver)
Windows
Internal walls and ceiling of the room are resistant to explosion pressure (pressure-resistant wall) with a thickness of not less than 30 cm

3.3.4.3.4 Permissible Gas Quantity for Gas Cylinder Rooms within a Building

1. **Commercial purposes and residential complexes**

   The amount of gas in the room within the building shall not exceed 400 km. Two (optional) sets of cylinders for one Manifold main feed pipe as specified in Figure (9- 3- 1). In the event that an increase in the amount of gas is required in other rooms within the building, so that the distance between one room and another is not less than 6m, the distance shall be less than 6m and up to 3m as a minimum. In this case, all rooms shall be protected by the flooding system.

2. **Industrial purposes**

   (a) The amount of gas in the room within the building shall not exceed 400 kg, distributed two (optional) sets of cylinders for one main Manifold feed pipe. In the event that an increase in the amount of gas is required, other rooms within the building shall be built, so that the distance between one room and another is not less than 6 m. The distance shall be less than 6 m and up to 3 m as a minimum. In this case, all rooms shall be protected by the German immersion system.

   (b) The total quantity of a single installed gas shall not exceed 1200 kg.

3. **Educational and laboratories purposes (excluding public and private schools).**

   (a) The amount of gas in the room within the building shall not exceed 200 kg, distributed two (optional) sets of cylinders for one main Manifold feed pipe. In the event that an increase in the amount of gas is required, other rooms within the building shall be built, so that the distance between one room and another is not less than 6 m. The distance shall be less than 6 m and up to 3 m as a minimum. In this case, all rooms shall be protected by the German immersion system.

   (b) The total amount of gas for a single building for exploitation shall not exceed 400 kg.

3.3.4.4 Cage room LPG cylinders attached to a building exterior wall

3.3.4.4.1 Location

1. The location of the CAGE shall be at a distance of not less than 3 m from the outer fence of the facility borders and the sewage manholes.
2. The location of the CAGE shall be at a distance of not less than 6 m from neighboring buildings, works, mechanical and electrical devices, and any location containing hazardous Materials.
3. The location of the cage shall be at least 6 m from neighboring buildings inside the facility and mechanical and electrical works and devices.
4. The location of the cage shall be at least 3 m from the parking lots of all bodies, and in the event that it is close to the vehicle traffic location, it shall be protected by placing iron bars around it.
5. The cage shall be at least 3m away from the exits, entrances, stairs and escape corridors of the building.

3.3.4.4.2 Construction elements and Specifications

1. The cage shall be constructed of non- flammable metal Materials adjacent to an external wall of the building and at the ground floor level as shown in **Figure:- F.1-F13.**

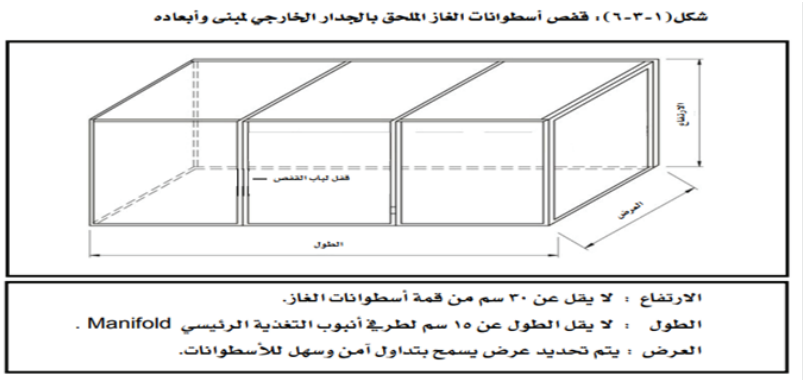


Figure:- F.1-F13: Gas cylinder cage attached to the outer wall of a building and its dimensions

Figure:- F.1-F13 : Gas cylinder cage attached to the outer wall of a building and its dimensions
Height – Width – Length – Lock for cage door
Height: Not less than 30 cm from the top of the gas cylinders.
Length: Length not less than 15cm for both ends of manifold
Proposal: A width is selected so as to allow for safe and easy handling of cylinders

2. The cage shall be fully ventilated from all sides.
3. The roof of the cage shall be made of light non- flammable Materials.
4. The external wall of the common building with the cage shall be fire- resistant for a period of not less than two hours.
5. The floor of the cage shall be solid concrete and free of any drainage openings.
6. The cage shall be sealed to prevent tampering.

3.3.4.4.3 Permissible Gas Quantity for Gas Cylinder Cage Attached to a Building Exterior Wall

1. **Commercial purposes and residential complexes**

   A- The amount of gas per cage shall not exceed 300 kg distributed in two (optional) sets for one main Manifold as specified in **Figure:- F.1-F16**. In the event that an increase in the amount of gas is required, other cages shall be constructed, so that the distance between the cage and the other is not less than 4 m and the distance is allowed to be less than 4 m and up to 2m as a minimum. In this case, General Directorate of Civil Defense has the right to impose a protection system as it deems appropriate, such as a flooding system for all cages or the construction of a fire- resistant separation wall for a period of not less than two hours between cages.

2. **Industrial purposes**

   (a) The amount of gas per cage shall not exceed 300 kg distributed over two (optional) sets of cylinders for one main Manifold. In the event that an increase in the amount of gas is required, other cages shall be constructed, so that the distance between the cage and the other is not less than 4 m. The distance is allowed to be less than 4 m and up to 2 m as a minimum. In this case, General Directorate of Civil Defense has the right to impose a protection system as it deems appropriate, such as a flooding system for all cages or the construction of a fire- resistant separation wall for a period of not less than two hours between cages.

   (b) The amount of gas in a single facility shall not exceed 900 kg.

3. **Educational and laboratories purposes (excluding public and private schools).**

   (a) The amount of gas per cage shall not exceed 150 kg distributed over two (optional) sets of cylinders for one main Manifold. In the event that an increase in the amount of gas is required, other cages shall be constructed, so that the distance between the cage and the other is not less than 4 m. The distance is allowed to be less than 4 m and up to 2 m as a minimum. In this case, General Directorate of Civil Defense has the right to impose a protection system as it deems appropriate, such as a flooding system for all cages or the construction of a fire- resistant separation wall for a period of not less than two hours between cages.

   (b) The amount of gas for one building for exploitation shall not exceed 300 kg

4. **For the purposes of the special activity (restaurant complex):**

   It is allowed to construct a cage and it is referred to as the “Set” (Set: Means three cages in the amount of 100 kg for each cage, so that each cage exits a Manifold (as specified in **Figure:- F.1-F14**. In the event that an increase in the amount of gas is required, other groups shall be constructed as specified in **Figure:- F.1-F15**, so that the distance between the cages is not less than 4 meters.

   The distance between the sets shall not be less than 4 m to 2 m as a minimum. In this case, a Fire-resistant separation wall shall be built between the sets for a minimum of 2 hours.

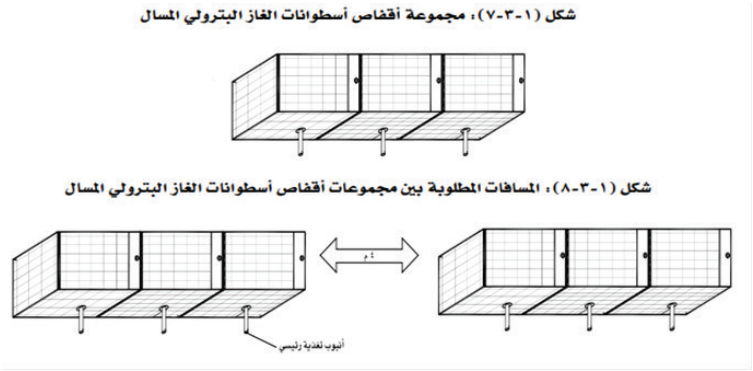


Figure:- F.1-F14: LPG Cylinder Cage Set
Figure:- F.1-F14: LPG Cylinder Cage Set
Figure:- F.1-F15: Required distances between LPG cylinder cage sets
4m
Main feed pipe

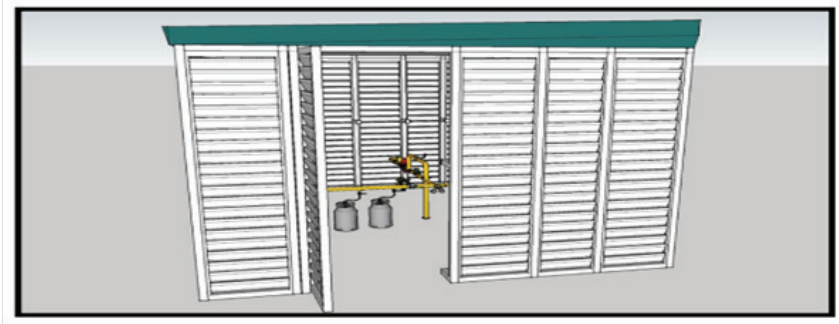
3.3.4.5 Requirements for Petroleum Gas Cylinder Room in Rooftops (roof of the ground floor/ Mezzanine)

3.3.4.5.1 Location

1. The location of the room shall be at a distance of not less than 6 m from any exploitation or storage of hazardous Materials.
2. The room shall be at least 3m away from exits, entrances, stairs, escape corridors, windows and rainwater drainage network.
3. The room shall be at least 3m away from mechanical and electrical works and devices, ventilation openings, air conditioning equipment and systems of the building.

3.3.4.5.2 Construction elements and Specifications

1. The room shall be constructed of non- flammable and well- ventilated metal Materials from at least two sides in a way that does not penetrate direct sunlight (Louver). In the absence of adequate natural ventilation, lower air vents shall be made in the roof walls, not exceeding 6 m.



2. The room shall have a minimum of one door and shall be sealed and of non-flammable Materials.
3. The floor of the room shall be solid concrete and free of any drainage openings.
4. The ceiling of the room shall be of light and non- flammable Materials.

3.3.4.5.3 Permissible Gas Quantity for Gas Roofs

3.3.4.5.3.1. Commercial and industrial purposes and residential complexes

1. The amount of gas in one room shall not exceed 450 kg distributed over two (optional) sets of cylinders for one Manifold, as specified in Figure (1.3.9). In the event that an increase in the amount of gas is required, other rooms shall be built so that the distance between one room and another is not less than 15 m.
2. Educational and laboratories purposes (excluding public and private schools). The amount of gas in one room shall not exceed 200 kg distributed over two (optional) sets of cylinders for one Manifold. No more than this amount shall be allowed for one building for separation.

3.3.4.6 Preventive Requirements for LPG Extension Cylinder Rooms

3.3.4.6.1 Electrical installations and Wiring

1. Electrical switches and control equipment shall be installed outside the room and shall be of the spark insulation type.
2. The electrical wiring fixtures and installations of the room shall be of the spark insulation type or the wiring shall be inside galvanized iron pipes.
3. The room shall be provided with fixed lamps and with an amount of lighting appropriate to the size of the room, so that these lamps are installed on the internal ceiling or on the upper walls of the room.
4. The light bulbs used for lighting shall be of types that do not heat up and do not radiate heat and shall be equipped with spark- insulating covers that are resistant to shocks and weather factors.

3.3.4.6.2 Fire Protection:

1. The room shall be equipped with dry powder manual fire extinguishers according to the numbers and capacities determined by the General Directorate of Civil Defense.
2. The General Directorate of Civil Defense has the right to request what it deems appropriate to provide preventive systems (combating, warning, and ventilation systems), according to the risk assessment of the location.
3. Gas detectors shall be provided to the room, provided that they are installed at a height of 30 cm from the floor of the room (according to the recommendations of the manufacturer) and at a distance of no more than 4 m from the cylinders, and the detectors shall be of spark insulation type and resistant to weathering.
4. Warning signs shall be placed around the location of the room, written in clear writing in Arabic and English and in letters not less than 10 cm high, including the following: Danger, Flammable Gas, No smoking, No entry for non- specialists.

Table:- F.1-T12, the quantity of liquefied petroleum gas allowed (kg), as a maximum, according to the nature of the rooms and exploitation

Room Style	Exploitation					
	Commercial and Residential Complex		INDUSTRIAL		Educational and Laboratory	
Separate room	*Quantity of gas cylinders KG		Quantity of gas cylinders KG		Quantity of gas cylinders KG	
	Per room	Per facility	Per room	Per facility	Per room	Per Exploitation Building
	500	Unlimited * *	500	1500	250	500
A room in a building	Quantity of gas cylinders KG		Quantity of gas cylinders KG		Quantity of gas cylinders KG	
	Per room	Per facility	Per room	Per facility	Per room	Per Exploitation Building
	400	Unlimited	400	1200	200	400
cage; retainer (mech.)	Quantity of gas cylinders KG		Quantity of gas cylinders KG		Quantity of gas cylinders KG	
	Per room	Per facility	Per room	Per facility	Per room	Per Exploitation Building
	300	Unlimited	300	900	150	300
A room with a floor surface. Mezzanine	Quantity of gas cylinders KG		Quantity of gas cylinders KG		Quantity of gas cylinders KG	
	Per room	Per facility	Per room	Per facility	Per room	Per Exploitation Building
	450	Unlimited	450	Unlimited	200	200

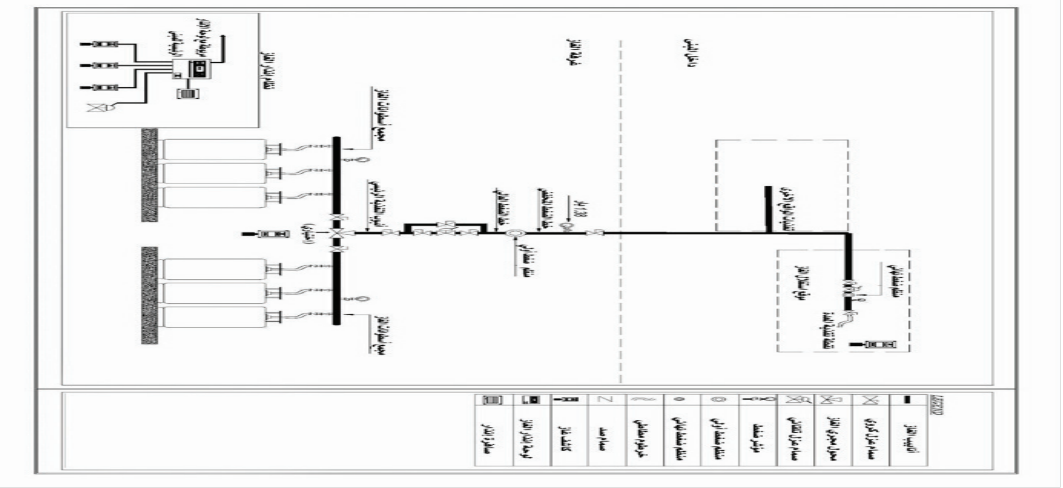
*Quantity of LPG cylinders measured in kilograms of LPG weight inside the gas cylinder.
* *Unlimited, multiple rooms are allowed provided the rest of the requirements are met.

3.3.4.7 Preventive Requirements for LPG exploitation Sites

3.3.4.7.1 The design shall take into account that the site of gas exploitation shall be in the ground floor or the upper floors and shall contain components for natural ventilation, such as doors and windows that lead directly to the outside, in order to dissipate accidental gas leaks.

3.3.4.7.2 Exploitation of LPG is permitted in the First tunnel only. The General Directorate of Civil Defense has the right to request the provision of separate lower mechanical ventilation (due to the fact that the gas is heavier than air) near the gas equipment feeding points, by making lower ducts to withdraw the gas in the event of release according to the following requirements:

1. Mechanical ventilation fans shall be of spark insulation type and placed outside the building so that the gas is dispersed to a safe location and does not contain combustion sources and has excellent natural ventilation.



Gas Pipes
Ball Isolation Valve
Gas Conduit Transformer
Automatic Isolation Valve
Pressure indicator
First Stage Regulator
Final Stage Regulator
RUBBER HOSE
Buffer valve
Gas Detector
Gas alarm panel
Siren
Final Stage Regulator
Feed point of equipment
Gas Exploitation Site
Other Sites Feeds
Inside the building
Gas chamber
Gas Cylinder Assembly
1.38 bar
Low pressure line
First Stage Regulator
high-pressure line
Gas chamber
Main feed pipe
Gas Alarm System
Gas chamber
Inside the building
Gas Cylinder Assembly
(optional)
Linked to the building's main alarm panel

2. The capacity of the ventilation fans shall accommodate an amount of ventilation not less than 6 times per hour to refresh the air for the gas exploitation site, provided that they operate continuously.

3. Mechanical ventilation fans shall be connected to the building alarm panel, so that it gives an alarm in the event that the ventilation fans stop.

3.3.4.7.3 Electrical switches and circuit breakers in the gas exploitation area shall be of the spark insulation type, or shall be of the normal type, provided that their height from the floor of the gas exploitation area is not less than 1 m, and a horizontal distance of not less than 3 m from the gas exploitation equipment.

3.3.4.7.4 Equipment issuing sparks in gas exploitation area shall be at least 1 m high from the site floor and at a horizontal distance of not less than 3 m from the gas exploitation equipment.

3.3.4.8 LPG Cylinder Network Extension Requirements

3.3.4.8.1 The pipelines and connections for the uses of liquefied gas shall be of copper, iron, or polyethylene, including carbon steel or brass, in accordance with the approved international standards, and cast iron may not be used in their manufacture.

3.3.4.8.2 Seamless carbon steel gas pipes shall be of a size not less than (Sch.40) in accordance with the standards (ASTM A53, ASTM A106, ASME B36.10M) or equivalent Materials manufactured according to the approved international standards.

3.3.4.8.3 The rubber hose connecting the gas cylinder and the cylinder assembly as shown in **Figure:- F.1-F16** shall be made of Materials manufactured according to the approved international standards.

3.3.4.8.4 In the event that gas pipelines enter any building, the gas pressure shall not exceed 1.38 bar, and the General Directorate of Civil Defense may allow an increase in pressure in industrial facilities.

3.3.4.8.5 Gas pipes shall be underground or within walls and shall be protected with Materials against corrosion and rust, and the pipes shall be welded together.

3.3.4.8.6 The construction of duct passages, in grounds and walls, is permitted, especially for gas installations, provided that they are protected with a metal cover against accidental shocks and tampering in all cases.

3.3.4.8.7 Gas pipes shall be extended vertically with Separate Shaft corridors (up or down), so that all types of elevators, ventilation and air conditioning channels, Electrical Installations or other services that are estimated to be a source of combustion or flammation, such as clothing and garbage disposal channels are not shared with them in the corridor.

3.3.4.8.8 The flexible connections (rubber hoses) at the end of the pipelines, used for burner installations, shall be of Materials manufactured according to the approved international standards. In the event that a strand of braided wire is used to strengthen the gas carrier hose, it shall be made of stainless steel.

3.3.4.8.9 In all cases, it shall be ensured that air does not enter the gas line.

3.3.4.8.10 The readiness of gas pipelines shall be tested before use by compressing them to 150% of their operational pressure.

3.3.4.9 Requirements for LPG Line Valves and Regulators Figure:- F.1-F16

3.3.4.9.1 Buffer valves and ball isolation valves shall be installed on the gas network pipes as shown in **Figure:- F.1-F16**, provided that they are manufactured according to the approved international standards.

3.3.4.9.2 The gas line, before being connected to the gas cylinder complex, shall be provided with a stop valve and a ball valve, in order to avoid the exit of gas from the complex to the outside when replacing the cylinders.

3.3.4.9.3 Gas pressure indicators shall be installed on the gas network pipes as shown in **Figure:- F.1-F16,** so that the pressure indicator range for the high pressure line is from 10 to 20 bar, and for the low pressure line is from 0 to 3.5 bar.

3.3.4.9.4 It is preferable to install the gas duct converter as shown in **Figure:- F.1-F16**, in order to facilitate the control of the feed gas source of the Manifold in a safe manner, by automatically or manually diverting the gas path when the gas runs out of the cylinders of one of the two gas cylinders, so that the gas path is diverted to supply the Manifold from full cylinders complex until the exhausted cylinders are replaced.

3.3.4.9.5 The gas main line shall be provided with an Solenoid Valve Solenoid Valve connected to the gas alarm panel in order to stop the flow of gas in the event of gas release.

3.3.4.9.6 The gas alarm panel shall be attached to the main alarm panel of the building to automatically close the isolation valve on the Manifold in the event of a fire in the building.

3.3.4.9.7 Three ball isolation valves shall be installed around the Solenoid Valve on the Manifold as shown in **Figure:- F.1-F16** for locations where the interruption of the gas supply is detrimental to the existing activity, so that these three valves operate a gas bypass (closing the two valves adjacent to the Solenoid Valve and opening the third), as necessary when servicing and maintaining the Solenoid Valve. Provided that the two valves adjacent to the Solenoid Valve are opened and the third is closed (normal position) immediately after the completion of maintenance operations, and that this process is carried out only by maintenance specialists.

3.3.4.9.8 Gas pressure regulators shall be installed as shown in **Figure:- F.1-F16** to ensure that the pressure does not exceed the permissible limit.

3.3.4.9.9 The gas pressure regulator shall be outside the building. In the event that the design requires the installation of the gas pressure regulator inside the building, a special ventilation pipe shall be installed for the regulator gas discharge port, provided that the ventilation pipe extends outside the building and leads to a security space for gas discharge. Further, it is excluded from installing a special ventilation pipe for the regulator gas discharge port in the event that the gas pressure regulator is integrated with a tool to stop the flow of gas permanently when exposed to any defect.

3.3.4.9.10 In the event that the gas piping network is long and manifold, a secondary pressure regulator may be installed.

3.3.4.9.11 The pressure exiting the final pressure regulator shall be in proportion to the equipment exploiting the gas.

3.3.4.9.12 The discharge openings of the regulators shall have covers that protect them from dust, etc.

3.3.4.9.13 A gas detector shall be installed near the gas pressure regulator (i.e. gas not secured from leaks) if installed inside the building, provided that an automatic isolation valve is installed on the gas line before it enters the regulator.

3.3.4.9.14 A gas alarm system shall be provided for the exploitation site as shown in **Figure:- F.1-F16**, provided that the system contains an alarm panel, gas detectors and an alarm whistle, and that the alarm panel is connected to an Solenoid Valve on the final gas line (the beginning of the gas pipelines at the gas exploitation site).

3.3.4.9.15 Special protection systems for gas exploitation equipment, such as the wet powder system, shall be connected to the gas alarm panel, so that the equipment is deprived of gas if its protection system works.

3.3.4.9.16 The placement of the valves shall be arranged in such a way as to prevent them from being damaged and tampered with.

3.3.5. Means of transporting liquefied petroleum gas.

3.3.5.1 Gas cylinder transport vehicles:

Gas cylinder transport vehicles: Vehicles specifically designed to transport a range of LPG cylinders, excluding locomotives and semi- trailers of LPG filling plants.

3.3.5.1.1 GENERAL

1. LPG transport vehicles shall be of diesel fuel type.
2. No vehicle can be used for the purposes of transporting, selling or distributing liquefied petroleum gas cylinders unless it meets all safety requirements and obtain a license for this from the General Directorate of Civil Defense.
3. The license of the vehicle transporting LPG cylinders shall be renewed periodically after it is subject to the technical inspection procedures by the General Directorate of Civil Defense.
4. Each gas cylinder distribution and transportation bodies may not finance any sites designated for the purpose of reselling, distributing or replacing gas cylinders without a valid license from the General Directorate of Civil Defense for this activity.
5. The LPG cylinder distribution and transportation bodies may not supply the use sites unless they obtain a valid license from the General Directorate of Civil Defense to use gas cylinders, specifying the number of cylinders allowed to be used at the designated site.
6. Closed vehicles (such as passenger cars, vans and the like) may not be used to transport more than two LPG cylinders with a capacity of 25 kg per cylinder.

3.3.5.1.2 LPG Cylinder Transport Vehicle Design Requirements:

LPG transport vehicles shall meet the safety requirements in terms of processing and performance as follows:

1. The vehicle box prepared to accommodate the cylinders shall be closed from all sides, rear and roof) with durable metal barriers to ensure that the cylinders do not fall from the box with the availability of natural ventilation of the box in all circumstances as shown in **Figure:- F.1-F17**.
2. All side and back sides shall be openable to ensure the ease of filling and discharge of cylinders as shown in **Figure:- F.1-F17.**
3. The floor of the box and the metal parts, on which the cylinders rest, of the box shall be coated with a durable insulating Material that is resistant to friction and sparks and is suitable for the purpose.
4. 4- The box of the gas cylinder transport vehicle shall be durable and firmly installed to the vehicle.
5. The box shall be equipped with strong ties to stabilize the movement of the cylinders in order to avoid their displacement, vibration and collision with each other during the movement of the vehicle.
6. The height of the ceiling of the cylinder box shall not be less than 180cm from the floor of the box in order to facilitate the filling and discharge of the cylinders. In the event that the ceiling of the box is designed in a way that it is fully openable and safe, so that only the filling and discharge time is open, the height may be less than that and the minimum shall be 130 cm.
7. It is strictly prohibited to place the cylinders on top of each other, and to place any objects or Materials on top of the cylinders.
8. The vehicle shall be painted with a transverse line - around the vehicle from all sides as shown in **Figure:- F.1-F17** - provided that it is orange in color and with a height of 30 cm and written on it “Danger, flammable gas cylinders” from all sides with the obligation to apply HazChem of vehicles transporting hazardous Materials.
9. The gas cylinder transport vehicle shall be provided with a small hand trolley used by the workers to transport the cylinder from the vehicle to the customer's site.
10. The vehicle shall be provided with a durable front and rear bumper. Further, reflective striped phosphor stripes shall be affixed to the rear, to facilitate vehicle identification.
11. The vehicle shall be provided with durable wooden pieces (crammed under the tires) to stop its movement during filling and discharge of cylinders.

12. The vehicle shall be equipped with the total number of front and rear light signals in addition to the side lights that indicate the limits of the vehicle. Further, a flashlight in yellow shall be installed above the cockpit.
13. The vehicle shall be equipped with a manual circuit breaker that is accessible to the driver of the vehicle, for use when filling, discharge and emergency situations, in addition to the automatic breaker that takes over the cutting when the load is increased on the Electrical Installations.
14. The wrapping of the electrical pipelines of the vehicle shall be of a thick and durable type that is resistant to tension and damage factors. The external pipelines shall be within metal pipes.
15. The Exhaust discharge Unit (Exhaust) shall be installed downward in the front corner of the vehicle (below the bumper). The end of Exhaust shall be equipped with the Spark Arrester, to prevent the exit of sparks.
16. The brake system shall be intact and strong at all times.
17. The engine shall work properly and its appearance shall be sound and free from any release of fuel or oil.

شكل (١-٣-١٠): مركبة نقل أسطوانات الغاز البترولي المسال

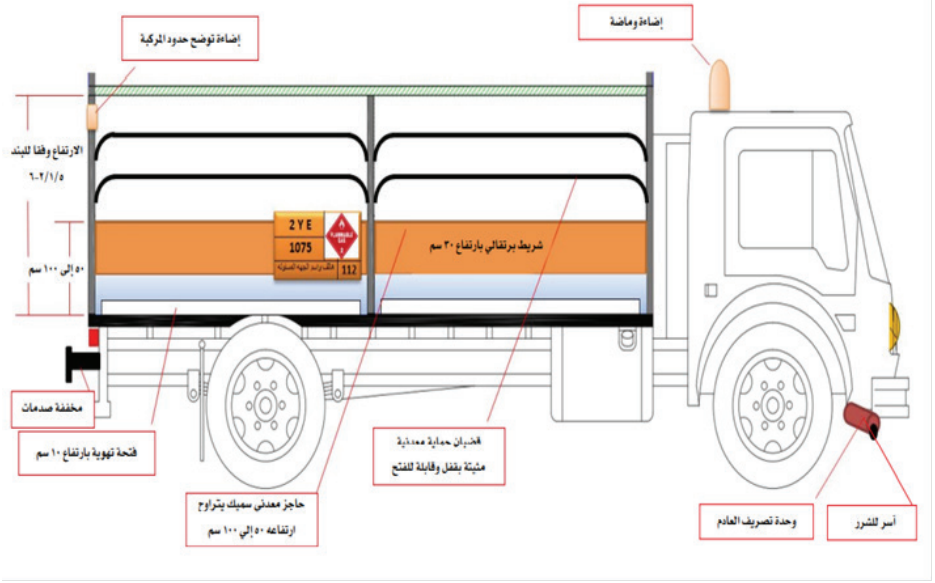
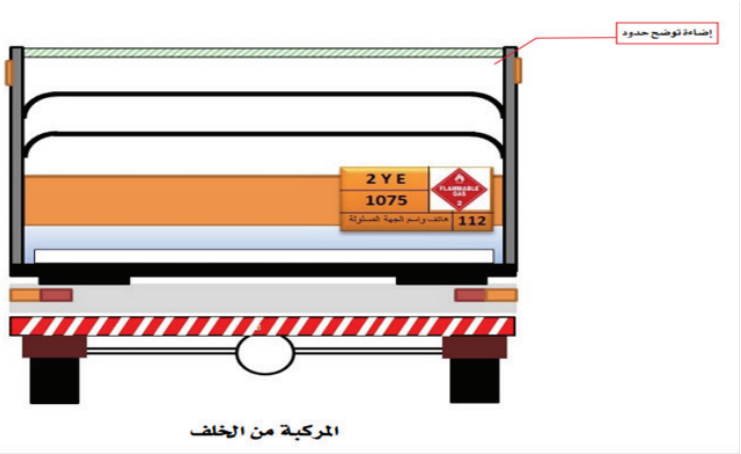


Figure:- F.1-F17 : LPG Cylinder Transfer Vehicle
Flame arrestor
Exhaust Drain Unit.
Flash Light
Orange tape 30 cm high
Illumination showing vehicle limits
Height as per clause 5/1/2-6
50 to 100 cm
Locked and unlockable metal guard rails
Thick metal barrier ranging from 50 to 100 cm high
Shock reducer
10cm high air vent

A light showing the limits of the vehicle from the back

Lighting shows boundaries
The vehicle from the back

3.3.5.1.3 Daily Inspection of Gas Cylinder Transport Vehicles:

The entity, gas cylinders transportation and distribution licensor, shall inspect the following on a daily basis to ensure the safety and validity of the vehicle before starting to use it:

1. Electrical connections with regard to electrical insulation, resistance to moisture and heat, damage resulting from its exposure to damaged Materials, and the validity of circuit breakers in the event of malfunctions.
2. Checking the validity and cleanliness of the engine and fuel lines before each trip, including checking the vehicle oil, cooling water and movement belts.
3. Checking the efficiency of the vehicle's brakes and that they are working properly.
4. Checking the air pressure adjustment of the vehicle's tires.
5. Checking the validity of the vehicle lights, including warning lights and mirrors.
6. Checking the technical validity of the steering wheel.

3.3.5.1.4 Safety precautions in the handling, transportation and distribution of gas cylinders:

1. The cylinders shall be sealed in their normal position (vertical) when transported in the vehicle and installed in accordance with Clause (5.1.2- 4), provided that the total weight of the cylinders does not exceed 90% of the permitted load of the vehicle.
2. The entire body of the cylinder shall be inside the vehicle, without showing anything outside (side) of the vehicle or from behind it.
3. The load of the vehicle shall not exceed the limit specified in the license, regarding the cylinders.
4. The driver of the vehicle transporting gas cylinders shall adhere to the minimum speed limits specified for the roads he takes, so that the speed of the vehicle is not less than it and does not increase with the installation of plates behind the vehicle indicating the minimum speeds of the roads it takes.
5. Cylinders shall be handled with a high degree of caution and care. They cannot be thrown, rolled or shocked, even if they are empty.
6. The cylinder transport vehicle shall be free of flammable Materials.
7. The (empty or packed) gas cylinders may not be loaded and transported with other things. Gas cylinder transport vehicles may not be used for other purposes.
8. (Filled or empty) vehicles transporting gas cylinders may not be parked and waited in places crowded with pedestrians except at the specified periods for filling and discharge in the distribution places.

9. In the event of failure of vehicles transporting loaded gas cylinders, it is prohibited to leave them on the main roads or in residential areas, with the need to notify the General Directorate of Civil Defense and the security authorities 999 and company officials to take the necessary measures to ensure the safety of the situation, and then drag them to a specialized workshop after discharge them from the cylinders with the need to stop their engine until the completion of the discharge process.
10. The vehicle shall be in a fully parked condition during filling and discharge operations in the open air in places that are not crowded and suitable for this.
11. In all cases, the driver of the vehicle shall be accompanied by an assistant filling agent in vehicles with a load of more than 10 cylinders.
12. No gas cylinder may be transported or used unless it is of the types approved by the competent authorities, and sound and completely free from apparent defects, such as body roughness, paint damage, scratches, cracks and bruises.
13. Attempts to hide scratches, scars and cracks from the body of the gas cylinder using putty or any other Materials are prohibited.
14. The use of any cylinder is not allowed unless it is equipped with a metal protection collar surrounding its valve in order to protect it from shock and damage during transportation and handling.
15. The gas cylinder may not be loaded and transported unless its valve is sealed and the cover is secured.
16. In all cases, the cylinder valves shall be sealed.
17. Empty cylinders shall be transported in the same manner as filled cylinders.
18. Vehicles not designed to load LPG cylinders shall not enter the filling area.
19. It is strictly prohibited for cylinder transport vehicles and other vehicles to enter gas storage.
20. Signboards shall be placed on the doors of the side vehicle indicating the name of the distributor, the license number and the telephone number.

3.3.5.1.5 Fire Protection Requirements for Handling, Transportation and Distribution of Gas Cylinders:

1. The vehicle shall be provided with at least 2 dry powder type manual fire extinguishers with a capacity of 6 kg, installed outside the vehicle on both sides of the driving room (from the rear), provided that nothing appears from them and from their accessories outside the dimensions of the vehicle.
2. Smoking is strictly prohibited while working on vehicles transporting liquefied petroleum gas cylinders, and electric cigarette lighters (etc.) inside the driving room is prohibited.
3. Employees shall be trained to follow the correct methods for filling, transporting and discharge gas cylinders and be aware of their risks. The driver of the vehicle shall always carry with him the manual for dealing with liquefied petroleum gas accidents. He shall also carry with him the gas cylinders transportation vehicle license.
4. The vehicle loaded with gas cylinders may not be left unattended.
5. In the event of a rollover or a serious accident, people shall be removed from the accident area, while prohibiting all forms of combustion sources, informing the competent official of the company, calling General Directorate of Civil Defense and security authorities 999 to control the accident, organize traffic, control the crowd around the accident, and inform the vehicle's owner.

3.3.5.2 Tanker of transporting liquefied petroleum gas:

A vehicle designated in terms of design and integrated (installed) with a tank to transport liquefied petroleum gas.

Caution: The term “tanker” in this clause is used to refer to both the (individually) transported tank and the vehicle integrated into the tank.

3.3.5.2.1 GENERAL

1. The liquefied petroleum gas tank may not be used without meeting all safety requirements and obtaining the necessary license from the competent authorities, such as the General Directorate of Traffic and General Directorate of Civil Defense, provided that the license is renewed periodically, after passing all technical inspection requirements.
2. LPG supply entities are prohibited from supplying unlicensed sites with LPG storage.

3.3.5.2.2 LPG Tank Design Requirements:

1. The design and manufacture of the tank shall be in accordance with the approved international standards, so that it can withstand the quality of the gas, the transported capacity and the operating pressure.
2. The discharge outlet of the tank shall be equipped with an Solenoid Valve. The discharge pipe shall be closed when it is accidentally separated from the filling hose during filling of the tank.
3. The engine of the vehicle shall be of the diesel fuel type and meet the safety requirements in terms of equipment and performance.
4. The tank shall be painted white and marked with “ Danger, a liquefied flammable gas”, while adhering to the application of HazChem.
5. The vehicle shall be provided with a durable front and rear bumper. Further, reflective striped phosphor stripes shall be affixed to the rear, to facilitate vehicle identification.
6. The vehicle shall be provided with durable wooden pieces (crammed under the tires) to stop its movement during filling and discharge.
7. The vehicle shall be equipped with a sufficient number of front and rear light signals, so that it is not less than six, two of which are installed at the top of the driving room, in addition to the side lights that indicate the limits of the tank.
8. The vehicle shall be equipped with a manual circuit breaker, one at the rear of the tank and another at the filling and discharge connections, to enable the driver of the vehicle to stop the filling or discharge process in emergency cases.
9. The vehicle shall be equipped with a manual circuit breaker near the driver of the vehicle to enable him to cut off its electrical circuit during the filling and discharge process and in emergency cases, in addition to the automatic circuit breaker that automatically disconnects the electrical circuit of the vehicle when the load on the electrical pipelines is increased.
10. The wrapping of the electrical pipelines of the vehicle shall be of a thick and durable type that is resistant to tension and damage factors. The external pipelines shall be within metal pipes.
11. The Exhaust discharge Unit (Exhaust) shall be installed downward in the front corner of the vehicle (below the bumper). The end of Exhaust shall be equipped with the Spark Arrester, to prevent the exit of sparks.
12. The brake system shall be sound and strong.
13. The engine shall work properly and its appearance shall be sound and free from any fuel release.

3.3.5.2.3 Daily LPG Tank Inspection Requirements:

The requirements mentioned in Clause (**3.3.5.1.3**) shall be adhered to, in this regard.

3.3.5.2.4 Safety Requirements in Transporting and Driving Gas Tanks on Roads:

1. The load of the vehicle shall not exceed the quantity and operating pressure prescribed for the tank.
2. The gas tanker commander shall adhere to the minimum speed limits specified for the roads he takes so that the speed of the tanker is not less than it and does not increase with the installation of plates behind the tanker indicating the minimum speeds of the roads the tanker takes.
3. The vehicle shall be clean and free of any other inflammable Materials.
4. The filled or empty tanker may not be parked or waited in places crowded with the public. Further, the tanker may not be driven on the roads prohibited for liquefied petroleum gas tankers.
5. In the event of malfunction, the filled or empty tanker be not be left on the main roads or in residential areas. Otherwise, the General Directorate of Civil Defense, the security authorities and the officials of the owning company shall be informed to take the necessary measures to ensure the safety of the situation, and drag the tanker to the workshops of the company, with a preference to discharge it before withdrawing it, and before entering the maintenance workshop.

3.3.5.2.5 Safety requirements to be followed in tank filling and discharge operations:

The filling and discharge of the tank shall be carried out under the supervision of a technical person trained in emergency procedures and their responsibilities shall be as follows:

1. Any tanker in which release is detected at the filling site may not be filled. It shall be immediately withdrawn to a safe place (in accordance with the procedures for this) with the evacuation of the area and the summoning of the owner and the General Directorate of Civil Defense.
2. It is prohibited to fill at night unless the lighting is sufficient, protected and spark- proof.
3. During filling and discharge operations, the tank shall be parked in a safe place and away from the risk of collision, making sure that the manual brakes are tightened and the wooden pieces are placed under the tires to completely stabilize the movement of the vehicle.
4. The tanker engine shall be completely isolated and stopped, including any mobile units or Electrical Installations, except for installations for filling and discharging gas.
5. Workers shall wear protective gloves during the filling and discharge process.
6. The receiving tank of the liquefied gas shall be inspected to verify its suitability to receive the quality and quantity of the gas.
7. It shall be ensured that the tank to be filled and its pipelines are in a sound condition and free from any defects or malfunctions and that it is suitable in terms of design to withstand the pressure and quality of the transferred gas.
8. The tanker shall be earthed, connected to the special earthing line, before and during the filling and discharge process to discharge static electricity from it, and ensure that the earthing cable is disconnected from the vehicle before moving it.
9. The tanker pressure meters (during filling) and the tank (during discharge) shall be monitored in case of rash. The reading of the meters shall be re- checked after the completion of the process.

3.3.5.2.6 Fire Protection Requirements for LPG Transport Tanks:

1. The vehicle shall be provided with at least 2 dry powder type manual fire extinguishers with a capacity of 9 kg, installed outside the vehicle on both sides of the driving room (from the rear), provided that nothing appears from them and from their accessories outside the dimensions of the vehicle.
2. Smoking is strictly prohibited during the transport, filling and discharge of liquefied petroleum gas tanks. The presence of electric cigarette lighters (etc.) inside the driving room is prohibited.
3. Workers shall be aware of the dangers of liquefied petroleum gas and trained to follow the correct procedures for transporting, filling and discharge gas tanks. The driver of the vehicle shall always carry with him a guide to deal with emergency accidents of liquefied petroleum gas tanks, and carry with him the necessary license of the gas transportation vehicle.
4. The vehicle may not be left unattended, whether it is packed or empty.
5. In the event of a rollover of the tanker or a serious accident, people shall be removed from the accident area, while prohibiting all forms of combustion sources, informing the competent official of the company, calling General Directorate of Civil Defense and security authorities to control the accident, organize traffic, and control the crowd around the accident.
6. The tank vehicle shall be maintained. Its validity and safety shall always be maintained, including subjecting it to a comprehensive technical inspection periodically. The contractor or the owner of the tanker shall keep a permanent reference record of the tanker operation, its mileage, maintenance and repairs, to be submitted to the competent authorities upon request.

3.3.6. Odorless LPG.

Definitions: Liquefied petroleum gas (LPG) is initially produced without odor from petroleum product factories. The characteristic odor is added to it at a later stage to be distinguished when any release of the containers containing it occurs, due to the danger of LPG and its common use in industrial and domestic activities.
It shall be noted that some industries require the provision of LPG without its distinctive odor, such as the aerosols (air conditioners, hairspray, etc.). The following are the protective requirements for odorless LPG.

3.3.6.1 Gas receptacles shall be marked with indicative signs bearing the name of the gas and next to it the words: “Odourless”.
3.3.6.2 All equipment and wiring shall be inspected daily by a responsible person.
3.3.6.3 Odorless LPG detectors shall be provided, for alerting on accidental gas release.
3.3.6.4 Good natural ventilation shall be provided with lower mechanical ventilation for traction from below. This mechanical ventilation shall be attached to the operating equipment, so that this equipment does not operate before starting the traction fans.
3.3.6.5 All the above mentioned LPG conditions shall be applied according to the activity.

3.4 Compressed Gases

Introductory Definitions:

Compressed Gases: Gases that retain their gaseous state when filled inside the cylinders they contain. The filling process takes place under relatively high pressure, and under normal or very low temperature conditions.

Liquefied Gas: A gas that, under the pressure of its packaging, is in its liquid and gaseous states at a normal temperature of 25 °C. These gases can be classified according to their filling conditions into two types:

1. Liquefied gases with medium pressure and very low cooling (- 190 °C), such as oxygen, nitrogen and argon.
2. Liquefied gases with high pressure and light cooling (- 20 °C), such as carbon dioxide and nitrous oxide.

Liquefied gases are called cryogenics.

Medical Gases: Gases that are used in medical fields for surgical purposes and anesthesia, and have a high degree of purity.

Toxic Gases: Highly toxic gases that if living organisms and humans are exposed to by touch, swallowing or inhalation, have the inherent ability to damage and destroy tissues and organs of the body or injure the functioning of vital functions of the body and may lead to death, depending on the extent of exposure to the gas and its concentration, rate, style, location and area of absorption by the body. These gases may be flammable or oxidizing.

Flammable Gas: A gas that, if mixed in appropriate proportions with air, oxygen, or other oxidizers, burns under conditions of normal pressure and combustion temperature of the gas.

Gas Detector: A device integrated with the sensor that senses and measures the proportion of gas, designed and assigned to it, around the site where it is installed. For the record, each gas has its own sensor and cannot be used for other gases.

Sensor: A sensor installed with a gas detector, especially for a specific gas. Some gas detectors have a multi- detection feature (of more than one gas) - because they contain more than one sensor. Others have a sensor replacement feature, to detect multiple gases.

Solenoid Valve: An electromechanical valve (electrical part that moves a mechanical part) attached to a control device (panel), used for gas or liquid, that stops the flow of gas or liquid if it receives an electrical signal from the control device.

Normally Close Valve: An electromechanical valve that remains closed if the electrical current is disconnected from it.

Normally Open Valve: An electromechanical valve that stays open if the current is disconnected. Regulator Valve: A pre- set valve that does not allow the passage of gas at a pressure higher than the pressure calibrated thereon.

Safety Relieve Valve: A valve to relieve (by draining) excess pressure - automatically opens and closes when the designed pressure is exceeded - to maintain the internal pressure of the container on which the valve is installed.

Check Valve: A valve that allows one- way flow of gas or fluid and the opposite is prevented.

Vaporizer: An Vaporizer using heat - receives the gas in its liquefied state and adds enough heat to convert it to the gaseous state, in preparation for utilizing the gas in general uses such as heating, cooking, etc.

Cathodic Protection: Technology to control (or force the electric current to prevent (for example) the corrosion of the metal surface of an buried tank by making it a Cathode, by connecting (linking) the metal to be protected (i.e. the tank) to another metal that is easy to corrode to act as an anode. (Caution: The concept of corrosion is different from the concept of rust).

3.4.1 Preamble and General Requirements.

3.4.1.1 This chapter is concerned with the activities and processes related to the handling, handling, storage and handling of flammable, toxic or industrial or medical compressed gases, packed in fixed, movable or used cylinders or tanks within an extension network.

3.4.1.2 Initial approval shall be obtained from the General Directorate of Civil Defense and then (later) the license required for the storage or circulation of flammable, toxic, industrial or medical compressed gases, including the extension networks used therein, shall be issued.

3.4.1.3 Compressed gas cylinders shall be marked in accordance with the international standard approved by the General Directorate of Civil Defense in this regard.

3.4.1.4 Pipelines for the uses of compressed gases may only be installed (or attempted to be repaired) by specialists.

3.4.1.5 Persons dealing with these gases shall be fully aware of the suppliers and how to contact them when needed, in the event of an emergency.

3.4.1.6 When dealing with these gases, wear protective clothing to protect the skin, which does not react with the skin in case of fire, with the need to wear protective gas masks for the face and gloves for places dealing with compressed gases, provided that they are of the type that is easy to remove when the gas leaks into it, as well as suitable rubber shoes.

3.4.7.1 A pre- contingency plan (in writing) shall be prepared in coordination with the General Directorate of Civil Defense on the handling of compressed gas incidents.

3.4.2. Compressed Gas Cylinder.

3.4.2.1 Storage site requirements.

3.4.2.1.1 The storage site shall keep compressed gas cylinders away from neighboring facilities, public places and parking lots for a distance of not less than 15 m.

3.4.2.1.2 The external spaces surrounding the compressed gas cylinder storage building shall be paved, flat, and free of obstructions, grasses, woods, and any other flammable Materials.

3.4.2.2 Storage building requirements.

3.4.2.2.1 Construction Elements and standards:

1. The compressed gas cylinder storage building shall be of one ground floor only (stand-alone store).
2. All walls and floors shall be constructed fire- resistant for a period of not less than 4 hours for the separate storage building. The separation distance of the Separate cylinder store from neighboring buildings shall be from 15 m to 6 m, as a minimum. In this case, all walls of the warehouse shall be Pressure- Resistant Walls with a thickness of not less than 30 cm.
3. A room is allowed to store compressed gas cylinders within a building with an area of not more than 50 square meters. In this case, all internal walls and the ceiling of the room of the compressed gas cylinders store within the building shall be Pressure- Resistant Walls with a thickness of not less than 30 cm, provided that the external wall (the front of the room overlooking the open air) is made of light and fire- resistant Material for a period of not less than two hours in order to discharge the potential explosion pressure and to limit damage while applying all other Requirements for the Separate storage building.
4. When designing the walls of the warehouse, the potential bursting pressure discharge openings shall be made in the compressed gas cylinders so that the discharge is to the point of least probability of damage. The roof shall be constructed of light Material to discharge the bursting pressure.
5. More than one exit shall be provided for the storage building.

6. The doors of the storage building shall be constructed of fire- resistant Materials with a resistance of not less than two hours. They shall also be opened directly outside and closed automatically.

3.4.2.1.2 Compressed Gas Cylinder Storage Building Ventilation:

1. Upper and lower natural ventilation shall be provided to refresh the air of the storage building at least 6 times per hour.
2. The distance between the lower openings of the building and its floor shall not be less than 15 cm.
3. The distance between any two adjacent air vents shall not be less than 1.5 m.
4. In the event that natural ventilation is not possible or natural ventilation is insufficient at the above required rate, Separate mechanical ventilation shall be installed to refresh the air of the warehouse building at least 6 times per hour, provided that this mechanical ventilation works continuously and that it is of spark insulation type and that this ventilation is linked to the alarm system of the building (the main alarm panel of the building).

3.4.2.1.3 Electrical wiring:

1. All electrical works of the storage building shall be of spark insulation types.
2. Electrical wiring and installations shall be lifted from the floor of the warehouse by 1.5 m.
3. The electrical switchboard of the storage building shall be installed outside the warehouse and shall be of the type that is tightly closed.
4. The electrical lamps of the storage building shall be of the type that does not radiate heat, such as fluorescent lamps and the like.
5. The light bulbs of the storage building shall be installed in the ceilings or high walls.
6. The light bulbs of the storage building shall be protected with breakage- proof covers.
7. The storage building's heating equipment, if any, shall be of the types powered by steam, hot water or other indirect means.

3.4.2.3 Compressed Gas Cylinders Storage Requirements:

3.4.2.3.1 Storage within the Storage Building:

1. The storage height of the cylinders shall not exceed 2 m.
2. The width of the corridors between the storage rows shall not be less than 1 m.
3. The width of one storage row shall not exceed the width of 5 cylinders.
4. The distance between the storage rows and the walls shall not be less than 1 m.
5. Cylinders shall be stored seated in their normal (vertical) position.
6. Cylinder valves shall be sealed when stored.
7. No other Materials may be stored inside the warehouse.
8. In all cases, random storage in compressed gas cylinder stores is prohibited. All corridors and entrances and exits of the warehouse shall be completely free of obstacles.
9. An area shall be allocated inside the warehouse to store the empty cylinders.
10. Compressed gas cylinders shall not be exposed to temperatures exceeding 50°C.
11. Packaged cylinders shall be distinguished from empty cylinders with clear indicative marks on them.
12. Compressed gas cylinders shall be stored in separate sets depending on the type of gas for each set.
13. The compressed gas cylinders may be repainted for use only by the supplier or the packaging factory, after confirming their validity.
14. Special seating rules shall be provided for the storage of cylinders with a ball base, to enable their storage in accordance with the above conditions.
15. It shall be ensured that the data on the cylinder body matches its contents.
16. Packaged cylinders shall be isolated from empty cylinders even if they are in the same storage area.

3.4.2.3.2 External Storage:

1. A fence of the metal mesh shall be made around the storage area with openings not exceeding 12 cm2.
2. The height of the external storage site fence shall be at least 3 m.
3. The number of exits of the warehouse shall not be less than 2 and the width of each of them shall not be less than 3 m.
4. The storage area of the cylinders shall be dry (free of moisture).
5. The distance between the fence and the cylinders shall not be less than 1 m.
6. The roads and corridors leading to the storage site shall be paved and free of obstacles.
7. The storage area shall be cleaned of weeds, woods and other flammable Materials.
8. Doors shall be placed in the storage area in places that are quickly accessible in case of emergency.
9. It is prohibited to install any electrical equipment less than 6 m from the cylinder site.
10. It is prohibited to install compressed and liquefied (very cold) gas pipelines and installations on paved floors of asphalt or other combustible Materials.
11. Cylinders shall be stored seated in their normal (vertical) position and placed in locations that are easily accessible to transportation equipment.

3.4.2.3.3 Precautionary Requirements for Trading Compressed Gas Cylinders:

1. Pressure regulators, gauges, hoses and other devices used to handle a particular gas, or a particular set of gases, shall not be used on cylinders containing gases with different other characteristics.
2. The network of pipelines connecting the cylinders shall be suitable in terms of design and pressure of the cylinders.
3. All gas distribution network pipes shall be made of steel, brass or copper alloy with a thickness of not less than 1.25 mm. If flexible gas distribution pipes are used, they shall be of the approved types.
4. All gas pipes shall be cleaned of oil, grease, oxidizers and other foreign Materials, before starting installation operations, using special solutions or solvents for the purpose and do not react with the gas.
5. Regulators, hoses or meters of any cylinder may not be used unless they are suitable, especially for the type of cylinder and the type of gas it contains.
6. The regulator installed on the cylinder shall be of the approved type suitable for the pressure of the gas contained in the cylinder.
7. Protective covers shall be placed on the valves when the cylinder is not used.
8. Valves, regulators, measuring instruments and accessories shall be protected from tampering and damage.
9. The data, labels and colors on the cylinder body shall not be damaged or removed.
10. The cylinder valve shall be closed before the regulator is disconnected from it and then the regulator pressure is discharged.
11. The validity of the hoses connected to the cylinder shall be ensured.
12. The contents of a cylinder may be filled or transported to another only by the producer or specialists.
13. The damaged cylinder may not be refilled without passing the approved tests in this regard.
14. Cylinders shall be well fixed (with special fasteners and brackets for the purpose) before use.
15. It is prohibited to throw cylinders or make them hit each other or other objects.
16. 16. Cylinders shall not be handled with magnetic lifts and slings, ropes or chains shall not be used for their transport.
17. All valves shall be tightly closed when gas is not used.

18. In the event of gas release, compressed gas cylinders shall be isolated and kept away to an empty area away from combustion sources.
19. Sources of combustion, such as open flames, electrical equipment and heating devices, are prohibited inside the warehouse.
20. 20. Smoking inside the warehouse is strictly prohibited.
21. Sign boards shall be installed on the entrances to the cylinder storage building bearing the names of the gases and the approved colors of the stored cylinders.
22. The protective cover may not be removed from the cylinder valve except when in use.
23. The valves and flanges of cylinders containing oxidizing gases may not be lubricated.
24. The cylinder may not be dissolved or considered as a part of an electrical circuit.
25. Compressed gas cylinders may not be stored in their use rooms.
26. Be sure to tighten the regulators on the cylinder valves before using them.

3.4.2.3.4 Maintenance and Inspection Requirements for Compressed Gas Cylinders:

1. Samples of cylinders shall be subjected to static pressure testing periodically in accordance with the manufacturer's instructions and instructions.
2. The monthly virtual inspection shall be applied to the cylinder body and its accessories shall be inspected in accordance with the manufacturer's instructions to ensure that it is valid and working properly.
3. The source of release in the cylinders shall be inspected and detected using a soapy solution.
4. The content of the cylinder shall be verified through its label. If the content does not match the requirements, it shall be returned to the supplier.
5. All imported and packed cylinders in other countries shall be inspected to ensure their safety and conformity with the approved international systems.
6. Filled and empty cylinders shall be marked with special labels and marks for the purpose.
7. The maintenance building shall meet all safety and fire prevention requirements.
8. All maintenance work shall be carried out by a specialized technical staff.

3.4.3. Fixed tanks for Compressed Gases.

3.4.3.1 Tank location requirements.

3.4.3.1.1 The location of the tanks shall be away from populated places.
3.4.3.1.2 In all cases, to place or use underground compressed gas tanks, whether in a basement, open or buried pit, etc. may not be placed nor used
3.4.3.1.3 The distance between compressed gas tanks and adjacent buildings shall be determined according to the General Directorate of Civil Defense Requirements according to the type of gas for each tank.
3.4.3.1.4 The distance between the tank sites and adjacent buildings increases directly as the capacity of the tanks increases.
3.4.3.1.5 The distance between the tanks, located in one storage site, increases directly as their capacity increases.
3.4.3.1.6 These distances can be reduced if there is a cooling system (by submergence) or fire-resistant partition walls.
3.4.3.1.7 It is prohibited to erect tanks on top of each other.
3.4.3.1.8 The number of tanks in one set shall not exceed 6.
3.4.3.1.9 The distance between one set of tanks and another shall not be less than 8 m except in special cases, such as the presence of a fire- resistant wall or a water curtain separating them or that the tanks are protected by the flooding system.

3.4.3.1.10 The distance between oxidizing gas tanks and flammable liquid tanks shall not be less than 7 m.

3.4.3.1.11 Combination of flammable gas tanks and flammable liquid tanks within a single gated area is prohibited.

3.4.3.1.12 The area surrounding the tanks shall be free of weeds or any flammable Materials for a distance of not less than 3 m.

3.4.3.1.13 Insecticides, especially sodium chlorate, may not be used in the vicinity of the tank area.

3.4.3.1.14 The area of the compressed gas tanks shall be fenced with a metal mesh. The area of its openings shall not exceed 12 cm2 and its height shall not be less than 3 m.

3.4.3.1.15 The tank area shall have more than one exit with a width of not less than 3 m.

3.4.3.1.16 Approved warning signs shall be placed depending on the hazard of the gas in the tank area.

3.4.3.1.17 The location of the tanks shall be equipped with the necessary requirements for firefighting - including:

1. Adequate and continuous water source.
2. Adequate external fire nozzles in the tank area.
3. Adequate rubber water hoses throughout the Tank area.
4. Dry powder manual fire extinguishers whose number and capacity are commensurate with the capacity of the tank.

3.4.3.1.18 The tanks shall be protected by a manually operated submersion cooling system by means of a valve near the tank area, and automatically by heat detectors that operate the system when the temperature of the atmosphere surrounding the tank increases to 50°C, and the system operates for a period of not less than 50 minutes, as requested by the General Directorate of Civil Defense.

3.4.3.1.19 A flood cooling system shall be provided for the gas tank stand during filling and discharging, as requested by the General Directorate of Civil Defense.

3.4.3.1.20 Paved roads shall be secured to enable General Directorate of Civil Defense vehicles to easily reach the tank site.

3.4.3.1.21 Adequate emergency exits shall be provided in the tank area.

3.4.3.1.22 The system of international symbols and signs shall be applied to gas tanks.

3.4.3.2 Fixed Tanks Components:

The tank consists of the tank body, pipelines, valves, and vaporizers for liquefied compressed gas tanks.

3.4.3.3 Design standards and Requirements for Tanks:

3.4.3.3.1 The tank shall be designed according to the approved international standards.

3.4.3.3.2 The tank shall be equipped with the necessary openings for all devices used as a pressure gauge, safety valve to relieve (discharge) excess pressure, and filling counter to indicate the maximum permissible filling of the tank.

3.4.3.3.3 The tank shall be lined with Materials resistant to the reactions of the gas it contains.

3.4.3.3.4 The Design Pressure of the tank shall not be less than the vapor pressure of the liquefied gas (gas pressure) at the highest possible temperature to which the tank may reach. The safety valve operating pressure shall be designed at 120% of the working pressure allowed for the tank.

3.4.3.3.5 A panel indicating the following shall be installed on the tank:

1. Type and number of tank design specification.
2. The name of the manufacturer, the serial number of the tank, and the year of manufacture.
3. Operating pressure and maximum design pressure of the tank.
4. Tank capacity

3.4.3.3.6 The tank shall have handles (slings) to be used for lifting and installing the tank.

3.4.3.3.7 The tank shall be equipped with a suitable grounding cable to discharge static electricity charges.

3.4.3.4 Technical Installation Requirements for Tanks:

3.4.3.4.1 Tanks shall be installed and fixed on iron bases not more than 10 cm above the concrete base surface.
3.4.3.4.2 Supports shall be of steel or non- extendable or non- shrinkable concrete.
3.4.3.4.3 The exterior of the tank shall be painted with reflective colors.

3.4.3.5 Tank Pipeline and Connection Requirements:

3.4.3.5.1 Compressed gas tank piping shall be provided with automatic shut- off valves, in case the gas flow rate exceeds the prescribed limit, non- return valves, manual ball shut- off valves for emergency cases, in addition to liquid discharge valves (for liquefied gas tanks).
3.4.3.5.2 Tank pipes shall be manufactured from copper, steel or polyethylene according to the approved international standards. It is prohibited to manufacture them from cast iron.
3.4.3.5.3 Seamless pipes shall be used for pipelines, and copper pipes shall not be used for acetylene gas pipelines.
3.4.3.5.4 The melting point of extension Materials and pipes shall not be less than 815°C.
3.4.3.5.5 All pipelines shall be installed on special purpose earth lifted slings to protect them from accident damage, etc.
3.4.3.5.6 The necessary means shall be secured to prevent the entry of air into the gas line.
3.4.3.5.7 All pipelines shall be at the top surface of the tank, except for the liquid drain valve of the LPG tank, from below.
3.4.3.5.8 The tank and all its pipelines shall be connected to the grounding line.
3.4.3.5.9 Appropriate forms of protection shall be provided for underground installations against corrosion and other factors.
3.4.3.5.10 All pipelines shall be marked with distinctive colors and approved gas quality markings.
3.4.3.5.11 It is prohibited to exploit the pipelines of the tank for earthing purposes.

3.4.3.6 Requirements for Extension Valves:

3.4.3.6.1 All intake lines (from the tank) shall be provided with automatic valves to discharge the overpressure.
3.4.3.6.2 Drain valve assemblies and connections shall be of appropriate sizes that ensure the required flow rates from the receptacles on which they are installed.
3.4.3.6.3 The main gas feed line shall be provided with an Solenoid Valve, with connection to the main alarm panel of the site.
3.4.3.6.4 A manual ball shut- off valve shall be installed near the tank on the mains.
3.4.3.6.5 Gas pipes with a diameter greater than 25 mm shall be (installed) provided with the following:

1. Automatic valves to discharge the excess pressure on all external lines of the feed from the tank.
2. Automatic shut- off valve, with connection to alarm panel.
3. Check Valve.

3.4.3.6.6 The overpressure relief valve shall be installed at the top of the tank, with the drain opening always facing upwards and at a height of 1 m from the tank.
3.4.3.6.7 The ends of the discharge devices shall be properly placed and fixed in place to ensure that they are protected from damage.

3.4.3.6.8 The (position and location) of the valves shall be selected or arranged to minimize the possibility of tampering and accidents.
3.4.3.6.9 Shut- off valves may not be installed between the safety valves and the tank.
3.4.3.6.10 The regulators used shall have discharge openings, and the discharge openings shall have protection covers to prevent clogging.
3.4.3.6.11 Excess pressure relief valves shall be directly connected at all times to the gas compartment within the tank.

3.4.3.7 Maintenance Requirements for Gas Tanks:

3.4.3.7.1 General maintenance shall be performed on the tank every 3 months. Possible leaks shall be detected using a soapy solution.
3.4.3.7.2 Visual inspection of the tank body, its pipelines and supports shall be carried out on an annual basis to detect any possible corrosion or damage.
3.4.3.7.3 Periodic inspection of the tank shall be performed every 5 years by ultrasound.
3.4.3.7.4 An emergency plan shall be prepared before carrying out tank maintenance work and shall be strictly applied during maintenance operations.

3.4.4. Compressed gas transport tanks.

Tanker Compressed Gas Transportation:
A vehicle designated in terms of design and integrated (installed) with a tank to transport compressed gas.
Caution: The term “tanker” in this clause is used to refer to both the (individually) transported tank and the vehicle integrated into the tank.

3.4.4.1 Compressed gases shall be filled in special tanks designed for the purpose and licensed by the General Directorate of Civil Defense.
3.4.4.2 It is prohibited to fill the tank with any gas without completely cleaning it of any other gases that may react with it, by pushing it with an inert gas.
3.4.4.3 The system of approved international signs and symbols shall be applied to the tanks.
3.4.4.4 Any tanker in which release is detected at the filling site may not be filled. It shall be immediately withdrawn to a safe place (in accordance with the procedures for this) with the evacuation of the area and the summoning of the owner and the General Directorate of Civil Defense.
3.4.4.5 Special parking shall be allocated for filling and discharge of compressed gas tanks.
3.4.4.6 The filling and discharge process shall be carried out in the presence of trained supervisors who are fully aware of the dangers of compressed gases and how to deal with them in emergency situations, and by using protective devices for the purpose.
3.4.4.7 The tank shall be earthed, before proceeding with the discharge process, when the contents are flammable.
3.4.4.8 It is prohibited to start the filling or discharge process without confirming the complete braking of the tank (and using hand brakes).
3.4.4.9 Warning signs shall be placed during, and until the completion of the filling or discharge process to warn non- specialized persons not to approach, provided that the plate measures 30x40 cm and is written in white on a blue background and carries phrases such as Stop, Hazardous Gases.
3.4.4.10 The tank valves shall be sealed after discharge and then put a gas tank statement – Empty – thereon with the name of the gas in the vacuum depending on the type of gas, before leaving the tank.

3.4.4.11 It is prohibited to use excessive force to close the tank valves when filling or discharge, especially in the event of a leak. It is also prohibited to tamper with the wiring or use a hammer to open any valve that is difficult to open, while calling the competent authorities, such as the General Directorate of Civil Defense, the owner, the supplier, etc.

3.4.4.12 Ensure that the tank is completely free of all its contents before subjecting it to any welding or maintenance operations

3.4.5. Special precautionary requirements for some compressed gases.

3.4.5.1 Cryogenics:
They are very cold liquefied gases that can reach temperatures below minus 180 °C, such as oxygen, nitrogen and argon.

3.4.5.1.1 Oxygen receptacles and cylinders shall be disinfected from greases, oils and any contaminants before they are filled.

3.4.5.1.2 Combustion sources shall be kept away from compressed and liquid oxygen gas.

3.4.5.1.3 Flammable gas cylinders with oxygen cylinders are prohibited to be stored.

3.4.5.1.4 Water shall be kept away from the safety valves to avoid freezing the water on it, which may result in a malfunction of the safety valve.

3.4.5.2 Highly flammable gases (hydrogen - acetylene):

3.4.5.2.1 Such cylinders may not be stored near flammable solvents or combustion residues or near electrical connections or any combustion sources.

3.4.5.3 Medical gases (cyclopropane, nitrous oxide, medical oxygen, helium):

3.4.5.3.1 Those dealing in the fields of medical gases shall be fully aware of the characteristics of these gases and how dangerous they are.

3.4.5.3.2 The gas valve shall be fully opened when used, to ensure that the flow of gas does not fall below the required limit in any way, due to the importance and specificity of medical applications.

3.4.5.3.3 Any attempts to mix these gases in cylinders without the consent of the supplier and manufacturer shall be prohibited.

3.4.5.3.4 The gas valve shall be opened slowly and carefully, after removing the cap, for a short time to eliminate possible dust and dirt.

3.4.5.3.5 The opening direction of the gas valve shall be away from personnel, with only equipment intended for the opening operation being used.

3.4.5.3.6 If gas may be contaminated with foreign Materials from any sources, it may not be used unless it is equipped with special filters for pollutants or check valves.

3.4.5.3.7 The name of the gas shall be clearly marked on the cylinder, and considered in the first instance before the colour.

3.4.5.3.8 It is prohibited to handle cylinders of these gases with hands or gloves contaminated with oil and grease.

3.4.5.3.9 Colors shall be adhered to in distinguishing medical gases according to **Table:- F.1.T13** and the distinctive colors of compressed gas cylinders listed in the Appendix:

Table:- F.1.T13 :The distinctive colors of medical gas cylinders

Gas Name	Cylinder Color Gas Container	Gas Name	Cylinder Color Gas Container
Oxygen	Green	Cyclopropane	Orange
CO_2	Gray	Helium	Brown
Nitrous oxide (N_2O)	Pale Blue	Ethylene	Red

CO_2 + Oxygen	Gray + Green	Helium + Oxygen	Brown + Green

3.4.5.3 Toxic gases:

3.4.5.4.1 Persons dealing with these gases shall have sufficient contact information for those concerned and competent with these gases (such as the supplier) in emergency situations.

3.4.5.4.2 Respirators and gas masks for toxic gases shall be provided and used in emergency situations, especially when the concentration of gas exceeds the permitted percentage. Further, such equipment shall be kept in the place designated for it away from pollution.

3.4.5.4.3 The appropriate volume of cylinders of these gases shall be used for the required purpose. Further, it shall be provided only for the time specified for use and shall be removed immediately upon completion thereof.

3.5 Radioactive Material

Introductory Definitions:

Radioactive Materials: Materials or devices that emit ionizing radiation, or devices that are used to accelerate the atomic components.

Ionizing radiation: All charged or neutral particles or electromagnetic rays that directly or indirectly ionize matter when they fall on it, including alpha and beta particles, neutrons, electrons, gamma rays, and x-rays.

Competent authorities: The competent authorities in this chapter mean all official authorities, who are concerned with the protection and prevention of the hazards of radioactive Materials, and responsible for issuing legislation on the handling of radioactive Materials.

3.5.1 Preamble and General Requirements.

3.5.1.1 Radioactive Materials may not be transported, handled and stored without the approval of the competent authorities and General Directorate of Civil Defense.

3.5.1.2 The concerned party shall submit a detailed plan of the site to be licensed for radioactive devices or Materials, indicating the dimensions and its surroundings, for the approval of the competent authorities, before occupying the site with the activity to be licensed.

3.5.1.3 After fulfilling the preventive requirements and acquiring the license, No person or entity may bring radioactive devices or materials in quantities exceeding the quantities allowed by the competent authorities under the license.

3.5.1.4 Radioactive devices or Materials may not be transported outside the licensed places. Their specifications may not be changed or modified. Their quantities may not be increased unless they obtain prior approval from the competent authorities.

3.5.1.5 Radiology devices may only be used by specialists, provided that they obtain the necessary license from the competent authorities.

3.5.1.6 Radioactive Materials may be handled only by competent persons.

3.5.1.7 Accurate procedures shall be prepared to monitor and record all traded quantities of radioactive Materials in special records in which the consumption of the Material is recorded, with full accuracy in following up the registration to ensure that they are not lost.

3.5.1.8 The owners of the facility licensed to use radiology devices shall provide all necessary personal protective means and equipment for radiology workers.

3.5.1.9 The owners of the facility licensed for any radioactivity shall prepare a prior emergency plan, in cooperation with the General Directorate of Civil Defense, on dealing with emergency cases in these facilities and the emergency evacuation of the facility, with training workers on it.

3.5.1.10 The contingency plan, and take preventive action, shall be drawn up in accordance with the worst-case hypothesis of the effects of radioactive Materials and the likelihood of them getting out of control.

3.5.1.11 The instructions issued by the competent authorities regarding work and occupational safety in the places of presence of radioactive Materials shall be adhered to.

3.5.1.12 The systems and instructions approved by the competent authorities in the methods of disposal of radioactive waste shall be followed.

3.5.2. Storage site Requirements.

3.5.2.1 Do not expose facilities and installations adjacent to the radioactive Material storage area to the risk of radioactive contamination.
3.5.2.2 Do not expose the storage area to potential fire and explosion hazards from adjacent facilities and installations.
3.5.2.3 The storage site shall be in a safe area suitable for the Requirements for the competent authorities, according to the risk assessment.
3.5.2.4 The storage site shall be determined according to a comprehensive purpose study that takes into account the typical change of wind directions and other considerations of the potential risk consequences of radioactive Materials and considerations of avoiding them.

3.5.3. Requirements for Radioactive Materials Store.

3.5.3.1 Storage Building Requirements (adjacent to other buildings):

3.5.3.1.1 All construction elements shall be at least 2 hours fire resistant.
3.5.3.1.2 The floor of the warehouse shall be inclined to allow water to accumulate and leaks towards a separate drainage and shall be prepared in a fit for purpose manner.
3.5.3.1.3 The walls, ceilings and doors of the warehouse shall be painted with non-porous water-washable paint if liquid radioactive Materials are stored in it.
3.5.3.1.4 All Electrical Installations shall conform to the approved international standards.
3.5.3.1.5 The warehouse shall be equipped with suitable lighting and protected with protective covers.
3.5.3.1.6 (Natural or mechanical) Ventilation shall be provided for the warehouse, in accordance with the Requirements for the competent authorities, provided that it does not allow the release of radiation to the outside.

3.5.3.2 Requirements for open storage (away from buildings):

3.5.3.2.1 The storage area shall be away from buildings, vehicles and pedestrians at an appropriate distance.
3.5.3.2.2 The storage area shall be fenced with metal mesh reinforced with iron barriers for its protection.
3.5.3.2.2 The fence shall be at least 2m away from all sides of the radioactive Material storage site or the device containing it, provided that the storage fence has a gate that is securely locked and its key is in the possession of the person in-charge only.

3.5.4. Requirements for storing radioactive Materials.

3.5.4.1 The warehouse and work sites shall be equipped with the requirements for the specifications of fire protection systems.
3.5.4.2 Radioactive Materials and devices containing them shall be kept inside a special pit lined with a steel pipe with a depth of not less than 1 m and a diameter of 45 to 60 cm and with a welded base with a small part of the pipe visible above the ground and with a (lead or steel) cover locked with a key that is in the possession of the person in-charge only.
3.5.4.3 The flammable Materials at or near radioactive Material storage sites are prohibited.
3.5.4.4 Radioactive Materials shall be kept in shields (designed for the purpose) to prevent the release of radiation from them abroad, provided that these containers conform to the specifications approved by the competent authorities. The thickness of the shields of these

containers (and their manufacturing Materials) varies according to the type and intensity of radiation issued by them.

3.5.4.5 The approval of the competent authorities shall be obtained before the radioactive Materials are removed from the devices containing them.

3.5.4.6 If the Material is stored for more than one year, a leak test shall be carried out by the competent personnel.

3.5.4.7 In the event of the loss of the shield of the radioactive Material, another (temporary) shield shall be made completely encapsulating it until the approved shield is provided.

3.5.4.8 The radioactive Material data shall be provided and placed in a clear place within the warehouse, provided that it includes the following information:

1. The flammability of the material and its solubility in water.
2. Evaporability of the Material and its vapor density.
3. The type of protective shield suitable to contain the Material during transport and storage.
4. The name of the producer of the Material and its local agent.
5. The method of handling the Material, the protective clothing to be used, and other important precautions and measures in this regard.

3.5.5. Preventive Requirements for Radioactive Materials.

3.5.5.1 Only specialists approved by the competent authorities are allowed to open the device containing the radioactive Material.

3.5.5.2 Only specialists are permitted to access to the radioactive Material use and storage areas.

3.5.5.3 The maximum dose of radiation to which exposure is permitted is as follows:

- For workers and specialists 20 (mSv/year)
- For the general public 1 (mSv/year).

3.5.5.4 The area of use of radiological devices shall be separated from other areas by an insulating wall, made of suitable Materials, according to the type and intensity of radiation, in order to reduce exposure to radiation.

3.5.5.5 Radiation measurement devices shall be provided by the concerned party, taking into account the verification of the validity of these devices on a permanent basis.

3.5.5.6 Sound and light alarms shall be installed before and during the operation of the radiology devices to alert the workers.

3.5.5.7 All used electrical devices shall be connected to the grounding line.

3.5.5.8 Workers shall be subjected to prior procedural medical examinations before carrying out any work involving radioactivity. They shall also be subjected to periodic examinations to measure their radiation levels, provided that these examinations are carried out by the competent authorities.

3.5.5.9 All radiology workers shall be provided with instruments to measure the amount of radiation absorbed by their bodies throughout the work period, provided that these instruments are examined once every four weeks by specialists. Then, radiation data are recorded in the record of each individual.

3.5.5.10 Information on the quality of the stored radioactive Materials shall be provided (in Arabic and English) and pasted outside the warehouse, provided that it is clear and includes the following:

1. International Marks and Codes for Stored Radioactive Materials
2. Name of Radioactive Material and Type of Radiation emitted by it, whether it is alpha, beta or gamma.
3. State of the Material, whether it is gaseous, liquid or solid.
4. Procedures to be followed in emergency situations, (such as breaking or damage to packages, release of contents, exposure to fire or high temperature).
5. Phone numbers of the competent authorities and the person in charge of the site.

3.5.5.11 Inspections and maintenance of firefighting and alarm equipment shall be carried out on time in accordance with the instructions issued in this regard by the competent authority.

3.5.5.12 "The site shall be provided with warning signs for the availability of radioactive Materials, and with the following indicative signs: No Approach, Danger, Radioactive Materials, No Entry for Non-Specialists, No Smoking, making sure it is clear (in Arabic and English) from all sides and can be distinguished by pedestrians from a safe distance.

3.5.5.13 Necessary precautions shall be taken to ensure that there is a sufficient distance between the source of radiation and the areas of gathering of people, and that a comprehensive survey shall be carried out with radiation detectors around the perimeter of this area to measure the quantities of radiation, and to prohibit approaching any point where high levels of radiation are detected, by placing clear warning signs in this regard.

3.5.5.14 The competent authorities shall be notified immediately when the source of radiation is damaged or lost.

3.5.5.15 In the event that the device is exposed to an emergency accident, or is installed or dismantled incorrectly, the release site shall be inspected with special devices for the purpose. In the event that the defect is discovered, due precautions shall be taken to transfer the source of radiation to another container, and the damaged container shall be returned to the manufacturer or authorized dealer for inspection and repair. It is prohibited to use it again except after confirming its validity with a safety certificate by them.

3.5.5.16 Smoking, eating and drinking are prohibited in atmospheres likely to be contaminated with radioactive Materials.

3.5.5.17 The area contaminated by radiation shall be determined by the specialists by their use of special measuring devices for the purpose.

3.5.5.18 All persons and Materials in the contaminated area shall be isolated until the necessary measures are taken by the officials in this regard.

3.5.5.19 No vehicle is allowed to enter the area of radioactive contamination.

3.5.5.20 Any person who suffers from a wound or cut in his body shall be removed from the radiation area, with warning him to wash, disinfect and cover the wound or cut immediately, according to the followed instructions.

3.5.6. Requirements for Transporting Radioactive Materials.

3.5.6.1 Transport of radioactive Materials shall always be subject to strict security measures to ensure that they are not tampered with or damaged, while ensuring that personnel are trained in procedures for dealing with them in emergency situations.

3.5.6.2 It shall be ensured that the procedures for the virtual inspection of packages of radioactive Materials before they are transported from ports to their storage sites are applied to ensure that they are intact.

3.5.6.3 In the event that the packages are fit for transport, the following procedural measures for their transport shall be adhered to:

3.5.6.3.1 Transportation of packages shall be carried out by professionals.

3.5.6.3.2 Personal contact with the package shall be minimized.

3.5.6.3.3 Appropriate measures shall be taken to protect package casings from damage due to the effects of moisture and other damaging elements and agents.

3.5.6.3.4 The packages shall be kept away from the presence of persons and vehicles until they are transported.

3.5.5.3.6 Customs procedures for clearing packages shall be completed as soon as possible without delay and without opening the package.

3.5.6.3.6 If it is necessary to open a package, this shall be done in the presence of a specialist from a competent authority concerned with monitoring radiation protection, provided that this specialist is equipped with the appropriate means to measure radiation levels.

3.5.6.4 Radioactive Material containers shall be placed (fixed) in their proper place in the rear of a locked vehicle with an insulated place designated for the transport of radioactive Material containers, they shall be equipped with special barriers and cleats to secure the containers and prevent their movement.

3.5.6.5 The driver of the vehicle shall be provided with written information regarding the radioactive Material to be transported in accordance with clauses (3.5.4.8) and (3.5.5.10) above.

3.5.6.6 The radioactive Material transport vehicle shall be provided with two dry powder fire extinguishers of 6 kg each, as well as a device to measure the radiation level.

3.5.6.7 The driver of the vehicle shall be trained in the necessary procedures to be taken in the event of any accident, and shall be familiar with the use of a radiometer.

3.5.6.8 The driver of the vehicle shall be provided with a measurement tool for the amount of exposure radiation absorbed by his body, provided that it is periodically checked, and the recorded radiation is read, by the competent authorities.

3.5.6.9 In all cases, the driver of the vehicle is not allowed to leave the vehicle in a public place unattended.

3.5.6.10 The transport of radioactive Materials shall be initiated immediately with the arrival of the vehicle to the required location using a special purpose hand trolley through the shortest way to reach the storage site, under the supervision of the specialized official.

3.5.6.11 The approved HazChem shall be applied to Radioactive Material Transport Vehicles.

3.5.6.12 The warning label for radioactive Materials shall be removed from the vehicle if it is not.

3.5.6.13 In the event that the radioactive Material is lost during its transport, the competent authorities shall be notified immediately, and when the Material or the device containing the Material is recovered, a competent person shall write a report to that effect.

3.6 Explosives

Introductory Definitions:

Explosives: Materials with the ability to interact with each other at very fast rates up to explosion levels.
Explosion: The phenomenon of very rapid (instantaneous) expansion of the gaseous system followed by a rapid rise in the pressure leading to the explosion and loud sound. The explosion can result in rapid release of hot gases (due to rapid chemical reaction), rapid generation of energy (very high heat), rapid release of gases at very high pressures, which may be accompanied by potentially destructive consequences, or a combination of these effects.

3.6.1 Preamble and General Requirements.

3.6.1.1 The General Directorate of Civil Defense Requirements in this field are limited to covering the aspects of fire prevention and the potential destructive consequences of explosions on the one hand, and prior knowledge of the whereabouts of explosives on the other hand, in preparation for taking the necessary security measures and precautions against them in cooperation with other concerned authorities.

3.6.1.2 Without prejudice to any other legislation or system, a license shall be obtained from the General Directorate of Civil Defense (Firefighting Dept.) regarding all trading and activities related to explosives

3.6.2 The location of the explosives storage.

3.6.2.1 The distance between the explosives store and any adjacent building or gathering of the public shall not be less than 30 m. The warehouse shall be away from residential and industrial areas and public streets. The distance from these areas is determined by the strength and quantity of the explosives.

3.6.2.2 The site floor surrounding the warehouse shall be with water drainage inclinations and shall be free of any dry weeds or any flammable Materials for a distance of at least 15m from the storage depots.

3.6.2.3 A strong fence shall be constructed around the site at a height of not less than 3 m and shall be at least 50 m from the warehouse to prevent the access of stray animals or unauthorized persons.

3.6.2.4 The site shall be clearly marked with warning words such as Explosives, Danger, No Smoking, No Approach, in Arabic and English.

3.6.2.5 The roads leading to the site shall be well paved, making it easy and direct.

3.6.2.6 24-hour guarding of the storage area shall be provided.

3.6.3 Requirements for Explosives Storage Building.

3.6.3.1 Construction Elements and Specifications:

3.6.3.1.1 The Explosive Storage Places shall be subject to the conditions of General Directorate of Civil Defense mentioned in Part I in the chapter relating to special hazardous places requirements.

3.6.3.1.2 Construction elements shall be constructed of Materials resistant to projectiles, lightning and earthquakes.

3.6.3.1.3 Building walls, floors and ceilings shall be constructed with fire-resistant Materials for at least two (2) hours.

3.6.3.1.4 The warehouse shall be tightly sealable. All door and window hinges and locks (and similar openings) shall be of a durable type and well-fixed to ensure that they cannot be opened from the outside, and shall be equipped with radiators and open directly to the outside.

3.6.3.1.5 The doors of the warehouse shall always be tightly closed, except during transport operations or during the inspection of the warehouse.

3.6.3.2 Ventilation Requirements:

3.6.3.2.1 It shall be ensured that air is circulated regularly in explosive storage depots and explosive receptacles.

3.6.3.2.2 In the event of the installation of Separate mechanical ventilation to refresh the air of the warehouse at least 6 times per hour, provided that this mechanical ventilation works continuously and that it is of the type of insulation for sparks and that this ventilation is linked to the alarm system of the building (the main alarm panel of the building).

3.6.3.2.3 Spark-insulating ventilation shall be sufficient to prevent moisture or excessive heat. There shall be openings to discharge explosion pressure, which shall be covered with a mesh wire whose openings area shall not exceed 1 cm2.

3.6.3.3 Electrical Installation Requirements:

3.6.3.3.1 All electrical wiring and alarms in explosives storage depots shall be of spark insulation type.

3.6.3.3.2 The heating and cooling units of the explosives store shall be outside the building at a distance of not less than 7.5 m if they are powered by electricity, and at a distance of 15 m when using liquid fuel, where cold air is connected through ducts of insulated air inside the warehouse, and heat is connected and distributed by pipes inside the warehouse by passing hot air or hot water.

3.6.3.3.3 All electrical switchboards shall be located at a distance of not less than 7.5 m from the warehouse.

3.6.4 Requirements for explosives storage:

3.6.4.1 The temperature of the warehouse shall not exceed 29°C and shall not be less than 10°C.

3.6.4.2 Explosive boxes shall be placed on bases of fire-resistant and spark- proof Materials - at least 10 cm high from the ground, and shall be 1 m away from the walls so that they are firm and stable.

3.6.4.3 The boxes shall be arranged in rows so that the height of one row shall not exceed the height recommended by the manufacturer and a maximum of 2 m, provided that the distances between these rows shall not be less than 1 m.

3.6.4.4 The explosive box interfaces shall be shown so as to clearly indicate the quality of the stockpile and the date of manufacture.

3.6.4.5 The explosive hazard of the box stock shall be classified and marked with the following classification marks:

- Extremely Hazardous Explosives ZZ
- Highly Hazardous Explosives Z
- Medium Hazard Explosives Y
- Low-risk explosives X

3.6.4.6 Explosive boxes shall be stored according to the similarity of their types, making sure that the labels and information are clear on them in a way that can be easily inspected and their content is known.

3.6.4.7 The explosives shall be discharged from the warehouse for the purpose of use according to their seniority in storage.

3.6.4.8 It is not permitted to store explosives in quantities greater than the prescribed quantity (authorized to be stored).

3.6.4.9 The movement of stock to and from the warehouse shall be recorded. The competent authorities shall be immediately informed of the discovery of any shortage, theft or unauthorized entry into the warehouse.

3.6.4.10 Explosives Boxes may not be opened inside the warehouse. Metal Tools that issue sparks may not be used.

3.6.4.11 Open boxes shall be sealed before being returned to the warehouse.

3.6.4.12 Non-Authorized Materials are not allowed to be stored.

3.6.4.13 Explosive caps (detonators) may not be stored in the same explosive depot.

3.6.4.14 It is prohibited to have or bring matchboxes, lighters, or any igniters or sparks-producing tools, including firearms, into the storage area up to a distance of 150 m from the warehouse, except for weapons carried by guards. These belongings shall be taken and kept at the entrance to the storage area before they enter for those authorized to enter.

3.6.4.15 The floors of the warehouse shall be cleaned on a daily basis, provided that the cleaning tools are of a non-sparking type.

3.6.4.16 Before making any repairs inside the warehouse, the explosives depot shall be discharged to another depot with clean floors, and with the same approved specifications for storing explosives, under the supervision of the competent authority.

3.6.4.17 Explosive stores shall be inspected and stock inspected continuously every three days to monitor storage and transportation operations and conform to specifications.

3.6.4.18 Returned explosive caps (detonators) (as a result of their failure to combust) shall be placed in separate warehouses with their use prohibited until disposed of - in the appropriate manner, by the competent authority.

3.6.4.19 In the event that any of the explosives inside the depot are damaged in a way that poses a danger, the competent authorities shall be notified immediately.

3.6.5 Requirements for explosive transport vehicles:

3.6.5.1 An emergency plan for the transport of explosives shall be prepared in coordination with the competent authorities before carrying out the transport operation.

3.6.5.2 The explosive transport vehicle shall be licensed for the purpose by the General Directorate of Civil Defense.

3.6.5.3 Explosives shall be transported in transport vehicles with a closed box of non-flammable and moisture-insulating Materials.

3.6.5.4 All explosives transport vehicles shall have a secure floor and all exposed metal parts inside the box shall be coated with non-sparking Materials.

3.6.5.5 The explosive transport vehicle shall be robust, capable of easily transporting the load, in good mechanical condition and operating properly with the following checks on the vehicle engine prior to loading:

1. All parts of the vehicle shall be clean of any stuck oils or greases.
2. The fuel tank of the vehicle and the pipes connected to it shall be intact and free of any residues.
3. The vehicle's brakes, lights, alarms, and front wipers shall be in proper condition.
4. All tires of the vehicle shall be intact and filled with air.

5. All electrical wires of the vehicle shall be laid inside well-installed plastic pipes.

3.6.5.6 The vehicle shall be equipped with two dry powder extinguishers with a capacity of 6 kg if the vehicle load is less than 635 kg, and with a capacity of 9 kg when the vehicle load is 635 kg and more.

3.6.5.7 Explosive transport vehicle fire extinguishers shall be inspected periodically by an entity approved by the General Directorate of Civil Defense.

3.6.5.8 The load of explosives transport vehicles shall not exceed 75% of its planned loading capacity.

3.6.5.9 The vehicle shall be clearly marked with the approved International Signs and Codes System and Incident Management System (HazChem).

3.6.5.10 It is strictly prohibited to transport explosives on any of the vehicles not designated for transporting explosives.

3.6.5.11 EOD loading and discharging operations shall be completed under the supervision of subject matter experts and preparedness of personnel and equipment for emergencies.

3.6.5.12 Caution shall be exercised while driving the vehicle as well as during filling or discharging.

3.6.5.13 Smoking or carrying matchboxes, any igniters, firearms, oxidizing or corrosive materials in the vicinity of an explosive vehicle is prohibited.

3.6.5.14 It is prohibited to transport explosives at night without the prior approval of the competent authorities in this regard.

3.6.5.15 The route of the explosives transport vehicle shall be determined in advance in coordination with the competent authorities.

3.6.5.16 It is prohibited to transport electric batteries, flammables, oxidizers, chemical solutions, and the like, inside explosive compounds.

3.6.5.17 It is prohibited to transport explosives from one broken down vehicle to another within the boundaries of any area without informing the competent authorities, provided that the transfer takes place under the supervision of explosives experts in such cases.

3.6.5.18 It is prohibited to transport explosive caps (detonators) of all kinds in the same explosive transport vehicle. They shall be transported in another vehicle with the same specifications approved for explosive transport vehicles.

3.6.5.19 The explosives vehicle shall be accompanied by two police vehicles, one in front and the other in the back, provided that they are 50 m away from the vehicle.

3.6.5.20 In all cases, it is prohibited to stop the explosives vehicle on any public street near residential units, buildings, workplaces or gatherings before reaching the discharging site, except in emergency cases and with notification.

3.6.5.21 It is prohibited to leave the vehicle, without the presence and control of its driver or another individual assigned by officials, in an area surrounded by a fence or wall where all its gates and entrances are closed, even if waiting is allowed.

3.6.5.22 Explosives shall be delivered to approved persons in warehouses or in approved temporary storage areas.

3.6.5.23 The explosives transport vehicle shall be provided with warning lights at the front, rear and sides of the vehicle and shall be operated during the transport of explosives.

3.6.5.24 The Explosive Transport Vehicle Commander shall be familiar with the following:

1. The dangers and hazards of transported explosives and ways to deal with their accidents and confront their dangers.
2. Primary firefighting methods.
3. Roads leading to the place to be reached.
4. How to contact the officials and the competent authorities in case of emergency.
5. Requirements for permits for workers in the handling of explosives.

All persons working in handling explosives shall pass a written and oral test in all matters related to Explosives, each according to his job position, by the competent authorities, each according to its own conditions and procedures.

3.7 Hazardous Chemicals

Introductory Definitions:

Incompatible Materials: Materials posing a risk of hazardous reactions with other Materials in the same storage site, especially in conditions of possible exposure to proximity, convergence, or accidental or intentional mixing, resulting in hazardous reactions that may lead to combustion, explosion, the generation of toxic gases, or the production of other hazardous Materials.

3.7.1 Preamble and General Requirements.

3.7.1.1 Classifications of Hazardous Chemicals:

1. * Inorganic oxidizers.
2. * Organic peroxides.
3. * Oxidizer gases.
4. * Corrosive materials.
5. * Self-heating materials and water-reactive materials.
6. Spontaneously combustible Materials & Dangerous when wet Materials.

3.7.1.2 The General Directorate of Civil Defense Requirements in this field are limited to covering the aspects of prevention of fire hazards and other potential damage to these Materials on the one hand, and prior knowledge of the whereabouts of these Materials on the other hand, in preparation for taking the necessary security measures and precautions towards them in cooperation with other competent authorities.

3.7.1.3 This clause is concerned with the preventive measures required in the storage of commonly used organic Materials in packages made of approved Materials for storage purposes.

3.7.1.4 A licence shall be obtained to store, transport or handle quantities in excess of the following quantities:

1. More than 230 liters of corrosive liquids.
2. More than 225 kilograms of oxidizers.
3. More than 5 kg organic peroxides.
4. More than 225 kilograms of nitromethane.
5. More than 450 kg of ammonia nitrate or ammonia nitrate fertilizers.
6. Any quantity of highly toxic materials, pyrophoric materials, low-temperature materials or gases.

3.7.1.5 It is prohibited to store hazardous chemicals in places other than places assigned for the purpose and licensed by the competent authorities, in order to avoid exposing neighboring lives and property to their risks, provided that they have appropriate firefighting water sources.

3.7.1.6 Internal and external roads and corridors shall be provided to the warehouse, so that they are easy and safe at all times in order to facilitate the smooth movement of vehicles and emergency equipment and the speed of removal, disposal and handling of stock.

3.7.1.7 The "Material Safety Data Sheet" (MSDS) for each Material shall be provided and deposited with the site official, for reference when necessary. The warehouse shall be equipped with the necessary requirements for fire prevention and protection in accordance with the General Directorate of Civil Defense Requirements.

3.7.1.8 The owner of the facility shall provide all personal protective equipment for the workers on the site, such as protective jackets, shoes, safety glasses, etc.

3.7.1.9 General Requirements for Storage of Hazardous Chemicals:

3.7.1.9.1 Packages of hazardous chemicals shall be stored, handled and stacked in a manner appropriate to the nature of their risks, so that they remain in a fixed (stable and balanced) position at all times, especially when fire and other emergencies occur, while reducing as much as possible the size of the stacks and not exceeding the maximum height of the stacks according to the manufacturer's recommendations.

3.7.1.9.2 The containers containing the hazardous Material shall be universally approved, so that they are not affected by the hazardous Material. The international labels for each Material shall be placed on its container to clearly indicate the chemical name of the Material, its quality and danger (refer to the Appendix).

3.7.1.9.3 Stacks shall be arranged in a manner that reduces the spread of fire in the event of its occurrence, and facilitates the process of transporting and removing packages from the warehouse in emergency cases.

3.7.1.9.4 Materials with a high fire risk shall be separated from the rest of the Materials by a fire-resistant wall, and incompatible Materials (which react when they meet or contact each other) shall be separated (Refer to Appendix).

3.7.1.9.5 It is prohibited to store flammable Materials near the main columns of the building except in cases of protecting the columns with high fire resistance Materials.

3.7.1.9.6 Containers exposed to water damage shall be placed on bases at least 10 cm high, taking into account that these bases are non-flammable Materials.

3.7.1.9.7 It shall be taken into account that storage shall not hinder the operations of the fire extinguishing equipment.

3.7.1.10 Attachments to a License Application for Storage of Hazardous Chemicals:

3.7.1.10.1 Submit an engineering drawing of the site and the building to be constructed for storage, indicate the details of the adjacent buildings and the roads leading to it, specify the dimensions and distances on the drawing, and determine the method of storage.

3.7.1.10.2 Provide detailed information on the types, characteristics, condition and quantities of the Materials to be stored, the sizes of their packages, their risks and the rules prescribed for their storage, along with a copy of the permit for importing the Material attached to the MSDS for all Materials to be stored and used.

3.7.1.11 These requirements do not apply to the group of unstable and explosive organic oxidizer within their packaging under normal conditions by the action of heat.

3.7.2 Oxidizers.

They are not flammable Materials, but they help to combust. Most of them contain oxygen in their chemical composition and have the ability to release oxygen when it decomposes, which makes it increase the intensity of combustion and its ferocity, and thus the fire continues. Some of these materials may not contain oxygen but are oxidizing agents in their chemical reactions. There are some materials that cause or help other Materials to

burn, and others may lead to explosions. Depending on their chemical and physical effects, these materials can be classified into the following four classes:

3.7.2.1 Classification of Oxidizers:

3.7.2.1.1 Class I Materials: Oxidizers capable of increasing the combustion rate of the burning material.

1- All inorganic nitrates (unless otherwise classified)
2- All inorganic nitrites (unless otherwise classified)
3- Ammonium persulfate
4- Barium peroxide
5- Calcium peroxide
6- Hydrogen peroxide solutions (greater than 8 percent up to7.5 percent)
7- Lead dioxide
8- Lithium hypochlorite (39 percent or less available chlorine)
9- Lithium peroxide
10- Magnesium peroxide
11- Manganese dioxide
12- Nitric acid (40 percent concentration or less)
13- Perchloric acid solutions (less than 50 percent by weight)
14- Potassium dichromate
15- Potassium percarbonate
16- Potassium persulfate
17- Sodium carbonate peroxide
18- Sodium dichloro- s- triazinetrione dehydrate (sodium dicholorisocyanurate dehydrate)
19- Sodium dichromate
20- Sodium perborate (anhydrous)
21- Sodium perborate monohydrate
22- Sodium perborate tetrahydrate
23- Sodium percarbonate
24- Sodium persulfate
25- Strontium peroxide
26- Trichloro- s- triazinetrione [trichloroisocyanuric acid (TCCA; trichlor), all physical forms
27- Zinc peroxide

3.7.2.1.2 Class II Materials: Oxidizers capable of increasing the combustion rate more than the previous class causing spontaneous combustion of the Materials they come in contact with.

1- Barium bromated
2- Barium chlorate
3- Barium hypochlorite
4- Barium perchlorate
5- Barium permanganate
6- 1- Bromo- 3- chloro- 5,5- dimethylhydantoin (BCDMH)
7- Calcium chlorate
8- Calcium chlorite
9- Calcium hypochlorite (50 percent or less by weight)
10- Calcium perchlorate
11- Calcium permanganate
12- Chromium trioxide (chromic acid)
13- Copper chlorate
14- Halane (1,3- dichloro- 5,5- dimethylhydantoin)
15- Hydrogen peroxide (greater than 27.5 percent up to 52 percent)
16- Lead perchlorate
17- Lithium chlorate
18- Lithium hypochlorite (more than 39 percent available chlorine)
19- Lithium perchlorate
20- Magnesium bromated
21- Magnesium chlorate
22- Magnesium perchlorate
23- Mercurous chlorate
24- Nitric acid (more than 40 percent but less than 86 percent)
25- Nitrogen tetroxide
26- Perchloric acid solutions (more than 50 % but less than 60%)
27- Potassium perchlorate
28- Potassium permanganate
29- Potassium peroxide
30- Potassium superoxide
31- Silver peroxide
32- Sodium chlorite (40 percent or less by weight)
33- Sodium perchlorate
34- Sodium perchlorate monohydrate
35- Sodium permanganate
36- Sodium peroxide
37- Strontium chlorate
38- Strontium perchlorate
39- Thallium chlorate

40- Urea hydrogen peroxide
41- Zinc bromate
42- Zinc chlorate
43- Zinc permanganat

3.7.2.1.3 Class III Materials: Oxidizers capable of increasing the combustion rate in a high way, or decomposing spontaneously rapidly due to the influence of heat or the presence of some auxiliary factors.

1- Ammonium dichromate
2- Calcium hypochlorite (over 50 percent by weight)
3- Chloric acid (10 percent maximum concentration)
4- Hydrogen peroxide solutions (greater than 52 percent up to 91 percent)
5- Mono- (trichloro)- tetra- (monopotassium dichloro)- penta- s- triazinetrione
6- Nitric acid, fuming (more than 86 percent concentration)
7- Perchloric acid solutions (60 percent to 72 percent by weight)
8- Potassium bromate
9- Potassium chlorate
10- Potassium dichloro- s- triazinetrione (potassium dichloroisocyanurate)
11- Sodium bromate
12- Sodium chlorate
13- Sodium chlorite (over 40 percent by weight)
14- Sodium dichloro- s- triazinetrione anhydrous(sodiumdichloroisocyanurate)anhydrous

3.7.2.1.4 Class IV Materials: Oxidizers that can produce a reaction accompanied by an explosion in the presence of some auxiliary factors or by the influence of heat, shocks or friction, which leads to an increase in the rate of combustion and ferocity of the burning Material.

1- Ammonium perchlorate (particle size greater than 15microns)
2- Ammonium permanganate
3- Guanidine nitrate
4- Hydrogen peroxide solutions (greater than 91 %)
5- Tetranitromethane

3.7.2.2 Oxidizer Storage site Requirements:

3.7.2.2.1 These sites shall be licensed by the General Directorate of Civil Defense (Firefighting Dept.) in the following cases:

1. - If the stock of Class 1 exceeds 1814 kg.
2. - If the stock of Class 2 exceeds 454 kg.
3. - If the stock of Class 3 exceeds 91 kg.
4. - If the stock of Class 4 exceeds 4.5 kg.

3.7.2.2.2 The distance between the storage site of the second category of these Materials and other facilities or gathering places shall not be less than 10 m if the warehouse is equipped with an automatic water sprinkler network. The distance shall not be less than 15 m if the warehouse is not equipped with a sprinkler network.

3.7.2.2.3 The distance between the storage site of the third category of these Materials and other facilities or gathering places shall not be less than 15 m if the warehouse is equipped with an automatic water sprinkler network. The distance shall not be less than 23 m if the warehouse is not equipped with a sprinkler network.

3.7.2.2.4 Inorganic oxidizers shall not be stored in close proximity to flammable, organic or reducing materials (acting as a reducing agent).

3.7.2.2.5 The distance between the location of a tank or stand-alone storage building for Class IV Materials and adjacent buildings, depending on the quantity of stock, shall not be less than as per the table below. Provided that it is not less than what is specified in the table below.

Table:- F.1-T14 : Distance between the location of a warehouse or stand-alone building for storing Class IV Materials and adjacent buildings

Oxidizer Quantity (kg) (Class 4)	Distance (M)
50 - 4.5	25
227 - 50	30
454 - 227	38
1361 - 454	61
2268 - 1361	91
2268 – 4536	122
+4536	As per General Directorate of Civil Defense approval

3.7.2.2.6 The General Directorate of Civil Defense has the right to request the distance it deems appropriate when the storage of Class 4 of oxidizers is increased to 4536 kg.

3.7.2.3 Requirements for Oxidizer Storage Premises:

3.7.2.3.1 Building Elements and Specifications:

1. The storage building shall be standalone and consist of one floor (ground floor only).
2. All building elements, including floors, shall be constructed of Materials suitable for the nature of the oxidizers to be stored, provided that their fire resistance is not less than two hours.
3. When designing the building, the possibility of discharging the (potential) explosion pressure from the building in the direction least exposed to danger and damage shall be

taken into account and that the ceiling or one of the walls shall be made of light and fire-resistant Materials.

4. A room is allowed to store oxidizers within a building with an area of not more than 50 square meters. In this case, all internal walls and the ceiling of the storage room within the building shall be Pressure Resistant) with a thickness of not less than 30 cm, provided that the external wall of the room is open-air view of a light and fire-resistant Material for a period of not less than two hours in order to discharge the potential explosion pressure and to limit damage while applying all other Requirements for the Separate storage building itself.
5. A
    a) The finishes and connections between the walls, ceilings, floors and openings resulting from the electrical and sanitary installations of the oxidizer warehouse shall be sealed and waterproof to the inside of the warehouse, and the floor shall be tilted to drain any possible release of oxidizers into a separate dedicated pit.
    b) Arrangements shall be made. Using traps, separators, sinks, or the use of effective treatment units, to prevent the entry of oxidizing liquids into the public discharge system or to neutralize their harmful effect before they are discharged or transported.
    c) When storing large quantities of oxidizers, an effective emergency drainage system shall be secured to ensure the immediate absorption of all leaking Materials and contaminated water resulting from extinguishing operations and washing these Materials, etc..
    d) Each potential release of oxidizers by itself shall be evaluated according to the surrounding circumstances (which govern them) and the properties of the materials, and then its requirements for preventive measures and appropriate treatment of the risks that may result from them shall be assessed in accordance with the requirements determined by the competent authorities of the case.
6. Sills shall be constructed in front of the doors of the oxidizer warehouses with a height of at least 10 cm to prevent spills of oxidizers from leaking out of the warehouse, or the floor of the storage area shall be at least 10 cm lower than the surface of the surrounding ground.
7. More than one exit shall be provided in suitable locations and free of obstacles in accordance with the Requirements for the competent authorities, in order to facilitate the handling of accidents.
8. The doors of the warehouse shall be made of fire-resistant Materials for a period of not less than half an hour. They shall be opened outside and closed automatically when left.
9. Storage silos (compartments) and tanks of oxidizers shall be designed in a way that prevents pollution or increased pressure inside them when exposed to fire. It is prohibited to store them in the form of piles or in open silos.
10. Proper and safe lighting shall be provided in the warehouse at all times.

3.7.2.3.2 Ventilation of Storage Buildings:

1. Upper and lower natural ventilation shall be provided to refresh the air of the oxidizer storage building at least 6 times per hour.
2. In the event that natural ventilation is not possible or natural ventilation is insufficient at the above required rate, Separate mechanical ventilation shall be installed to refresh the air of the warehouse building at least 6 times per hour, provided that this mechanical ventilation works continuously and that it is of spark insulation type type and that this ventilation is linked to the alarm system of the building (the main alarm panel of the building).

3. When storing liquid oxidizers, the ventilation outlets shall lead to the outside of the building and be made of fire-resistant Materials for a period of at least two hours.

3.7.2.3.3 Electrical Installations for Storage Buildings:

1. All Electrical Installations shall be in galvanized iron pipes.
2. The light bulbs shall be of types that do not radiate heat and are protected by a protective net.
3. In the event that there is a heating system in the stores of oxidizers, the pipelines and heating channels shall be isolated away from the oxidizers, with the need to maintain the temperature of the stores between 4°C and 49° C. It is prohibited to use open or direct flame in the heating process.

3.7.2.4 Storage Requirements for Oxidizers:

3.7.2.4.1 When storing such Materials, account shall be taken of the amount of toxic vapors that emanate from them as a result of spillage, decomposition, or during fire, as well as their harmful effects on individuals and the surrounding environment.
3.7.2.4.2 The storage height of oxidizers shall not exceed 2 m and as per manufacturer's recommendations (whichever is lower).
3.7.2.4.3 The width of the corridors between the storage rows shall not be less than 1 m.
3.7.2.4.4 Containers shall be placed on bases not less than 15 cm high.
3.7.2.4.5 The distance between the stock and the walls shall not be less than 1 m.
3.7.2.4.6 Containers shall be kept in their normal (upright) position and sealed.
3.7.2.4.7 It is prohibited to store any other Materials except with the approval of the competent authorities.
3.7.2.4.8 Non-specialists are prohibited from entering the warehouse.
3.7.2.4.9 Class IV Materials shall be stored either in an open outdoor location or in a stand-alone building, which does not contain incompatible Materials, away from other installations.
3.7.2.4.10 The limits of quantities and stack sizes for Class IV if storage is within drums, containers or containers shall be as per the table below.

Table:- F.1.T15 : Storage limits and quantities for Class IV depending on the availability of an automatic fire sprinkler system

Maximum stack dimensions to be adhered to (m)	In case of lacking Sprinklers	In case Sprinklers
Length	3.0 m	3.0 m
Width	1.2m	1.2m
Height	1.2m	2.4m
Minimum distance between stacks	1.8m	2.4m
Maximum Allowable Quantity in One Building (Ton)	0.9	Any quantity is allowed

3.7.2.4.11 If the stock of Classes 1 & 2 is in glass containers, the height shall not exceed 2 m according to the manufacturer's recommendations (whichever is less).
3.7.2.4.12 In all cases, the stock height of Classes 3 & 4 shall not exceed 1m according to the manufacturer's recommendations (whichever is less).
3.7.2.4.13 The distance between the walls and the storage rows shall not be less than 1 m.

3.7.2.4.14 Storage shall be limited to authorize Materials.
3.7.2.4.15 An area in the warehouse shall be allocated for keeping empty containers.
3.7.2.4.16 Smoking is prohibited in all oxidizer stores.
3.7.2.4.17 It is prohibited to collect flammable waste in and around the warehouse.
3.7.2.4.18 In the event of spillage, effluent or accidental release of the oxidizer, it shall be removed immediately to a safe place, following the manufacturer's instructions on how to dispose of it.
3.7.2.4.19 Personnel in oxidizer storage facilities shall be trained in the use of firefighting equipment.
3.7.2.4.20 Maintenance operations within oxidizer stores shall be carried out by specialized personnel.
3.7.2.4.21 All welding and cutting operations shall be subject to the technical General Directorate of Civil Defense Requirements.
3.7.2.4.22 The following warning signs shall be placed in the warehouses and at the oxidizer storage sites: Danger - No Smoking
3.7.2.4.23 Indicative markings identifying the type of Material stored shall be placed.
3.7.2.4.24 All oxidizer stores shall be coded according to their quality as follows: Oxidizers
3.7.2.4.25 The warehouse shall be coded according to the maximum risk category among the different categories of inventory.
3.7.2.4.26 The scientific name of the material shall be noted on the stored containers.
3.7.2.4.27 The HazChem shall be applied to all stores and receptacles of oxidizers.
3.7.2.4.28 Liquid oxidizers shall be stored in specially manufactured and approved tanks, containers or packages.

3.7.3 Organic Oxidizers.

Organic Peroxides: They are organic compounds that contain in their chemical structure a di-oxygen bond or a peroxide group (O- O). They may be solid, liquid, or gaseous, and their danger lies in their flammability, as they spontaneously decompose and then combust or explode. Organic peroxides are divided, depending on their chemical and physical effects, into five categories, the highest of which is the first category and the risk decreases down to Class 5.

3.7.3.1 Organic oxidizers.

3.7.3.1.1 **Class I Materials:** Organic oxidizers that combust easily and are accompanied by a pop.

Container's Capacity	Concentration (%)	Material name
19 L	90	t- Butyl hydroperoxide
0.5 kg	98	t- Butyl monoperoxymaleate
19 L	75	t- Butyl peroxyacetate
19 L	60	t- Butyl peroxyacetate
19 L	92	t- Butylperoxy isopropyl carbonate
0.5 kg	98	Dibenzoyl peroxide
4 Liter	50	(t- butylperoxy) butane 2,2- Di
4.5 kg	99	Diisopropyl peroxydicarbonate
4 Liter	98	Di- n- propyl peroxydicarbonate
4 Liter	85	Di- n- propyl peroxydicarbonate

3.7.3.1.2 **Class II Materials:** Organic oxidizers that combust easily and are accompanied with high risk reactions.

Container's Capacity	Concentration (%)	Material name
19 Liter	96	t- Amyl peroxybenzoate
19 Liter	98	n- Butyl- 4,4- di(t- butylperoxy(valerate
208 Liter	70	t- Butyl hydroperoxide3
19 Liter	98	t- Butyl peroxybenzoate
208 Liter	97	t- Butyl peroxy- 2- ethyl- hexanoate
19 Liter	75	t- Butyl peroxyisobutyrate
19 Liter	75	t- Butylperoxy isopropyl carbonate
19 Liter	75	t- Butyl peroxypivalate
19 Liter	25	Diacetyl peroxide
11 kg	78	Dibenzoyl peroxide
19 Liter	80	1,1- Di(t- butylperoxy(cyclohexane
4 Liter	98	Di- sec- butyl peroxydicarbonate
19 Liter	75	Di- sec- butyl peroxydicarbonate
19 Liter	75–95	1,1- Di(t- butylperoxy(3,3,5- - trimethyl - cyclohexane
4 Liter	97	Di(2- ethylhexyl(peroxydicarbonate
2.3 kg	95	2,5- Dimethyl- 2,5- di(benzoylperoxy(hexane
45 KG	70	2,5- Dimethyl- 2,5- dihydroperoxy hexane
110 Liter	43	Peroxyacetic acid, Type E, stabilized

3.7.3.1.3 Class III Materials: Organic oxidizers that combust easily and are accompanied with Medium- risk reactions.

Container's Capacity	Concentration (%)	Material name
208 Liter	88	t- Amyl hydroperoxide
19 Liter	60	t- Amyl peroxyacetate
208 Liter	96	t- Amyl peroxy- 2- Ethylhexanoate
19 Liter	75	t- Amyl peroxyneodecanoate
19 Liter	75	t- Amyl peroxypivalate
19 Liter	97	t- Butyl peroxy- 2- ethylhexanoate
208 Liter	50	t- Butyl peroxy- 2- ethylhexanoate
19 Liter	95	t- Butyl peroxy- 2- ethylhexyl carbonate
19 Liter	75	t- Butyl peroxyneodecanoate
208 Liter	88	Cumyl hydroperoxide
19 Liter	75	Cumyl peroxyneodecanoate
19 Liter	75	Cumyl peroxyneoheptanoate
19 Liter	80	1,1- Di(t- amylperoxy(cyclohexane
11 KG	75	Dibenzoyl peroxide
160 KG	55	Dibenzoyl peroxide (paste)
170 KG	50	Dibenzoyl peroxide (paste)
40 KG	98	Di(4- t- butylcyclohexyl) peroxydicarbonate
208 Liter	99	Di- t- butyl peroxide3

45 KG	96	Di(2- t- butylperoxy isopropyl) benzene
23 KG	98	Didecanoyl peroxide
19 Liter	50	Di- 2,4- dichlorobenzoyl peroxide
2.3 KG	30	Diisopropyl peroxydicarbonate
110 Liter	92	2,5- Dimethyl- 2,5- di)t- butylperoxy(hexane
19 Liter	90	2,5- Dimethyl- 2,5- di- (- 2ethyl hexanoylperoxy)
19 Liter	75	Ethyl- 3,3- di (t- amylperoxy) butyrate
19 Liter	75	Ethyl- 3,3- di (t- butylperoxy) butyrate
19 Liter	9.0% Active Oxygen	Methyl ethyl ketone peroxide
19 Liter	9.0% active Oxygen	Methyl ethyl ketone peroxide and Cyclohexanone peroxide mixture

3.7.3.1.4

Cl

ass IV Materials: Organic oxidizers that combust as combustibles with low- risk reactions.

Container's Capacity	Concentration (%)	Material name
208 Liter	95	t- Butyl cumyl peroxide
208 Liter	70	t- Butyl hydroperoxide
19 Liter	50	t- Butyl peroxy- 2- ethylhexanoate
19 Liter	45	t- Butyl peroxypivalate
11 KG	70	Dibenzoyl peroxide
160 KG	55	Dibenzoyl peroxide (paste)
170 KG	50	Dibenzoyl peroxide (paste)
170 KG	40	Dibenzoyl peroxide (slurry)
19 Liter	40	Dibenzoyl peroxide (slurry)
45 KG	35	Dibenzoyl peroxide (powder)
110 Liter	40	Di(t- butylperoxy) phthalate
20 KG	85	Dicetyl peroxydicarbonate
208 Liter	98	Dicumyl peroxide
19 Liter	40	Di(2- ethylhexyl) peroxydicarbonate
50 Liter	98	Dilauroyl peroxide
208 Liter	54	p- Menthyl hydroperoxide
19 Liter	5.5% active oxygen	Methyl ethyl ketone peroxide
19 Liter	9.0% active oxygen	Methyl ethyl ketone peroxide
19 Liter	4.0% active oxygen	2,4- Pentanedione peroxide

3.7.3.1.5 **Class V Materials**: Organic oxidizers that combust with less sensitivity than combustible Materials and may not continue to burn and do not pose a reaction risk.

Container's Capacity	Ratio Concentration (%)	Material name
45 KG	35	Dibenzoyl peroxide (powder)
45 KG	40	Di(2- t- butylperoxy isopropyl) benzene
45 KG	40	1,1- Di(t- butylperoxy)- 3,3,5- trimethyl cyclohexane
45 KG	40	Dicumyl peroxide
45 KG	47	2,5- Dimethyl- 2,5- di(t- butylperoxy) hexane
45 KG	40	Ethyl- 3,3- di(t- butylperoxy) butyrate

3.7.3.2 Requirements for Organic Oxidizer Storage Site:

3.7.3.2.1 The distance between the storage site of these Materials and any adjacent facilities shall not be less than 3 m.

3.7.3.2.2 The distance between the storage site of these Materials and the storage site of the flammable liquids shall not be less than 8 m unless these Materials are separated from the flammable liquids by fire-resistant walls for a period of not less than two hours.

3.7.3.2.3 The site shall be provided with an external fire nozzle network connected to a water source (fire) so that its flow is sufficient and continuous, according to the General Directorate of Civil Defense Requirements.

3.7.3.2.4 All parts of the building shall be provided with suitable manual fire extinguishers.

3.7.3.3 Organic Oxidizer Storage Building Requirements:

3.7.3.3.1 Building Elements and Specifications:

1. The storage building shall be standalone and consist of one floor (ground floor only).
2. All building elements, including floors, shall be constructed of Materials suitable for the nature of the Materials to be stored, provided that their fire resistance is not less than two hours.
3. When designing the building, the possibility of discharging the (potential) explosion pressure from the Materials stored in the building in the direction of the least risk of danger and damage shall be taken into account and that the ceiling or one of the walls shall be made of light and fire-resistant Materials.
4. A room is allowed to store organic oxidizers within a building with an area of not more than 50 square meters. In this case, all internal walls and the ceiling of the storage room within the building shall be resistant to explosion pressure with a thickness of not less than 30 cm, provided that the external wall (the front of the room overlooking the open air) is made of light and fire-resistant Material for a period of not less than two hours in order to discharge the potential explosion pressure and to limit damage while applying all other Requirements for the Separate storage building itself.
5. Requirements for Protection from Leaks of Organic oxidizers:
    a) Finishes and connections between walls, ceilings, floors, and openings resulting from electrical and sanitary installations of organic oxidizers stores shall be sealed and waterproof to the inside of the warehouse. The floor shall also have a tendency to drain any possible release of oxidizers into a separate dedicated pit.

b) Arrangements shall be made, using traps, separators, sinks, or the use of effective treatment units, to prevent the entry of organic oxidizing liquids into the public drainage system or to neutralize their harmful effect before they are discharged or transported.
c) When storing large quantities of organic oxidizers, an effective emergency drainage system shall be secured to ensure the immediate absorption of all leaking Materials and contaminated water resulting from extinguishing operations and washing these Materials, etc..
d) Each case of potential diversion of organic oxidizers by itself shall be evaluated according to the surrounding circumstances (which govern them) and the properties of the materials, and then its requirements for preventive measures and appropriate treatment of the risks that may result from them shall be assessed in accordance with the requirements determined by the competent authorities for the case.

6. Sills shall be constructed in front of warehouse doors (at least 10 cm high) to prevent Material spills from leaking out of the warehouse, or the floor of the storage area, shall be at least 10 cm below the surface of the surrounding ground.
7. More than one exit shall be provided in suitable locations and free of obstacles in accordance with the Requirements for the competent authorities, in order to facilitate the handling of stock during accidents.
8. In all cases, the doors of the warehouse shall be kept closed except during transport, storage or inspection of the warehouse.
9. The warehouse shall be isolated from the rest of the building with fire-resistant Materials for a period of not less than two hours.
10. Proper and safe lighting shall be provided in the warehouse at all times.
11. The quantities of water required to be provided for fire sprinklers (in storage), fire nozzles and rubber hoses shall be calculated for the site for at least 90 minutes.
12. 12- The quantities of fire water for the sprinkler system shall be provided at the rates mentioned in the following table:

Table:- F.1-T16 : Fire Water Rates Required for Organic Oxidizer Storage Sprays

Class 1	20.4 Liter/ Minute/ M^2)
Class 2	16.3 Liter/ Minute/ M^2)
Class 3	12.2 Liter/ Minute/ M^2)
Class 4	10.2 Liter/ Minute/ M^2)

3.7.3.3.2 Ventilation Requirements:

1. A separate mechanical ventilation shall be installed to refresh the air of the spark insulation type stored at least 6 times per hour, provided that this mechanical ventilation works continuously and that it is of the spark insulation type and that this ventilation is linked to the alarm system of the building (the main alarm panel of the building).
2. An automatic cooling system shall be provided for the warehouse, so that it always maintains the temperature of the warehouse to remain below the degree of automatic decomposition of the stored Materials.

3.7.3.3.3 Electrical wiring Requirements:

1. Electrical wiring and switches shall be of spark insulation type.

2. The light bulbs shall be of types that do not radiate heat and are protected by a protective net.
3. The electrical switchboard shall be located at a minimum distance of 7.5 m from the warehouse.

3.7.3.4 Requirements for Storage of Organic Oxidizers:

3.7.3.4.1 Organic oxidizers shall be marked with indicative and warning signs indicating the quality of the stored category with the addition of the words "organic oxidizers" to the indicative signs.

3.7.3.4.2 If the warehouse includes more than one category of organic oxidizers, the warehouse shall be marked with indicative and warning signs according to the most dangerous category.

3.7.3.4.3 Packages containing organic oxidizers shall be marked with labels showing the chemical name of the material and other data showing their classifications according to their hazard categories.

3.7.3.4.4 Organic oxidizers packages that require storage under certain temperatures shall be marked with labels showing the required storage temperature for each package.

3.7.3.4.5 The person, who is responsible for dealing with organic oxidizers, and those working in storage areas, shall be familiar with the preventive requirements followed in the methods of storing these Materials and how to deal with them in emergency situations, including the use of personal protective equipment, such as protective jackets, safety shoes and glasses, how to get rid of their leaks and spills, develop training, evacuation and firefighting plans, use alarms and address emergency release, and adhere to all instructions set by the manufacturer in this regard.

3.7.3.4.6 All maintenance operations within the organic oxidizers stores shall be carried out under the supervision of competent personnel and based on prior action plans in this regard. It is prohibited to carry out any welding or cutting work until after the warehouse is completely emptied of the stock.

3.7.3.4.7 Permissible Storage Limits for Organic Oxidizers: The quantities of storage of these Materials are determined according to their degree of danger. The following table shows the maximum allowable storage quantities (in metric tons) according to the availability of protection (fire sprinklers) for the warehouse or not.

Table:- F.1-T17 : The maximum permissible storage limits for the categories of organic oxidizers in the event of the presence of (+) and the absence of (-) automatic fire water sprinkler system

If there are (+) or no (-) fire sprinklers for each category of organic oxidants		Place of storage of organic oxidants				
		Located with other materials at safe distances	Room insulated from other materials	Standalone Store		
				not less than 15 m	Not less than 30 m	Not less than 45 m
Category		Ton	Ton	Ton	Ton	Ton
1	-	0.0	0.0	0.454	1.81	4.45
	+	0.0	0.907	0.907	9.07	79.4
2	-	0.0	0.907	9.070	36.3	237
	+	1.81	22.7	45.4	90.7	Any quantity
3	-	0.68	1.36	31.8	90.7	340
	+	22.7	45.4	90.7	Any quantity	Any quantity
4	-	45.4	90.7	136	227	454
	+	Any quantity	Any quantity	Any quantity	Any quantity	Any quantity
5	-	Any quantity	Any quantity	Any quantity	Any quantity	Any quantity
	+	Any quantity	Any quantity	Any quantity	Any quantity	Any quantity

3.7.3.4.8 Smoking is prohibited in all storage areas, with the need to place warning signs at the entrances.

3.7.3.4.9 If more than one class of these organic oxidizers is stored in a single warehouse, the stock of each class shall not exceed the maximum allowable limits, according to its percentage among the percentages of the other classes and the maximum allowable storage limits for each class, so that the total stock percentages do not exceed 100%.

3.7.3.4.10 Storage in the Separate store shall be limited to organic oxidizers only.

3.7.3.4.11 It is prohibited to keep or collect any flammable residues in organic oxidizers stores.

3.7.3.4.12 Spilled and leaking Materials and damaged receptacles shall be disposed of immediately to a safe place.

3.7.3.4.13 The proper methods used in the disposal of all wastes of organic oxidizers shall be studied and prepared, provided that these practices are subject to the approved international and local laws and in accordance with the instructions of the manufacturer.

3.7.3.4.14 The width of the corridors between the storage rows shall not be less than 2.5m for Class 1 and 2m for Classes 2 & 3 and 1.5m for Class 4.

3.7.3.4.15 The distance between the storage rows and the walls of the warehouse shall not be less than 1m.

3.7.3.4.16 Stored containers shall be hermetically sealed.

3.7.3.4.17 Organic Oxidizer shall not be stored in silos that are not designed and approved for storage.

3.7.3.4.18 The height of one stack shall not exceed 3 m and the width shall not exceed 5 m when storing Class 4 of organic oxidizers in the form of stacks of bags, packages or containers.

3.7.3.4.19 In the case of storage of Classes 2 & 3 of organic oxidizers, the storage system shall be as follows:

1. If the Material is in bags or packages, the storage height shall not exceed 2.5 m.
2. If the Material is in 220- liter barrels, the storage shall not exceed the height of one barrel.

3.7.3.4.20 The height of the storage stacks shall not exceed 2 m. In the case of storing Class 1 of organic oxidizers, whether in bags, barrels, containers or other packages, the height of the storage stacks shall not exceed 1.5 m.

3.7.4 Oxidizing Gases

Oxidizing Gases: They are non-flammable gases but, in the presence of the combustion source and fuel, they can catalyze and sustain the combustion process, accelerating combustion and increasing the intensity of the fire. It blows oxygen (or another oxidizer) easily to other Materials, triggering the process of oxidation (or combustion). Oxidizing gases may not contain oxygen (such as chlorine, fluorine, and bromine), but in their chemical reactions, they are considered a catalyst and accelerator of oxidation.

3.7.4.1 General Requirements for Oxidizing Gases:

3.7.4.1.1 This clause is concerned with the Requirements for the methods used in the storage of oxidizing gases that are kept in cylinders, tanks or other forms of containers.

3.7.4.1.2 These requirements apply to oxidizers when they are gaseous at 20°C or are in the form of liquid vapours with a vapour pressure above 3 (kg. cm2) at 37.8°C and stored in containers, cylinders or tanks.

3.7.4.1.3 These requirements shall apply if the amount of stored gases is more than 45.4 kg whether their cylinder is fully or partially filled or empty.

3.7.4.1.4 Common oxidizing gases include chlorine, fluorine, nitrogen trioxide, nitrous oxide and oxygen.

3.7.4.1.5 The storage sites of these Materials shall be marked with the following indicative and warning signs: Danger, Oxidizing Gases, as well as providing oxidizing gas data and its international labelling and codes.

3.7.4.1.6 All oxidizing gas cylinders and tanks shall be manufactured in accordance with the approved international standards.

3.7.4.1.7 All relevant conditions contained in Chapter 3.7.4 of this Part shall be adhered to.

3.7.4.2 Oxidizing gas storage site requirements:

3.7.4.2.1 The location of the storage building shall be at least 15 m away from any adjacent buildings.

3.7.4.2.2 Dry grass, woods and trees shall be removed from around the oxidizing gas storage sites. No flammable residues shall be collected at these sites.

3.7.4.2.3 If the storage site contains more than one oxidizing gas, it shall be marked with the warning sign and the guidance data for the most dangerous oxidizing gas.

3.7.4.3 Requirements for Oxidizing Gas Storage Buildings:

3.7.4.3.1 Construction Elements and Specifications:

1. The storage building shall be standalone and consist of one floor (ground floor only).
2. All building elements, including floors, shall be constructed of Materials suitable for the nature of the Materials to be stored, provided that their fire resistance is not less than two hours.

3. When designing the building, the possibility of discharging the (potential) explosion pressure from the building in the direction least exposed to danger and damage shall be taken into account and that the ceiling or one of the walls shall be made of light and fire-resistant Materials.
4. A room is allowed to store oxidizing gases within a building with an area of not more than 50 square meters. In this case, all internal walls and the ceiling of the storage room within the building shall be Pressure Resistant with a thickness of not less than 30 cm, provided that the external wall (the front of the room overlooking the open air) is made of light fire-resistant Material for a period of not less than two hours in order to discharge the potential explosion pressure and to limit damage while applying all other Requirements for the Separate storage building itself.
5. Release Protection Requirements:
    a) The finishes and connections between the walls, ceilings, floors, and openings resulting from the electrical and sanitary installations of the warehouse shall be sealed and waterproof into the warehouse.
    b) When storing large quantities of these gases, an effective emergency discharge system shall be secured to ensure the immediate absorption of all released Materials and contaminated water resulting from extinguishing and cooling operations on cylinders, etc.
    c) Each oxidizing gas release case shall be evaluated by itself according to the surrounding circumstances (which govern it) and then its requirements for preventive measures and appropriate treatment of the risks that may result from it shall be assessed in accordance with the Requirements for the competent authorities and their decisions for the case.
    d) Store doors shall be fire resistant for a period of not less than two hours and shall be opened outside automatically when left.

6. More than one exit shall be provided in suitable locations and free of obstacles in accordance with the General Directorate of Civil Defense Requirements, in order to facilitate the handling of oxidizing gases during accidents.
7. Proper and safe lighting shall be provided in the warehouse at all times.

3.7.4.3.2 Ventilation Requirements:

1. Upper and lower natural ventilation shall be provided to refresh the air of the storage building at a rate of more than 6 times per hour.
2. In the event that natural ventilation is not possible or natural ventilation is insufficient at the above required rate, Separate mechanical ventilation shall be installed to refresh the air of the warehouse building at least 6 times per hour, provided that this mechanical ventilation works continuously and that it is of spark insulation type and that this ventilation is linked to the alarm system of the building (the main alarm panel of the building).

3.7.4.3.3 Electrical Installations of Oxidizing Gas Storage Places:

1. All Electrical Installations shall be of spark insulation type.
2. It is prohibited to heat the warehouse above the prescribed temperature for the storage of oxidizers, and it is also prohibited to directly expose the cylinders and packages of these Materials to heat.

3.7.4.4 Oxidizing Gas Storage Requirements:

3.7.4.4.1 All stored cylinders shall be subject to the compressed gas storage requirements contained in Chapter 4 of this Part.

3.7.4.4.2 Oxidizing gas cylinders may not be stored next to the elevator shaft, ventilation systems or any other openings.

3.7.4.4.3 All oxidizing gas cylinders shall be provided with the explanatory data of the gases they contain.

3.7.4.4.4 The person, who is responsible for dealing with oxidizing gases, and those working in storage areas, shall be familiar with the preventive requirements followed in the methods of storing these gases and how to deal with them in emergency situations, including the use of personal protective equipment such as protective suits, safety shoes and glasses, how to get rid of their leaks, develop training plans, evacuation, firefighting, the use of alarms and emergency release treatment, while adhering to all instructions set by the manufacturer in this regard.

3.7.4.4.5 Respirators shall be provided in suitable places outside the storage area for emergency use by trained personnel only.

3.7.4.4.6 It is prohibited to carry out any welding or cutting operations until the warehouse has been completely emptied of stock.

3.7.4.4.7 Rubber hoses for fire water and manual fire extinguishers shall be provided according to the General Directorate of Civil Defense Requirements.

3.7.5 Corrosive Materials.

Introductory Definitions:

Corrosion: Peeling, decomposition and chemical changes that occur in solids, especially metals, as a result of exposure to harsh chemical and climatic encroachments.

Corrosive Materials: Corrosive materials include Strong acids and strong alkalis (bases). The strength of acids or alkalis is measured by a relative scale called "pH", which ranges from 0 to 14. An acid is considered strong if its pH is less than 2, and an alkali is considered strong if its pH is higher than 12.5, or if both have the ability to corrode iron (SAE 1020) at a rate greater than 6.25 (mm/ year) measured at a temperature of 55°C. These materials have a corrosive effect on the skin, tissues and membranes and may produce toxic fumes when interacting with certain materials. If these Materials come into contact with wood or organic matter, they can pose a fire hazard. In addition, Corrosive materials can react with some metals and release flammable and explosive hydrogen gas.

Power of Hydrogen (or pH): is the measurement that determines whether a liquid is acid, base, or neutral. Liquids with a pH of less than 7 are considered acidic, while liquids with a pH of more than 7 are considered alkaline solutions or bases. pH 7 is considered neutral, which is equal to the pH of pure water at a temperature of 25 ° C. The pH of any solution can be determined using the pH indicator.

3.7.5.1 Corrosive Storage site Requirements:

3.7.5.1.1 Corrosive receptacles (packages) shall be stored inside special stores in accordance with the protective conditions in the storage buildings mentioned in Chapter 13 and shall be in suitable locations depending on the type and quantity of liquid to be stored.

3.7.5.1.2 The storage site shall be at ground level and away from adjacent buildings by a distance of not less than 6 m.

3.7.5.2 Requirements for Corrosive Storage Buildings:

3.7.5.2.1 Construction Elements and Specifications:

1. The storage building shall be standalone and consist of one floor (ground floor only).

2. All building elements, including floors, shall be constructed of Materials suitable for the nature of the Materials to be stored, provided that their fire resistance is not less than two hours.
3. When designing the building, the possibility of discharging the (potential) explosion pressure from the building in the direction least exposed to danger and damage shall be taken into account and that the ceiling or one of the walls shall be made of light and fire-resistant Materials.
4. A room is allowed to store corrosive Materials within a building with an area of not more than 50 square meters. In this case, all internal walls and the ceiling of the storage room within the building shall be Pressure Resistant with a thickness of not less than 30 cm, provided that the external wall (the front of the room overlooking the open air) is made of light fire-resistant Material for a period of not less than two hours in order to discharge the potential explosion pressure and to limit damage while applying all other Requirements for the Separate storage building itself.
5. Requirements for protection against leaks of corrosive Materials:
    a) The finishes and connections between the walls, ceilings, floors and openings resulting from the electrical and sanitary installations of the corrosive stores shall be sealed and waterproof into the warehouse. The floor shall be tilted to discharge any possible release of oxidizers into a separate dedicated pit.
    b) Arrangements shall be made, using traps, separators, sinks, or the use of effective treatment units, to prevent the entry of corrosive materials into the public drainage system or to neutralize their harmful effects before they are discharged or transported.
    c) When storing large quantities of corrosive Materials, an effective emergency drainage system shall be secured to ensure the immediate absorption of all leaking Materials and contaminated water resulting from extinguishing operations and washing these Materials, etc..
    d) Each case of diversion of corrosive materials shall be evaluated by itself according to the surrounding circumstances (which govern them) and then its Requirements for preventive measures and appropriate treatment of the risks that may result from them shall be assessed in accordance with the Requirements for the competent authorities and their decisions for the case.
6. Sills shall be constructed in front of the doors of the corrosive stores with a height of not less than 10 cm to prevent spills of corrosive Materials from leaking out of the warehouse, or the floor of the storage area shall be at least 10 cm lower than the surface of the surrounding ground.
7. More than one exit shall be provided in suitable locations and free of obstacles according to the Requirements for the competent authorities, in order to facilitate the handling of the stock of corrosive Materials during accidents.
8. Store window glass shall be fire resistant for a minimum of two hours.
9. The doors of the warehouse shall be made of fire- resistant Materials for a period of not less than two hours, and they shall be opened outside and closed automatically when left.
10. Proper and safe lighting shall be provided in the warehouse at all times.

3.7.5.2.2 Ventilation of Storage Buildings:

1. Upper and lower natural ventilation shall be provided to refresh the air of the storage building at a rate of more than 6 times per hour.
2. In the event that natural ventilation is not possible or natural ventilation is insufficient at the above required rate, Separate mechanical ventilation shall be installed to refresh the air of the warehouse building at least 6 times per hour, provided that this mechanical ventilation works continuously and that it is of spark insulation type and that this

ventilation is linked to the alarm system of the building (the main alarm panel of the building).

3.7.5.2.3 Electrical Installations and Wiring:

1. All Electrical Installations shall be in galvanized iron pipes.
2. The light bulbs shall be of types that do not radiate heat and are protected by a protective net.
3. The electrical wiring and switches shall be of the acid-resistant type, and be coated with Materials, such as PVC, with the need to inspect their validity periodically and regularly.

3.7.5.3 Corrosive Material Storage Requirements:

3.7.5.3.1 Corrosive materials may not be stored with Materials that can react with them, such as wood, paper, cotton, flammable liquids and flammable gas cylinders.

3.7.5.3.2 Containers of corrosive Materials, containers or tanks, shall be of Materials resistant to the effects of corrosive Materials and shall not react with them and shall be approved for the Material.

3.7.5.3.3 Large quantities of corrosive Materials shall be stored in metal tanks or drums, and the type of metal and lining varies according to the quality of the stored Material.

3.7.5.3.4 Glass containers may not be used for storing corrosive Materials except for small quantities of them, for laboratory use only.

3.7.5.3.5 Acid tanks shall be constructed in the open, so that they are walled with metal grating while protecting the tanks from the effects of weathering.

3.7.5.3.6 A basin shall be made around the tank with a volume of 110% of the tank volume – to accommodate the full capacity in the event of any release. Further, The tank shall be provided with a measure of the level of the tank content and with pipes for ventilation.

3.7.5.3.7 Drums of corrosive Materials may not be stored in a place other than the following locations:

1. Out in the open so that they are in a fenced and shaded area.
2. In a separate building (such as a warehouse) in which the building elements are made of fire-resistant Materials.
3. In the ground floor of the building, provided that it is in a room isolated from the rest of the building with fire-resistant walls and floors.

3.7.5.3.8 Corrosive drums shall be protected from exposure to direct sunlight.

3.7.5.3.9 Wood, paper or any other organic Materials may not be used in building elements, especially floors and walls.

3.7.5.3.10 The floor shall be impermeable to corrosive Materials and shall have Separate drainage.

3.7.5.3.11 Sills shall be erected on store entrances.

3.7.5.3.12 Corrosive receptacles and stores shall be marked with warning signs.

3.7.5.3.13 The width of the corridors between the corrosive storage rows shall not be less than 1 m.

3.7.5.3.14 The distance between the storage rows and the walls shall not be less than 1 m.

3.7.5.3.15 The warehouse shall be provided with more than one emergency exit, according to the General Directorate of Civil Defense Requirements.

3.7.5.3.16 Processes requiring the use of large amounts of acids shall be in an open area.

3.7.5.3.17 All sources of combustion shall be removed from inside the corrosive stores.

3.7.5.3.18 Smoking is prohibited in and around corrosive stores.

3.7.5.3.19 Water hoses shall be provided in the warehouses and their surroundings for the purposes of washing and discharging minor transverse flows of corrosive Materials, using abundant quantities of water with the need to wear protective vests and safety glasses and use respirators to avoid inhalation of fumes of corrosive Materials.

3.7. 5.3.20 When the flow is large (threatening) or there is a fire involving a corrosive, such as nitric acid, the following sequence of actions shall be followed by trained persons only:

1. Inform and call the General Directorate of Civil Defense.
2. Immediately evacuate the site from non- specialists.
3. Wear and use all personal protective equipment
4. Attempt to neutralize nitric acid with sodium bicarbonate.
5. Attempt to pull the barrels of hazardous Materials (away from the fire) to another place and working immediately to cool them with water spray.

3.7.6 Self-combusting materials in air and materials that react with water

Some chemicals have the property of self-combustion when in contact with air at normal temperatures, such as white phosphorus. Some of them react with water and emit heat, such as carbides, sodium and potassium, where their interaction with water produces oxygen gas (oxidizing), hydrogen (flammable) and enough heat to combust, leading to explosions (hydrogen gas explosions)

3.7.6.1 Keeping self- combusting Materials in the air:

These Materials are kept (submerged) under the surface of inert gases or liquids that do not react with them. For example, white or yellow phosphorus is kept submerged under the surface of water.

3.7.6.2 Preservation of Water Reactive Materials:

1. These Materials shall be kept in sealed containers that completely prevent the penetration of water and air.
2. Keep some of these materials (submerged) under the surface of inert gases or liquids that do not react with them, such as keeping sodium (for example) submerged under the surface of kerosene.
3. It is prohibited to have control equipment that uses water at the storage site of these Materials. It is also prohibited to have any other sources of water.

3.7.7 Incompatible chemicals.

Incompatible Materials: Materials posing a risk of hazardous reactions with other Materials in the same storage site, especially in conditions of possible exposure to proximity, convergence, or accidental or intentional mixing, resulting in hazardous reactions that may lead to combustion, explosion, the generation of toxic gases, or the production of other hazardous Materials.

3.7.7.1 Separate warehouses shall be allocated for conflicting chemicals, and the appendix includes common conflicting chemicals, to guide him when storing these Materials.

3.7.7.2 All the Requirements for the aforementioned hazardous chemicals regarding sites, buildings and storage shall be adhered to in line with reducing the risk of these chemicals according to the decisions of the competent authorities.

3.8 Fire Works

Introductory Definitions:

Fireworks: any mixtures of chemicals (and may be combined with devices and equipment) used for the purposes of emitting light or audio signals by means of combustion, fission or explosion of reactants and components of fireworks.

Fireworks Handling: In this chapter, Fireworks Handling means both storage, assembly and sale.

3.8.1 Preamble and General Requirements.

3.8.1.1 Without prejudice to any other legislation or system, before practicing any work regarding the handling of fireworks in accordance with the preventive requirements for the same. A license shall be obtained from the General Directorate of Civil Defense

3.8.1.2 This chapter does not include the special protective requirements and requirements for fireworks factories, which usually contain powders for flammable metals, black gunpowder and other Materials that are used in the manufacture of fireworks.

3.8.1.3 The following activities are subject to licenses:

1. Storing, transporting and Shooting fireworks.
2. Shooting fireworks in public displays.

3.8.1.4 A copy of the license granted to the person to handle fireworks shall be posted in a visible and safe place at the location of the licensee, and the General Directorate of Civil Defense shall be informed in the event of damage or loss of the license.

3.8.1.5 The license may not be transferred, waived, or assigned to any other person without the approval of the General Directorate of Civil Defense.

3.8.1.6 In the event of changing the address of the fireworks handling site or the concerned party, the General Directorate of Civil Defense shall be notified immediately.

3.8.1.7 The concerned party shall have records to record the quantities and types of fireworks in circulation, provided that these records are kept for five years at the request of the General Directorate of Civil Defense.

3.8.1.8 The size of employment shall be commensurate with the sizes of the activity and the warehouse, in order to reduce the stress of workers in this field and thus reduce human errors to the lowest possible level.

3.8.1.9 The stakeholder shall have a record of the names of all employees on the handling site.

3.8.1.10 A person in-charge shall be assigned to follow up the commitment to implement safety, fire prevention and personal safety requirements at the site and to educate workers about them, with training plans for evacuation and dealing with emergency cases, provided that the age of the person in-charge is not less than 21 years.

3.8.2 Requirements for fireworks handling site.

3.8.2.1 The site for storing fireworks shall be away from residential complexes, main roads, pedestrian crossings, shops and public gathering places for distances ranging from 8 to 70 m depending on the quantity and quality of the stock and the request of the General Directorate of Civil Defense.

3.8.2.2 Fireworks storage buildings shall be separated from the rest of the buildings within the site for safe distances ranging from 12 to 30 m. These distances depend on the quantity and quality of the stock and the General Directorate of Civil Defense Requirements.

3.8.2.3 The distance between any stores of flammable Materials and fireworks storage buildings shall not be less than 15 m.

3.8.2.4 The area around the fireworks storage site and for a minimum distance of 8 m from the warehouse, shall be free of woods, grasses, weeds and dry flammable waste.

3.8.2.5 The floor around the storage building shall have a calculated slope to drain water away from the fireworks storage area.

3.8.2.6 There shall be paved roads to the site for easy access.

3.8.2.7 Gates shall be erected on all roads leading to the Site.

3.8.2.8 Vehicular roads, especially the internal roads of the site, shall be provided with means to reduce their speed, such as barriers and artificial bumps.

3.8.3 Requirements for Fireworks Handling Building.

3.8.3.1 Construction Elements and Building Specifications:

3.8.3.1.1 The storage building shall be standalone and consist of one floor (ground floor only).

3.8.3.1.2 All building elements, including partitions, ceilings, walls and floors, shall be constructed of materials suitable for the nature of the Fireworks to be stored, provided that their fire resistance shall not be less than two hours and shall be encased in non-sparking materials.

3.8.3.1.3 In the design of the building, consideration shall be given to the possibility of discharging the (potential) explosion pressure from the building in the direction least exposed to danger and damage and that the roof or one of the walls shall be made of light and fire-resistant Materials.

3.8.3.1.4 Finishes and connections between walls, ceilings, floors and openings resulting from electrical and sanitary installation works of firework warehouses shall be sealed and waterproof inside the warehouse.

3.8.3.1.5 Horizontal bridges shall be minimized within the building to avoid the accumulation of explosive powders over it, which may lead to its explosion if appropriate combustion conditions are available.

3.8.3.1.6 The routes of escape shall be subject to the General Directorate of Civil Defense Requirements mentioned in Chapter 3.8.1.

3.8.3.1.7 The warehouse shall be hermetically sealable, and all hinges and locks shall be of a durable type and shall be well fixed to ensure that they cannot be opened, and shall be equipped with radiators and open directly towards the outside.

3.8.3.2 Fireworks Store Ventilation:

3.8.3.2.1 Separate mechanical ventilation shall be installed to replenish spark insulation type air stored at least 6 times per hour, provided that this mechanical ventilation works continuously, and that it is spark insulation type and that this ventilation is connected to the building alarm system (the main alarm panel of the building).

3.8.3.2.2 The warehouse shall be equipped with special devices to prevent moisture.

3.8.3.2.3 The warehouse shall be equipped with air conditioning equipment to adjust the temperature of the warehouse to not more than 25°C and not less than 10°C.

3.8.3.3 Electrical wiring of fireworks stores:

3.8.3.3.1 All Electrical Installations, alarms and ventilation shall be of spark insulation type.

3.8.3.3.2 The heating and cooling units of the fireworks store shall be outside the building at a distance of not less than 7.5 m if they are powered by electricity, and at a distance of 15 m when using liquid fuel, as cold air is connected through insulated air Ducts inside the warehouse, and heat is connected and distributed by pipes inside of the warehouse by passing hot air or hot water.

3.8.3.3.3 The main electrical switchboard shall be installed outside the warehouse at a distance of not less than 7.5 m.

3.8.3.3.4 It is prohibited to use flashlights inside the fireworks handling facilities.

3.8.3.3.5 A main break shall be provided to cut off power outside the boundaries of the fireworks handling building and where it is easily accessible.

3.8.4 Requirements for storing Fireworks.

3.8.4.1 Storage shall be on fixed metal shelves.

3.8.4.2 The spacing between the storage rows shall not be less than 1 m.

3.8.4.3 The distance between the walls of the warehouse and the storage rows shall not be less than 1m.

3.8.4.4 The width of one storage row shall not exceed 2 m.

3.8.4.5 The storage height shall not exceed 2.5 m and shall not exceed the manufacturer's recommended height.

3.8.4.6 When the stock is in a container, the container is carried (on its wheels) while it is on site. Its wheels shall be lifted or the container shall be fixed in such a way as to prevent its movement.

3.8.4.7 Fireworks stores shall be painted red with the following phrases written on them in white: Explosives, No Open Flame.

3.8.4.8 In all cases, the doors of the warehouse shall be kept closed except during transport, storage or inspection of the warehouse.

3.8.4.9 The site shall be provided with the following warning signs: Danger, no smoking, no explosives, no entry for non- specialists.

3.8.4.10 Fireworks stores and installations shall be closed at the end of working hours and in the absence of the person in-charge.

3.8.4.11 A safe area away from all the facilities of the fireworks site shall be allocated for the purposes of conducting experiments on some fireworks, if necessary.

3.8.4.12 Fireworks shall always be kept in tightly closed containers and shall only be opened using suitable non- sparking tools, provided that these containers are made of non- ferrous Material.

3.8.4.13 Explosive boxes may not be opened inside the warehouse.

3.8.4.14 Metal tools, devices or equipment that emit sparks may not be used inside the warehouse.

3.8.4.15 The fireworks warehouse may not be used to store any other Materials.

3.8.4.16 Quantities of Fireworks may not be stored or left in the assembly building after the end of working hours. All the rest of these Materials shall be transported to the storage building.

3.8.4.17 Packages and containers may not be opened inside the warehouse or re-stacked if they are within a container except within a distance of not less than 16m from the warehouse.

3.8.4.18 Fireworks shall be stored in groups according to the type and degree of danger of each group, and in a way that makes it easy to count them.

3.8.4.19 Fireworks stock shall be consumed as per their seniority, depending on the priority of the date of storage.

3.8.4.20 The contents of the warehouse shall be inspected weekly by the specialists to ensure that it matches the storage records.

3.8.4.21 All elements of the building shall be kept clean at all times to avoid the accumulation of dust (Fireworks powders) during assembly to reduce the likelihood of dust explosion.

3.8.4.22 All forms of smoking Materials, such as cigarettes, lighters, matchboxes (etc.) are prohibited in the warehouse or fireworks assembly building and shall be left in a special place outside the building.

3.8.4.23 Special smoking places shall be identified that are safe and away from storage and collection areas. These places shall be equipped with containers to collect smoking waste and with manual fire extinguishers in accordance with the General Directorate of Civil Defense Requirements.

3.8.4.24 Individuals may not access to smoking rooms if their clothing is contaminated with Fireworks.

3.8.4.25 In cases of flow or accidental collapse of the Material, during storage or collection operations, it shall be immediately re-collected and disposed of quickly by proper methods, and with the assistance of the competent authorities, such as General Directorate of Civil Defense.

3.8.4.26 Collection waste shall be collected and separated from other flammable waste, such as contaminated paper and cloth, each of which shall be kept in a separate container with its contents indicated. These contents shall be disposed of at least once a day at the end of working hours.

3.8.4.27 The Person in-charge shall inform the competent authorities immediately upon noticing any unusual decomposition or event of Fireworks inside the warehouse.

3.8.4.28 All workers handling fireworks shall wear all personal protective equipment, such as protective vests, during work and then remove them at the end of working hours, with the need to wash them completely to get rid of the residues of materials stuck to them and keep them in their own cabinets.

3.8.4.29 When carrying out any painting work for the warehouse, whether from the inside or from the outside, the warehouse shall be completely emptied of all its contents and transported to another warehouse, or stored away from the safe distance from the original warehouse, with protection and guarding until it is returned to the original warehouse after completion of work in it.

3.8.5 Fireworks Transport Requirements.

3.8.5.1 All **Fireworks Transport Operations** shall be subject to the General Directorate of Civil Defense Requirements.

3.8.5.2 Security and durability supplies shall be available in the **fireworks transport vehicle** in accordance with the General Directorate of Civil Defense Requirements, as stated in the Explosives Transport Requirements (this Part) and the Requirements for the **Technical Inspection Department** in the **Traffic Department**.

3.8.5.3 The driver of the vehicle shall be well trained professionally and be familiar with the work assigned to him in order to be:

3.8.5.3.1 Aware of the danger of transported explosives and the threats associated with transport operations.

3.8.5.3.2 Familiar with the roads leading to the place to be reached.

3.8.5.3.3 Familiar with primary firefighting methods.

3.8.5.3.4 Familiar with how to contact officials and persons in-charge in the event of an emergency, and holds a general driver's license.

3.8.5.3.5 Literate and at least 21 year-age.

3.8.5.3.6 He is familiar with the traffic rules and has passed the medical examination and is healthy and free from diseases and birth defects.

3.8.5.4 The driver of the vehicle shall be well informed and trained in all technical matters related to the operation of the tanker and shall have the authority to move the tanker in emergency cases.

3.8.5.5 The vehicle shall be clearly marked by the **HazChem approved by the General Directorate of Civil Defense** and the HazChem Incident Handling System.

3.8.5.5 The driver of the vehicle shall avoid traffic jams and crowded places and adhere to the routes determined by the **Traffic Department** and then deliver them directly to the concerned authority or persons.

3.8.5.6 The vehicle may not be stopped during the process of transporting fireworks in a place other than the place to be reached except in emergency cases.

3.8.5.7 Metal or non-metallic tools that generate electrical charges, batteries or flammable materials within the transported fireworks sets, may not be transported.

4. Activities related to the storage, handling and transportation of hazardous Materials

4.1 Safety requirements in Auto servicing and catering stations:- (Petrol stations)

Introductory Definitions:

Vehicle Service and Supply Station: A location for storing flammable liquids used as fuel forms for engines and distributing them by standalone fixed equipment, including pumps, to vehicle fuel tanks. These stations can include vehicle supply service facilities including provision (sale) of vehicle consumable spare parts, lubrication, engine oil change, laundry, battery repair, vehicle tire services and other minor maintenance work required by the vehicles. These stations may also include the storage and sale of kerosene, and other service facilities for passenger supplies, including groceries, restaurants, bathrooms, places of worship, and the like.

Fuel Filling Appliance: The fuel supply machine in vehicle fuel filling stations is designed to provide its contents according to the prescribed quantities (specified or calculated). The fillers are either equipped with a self-Priming pump (installed in it) to pump fuel into the vehicles or the fuel is pumped to them by pumps at the main fuel tanks.

Supply (Feed) Pumps: The main pumps that supply the fillers with vehicle fuel by pulling the fuel from the main tanks and then pumping it (distributing it) to the fillers.

Distribution Pump: A pump-operated by a control device, for measuring or calibrating, including a pumping assembly, which is used to distribute petroleum products from the storage tank to the discharge unit.

Person in charge at vehicle service and supply stations: It is the employee in-charge, appointed by the owner, who has the right to control the operation of the fuel filling station, service vehicles and manage their services on a daily basis.

Usage-safe circuit: Any electrical circuit in the vehicle service and supply station that, when installed and in normal operation, does not result in any electrical spark that may cause the combustion of flammable mixtures (from fuel vapor and air).

Safe electrical device: Any electrical device used in a vehicle service and supply station that, when installed and operating normally, does not produce any electrical spark that may cause the combustion of flammable mixtures (from fuel vapor and air).

Self-Service Fuel Filling Station: The fuel filling station and self-service vehicle service, which enables individuals to refuel (from fuel fillers) on their own and without the help of others. The management and control of these operations are controlled by the personnel in the control room inside the station.

Competent Authorities: The official (governmental) bodies authorized, or their representatives, that are legally responsible for issuing regulatory decisions, imposing technical requirements and requirements, and issuing licenses (permits) for establishing establishments for various activities, and then issuing the professional license (permit), after establishing the entity, to practice the activity allocated and authorized in licensing the entity. The General Directorate of Civil Defense is considered one of these competent authorities in addition to the ministries and other relevant government agencies. The responsibilities of the General Directorate of Civil Defense here are as follows:

1. Approve the selected plant site and issue the necessary license for it (for the owner) before implementation.
2. Approve the drawings (the design and implementation drawings of the plant) before starting the implementation of the construction works.
3. Issue the initial approval to start the implementation of the construction works.
4. Approve the construction works after their completion.
5. Issue the necessary professional license to operate the plant.

4.1.1 Preamble and General Requirements.

4.1.1.1 The competent authorities shall be competent to determine all licensing procedures and requirements for vehicle service and supply stations.

4.1.2 Specifications of Service Station Buildings.

4.1.2.1 Facilities within the service station shall be subject to the requirements contained in Part I with regard to building elements and specifications, emergency exits and ventilation outlets.

4.1.3 Requirements for Service Station Locations.

4.1.3.1 When choosing the location of the station, the horizontal and vertical distances that separate it from the air power lines shall be adhered to according to the decisions of the competent authorities.

4.1.3.2 The selected station site shall contain sufficient space for the safe installation of fuel tanks and ventilation pipes, the positions of the tank filler openings, the positions of the fuel transport tanks, the locations of the pumps and fillers, and other buildings attached to the station, so that the distances between them are appropriate to ensure the safe operation of the station and the safety of adjacent sites in accordance with the provisions of the local regulation and the instructions issued by the competent authorities regarding the licensing of vehicle service and supply stations.

4.1.3.3 In planning the site of the station, smooth movement of vehicles in the yards of the station shall be ensured, including safe entry and exit of the vehicles of the customers present, while they are refueling or availing other services.

4.1.3.4 The site shall allow the entry and parking of fuel tankers (feeding tanks), especially in conjunction with the arrival of customer vehicles inside the station, in accordance with the regulations of the General Directorate of Traffic.

4.1.4 Requirements for Installation of Service Station Tanks.

4.1.4.1 Fuel tanks, at fuel filling stations and vehicle service stations, shall be buried underground.

4.1.4.2 The requirements contained in clauses (4.1.3.1) and (4.1.3.2) of Chapter (3.3.4.1.1) shall be adhered to and clause 3.2.8.2 shall be excluded.

4.1.4.3 Each tank and each section (of the multi-section tank) shall be provided with a ventilation pipe with a diameter of not less than 5 cm.

4.1.4.4 The tank or each section (of the multi-section tank) shall have Separate ventilation. In all cases it is prohibited to connect tank ventilation pipes or sections of (multi-section tanks) to a common ventilation pipe.

4.1.4.5 In the event that the tanks, or the sections of the same tank, are equipped with means to balance the vapors, and in the event that the tanks and the sections of (multi-section tanks) contain similar products, the ventilation pipes of the tanks and sections may be collected in a joint ventilation pipe that is equipped with a hose to transport the vapors in accordance with the intentional standards.

4.1.5 Requirements for Feed Pumps and Fillers.

4.1.5.1 Feed pumps and fuel fillers shall be designed, manufactured and tested according to the approved international standards.

4.1.5.2 The feed pumps shall be allowed to be installed inside the fuel fillers (in the plant yards), provided that the feed pumps and fillers are approved and that their design is compatible with the installation process.

4.1.5.3 Feed pumps are allowed to be installed elsewhere (fillers do not have a pump in their design), so that fuel is transported from them to the fuel filler (s).

4.1.5.4 Fuel fillers shall be installed on sidewalks (platforms) elevated from the plant floors to the extent that protects them from being exposed to vehicle shocks during refueling.

4.1.5.5 Diesel fillers shall be on their own Separate platforms (at an appropriate distance from gasoline fillers), so as to allow the safe movement of diesel trucks without hindrance and without posing any danger to the traffic of other vehicles in the plant yards.

4.1.5.6 Feed pumps shall be protected from damage and factors of nature if they are located far away from fuel fillers.

4.1.5.7 When the feed pumps and fillers are installed, they shall be installed in place in accordance with the approved and followed professional principles for their installation.

4.1.5.8 When installing feed pumps and fillers, each intake pipe shall end with a fuel sealed pit below it. The walls and floor of the pit shall be constructed of cement with a thickness of not less than 15cm, taking into account that the pit shall be of sufficient depth to accommodate the flexible connections between the intake pipe and the feed pump.

4.1.5.9 The floor surrounding the feed pump shall be tiled with cement or asphalt.

4.1.5.10 The feed pump shall be provided with a control device, so that it actuates the pump as soon as the filling hose nozzle is picked up from its normal position and deactivates its operation as soon as the nozzle is returned to its normal position on the filler.

4.1.5.11 The maximum pressure of the pump shall not exceed 2atm.

4.1.5.12 If the filler is equipped with a glass bottle (showing the flow of liquid fuel), the bottle shall withstand a liquid hydrostatic pressure of 5 atm.

4.1.5.13 The filling hose shall conform to the approved specifications and shall withstand a test pressure of 5 atmospheres. The filling hose shall be made of special Materials for the purpose of use, resistant to petroleum liquids, flexible to use, soft to the touch, resistant to corrosion, application frictions and weathering.

4.1.5.14 The fuel filler hose nozzle shall be equipped with an automatic cutter (for fuel flow) to prevent fuel splashing as a result of bounces, vehicle tank filling, etc., and the maximum rate at which the cutter operates shall not exceed half of the discharge rate on which the nozzle valve retention latch is set open.

4.1.5.15 In addition to the requirements previously mentioned regarding fuel filling stations and vehicle service, the following requirements shall be met regarding fuel fillers and nozzles in self-service stations:

1. Special consideration shall be given to the design of the station and the risks surrounding it so as to allow easy entry and exit of customer vehicles to and from the area of fuel fillers in the yards of the station.
2. Self-service stations shall be subject to permanent supervision by the shift controller located in the control room that includes emergency keys for fuel fillers and work areas in the station.
3. The areas of the fillers shall be clearly visible from the control room at all times, so that there is no possibility of obstacles preventing the monitoring of the vehicles during the mobilization period.
4. Means of communication shall at all times be available and open between the controller and customers in the fuel filling areas.
5. At least one person shall be present as a guide throughout the work of the self-service station whose pumps work by paying cash automatically, for example by inserting currency into the payment machine or using any smart cards.
6. Precautions shall be taken to cancel (deactivate) any tool relating to the fillers (or filling nozzle) that would make the nozzle valve open.
7. The minimum operating flow rate of the automatic fuel cutter shall not exceed 9 (liters/ Min).

8. The design of the filler shall not allow the refilling to be restarted after the automatic fuel cutter is turned on without first returning the nozzle flow control handle to the locked position.
9. The filling nozzle shall be equipped with a tool that prevents filling unless the nozzle is in the correct filling position or directed downward.

4.1.6 Requirements for Feeding Pump Pipes, Fillers & Accessories

4.1.6.1 The Material of which the pipes, valves and their accessories are made shall not be affected by the fuel used, and shall not be damaged or leaked under the influence of heavy stresses, such as the passage of vehicles over them. They shall also withstand high temperatures when exposed to an adjacent fire or be protected in an appropriate manner.

4.1.6.2 The piping system shall be provided with a sufficient number of approved efficiency and safety valves necessary for use whether for normal operation purposes, for cases of damage accidents, or for emergencies.

4.1.6.3 Pipes exposed to external corrosion shall be painted with corrosion resistant Materials or supported with appropriate protection for the purpose.

4.1.6.4 The viability of the pipes and their connections shall be tested with the pressure of the liquid inside them up to 1 bar for 10 minutes to ensure that they are free from release before being buried in the ground with the lines of these pipes well installed in the ground and covered with a layer of soft concrete with a thickness of not less than 15cm or protected with stone tiles.

4.1.6.5 In the event that the pipes and their connections are subject to the movement of vehicles above them, the area shall be covered with reinforced concrete, or the pipes shall be installed inside a special duct on which a steel cover shall be installed that bears the maximum weight of the vehicles expected to pass over it.

4.1.6.6 In case of underground ducts for pipes, valves and their installations, they shall be designed with suitable dimensions allowing easy access for maintenance purposes and works.

4.1.7 Electrical Fitting Requirements

4.1.7.1 Whenever possible, electrical connections shall be placed and installed in locations that do not expose them to mechanical damage and the effects of heat, Materials and corrosive solvents. In the event that such damages cannot be avoided, other alternative precautions shall be taken that are appropriate to provide the desired protection.

4.1.7.2 When cable pipes penetrate a wall, floor, partition or ceiling, the vacuum surrounding the pipe shall be filled, to the depth completely penetrated, with cement or other fire-resistant Materials.

4.1.7.3 All electrical equipment and installations shall be of spark insulation type. Lighting shall be of protected type and heat shall not be radiated.

4.1.7.4 Hand lamps used for general purposes in the plant shall be of spark insulation type.

4.1.7.5 Electrical piping connections shall be waterproof.

4.1.7.6 Electrical piping passing through a hazardous location or area shall be provided with a tightly closed box, so that the box is flame resistant or made of approved flame resistant sealant Material, so that it provides the equivalent protection required starting from the point of entry of the pipe to the hazardous area.

4.1.7.7 All electrical fixtures, installations and installations shall be protected from the dangers of short circuit by equipping each electrical circuit with a circuit breaker with a capacity commensurate with the current load.

4.1.7.8 Each single or multi-nozzle filler shall be provided with a separate electrical circuit (or a power line for its operation) and another special circuit to illuminate the box of the device.

4.1.7.9 The metal casing of all electrical equipment, pipes, junction boxes and metal casing of cables shall be properly earthed.

4.1.7.10 The lighting in the fuel filling station shall be suitable for the work in which it is located, so that the lighting intensity in the service area and in the lubrication area at ground level is not less than 100 Lux (Lux is a lighting unit to measure the intensity of light).

4.1.7.11 Emergency switch: In addition to the public switch that controls the Electrical Installations of the plant, the electrical circuit shall be provided with a separate emergency switch to disconnect the electrical current from all fuel pumps and their integrated lighting, and this switch shall be placed, so that it can be seen clearly and is easily accessible and at a safe and appropriate distance from any opening in the fuel tank, fuel pump, or ventilation pipe.

4.1.7.12 Generator Room: The backup generator (if any) shall be placed in a separate room specially constructed for the purpose and shall be at a distance (determined by the competent authorities) that is safe and appropriate from any opening in the tank, from the pumps or the ventilation pipe opening.

4.1.8 Safety Requirements and Precautions to be followed when operating the Plant

4.1.8.1 Emptying the Fuel Transport Tanker:

4.1.8.1.1 The discharge of the tanker shall be carried out within the limits of the plant, taking into account the selection of the location and position of the emergency tanker, so that it can be driven directly out of the plant.

4.1.8.1.2 The movement of the tanker shall be completely fixed to the manual brake, reinforced with wooden or metal support stoppers (crammed under the frames) to avoid the tank from accidental movement during discharging.

4.1.8.1.3 The tanker shall be earthed in a safe manner to discharge it from static electricity charges before connecting the discharge hose and starting the process of discharging fuel from it to the tank.

4.1.8.1.4 Movement of other vehicles, within 4.5m of the tank discharge connection, during the tank filling period shall be strictly prohibited.

4.1.8.1.5 The fuel level in the tank shall be measured before starting to fill it to ensure that the tank understands the quantity to be emptied into it.

4.1.8.1.6 The area adjacent to the ventilation pipe nozzles shall be inspected to prevent any sources of combustion.

4.1.8.1.7 The tanker vehicle driver shall be continuously present in the valve area while the discharge hose is connected (attached) to the vehicle to enable the discharge to be stopped immediately upon the occurrence of an accidental fuel leak.

4.1.8.1.8 The liquid fuel level measurement in the tank shall be recorded at the end of the discharge process and then the discharge pipe caps and the filling room shall be sealed.

4.1.8.2 Fueling vehicles:

4.1.8.2.1 The engine of the vehicle shall be stopped before starting the filling.

4.1.8.2.2 The fuel filling nozzle shall be inserted well into the filling pipe of the vehicle tank, keeping the nozzle in contact with the filling pipe until the completion of the filling process, while avoiding the spillage of fuel outward.

4.1.8.2.3 Care shall be taken to avoid twisting or tightening the filling hose. It shall be returned to its normal position and position after completion of the filling process.

4.1.8.2.4 Drivers of mass and school transport vehicles shall be reminded and alerted that they bear full responsibility for the safety of passengers while refueling their vehicles.

4.1.8.3 Fueling Portable Vessels:

4.1.8.3.1 The containers of small portable fuel quantities shall be dedicated and approved for the purpose. The container shall be tightly closed after filling it. In all cases, it is prohibited to fill containers that are not equipped with a tight cap.

4.1.8.3.2 When filling portable containers, only manual (non-automatic) control method shall be followed in the use of the filling nozzle, whether the tap is operated manually or automatically.

4.1.8.3.3 The containers used shall be clearly marked, indicating the name of the petroleum product designated for its packaging. Such marks shall be subject to the rules governing the transport of this type of product.

4.1.8.4 Fire Supplies:

Vehicle service and supply stations and their facilities shall be provided with the necessary equipment to extinguish the fire in its early stages. The minimum requirements for these plant-friendly equipment and Materials are as follows:

8.4.1 Provide sufficient quantities of clean and dry sand to be placed in containers and distributed in appropriate places.

8.4.2 Provide dry powder manual extinguishers with a capacity of not less than 6 kg for both the beginning and the end of the island of fuel fillers. At least one extinguisher is provided if there is only one filler.

8.4.3 Provide at least (2) dry powder manual fire extinguishers with a minimum capacity of 25 kg near the main fuel tanks.

8.4.4 As decided by the General Directorate of Civil Defense, the plant may be equipped with an appropriate water source through fire hoses connected to the main feeding line in the area or an overhead tank inside the plant. The fire hoses used in the plant shall be of the approved types according to the conditions of the General Directorate of Civil Defense.

8.4.5 Manual fire extinguishers and other fire extinguishers and equipment shall be placed in suitable places, so that they are visible and easy to distinguish (not hidden and not covered by objects), and so that they are easily accessible, and the road to them is free of obstacles. It shall also be ensured that all workers know where they are and how to use them.

8.4.6 Personnel shall check and periodically inspect and maintain manual fire extinguishers and other fire extinguishers and equipment, as instructed by the manufacturer. Keeping a record of their examinations, maintenance work and dates of upcoming examinations.

4.1.8.5 Safety and fire prevention measures at the station:

4.1.8.5.1 Floors shall be of oil and water resistant Materials and covered if possible with a layer of slip resistant materials.

4.1.8.5.2 Smoking is prohibited throughout the station and its facilities.

4.1.8.5.3 Maximum care shall be taken throughout the station to exclude combustion sources such as flames, hot cuts and welding, as well as to exclude all forms of heat sources resulting from frictions and sparks, especially in the areas of fillers and feeding tanks.

4.1.8.5.4 The station floor shall be cleaned, and the residues of oil and fuel shall be removed on an ongoing basis.

4.1.8.5.5 It is prohibited to use petroleum liquid for cleaning purposes and works.

4.1.8.5.6 Greater care shall be taken when filling vehicles equipped with refrigerators, heaters, cement mixers and the like that may not stop their secondary engines during filling, which may generate sparks and friction.

4.1.8.5.7 Station maintenance tools and equipment shall be kept after their use in the equipment board designated for this.

4.1.8.5.8 Station floors shall be cleaned continuously, so that they do not lead to skiing.

4.1.8.5.9 The accumulation of waste and empty oil cans is prohibited and shall be collected and placed in a special fixed waste container.

4.1.8.5.10 All types of waste such as oils, etc. shall be disposed of in a safe manner. It is prohibited to throw them into sewage openings or sewage tanks or leave them on the ground.

4.1.8.5.11 The principles of safety, fire prevention and quality of services shall be observed in all plant facilities.

4.1.8.6 Station Personnel Training Requirements:

4.1.8.6.1 Employees shall be trained in the emergency procedures followed in cases of fire and emergency incidents, including the use of fire extinguisher and other equipment, and shall be familiar with the firefighting equipment throughout the station and its facilities.

4.1.8.6.2 The station shall be provided with the means of communication to call the General Directorate of Civil Defense and emergency teams. Further, the telephone numbers of these teams and the nearest police station shall be provided and placed prominently and clearly.

4.1.8.6.3 Personnel shall be trained in the safe practices and uses of fillers, pumps and the use of other service equipment at the station properly in order to avoid hazardous incidents.

4.1.8.7 Personal Protection of Station Personnel:

4.1.8.7.1 All Station personnel shall be provided with personal safety and protection equipment such as gloves, shoes, glasses, vests, etc., each according to the nature of the work performed.

4.1.8.7.2 Employees shall immediately report the discovery of any unsafe conditions or abnormal conditions that may pose a danger or cause an accident, and the official shall take corrective action thereon immediately.

4.1.8.7.3 All operation and maintenance work shall be planned, managed and supervised by a responsible person, who shall ensure that all safety precautions regarding operations are taken and managed.

4.1.8.7.4 Equipment malfunctions shall be immediately rectified and their use are prohibited until the malfunction is corrected.

4.1.8.7.5 Precautions shall be taken to avoid accidents and any required protective equipment shall be worn.

4.1.8.7.6 If the clothing is contaminated with fuel or any flammable Materials, it shall be removed immediately and the contaminated body area shall be carefully washed. All station workers are prohibited from wearing loose, torn or non-official clothes.

4.1.8.7.7 In the event that the body is exposed to allergens or skin burns, it shall be immediately necessary to wash the affected body area carefully in accordance with the rules of first aid.

4.1.8.7.8 Injuries resulting from any accident shall be treated immediately by first aid personnel, with the injured person immediately transported to the nearest hospital if necessary in critical cases.

4.1.8.7.9 First aid boxes shall be provided in all plant facilities, ensuring that they are equipped with treatments for minor wounds and burns. Staff shall be trained to carry out first aid.

4.1.8.8 General Station Requirements:

4.1.8.8.1 Vehicle washing facilities and service workshops shall be as far as possible from the fillers and from the discharging area of the fuel tanks. Traffic within the plant (to and from the washing area and workshops) shall not affect the movement of fueled vehicles.

4.1.8.8.2 The plant floor shall be worked downhill from the office (building) of the services up to the laundry facilities, to avoid the access of washing water to other facilities.

4.1.8.8.3 The entrances to the station shall be provided with signboards reading "Entrance only" and its exits with plates reading "Exit only". The types and writings of these plates shall conform to the approved specifications.

4.1.8.8.4 Appropriate markings shall be provided for the routing of vehicles to and from the pallets of fillers in order to regulate traffic within the station.

4.1.8.8.5 Drainage system for flammable oils and liquids:

1. (a) The ground inclinations required throughout the plant shall be studied and designed so that they lead to the discharge of leaks of flammable oils and fluids to a special drainage network.
2. (b) The necessary measures shall be taken to prevent the discharge of flammable oils and liquids to waterways, public sewers, or to neighboring properties.
3. (c) The necessary measures shall be taken to prevent the possible release of flammable oil and liquids from the yards of the station to the facilities and buildings attached to them, either by directing the inclination of the yards to take their liquids away from these sites, or by raising the sills of the entrances of these facilities to repel liquids from entering them.

4.1.8.9 Warning Signs and Guide Signs at the Station:

4.1.8.9.1 Warning signs and appropriate guide signs shall be placed according to the specifications approved at the station in prominent (visible) and clear places in Arabic and English in the places of fillers, tanks and feed pumps, and other applicable ones, as follows:

Flammable Liquid	No Smoking	Turn off the Engine
		

General Directorate of Civil Defense and Operations Tel. No. 999

4.1.8.9.2 The phrase “Emergency Switch” shall be affixed next to the Emergency Switches in a clear manner in both Arabic and English.

4.1.8.9.3 The tank shall have a label placed at the filling point indicating the type of fuel and the capacity of the tank.

4.1.8.9.4 Copies of licenses issued by the competent authorities shall be kept for the station.

4.2 Painting and Cladding

Introductory Definitions:

Combustible Powder: Any coating material in the form of very fine solid granules (powder) and has flammability.

Flammable or Combustible Material: Any Material, including its deposits or residues that is used in paint spraying operations, etc., and which also meets the definition of one of the following terms: (1) flammable Material, (2) combustible Material, (3) combustible powder.

Solution: When a material (solute) dissolves in another (solvent), a so-called solution is formed. It is the opposite of the concept of a mixture, where one compound is added to another compound and no chemical bonds are formed. To imagine the difference between the mixture and the solution, it is possible to imagine a cup of water with sand mixed against a cup of water containing some carbonates or salts, for example, where all the contents are homogeneous, and no deposits remain at the bottom of the cup.

Solvent: (or dissolver) is a generally liquid material that is a solvent of another material (solute) and results in a homogeneous solution (or new compound) by itself. Most commonly used

solvents are organic chemicals called organic solvents (generally considered flammable). To distinguish between solvents and solutes, solvents are usually present in much greater proportions than solutes. Organic solvents are generally used in cleaning, coating extension (diffusion), to facilitate the coating process, etc.
Solvents generally have low flash and boiling points and easily evaporate (or can be isolated by distillation) leaving behind dissolved materials. Most organic solvents are flammable or highly flammable and their vapors are often explosive. Solvent vapors are heavier than air making them flat on floors and can travel great distances depending on the airflow. Solvent vapors can also be found at the bottom of empty cans and barrels and may pose a sudden fire hazard, which shall be prevented by storing their empty containers either by permanently disinfection of the residues of the Material or sealing them or placing them open and upside down after completely emptying their content.

4.2.1 Preamble and General Requirements.

4.2.1.1 This clause is concerned with the separation of painting operations using the following methods:

1. Painting with flammable solvents, which are in the form of a spray, by compressed air, steam, static electricity, or any other means.
2. Painting by immersing the body to be clad in a basin containing paint (flammable solvents).
3. Painting using flammable powders by spray paint equipment (atomizer or sprayer), whether by ordinary methods or with static electricity.

4.2.1.2 This section is not concerned with painting buildings, facilities or tanks, with the need to take precautions in the use of flammable liquids in any of these sites.

4.2.1.3 This clause is not concerned with spray painting or immersion with non-flammable Materials.

4.2.1.4 It is prohibited to use organic peroxides in coating and cladding processes.

4.2.1.5 The necessary license shall be obtained for the purpose of General Directorate of Civil Defense (Firefighting Dept.) for the places where painting and cladding activities are carried out.

4.2.2 Spray Painting Requirements Using solvents (flammable liquids)

4.2.2.1 Spray Painting Site Requirements:

4.2.2.1.1 The practice of these activities is limited to industrial zones. It is strictly prohibited to establish them in residential and commercial areas.

4.2.2.1.2 Spray painting, or drying, operations in vaults are prohibited.

4.2.2.1.3 If the site is within the building, it shall be selected in one of its corners, and it shall be isolated from other activities in the building with fire-resistant walls for a period of not less than two hours. It shall be equipped with an automatic fire sprinkler network.

4.2.2.1.4 The distance between one worksite and another shall not be less than 1m or fire-resistant partitions shall be installed between them, in the event that the distance is not available.

4.2.2.1.5 The distance between worksites and adjacent buildings shall not be less than 6 m.

4.2.2.2 Requirements for Spray Painting Operations Building:

4.2.2.2.1 Construction Elements and Specifications.

1. Paint spraying and drying building shall be single storey (ground only).
2. The construction elements for the places of spraying and paint drying operations, shall be of concrete, cement brick or iron with a thickness of not less than 1.3 mm, and aluminum or other non-flammable Materials may be used in the places of spraying and drying operations with a narrow range.

3. The internal walls of these places shall be smooth to avoid the accumulation of combustion deposits and to facilitate their cleaning process.
4. The floor of the place shall be constructed of non-flammable Materials.
5. The entry and exit openings to and from the paint spray site shall be minimized as much as possible.

4.2.2.2.2 Ventilation Requirements for Spray Painting Building:

1. All spraying and paint drying places shall be equipped with natural ventilation to refresh the air at least 6 times per hour. In the event that natural ventilation is not possible or natural ventilation is insufficient at the above required rate, Separate mechanical ventilation shall be installed to get rid of (expel) the fumes and dust of flammable Materials to a safe area at least 6 times per hour, provided that this mechanical ventilation works continuously and is of spark insulation type and that this ventilation is linked to the alarm system of the building (the main alarm panel of the building).
2. The ventilation rate (velocity) in the spraying and paint drying place shall be adjusted and limited to 18- 30.5 (m/ Min.) so as to ensure that the vapors of paint solvents in the air are reduced to 25% of their minimum combustion.
3. The operation of mechanical ventilation shall be linked to the spraying and drying process, so that painting operations start only after the work of the ventilation fans, and the painting process stops when any malfunction or stoppage of the ventilation system occurs.
4. An automatic stop (deactivation) system shall be provided for the spraying and drying process in the event that the concentration of suspended solvent vapors in the intake air ducts reaches more than 25% of the minimum combustion of the vapors.
5. All air intake motors and fans shall be outside the paint spraying and drying area.
6. It is prohibited to circulate (return) the air drawn in.
7. The ventilation system shall be operated during the cleaning process.
8. Ventilation shall be designed, so that the sucked air is away from the fresh air inlets in order to avoid contamination.
9. Intake fans shall be connected to devices for collecting vapors and sediments from drawn air.
10. Air intake ducts shall be protected from shocks.
11. The distance between the air intake ducts and any other flammable building elements shall not be less than 50cm.
12. The distance between the intake air exit point and any external wall shall not be less than 2 m.
13. Intake channels shall be provided with side openings with gates on them to facilitate the cleaning process.
14. Iron feathered intake fans shall not be used for the ventilation system in the spray painting building.
15. There shall be sufficient distance between the blades of the fan and the housing of the fan (to avoid friction).The rotation axes of the fan shall be of self-lubricating types.

4.2.2.2.3 Electrical Pipelines for Spray Painting Building:

1. All Electrical Installations and lighting switches shall be of the spark insulation type, including installations 3m horizontally or 6m vertically from the place of spraying and drying, in the event that they are not isolated by any breakers.
2. The light can be shone from the outside through transparent glass panels, taking into account the distance between the light bulbs and the panels to avoid radiation heat.

3. All light bulbs shall be protected inside protective covers and of the type that does not radiate heat.
4. It is prohibited to use portable light bulbs during spraying and paint drying operations.
5. All tanks, pipelines and equipment of paint spraying and drying building shall be grounded.

4.2.2.3 Precautions to be observed in spraying and paint drying operations:

4.2.2.3.1 Maximum care shall be taken during filling or suctioning (taking) solvents to avoid spillage.

4.2.2.3.2 Approved pumps shall be used to pump (take) solvents if the amount of daily consumption (or during a shift) exceeds 225 liters.

4.2.2.3.3 All solvent transport pipes shall be of steel or other Material of suitable durability and resistant to thermal and mechanical stresses with the necessity of earthing all such pipelines.

4.2.2.3.4 It is prohibited to carry out any spraying operations outside the designated area.

4.2.2.3.5 Spray chambers shall be completely separate from drying chambers.

4.2.2.4 Storage and Operation Requirements:

4.2.2.4.1 Large quantities of solvents shall be stored in accordance with Chapter (4.1.1).

4.2.2.4.2 Small quantities of solvents shall be stored within the spray area, taking the necessary precautions and precautions, taking into account that they shall not exceed the following quantities:

a) Consumption per day (or for one shift);
b) 100 liters of solvents whose flash points are less than and equal to 23°C; or
c) 500 liters of solvents whose flash points are higher than 23°C.

4.2.2.4.3 Solvents shall be handled in packages in accordance with Clause (2.2) of Chapter (4.1.1).

4.2.2.4.4 The solvent storage site shall be provided with the following clear warning and indicative signs: No Smoking, No Entry for Non- Specialists, Danger, Flammable Liquid, etc. if necessary and installed in (visible) prominent places.

4.2.2.4.5 It is prohibited to carry out any welding or cutting operations at the worksites.

4.2.2.4.6 Operating locations shall be protected by suitable automatic extinguishing systems, either by total flooding or local application.

4.2.2.4.7 Fire sprinkler heads shall be protected with suitable covers to protect them from contamination in accordance with the General Directorate of Civil Defense Requirements.

4.2.2.4.8 The operating area shall be provided with suitable manual fire extinguishers (type and number).

4.2.2.4.9 The use of open flame or portable lighting equipment is prohibited.

4.2.2.4.10 Any steam pipelines or equipment with hot surfaces, may not be used within the operating area.

4.2.2.4.11 Waste contaminated with paint Materials shall be disposed of daily in a safe and correct manner.

4.2.2.4.12 Contaminated workers' clothing shall not be left in the painting area and shall be kept in the designated areas.

4.2.2.4.13 Solvents used for personnel hygiene and ejection nozzles shall have a flash point above 38°C.

4.2.2.4.14 All welding or cutting operations shall be carried out within the operating area based on a prior plan and under the strict supervision of the officials with the necessary primary fire extinguishing equipment.

4.2.2.5 Maintenance Requirements.

4.2.2.5.1 All equipment for spraying shall be periodically inspected and maintained against rupture or leakage.

4.2.2.5.2 It is prohibited to carry out any maintenance operation unless the place is completely cleaned of unsolved and flammable sediments.

4.2.2.5.3 All tools used for maintenance and cleaning of equipment shall be of a non-sparking type.

4.2.3 Requirements for Painting with (Burning) Powders

Powder coating operations include the following methods:

1. Pass the body to be painted in a cloud of paint Material.
2. Pass the object in the cloud of the Material by the difference in electrical charges between them.
3. Spray the powder on the body to be painted with a special purpose sprayer.
4. Spray the powder on the body using the atomizer according to the difference in electrical charges between them.

4.2.3.1 Powder Coating Site Requirements:

Site requirements are subject to what is applicable, according to the properties of the Material, of the requirements mentioned in Article (2.1) of this Chapter.

4.2.3.2 Powder Coating Operations Building Requirements:

The Building Requirements are subject to what is applicable - according to the properties of the Material, of the requirements mentioned in Article (2.2) of this Chapter.

4.2.3.3 Storage and Operation Requirements:

4.2.3.3.1 For powders, according to the Material properties, the storage and operation requirements shall be subject to the requirements mentioned in Article (2.4) of this Chapter in addition to the following:

1. When preheating the body to be sprayed (coated) with powder, its temperature shall not exceed 28°C below the spontaneous combustion point of the coating powder.
2. The powder coating area shall be equipped with heat detectors that separate the energy sources of all machines operating in the area in cases of fire, in addition to operating control systems.

4.2.3.4 Maintenance Requirements.

Maintenance requirements shall be subject to the same requirements mentioned in Article (2.5) of this Chapter.

4.2.4 Requirements for Immersion Painting Operations

4.2.4.1 Submersible Painting Operations Site Requirements:

According to the Material properties, Site requirements are subject to the requirements mentioned in Article (2.1) of this Chapter.

4.2.4.2 Submergence Painting Building Requirements:

According to the Material properties, the Building Requirements are subject to the requirements mentioned in Article (2.2.1) of this Chapter.

4.2.4.3 Requirements for Immersion Paint Sinks:

4.2.4.3.1 The level of the site of the flooding basins shall not be below the level of the sites of the equipment and other surrounding facilities.

4.2.4.3.2 The location of the flooding basins and its surroundings shall be free of obstructions as well as the corridors leading to the emergency exits.

4.2.4.3.3 Immersion basins shall be constructed of steel, reinforced concrete, cement bricks or non-flammable Materials with strong supports installed, and their resistance and the resistance of the supports to fire shall not be less than one hour.

4.2.4.3.4 The upper edges of the flooding basin shall be at least 15 cm higher than the surface of the solvent or the floor of the place, (if the tank is at ground level).

4.2.4.3.5 The flooding basins shall be provided with a separate drainage system sufficient to drain all the content of the basin to a safe place, so that the diameter of the drainage pipe is not less than 75 mm.

4.2.4.3.6 The upper surface of flooding basins with capacities greater than 750 liters, or with an internal area greater than 1 m2, shall be equipped with drainage pipes to drain excess content to a safe place, so that the diameters of these pipes are not less than 75 mm.

4.2.4.3.7 When designing drainage pipes, they shall be easily maintained and cleaned when necessary.

4.2.4.3.8 Drain pipes shall be installed, so that their horizontal level is 15 cm lower than the level of the upper edges of the flooding basin.

4.2.4.3.9 Sinks with capacities greater than 1900 liters shall be provided with manual and responsive bottom drainage pipes to drain all the liquid level from inside the sink in case of emergency, if the density of the liquid at ambient temperature hinders the work of the top drainage pipes .

4.2.4.3.10 The location of manually opened relief valves shall be in a safe and accessible location.

4.2.4.3.11 If the natural (gravity) drainage of the flooding basin is not feasible, vacuum pumps shall be installed to pump the content to a closed reserve tank (used for emergencies) with a capacity of 125% of the capacity of the flooding basin, or the content shall be drained to another safe place.

4.2.4.3.12 Standby tanks shall be completely empty when flooding operations are in operation.

4.2.4.3.13 The diameters of the bottom drainage pipes of the flooding basins shall be suitable, so that the content can be drained within five minutes at most, according to the following table:

Table:- F.1-T18 : Minimum drain pipe diameter according to the capacity of the flooding basin

Basin capacity (liters)	Drain pipe diameter (mm)
1900 – 2850	75
2851 – 3800	100
3801 – 9500	125
9501 – 15000	150
Over 15000	200

4.2.4.3.14 If the process requires heating, the heating devices shall be of the approved type of the used liquids.

4.2.4.3.15 The flooding basin shall be provided with a regulator that separates (deactivates) the two conveyor belt systems, for the purposes to be painted - and heating in the event of overheating.

4.2.4.3.16 It is prohibited to submerge the objects to be painted inside the basin if the difference between the surface temperature of the object to be submerged and the degree of spontaneous combustion of the liquid (used paint) is less than 55°C.

4.2.4.3.17 Periodic inspection shall be carried out (at least once a month) on the accessories of the flooding basins, including covers, drainage pipes, valves, Electrical Installations, grounding, ventilation, heating devices and extinguishing systems, with the necessity of maintaining any defect as soon as it is discovered.

4.2.4.3.18 Cleaning of sediment accumulated on dripping wet plates (from freshly painted objects) and on the walls of immersion basins and the surrounding area (which may be contaminated with some droplets) shall be taken care of.

4.2.4.3.19 Tools used in cleaning operations shall be of a non- sparking type.

4.2.4.3.20 Dedicated and approved receptacles shall be used for periodic collection and disposal of waste at least once a day or at the end of each shift.

4.2.4.3.21 No work, painting or maintenance, shall be carried out unless the cleanliness of the place has been ascertained.

4.2.4.3.22 Immersion basins with capacities less than 570 litres, or with a liquid surface area less than 1 m2, shall be equipped with either automatically closed lids or a suitable extinguishing system for the purpose.

4.2.4.3.23 Immersion basins with capacities greater than 570 liters, or with a liquid surface area greater than 1 m2, shall be equipped with special fire protection systems, to include the basin, drainage panels (which are placed under newly immersed objects to collect the falling liquids for drainage into the immersion basin), newly coated objects and surrounding areas.

4.2.4.3.24 One of the following automatic firefighting systems shall be installed, according to Part 2:

1. Water immersion system, which is effective for liquids whose flash points exceed 60°C.
2. Automatic foam system.
3. CO2 system
4. Dry Powder System.
5. Halon Replacement System.
6. Automatic water sprinkler system for basins containing liquids with flash points above 60°C and connected operations that are dangerous.
7. Automatic water sprinkler system for basins equipped with automatic closing covers in case of fire.

4.2.4.3.25 The covers that are automatically sealed on the immersion basin in the event of a fire shall be of flame-retardant Material.

4.2.4.3.26 The cover of the flooding basin shall be tightly closed, so that the end of the cover surrounds the outer surface of the basin for a distance, downwards, of not less than 2 cm.

4.2.4.3.27 The conveyor belt system, for the purposes to be painted, shall be designed to stop (deactivate) its operation automatically upon any malfunction in flooding or ventilation operations.

4.2.4.4 Ventilation Requirements for Immersion Painting Building:

Ventilation requirements shall be subject to the same requirements mentioned in Article (2.2.2) of this Chapter.

4.2.4.5 Requirements for Electrical Installations for Deluge Paint Building:

The requirements for Electrical Installations shall be subject to the same requirements mentioned in Article (2.2.3) of this Chapter.

4.2.4.6 Requirements for storage and handling of flammable liquids in the flood paint building:

4.2.4.6.1 Large quantities of solvents shall be stored in accordance with Chapter (3.3.4.1.1).

4.2.4.6.2 It is permitted to store liquids (required for daily consumption) in the paint area within 450 liters of each of the first, second and third classes of flammable liquids, so that they are inside one (approved) cabinet only. The total quantity of liquids of the first and second classes does not exceed 225 liters.

4.2.4.6.3 The amount of liquids (required for daily consumption) of the above-mentioned liquids shall be allowed to be stored outside the cabinet in the following cases:

1. If the quantity is for one day use.
2. The quantity shall not exceed 95 liters of the first class (A). It was inside approved containers.
3. The quantity shall not exceed 450 liters from other groups (first (b) and (c), second, third (a) and (b). It was inside approved containers.

4.2.4.6.4 Sealed receptacles, approved tanks, safe receptacles, or a pipe network shall be used to transport or store solvents (flammable liquids). Glass or open receptacles shall not be used for the purpose.

4.2.4.6.5 It is prohibited to transport these liquids, by means of pressure, using compressed air. It is allowed to use inert gases and by appropriate controls.

4.2.4.6.6 Pumps, gauges and pipes used in the transport of flammable solvents shall be approved.

4.2.4.6.7 The specifications of solvent tanks shall be subject to the provisions of Chapter (3.3.4.1.1).

4.2.4.6.8 The flooding basin shall be equipped with a liquid level controller that will automatically deactivate the pump when the level reaches the fill limit.

4.2.4.6.9 The pump drive circuit shall be connected to alarms connected to a suitable automatic extinguishing system.

4.3 Fruit Ripening Processes

Introductory Definitions:

Fruit ripening process: It is a process that takes place inside sealed rooms with fruit stocks where they are injected with a specific gas (usually ethylene gas) to accelerate the process of ripening fruits, such as bananas and citrus fruits. Any other gas approved by the General Directorate of Civil Defense may be used and acetylene gas may not be used in any case.

4.3.1 Preamble and General Requirements.

4.3.1.1 Sites and activities engaged in fruit ripening operations shall obtain prior authorization from the General Directorate of Civil Defense.

4.3.1.2 Fruit ripening processes shall be limited to the use of ethylene gas. If other gases are used, the General Directorate of Civil Defense shall be consulted for prior authorization.

4.3.1.3 The general specifications for gas cylinders used in fruit ripening processes are subject to the Requirements for Chapter 3.7.4.1.4.

4.3.2 Requirements for the Location of the Fruit Ripening Process

4.3.2.1 The location of the fruit ripening operations building shall be in industrial areas only.

4.3.2.2 The location of the fruit ripening building shall be overlooking at least one street.

4.3.2.3 If the fruit ripening site is integrated within a multi-activity building, it shall be erected in one of the corners of the building and isolated from the rest of the activities by fire-resistant walls for a minimum of 4 hours.

4.3.3 Requirements for Fruit Ripening Building

4.3.3.1 Construction Elements and Specifications:

4.3.3.1.1 The building shall consist of one floor (ground floor only).

4.3.3.1.2 All ceilings and partitions of the building shall be of fire- resistant Material for 4 hours.
4.3.3.1.3 The roof of the building or one of its external walls shall be of light Material to discharge the potential explosion pressure.
4.3.3.1.4 All doors (and other openings) shall be of fire-resistant Material for a minimum of 2 hours. The direction of opening the doors shall be directly outside.
4.3.3.1.5 More than one exit to the building shall be provided.

4.3.3.2 Ventilation Requirements for Fruit Ripening Building:

4.3.3.2.1 Separate mechanical ventilation shall be installed only to refresh the air of the fruit ripening building at least 6 times per hour, provided that this mechanical ventilation works continuously and that it is of the spark insulation type and that this ventilation is linked to the alarm system of the building (the main alarm panel of the building).

4.3.3.3 Requirements for Electrical Pipelines for Fruit Ripening Building:

4.3.3.3.1 All electrical fixtures and installations shall be of spark insulation type.
4.3.3.3.2 Lighting shall be of the type that does not radiate heat, fixed to the ceiling or top of the walls, and have protective covers.
4.3.3.3.3 Light switches and electrical equipment shall be of spark insulation type or shall be installed inside a panel, insulated from atmospheric influences, outside the building.

4.3.4 Fruit Ripening Process

4.3.4.1 The process of ripening fruits is done by injecting the ripening gas using approved regulators and devices to measure the components of the air, so that the amount of gas does not exceed the permissible limit in the air, which is 1 part (of the gas) per 1000 parts of the volume of the ripening room air.

4.3.5 Storage and Preventive Fruit Ripening Requirements

4.3.5.1 Storage and preventive compressed gas cylinders requirements shall be subject to the same requirements mentioned in Clause (2.3) of Chapter (4.1.4).

4.3.6 Maintenance Requirements for Fruit Ripening Equipment

4.3.6.1 The maintenance requirements for the cylinders, regulators and the extension network of the fruit ripening building shall be subject to the same requirements mentioned in Clause (2.3.4) of Chapter (4.1.4).

4.4 Insecticides

Introductory Definitions:

Insecticides (or fogging, smoking, or fogging Materials) are highly toxic chemicals that may be flammable in their gaseous or liquid states and used, in a specific concentration and for a specific period, to eliminate insects and pests. They can permeate the furniture, furnishings, supplies, and things that fall on them and then fade, leaving slight effects on them. Its predominant applications (as a liquid) are spraying it as a spray or puffing it as a vapor, fumigation or smoke to disinfect the space and its contents.

4.4.1 Preamble and General Requirements.

4.4.1.1 This clause is concerned with the fumigation or evaporation of buildings, vehicles, marine vessels, devices and goods inside vehicles, basements, tanks and silos with insecticides for the purpose of disinfecting them from insects and pests.

4.4.1.2 This clause is not concerned with the disinfestation or fumigation of land and agricultural crops.

4.4.1.3 This clause is concerned with the requirements to be met in the storage of insecticides in transported containers of all forms, whether stored inside or outside the building in quantities not less than 2500 liters.

4.4.1.4 It is prohibited to use liquids whose flash point is less than 38 °C in evaporation operations.

4.4.1.5 The decisions of the competent and concerned authorities, (such as the Ministry of Public Health and others) regarding controls on the import, handling, manufacture, circulation and storage of insecticides and the provisions of control over them shall be adhered to. Only the use of pesticides authorized by these authorities shall be adhered to.

4.4.1.6 Coordination shall be made between the General Directorate of Civil Defense and the competent authorities regarding the controls and requirements for issuing licenses to practice pesticide handling activities.

4.4.1.7 The use and selection of pesticides shall be under the supervision of a specialized technical official authorized by the competent authorities.

4.4.1.8 The General Directorate of Civil Defense shall be notified in writing, at least 24 hours before the start of the closure of any building or ship for the purpose of fumigating it with flammable pesticides.

4.4.1.9 The General Directorate of Civil Defense shall be informed of the pesticide storage sites, their types, quantities, associated hazards, working hours in the storage sites, and contact phone numbers, including the phones numbers of the persons concerned with emergencies in these sites.

4.4.2.10 Staff specialized in the treatment of emergency cases – as a result of the circulation of these pesticides, shall be trained in coordination with the Ministry of Public Health.

4.4.2 Requirements for pesticide storage site

4.4.2.1 New locations shall be studied with great care, taking into account the general direction of the wind so that it is away from population centers, livestock barns, and places of storing fodder and foodstuffs.

4.4.2.2 Water coming out of the storage site, whether running or which may penetrate into the soil or as a result of firefighting operations, shall be kept away from gathering places, livestock sheds and water pools.

4.4.2.3 Storage sites and buildings shall not interfere with or impede General Directorate of Civil Defense operations and access to available water sources.

4.4.3 Requirements for Pesticide Building

4.4.3.1 The building shall be of one floor (ground floor) only, and storage in the basement is prohibited.

4.4.3.2 The Building Requirements shall be subject Chapter (3.7.4.1.1) if one of the components is a flammable fluid.

4.4.3.3 The central air conditioning shall be separated from the rest of the building if the warehouse is within a building, so that the warehouse has a separate air conditioning unit.

4.4.4 Requirements for Pesticides Storage

4.4.4.1 Pesticides may not be stored with ammonium nitrate used as fertilizer.

4.4.4.2 Pesticide containers shall be isolated from the rest of the Materials for sale (especially food) in storage places for the purpose of circulation for sale, and the supply shall be within

the limits of the quantity allowed for sale, with the need to store them on fixed metal shelves.

4.4.4.3 Gas fogging materials shall be stored in cylinders in accordance with Clause (2) of Chapter (4.1.4).

4.4.4.4 Where an insecticide component is a flammable fluid, it shall be subject to the requirements in Chapter 4.1.1.

4.4.4.5 Pesticides characterized by the seriousness of oxidizing agents shall be subject to the requirements contained in clauses (2) and (4) of Chapter (4.1.7).

4.4.5 Fumigations Precautions

4.4.5.1 The place (or part) to be fumigated shall be inspected before the fumigation process by the supervisor of the process. The necessary measures shall be taken to avoid potential risks to the health of individuals and the presence of sources of fire combustion.

4.4.5.2 All sources of flame and heat, boilers, etc. - shall be isolated and removed from the place to be evaporated, with gas and fuel valves closed, in the event that the pesticide used in evaporation is flammable.

4.4.5.3 All electrical and interior lighting switches shall be disconnected prior to evaporation except for air intake fans and extinguishing equipment operating switches.

4.4.5.4 Approved spark proof mobile light bulbs shall be used.

4.4.5.5 The place shall be cleaned of residues and flammable Materials before the fumigation process.

4.4.5.6 All Firefighting Equipment, such as automatic sprinklers, alarms and fire pumps shall be operated safely before starting the fumigation process.

4.4.5.7 Appropriate respirators of an approved type shall be worn while fumigating.

4.4.5.8 It is prohibited for persons may not access to the building to be fumigated before, during and after the fumigation, unless they are authorized to do so by the supervisor in charge of the fumigation process.

4.4.5.9 The process supervisor shall identify (and instruct the evacuation of) other adjacent places to be evacuated before starting the fumigation process, as they may be affected by pesticides.

4.4.5.10 The process supervisor shall consider the following before starting the fumigation process:

1. Ensure that the building (or part thereof) to be fumigated is completely free of people or animals.
2. There are no obstacles to carrying out the fumigation process easily and safely.
3. Take the necessary precautions to protect lives in neighboring buildings.
4. Remove any combustion sources from the building to be fumigated and its surroundings.
5. Ensure the safety of the fumigation equipment and that it is free from any defects in it or in its pipelines.

4.4.5.11 The places to be fumigated shall be marked at least two hours before the date specified for the fumigation process.

4.4.5.12 The places to be fumigated shall be provided with the following warning signs and data:

1. Visible warning signs and clear indicative data about the risk of the operation.
2. The type of pesticide used to spray and fumigate the place.
3. The names of those in charge of the operation, the name of the company specialized in spraying and the addresses of the specialists concerned with contacting them in cases of emergency.
4. The date and time of the start of the process of spraying the place and the hour of the end of the process.

4.4.5.13 Warning signs shall be placed on all doors and entrances to the building as well as on the basements and tanks to be fumigated.

4.4.5.14 Warning advertisements shall bear the emblem of the toxic materials used, dangerous phrases, toxic fumes, and the name of the pesticide in large red letters not less than 5 cm high on a white board.

4.4.5.15 Precautionary statements shall be written in Arabic and English.

4.4.5.16 All openings of the building during the evaporation process shall be blocked and confirmed by means of release or concentration meters of the pesticide used.

4.4.5.17 The place shall be subjected to natural or mechanical ventilation after the end of the prescribed period of fumigation.

4.4.5.18 After the completion of the fumigation and ventilation of the building and ensuring the safety of the working environment inside the building, all pesticide containers and other Materials accompanying the process and warning signs shall be removed and disposed of in accordance with the manufacturer's instructions in this regard.

4.4.6 Fire prevention Requirements

4.4.6.1 A deliberate emergency plan shall be developed in coordination with the General Directorate of Civil Defense and other concerned authorities.

4.4.6.2 The firefighting and alarm system within pesticide warehouses shall be determined, depending on the nature and quantity of the stock, its degree of severity and the extensibility of the fire, in accordance with the General Directorate of Civil Defense Requirements.

4.4.6.3 Manual fire extinguishers shall be provided, around fumigation and fumigation areas and at the pesticide storage site, in accordance with the General Directorate of Civil Defense Requirements.

4.5 Hot Work (Welding & Cutting) Works

4.5.1 Preamble and General Requirements.

4.5.1.1 This chapter applies to welding and metal cutting works by means of electricity or flammable gases (such as oxygen and acetylene gas mixtures).

4.5.1.2 This chapter is concerned with the requirements and precautions to be met and adhered to in welding and cutting operations by workers, Monitors, supervisors and site officials.

4.5.1.3 A special form shall be prepared for the "permit" to carry out hot welding or cutting works, by the safety officers concerned with monitoring the work at the welding and cutting sites.

4.5.1.4 The permit shall clearly indicate the minimum safety requirements and procedures followed in welding or cutting operations, taking into account the observance and discipline of the application of all provisions contained in the permit form by all workers at these sites.

4.5.1.5 In the event of welding work necessary for the maintenance of fuel tanks, it shall be ensured that there are no combustion vapors in them, using special measuring devices for the purpose, while ensuring that the remaining vapors are expelled by an inert gas.

4.5.2 Duties of Hot Work (Welding & Cutting) Site Officer

Hot Work (Welding & Cutting)

4.5.2.1 The Officer shall secure the safety and protection of the site in preparation for welding and cutting operations.

4.5.2.2 The Officer shall scrutinize the selection of devices and equipment approved for welding or cutting operations, such as hoses, regulators, acetylene cylinders, etc.

4.5.2.3 The Officer shall scrutinize the selection of personnel and safety Monitors (trainers) for welding operations.

4.5.2.4 The Officer shall scrutinize the selection of weld-trained manpower contractors.

4.5.2.5 The Officer shall inform the contractors of the nature of the place and the whereabouts of flammable and hazardous Materials.

4.5.3 Duties of Hot Work (Welding & Cutting) Supervisor

4.5.3.1 The Supervisor shall follow the proper and proper use of the equipment during welding and cutting operations.

4.5.3.2 The Supervisor shall identify flammable and hazardous Materials present in the welding area or potentially entering the area during welding operations.

4.5.3.3 The Supervisor shall secure protection for flammable Materials in one of the following ways:

1. Move the welding process away from flammable Materials.
2. Transport flammable Materials to another safe area away from welding operations.
3. Cover flammable Materials with covers of flammable Materials.

4.5.3.4 The supervisor shall instruct and inform the employees of the safety of the area and its readiness to start welding operations.

4.5.3.5 The Supervisor shall ensure the safety and availability of firefighting equipment and safety before proceeding with welding and cutting operations.

4.5.3.6 The Supervisor shall ensure that welding process monitors are on site prior to commencing welding or cutting operations.

4.5.3.7 After the completion of operations, the supervisor shall survey and inspect the entire welding or cutting operations area, for a period of not less than half an hour, to ensure that it is completely free of any residues that may constitute a source of combustion or situations that may lead to a fire hazard.

4.5.4 Monitor Hot Work (Welding & Cutting) Monitors' Duties and Requirements

4.5.4.1 Monitors shall be present (necessary) in the welding or cutting operations area if:

1. There are flammable Materials in the structural elements, or in the contents of the site, for a distance of less than 12 m around the welding point.
2. There are flammable Materials, easy to combust from volatile sparks, at a distance of more than 12 m.
3. There are cracks and openings in the floors and walls, for a distance of less than 12 m from the welding point, from which sparks may fall on flammable Materials.
4. There are flammable Materials adjacent to the other side of the side (or separator) on which the welding process is carried out, which may combust as a result of heat transfer to it by conduction or radiation.

4.5.4.2 Monitors shall be trained in the use of fire-fighting equipment, such as manual fire extinguishers, rubber water hoses and other equipment available on site.

4.5.4.3 Monitors shall be trained to operate alarms in the event of a fire.

4.5.4.4 After the completion of operations, the supervisor shall survey and inspect the entire welding or cutting operations area, for a period of not less than half an hour, to ensure that it is completely free of any residues that may constitute a source of combustion or situations that may lead to a fire hazard.

4.5.5 Duties of workers and technician of Hot Work (Welding & Cutting)

4.5.5.1 The welders shall be fully aware of how to properly use the welding equipment and ensure that it is approved by the supervisor before starting work.

4.5.5.2 Welders shall ensure that the work area is completely safe and free of flammable Materials, whether solid, liquid, accumulated dust or powders, and that the surrounding atmosphere is free of flammable fumes and gases before conducting Hot Work (Welding & Cutting) operations.

4.5.5.3 Welders shall inspect and take into account the pressures of the gases used when operating and shall not carry the welding hoses on the shoulder when using them.

4.5.6 Requirements for Handling Gas Cylinders and Welding Equipment

4.5.6.1 The storage site of the gas cylinders shall be outside the welding area.

4.5.6.2 The number of gas cylinders within the welding area shall not exceed one day's usage needs.

4.5.6.3 The distance between gas cylinders and heat sources shall not be less than 5 m, such as welding, cutting, open flame, heating units or other heat sources.

4.5.6.4 The gas content of the cylinders shall not exceed half of their content when used.

4.5.6.5 Gas hoses shall be kept from damage as well as valves, with the need to replace the damaged ones immediately.

4.5.6.6 Gas cylinder valves shall be closed when gas is not used.

4.5.6.7 The lengths of hoses used in welding and cutting operations shall not be less than 5 m and shall be connected (fixed) to the clips of the cylinder designated for this purpose.

4.5.6.8 If protective covers are required, on cylinder valves, they shall be removed only if used.

4.5.6.9 Pressure regulators or cylinder valves may be maintained only by professionals.

4.5.6.10 Care shall be taken of the cylinder and keep it from mechanical shocks. It shall be installed vertically in a safe position (by attaching it to special chains for the purpose) to avoid falling.

4.5.6.11 Oxygen gas cylinder hoses shall be taken care of and preserved from contaminants, such as oil and grease.

4.5.6.12 Oxygen gas hoses may not be used to transport other gases.

4.5.7 Requirements for Handling Gas Cylinders and Welding Equipment

Arc Welding: A process of welding using heat released by the electric (shock) arc to melt and weld the two pieces of metal together or to melt a metal spit, dissolved as an electrode, in the bonding area between them.

4.5.7.1 Electrical Arc transformers used in welding operations shall be approved and designated for this purpose.

4.5.7.2 These transformers may be connected to electricity only by specialists.

4.5.7.3 Approved cables intended for arc welding purposes shall be used.

4.5.7.4 Electric welding cables shall be protected from damage with the replacement of the damaged and defective ones, or the repair of the defect, by a competent electrician.

4.5.7.5 Transformers and generators shall be grounded prior to welding.

4.5.7.6 Welding spit pliers (Electrode) shall be fully insulated. If not used, it shall be placed on a stand of insulation (non-conductive) type.

4.5.7.7 The place shall be provided with a breaker to disconnect the power supply (in case of emergency) that is close to the place of welding.

4.5.7.8 When electrical welding is carried out in narrow and confined areas, such as boiler rooms and piping, only low voltage electricity shall be used.

4.5.7.9 Workers shall wear protective clothing and equipment during welding operations.

4.5.7.10 Whenever possible, welding areas shall be walled with protective fences to protect others from welding work.

4.5.7.11 In all cases, it is prohibited to weld or cut any object contaminated with flammable waste unless it has been thoroughly washed and cleaned.

4.5.7.12 In order to maintain the safety of workers and general safety, welding devices and equipment shall be subjected to periodic inspection and maintenance.

4.5.8 Requirements for Fire Prevention in Hot Work (Welding & Cutting) Areas

4.5.8.1 Welding operations shall be carried out in designated and secured areas for this purpose.

4.5.8.2 When welding operations are in an enclosed space within a factory or building, it shall be either in an area designated for this purpose or in a separate outdoor place constructed of fire-resistant Materials and free from any flammable liquids or gases.

4.5.8.3 The Hot Work (Welding & Cutting) area shall be completely free of any flammable Materials.

4.5.8.4 The ceiling height of the welding workshops shall not be less than 3 m.

4.5.8.5 The gases and vapors of Hot Work (Welding & Cutting) operations shall be continuously expelled (withdrawn), in closed locations, using ventilation means suitable for the purpose.

4.5.8.6 Hot welding or cutting operations shall not be carried out in the following areas:

1. Areas not authorized by the site officer.
2. Areas equipped with inactive firefighting and equipment systems.3- Areas of (or near) flammable Materials, such as sulfur powder, paper rolls and cotton bundles.

4.5.8.7 All flammable Materials shall be at least 12 m away from the perimeter of the welding site. If this is not possible, flammable materials shall be covered with fire-resistant covers that are not penetrated by fragments of hot work (welding and cutting) from underneath.

4.5.8.8 Cracks, openings and fractures in the floors and walls in the vicinity of the welding site, which may be reached or penetrated by sparks, shall be blocked for a distance of 12 m.

4.5.8.9 Care shall be taken of conveyor belts, which may transport flaming fragments to other places.

4.5.8.10 When welding or cutting operations are in close proximity to flammable building elements (or Materials), they shall be completely covered with covers made of fire-resistant materials.

4.5.8.11 When the welding or cutting process is on one side (or interface), and there is a fear of heat transfer to the other side and causing fire, the other side shall be monitored throughout the process.

4.5.8.12 Welding operations shall not be carried out on any building elements coated with flammable Materials or building elements that contain, in their composition, flammable insulating Materials.

4.5.8.13 It is prohibited to carry out hot welding or cutting operations on pipes or metal objects that may transfer sufficient heat by conduction to other flammable Materials and cause them to combust.

4.5.8.14 The hot work (welding or cutting) area shall be provided with a sufficient number of suitable manual fire extinguishers.

4.5.8.15 The hot work (welding or cutting) operations area shall be provided with water hoses connected to a continuous and usable fire water source.

4.5.8.16 Personnel in the welding operations area shall be alerted to protect themselves from flying splinters.

4.5.8.17 Sufficient number of fire rated covers shall be provided to cover (insulate) flammable Materials.

4.5.8.18 The firefighters shall be informed of their pre-positioning at hot welding or cutting locations prior to commencement of operations.

4.5.8.19 Plans for hot work (welding or cutting) operations shall be communicated in advance to the firefighters.

4.5.8.20 The welding and cutting works officer shall fill out the following work permit form:

Form of Permit of (hot work) welding and cutting using gas and electricity

Date:.....
Project:.....
Department:..... Floor:.....
Work required:.....
.....
.....
Special Precautions:.....
.....

Is it necessary to have Monitors at the welding works site: ☐ Yes ☐ No
The site of the welding works has been inspected and appropriate. Necessary precautions have been taken. The plan can be implemented according to the checklist indicated on the back of the form (see the back page).
Permit expires on:.....

Welding and Cutting Works Officer:.....
Signature:.....
Work started on:..... Completed on:.....
Final inspection
The welding area and adjacent areas, including the floors and adjacent walls, were fully inspected for half an hour after the completion of the work and found to be in a safe condition.
Welding and Cutting Works Officer

Signature

(The Back)
CHECK LIST
Caution: Before allowing any Hot Work (Welding or Cutting), the safety officer shall inspect the area and make sure of the following points:

GENERAL REQUIREMENTS	
✓	Automatic sprinkler operation
✓	Validity of welding equipment
✓	The floors are completely clean of any flammable Materials at a distance of not less than 12 m from the welding point
✓	Moisten flammable floors with water or coat with wet sand, metal or any non-flammable covers
✓	Sealing cracks and openings in walls and floors
✓	Covers to collect the falling sparks below the welding points
Welding of walls and ceilings	
✓	The element is non-flammable and has no flammable cladding
✓	Keep flammable Materials away from the other side of the wall
Working near equipment (tanks, containers, receptacles and the like)	
✓	The equipment is completely free of any flammable Materials

✓	Flammable vapors were removed from inside the tanks and containers
Welding Monitor (on duty and for 30 minutes after completion of work)	
✓	Provided with suitable extinguishers with water hose
✓	Trained in extinguishers and alarms
Final inspection	
✓	There are no risks after thirty minutes from the completion of the work (in the absence of the weld Monitor)

Welding and Cutting Works Officer

Signature

4.6 Fuel Combustion Works

Introductory Definitions:

Fuel combustion device: It is an integrated system of devices and equipment assembled and designed to obtain the necessary heat to carry out the required heating process by combusting the fuel in the attached burner and the flow of combustion heat in the heating space inside the device.

Burner: It is a device for absorbing and regulating fuel and air (oxygen) according to specific speeds, excitement and concentration according to the amount of required heat energy.

4.6.1 Preamble and General Requirements.

4.6.1.1 The Requirements for this Chapter are intended to provide appropriate precautions necessary to ensure the safety of persons and property from fire and explosion hazards caused by such devices.

4.6.1.2 Areas of Application:

4.6.1.2.1 The Requirements for this Chapter shall apply to fixed or mobile devices designed in an integrated manner (including Burner) and used for commercial purposes, industrial operations, building services, such as water heating, furnaces, heating, boiling water in steam boilers, etc., in accordance with the following two criteria:

1. Devices that generate heat at rates exceeding 252000 kcal.
2. Devices with a fuel tank capacity exceeding 230 liters.

4.6.1.2.2 These requirements do not apply to internal combustion burners, nor to fuel lighting burners.

4.6.1.3 Licensing:

These devices shall be licensed within the license of the activity or the building services affiliated with it.

4.6.1.4 Installation of Fuel Combustion Devices:

4.6.1.4.1 Installation works may not be carried out before submitting their design and implementation plans to the General Directorate of Civil Defense for study, in preparation for obtaining initial approval.

4.6.1.4.2 Appropriate safety and fire protection precautions shall be provided for such activity at the installation sites of such devices, in accordance with Chapter 11.

4.6.1.4.3 Installation shall be carried out by a contractor or a technical body specialized in this field in accordance with the installation requirements contained in Clause (2.8) of this Chapter.

4.6.1.5 Operation of Fuel Combustion Devices:

4.6.1.5.1 The device may not be operated without the necessary approval of the General Directorate of Civil Defense, after inspecting it and ensuring that the necessary requirements are implemented.

4.6.1.5.2 The device shall be operated by a professional technician who is sufficiently familiar with the requirements in this chapter on the one hand and the manufacturer's requirements and instructions on the device used on the other.

4.6.1.5.3 The place shall be kept clean, especially around the device, installations and fuel tank, taking into account not to allow the accumulation of trash, waste or flammable Materials on the site.

4.6.1.5.4 When any spillage or leakage of fuel is observed, immediate measures shall be taken to rectify the situation, and the device is immediately repaired, or the specialized maintenance contractor shall be called, and contact the General Directorate of Civil Defense shall be contacted immediately in case of necessity.

4.6.1.5.5 The device operator shall be trained in the use of firefighting equipment on site and in how to properly act in emergency situations and to contact the General Directorate of Civil Defense, when necessary.

4.6.1.6 Inspection

Fuel combustion devices shall be subject to periodic inspection by a specialized body approved by the General Directorate of Civil Defense in the event that they are associated with steam boilers or with other equipment that requires inspection by the General Directorate of Civil Defense.

4.6.1.7 Maintenance of Fuel Combustion Devices:

Fuel combustion devices shall be subject to periodic maintenance by a specialized body approved by the General Directorate of Civil Defense. Maintenance work shall be adhered to according to the instructions of the manufacturer in this regard.

4.6.2 Technical Requirements for Fuel Combustion Devices

4.6.2.1 Types of Fuel Combustion Devices:

1. Liquid-fueled devices.
2. Devices powered by gaseous fuel.

4.6.2.2 Components of Fuel Combustion Devices:

1. Ventilation and smoke discharge.
2. Source of fuel supply
3. Fuel connection pipes.
4. Fuel burner.
5. Burner control equipment.

4.6.2.3 Specifications of Fuel Combustion Devices:

4.6.2.3.1 The devices shall be manufactured according to international standards approved by the General Directorate of Civil Defense.

4.6.2.4 Ventilation Requirements:

4.6.2.4.1 The location of the device shall be chosen, so that it is in line with the existing natural ventilation and does not interfere with the desired general ventilation of the place or building.

4.6.2.4.2 It is necessary of calculate the amount of air in the places where the fuel combustion devices are located, according to the area of the ventilation openings, so that its area is not less than 25 mm (2.1000BTU/hour).

4.6.2.4.3 In the event that sufficient means of natural ventilation are not available, mechanical ventilation shall be carried out, so that it is separate of any ventilation system in the building.

4.6.2.4.4 An off-site supporting air source shall be provided, if the device space is limited. It is not possible to provide sufficient amount of air to combust and burn fuel efficiently inside the burner, under the following conditions:

1. The area of the cross-section of the air inlet ducts of the burner from the outside shall be equal to the openings connected to it to the inside, provided that the dimensions of the section are not less than 80x80 mm.
2. The amount of air shall be calculated on the basis of the total area of the vents so that its area is not less than 25 mm (2.500 BEU/H).

4.6.2.5 Requirements for Combustion Product Drainage Chimney:

4.6.2.5.1 Chambers of burners of fuel igniters shall be constructed of refractory brick, steel or other suitable materials as recommended by the manufacturer.

4.6.2.5.2 All devices shall be connected to a chimney to discharge the combustion exhaust.

4.6.2.5.3 The chimney shall be constructed with durability that resists weathering and external influences. It may be constructed of refractory brick or concrete, provided that the internal surfaces are smooth to facilitate its cleaning.

4.6.2.5.4 The chimney may be constructed of steel sheets of suitable thickness and shall be tightly connected to each other. The chimney shall be fixed to the wall or tightened with strong wires so as not to sway with the wind and not be affected by other external factors.

4.6.2.5.5 The height of the chimney shall not be less than 1 m from its exit point from the highest point in the building, and not less than 1 m from the highest adjacent building within a distance of 25 m.

4.6.2.5.6 The chimney shall be constructed, so that it is sufficient to discharge the combustion products resulting from the burner according to the sizes and instructions of the manufacturer regarding the size of the burner used.

4.6.2.5.7 The chimney shall be equipped with openings for cleaning and inspection with sufficient spaces and distances (spacing) depending on the nature of the place, especially in the places of curves and chimney bends.

4.6.2.5.8 If necessary, the top of the chimney shall be equipped with a spark-insulation device and a carbon filter if requested by the competent authorities.

4.6.2.5.9 More than one burner can be connected to the same chimney provided that its size accommodates the combined burner products, with the need to adjust the intake currents from each burner.

4.6.2.6 Burner Fuel requirements:

4.6.2.6.1 The quality of the used fuel shall be in accordance with the manufacturer's instructions regarding the used burner. It is prohibited to use any liquids with flash points less than 38°C. It is prohibited to use any mixed fuel containing gasoline in its composition.

4.6.2.6.2 If heavy oils are used, appropriate measures shall be taken, (such as preheating and pre-spraying) to make these oils in a suitable form at the operating temperature inside the burner, to facilitate and accelerate their combustion.

4.6.2.7 Burner Requirements:

4.6.2.7.1 Adequate source of air at an appropriate flow rate.

4.6.2.7.2 An adequate source of fuel with an appropriate flow rate

4.6.2.7.3 A suitable means of atomizing the fuel and pushing it at an appropriate pressure (mixed with air) to the burner (or incinerator, the fuel combustion compartment in the burner).

4.6.2.7.4 Air-fuel mix combustion device or tool.

4.6.2.7.5 Controls over the work of the burner, provided that:

1. Controlling the combustion process in the burner by regulating or stopping it when the water temperature rises, when it evaporates completely, when the boiler (or water heater) vapor pressure rises, or when the water level in the device is low.
2. Controlling turning off the burner completely when the initial combustion of the fuel fails, provided that the control is from a place from which the burner can be monitored or through a control panel to avoid air and fuel mixture explosion accidents.
3. A device to control the fuel and air spray required to cause the combustion process so that the fuel valve can be closed immediately in the event of failure of the atomization process or the air intake process.
4. A device to control the closure of the fuel pipe when the temperature rises outside the combustion chamber or when a fire occurs, by means of a fusible link that works at a temperature of 65°C or at the normal temperature of the place in addition to 20–30° C.
5. Designing an automatic electrical circuit to automatically close the fuel valve in the event that the air intake fans fail to work (if any).
6. Equipping fuel-fired furnaces with a control of the temperature of the heating air, so that it does not exceed 93° C.

4.6.2.8 Installation (erection) of Fuel Combustion Devices:

2.8.1 The device shall be installed, so that it has sufficient air for the fuel burning process. Natural ventilation shall be effectively ensured around it to avoid high temperatures in the place and the collection of fuel fumes, which constitute a fire or explosion hazard.

2.8.2 Ventilation and smoke drainage openings shall be provided with a metal grille that is easy to disassemble, clean and install.

2.8.3 The chimney and ventilation system shall be inspected by a fuel combustion technician, and checked for good condition, before proceeding with any burner installation work.

2.8.4 All duct connections between the chimney and the burner shall be shortened as much as possible, especially horizontal ones, and sharp corners in the ducts, which obstruct the smooth and easy passage and drainage of the exhaust, shall be minimized as much as possible.

2.8.5 Installation and fixing of burner exhaust drainage duct connections shall be tightened.

2.8.6 It is prohibited to pass chimney duct connections through floors and ceilings.

2.8.7 It is prohibited to pass chimney duct connections through flammable walls (and material media).

2.8.8 Chimney duct connections shall be routed away from any flammable Materials.

2.8.9 The chimney connections shall be easy to disassemble, clean, switch and install.

2.8.10 The chimney shall be installed in such a way as to provide the required current for exhaust intake in accordance with the instructions and Requirements for the manufacturer. If the current is not sufficient for the exhaust intake, the chimney can be equipped with a booster for this current, in which case the booster shall be connected to an electrical circuit for the automatic closure of the fuel valve, working (closing the fuel supply valve) in the event of a shortage of exhaust intake current.

2.8.11 (Dampers) may be installed to regulate the airflow in the chimney, unless the basic design of the device warrants the absence of such a regulator.

2.8.12 A manually operated intake current regulator shall be installed in the connection to the chimney.

2.8.13 Intake current regulators of approved mechanically operated types shall be installed, so that they open outwards at all times and so that the burner does not operate until the regulator is fully open.

2.8.14 A draft regulator shall be installed on each burner if there is a connection system for several burners to a common chimney.

2.8.15 The fuel tank may be provided with a fuel heater (operated by hot water pipelines), so that the water temperature does not exceed 121° C.

2.8.16 A fuel strainer shall be installed on the fuel burner feed pipe.

2.8.17 A plate shall be installed near the location of the burner, indicating the complete instructions for operating the burner and how to act during emergencies, to ensure the safety of operation in accordance with the manufacturer's recommendations and instructions in this regard.

4.6.2.9 Firefighting Equipment:

4.6.2.9.1 The location of the fuel combustion device shall be equipped with the necessary number and appropriate types of primary firefighting equipment, such as hand extinguishers and others, in accordance with the General Directorate of Civil Defense Requirements.

4.6.2.9.2 Firefighting Equipment shall be kept in a special cabinet in a suitable place that is visible and easily accessible according to General Directorate of Civil Defense specifications and Requirements.

4.6.2.9.3 The General Directorate of Civil Defense shall have the right to request that the site be equipped with one of the automatic fire-fighting equipment, such as water sprinklers, foam, dry powders (powder), etc.

4.6.2.10 Electrical wiring:

The Electrical Installations of fuel combustion devices shall be in accordance with the Ministry of Electricity Requirements, with the need to install an automatic circuit breaker and fuses that operate when the working voltage is increased.

4.6.2.11 Fuel Pipelines and Storage:

The design and installation of the liquid or gaseous fuel tank and pipelines for burners shall be in accordance with the requirements contained in Part I of this Part.

4.6.3 Furnaces

4.6.3.1 General requirements

4.6.3.1.1 This clause is concerned with the requirements, rules and methods to be followed for the correct and proper operation of the furnaces in order to preserve the safety of life and property.

4.6.3.1.2 The necessary license shall be obtained from the General Directorate of Civil Defense for the operation and use of furnaces, whose operating temperature exceeds 370° C.

4.6.3.1.3 Before installing any new furnace, or making any modifications to an existing furnace, the drawings and technical specifications shall be submitted in an appropriate drawing scale showing all the details necessary for the site, construction, ventilation, air intake, exhaust, fuel pipelines, controls and security and safety devices.

4.6.3.1.4 Before installing or making any modifications to a furnace, a list of all equipment mentioned in the previous Clause shall be submitted accompanied by technical catalogues and certificates from an approved laboratory, in preparation for study and approval by the General Directorate of Civil Defense.

4.6.3.1.5 Furnaces subject to licensing are divided into the following classes:

1. Class (1): Furnaces operating under normal pressure and temperatures below 760°C that are expected to have an explosion or fire hazard or both as a result of the fuel used or from the Material inside the furnace (vapors arising from dyeing during drying operations of Materials dyed with flammable liquids). Class 1 includes bakery furnaces, which are heated at normal pressure to produce bread and pastries.
2. Class (2): Furnaces operating at or above normal atmospheric pressure and temperatures above 760°C.

3. Class (3): Furnaces where there is a risk of explosion due to the use of a flammable material inside the furnace to treat another Material.
4. Class (4): Furnaces operating under pressure below atmospheric pressure and at temperatures above 2760°C using one of the heating systems and a special hydraulic system to control the pressure value inside the furnace.

4.6.3.2 Requirements for Furnace Locations:

4.6.3.2.1 When choosing the location of the furnace, the effects of the resulting heat and the possibility of its coincidence with the release of fuel through the cracks and fractures of the building shall be taken into account to form a flammable atmosphere that threatens the lives of its occupants due to the possibility of explosion.

4.6.3.2.2 The location of these furnaces shall be above the ground level (ground floor) to take advantage of natural ventilation and to reduce the work of outlets to drain the potential explosion (when necessary, the General Directorate of Civil Defense has the right to demand the provision of all preventive requirements and fire and explosion protection systems when choosing another site).

4.6.3.2.3 The furnace shall be kept away whenever possible from the elements of the building structure, provided that these elements are of non-flammable Materials.

4.6.3.2.4 The location of the furnace shall be away from any stores or sources of electrical power, equipment, automatic fire sprinkler pipelines or any flammable Materials.

4.6.3.2.5 The location of the furnace shall be selected so as not to expose the foundations of the building to heat, and not to expose the building to the effects of explosions, or the inhalation of toxic materials, and not to obstruct the emergency exits.

4.6.3.2.6 The location of the furnace shall be away from the tanks of combustion liquids and from the places of spraying or mixing these liquids.

4.6.3.2.7 The location of the furnace shall be away from locations where it is exposed (or expose it) to corrosion operations.

4.6.3.2.8 When erecting furnaces, care shall be taken to leave the necessary distance from them for fire systems, such as automatic sprinklers, etc., explosion drainage outlets, and inspection openings, including space for regular installation and maintenance.

4.6.3.2.9 Roofs and floors shall be thermally insulated from around the furnace while ensuring the ongoing ventilation of these areas so that they do not exceed 71°C.

4.6.3.2.01 The location of the furnace shall be marked with the necessary indicative and warning signs and phrases.

4.6.3.2.11 The necessary ventilation shall be provided around the furnace, so that these atmospheres do not reach the limits of combustion, especially in industrial furnaces containing combustion vapors. The air intake system shall be in places where dyes are sprayed away from the furnace sites.

4.6.3.2.12 The location of liquid-fueled devices shall be separated from the elements of the building according to the following table:

Table:- F.1-T19: Minimum distance between liquid-fueled devices and building components

Device Type	Minimum distances between device and building components (cm)			
	From the roof of the Device To Ceiling	From the front and back of the device	Distance between the chimney & Roof	From both sides of the device

Hot air generating furnaces (except horizontal ones) Its temperature does not exceed 121°C and its size is no larger than 100 ft^3	5	61	46	16
Horizontal Hot Air Generation Furnaces Its temperature is not more than 121°C and its size is no larger than 100 ft^3	16	61	46	16
Steam Generating Boilers Its pressure is not more than 50 psi.	46	122	46	46
Steam Generating Boilers Its pressure is over 50 psi	122	244	92	92
Water Heaters Its size is greater than 100 ft^3	16	61	46	46

4.6.3.3 Furnace Design Requirements:

4.6.3.3.1 Furnace construction elements shall be of non-flammable Material.

4.6.3.3.2 The structure of the site (the building containing the furnace) and the load-bearing columns shall be designed to withstand the thermal stresses caused by the operation of the furnaces.

4.6.3.3.3 Furnace incineration equipment shall be of Materials that withstand mechanical stresses and shall be placed in a location that does not expose them to accidental shocks.

4.6.3.3.4 The design of the furnace shall include points for maintenance and inspection operations.

4.6.3.3.5 Monitoring equipment and furnace operating valves shall be in an accessible and observable location.

4.6.3.3.6 All Electrical Installations of the furnace shall comply with the approved technical specifications in this regard, with the need to ground all equipment.

4.6.3.4 Requirements for Explosion discharge Outlets:

4.6.3.4.1 Industrial furnaces containing flammable vapors or gases shall be equipped with outlets for Explosion discharge.

4.6.3.4.2 The size of the explosion discharge ports, in the event of an opportunity to generate flammable vapors, shall not be less than 1 ft2. (15 ft3) of furnace size.

4.6.3.4.3 The size of the Explosion discharge outlets, with no chance of generating flammable vapors, shall not be less than 1 ft2. (30 ft3) of furnace size.

4.6.3.4.4 The location of the Explosion outlets shall be arranged in such a way as to avoid any obstructions to their openings, such as overhead ceilings, pipelines, concrete bridges, walls or devices, etc.

4.6.3.4.5 Explosion discharge outlets shall be to the lowest possible hazard.

4.6.3.5 Requirements for furnace exhaust ducts:

4.6.3.5.1 Exhaust intake ducts shall:

1. Be as short as possible.
2. Not have many bends.
3. Be thermally insulated.
4. Its temperature affecting the adjacent walls shall not exceed 71°C.

4.6.3.5.2 Exhaust intake ducts shall be made of iron or other fire-retardant Materials and shall have the required rigidity to withstand the expected thermal and mechanical stresses.

4.6.3.5.3 The thickness of the iron used for the exhaust intake ducts shall not be less than 16 mm.

4.6.3.5.4 Exhaust discharge ducts shall be free of any openings except those used for maintenance.
4.6.3.5.5 Exhaust discharge ducts shall be reinforced by metal supports and belts.
4.6.3.5.6 Exhaust intake ducts shall not penetrate walls that function as partition walls between fire zones.
4.6.3.5.7 Exhaust intake and discharge ducts shall be provided with openings having doors for cleaning purposes for the carbon deposits within them.
4.6.3.5.8 All exposed atmospheres, such as intake fans and exhaust drainage channels, shall be insulated to a height of 2 m from the floor of the building in order to avoid their impact on the persons present, and their temperature shall not exceed 71°C.
4.6.3.5.9 Exhaust duct waste and products shall not be discharged near doors, windows or other air intakes to avoid the possibility of flammable and toxic vapors entering the building.
4.6.3.5.10 Attached and additional equipment for the furnace, such as drawers, rails, belts, racks and receptacles, shall be of non-flammable Materials.

4.6.3.6 Furnace Heating System Requirements:

The thermal source, includes pipelines, connections, and intake fans, and the heating is either direct or indirect by combusting the fuel inside or outside the furnace. Heat is transferred through the furnace either by convection, conduction, or radiation, or by all of them.

4.6.3.6.1 Furnaces may be powered by LPG or natural gas, at which point the type of burner shall suit the type and pressure of gas used and the required operating temperature.
4.6.3.6.2 The gas installations and cylinders used shall be subject to the requirements in Part I of this section.
4.6.3.6.3 The design of the furnace heating system shall include valves for gas shut-off in emergency situations and the location of the valves shall be selected for easy access and shall be away from hazardous areas in the event of a fire.
4.6.3.6.4 The design of the furnace heating system shall include valves to close the gas manually and separately for each burner, with periodic maintenance, and shall always ensure that the gas valve closing handles are installed on the valves or located next to them.
4.6.3.6.5 The gas installations and valves attached thereto shall be subject to the approved international standard. The size of such installations and valves shall be commensurate with the pressures caused at the maximum expected rate of gas flow.
4.6.3.6.6 The combustion source, the burner that combusts the gas, air mixture inside the furnace, shall remain constant under all operating conditions and regardless of the furnace design.
4.6.3.6.7 Fuel and air may be mixed inside the pipes, so that the funnels are fed (atomizer, sprayer or fuel jet), in which case the fuel and air mixture inside the pipes shall be within the limits of combustion. The pipes shall be designed so that there is homogeneity by distributing the mixture between the funnels to avoid loss of pressure in one of them.
4.6.3.6.8 The total lengths of fuel pipelines shall be as short as possible.
4.6.3.6.9 There shall be specially designed valves that control the flow rate of the gas-air mixture, or gas only. These valves shall be connected by pipelines that close the gas valve in the event of deviation from the flow rate - whether by increase or decrease.
4.6.3.6.10 It is prohibited to use gas intake fans if the percentage of hydrogen in the gas is more than 10%.
4.6.3.6.11 The amount (percentage) of air required shall be calculated, so that it is sufficient for the combustion process.
4.6.3.6.12 Air inlets shall be provided with filters to avoid the entry of dust and solid plankton.
4.6.3.6.13 The combustion device shall be designed to include fuel cut-off controls in the event of any malfunction in the necessary air supply.
4.6.3.6.14 The concentration of gas in the mixture (with air) inside the combustion chamber in the furnace or burner shall not be less than the minimum combustion limit.

4.6.3.6.15 The furnace may be combusted by an electric arc or hot wire or by an internal or external burner provided that the combustion source is sufficient to combust the combustion mixture.

4.6.3.6.16 Requirements for liquid fuel furnaces shall be subject to the requirements for liquid and gaseous fuel combustion devices.

4.6.3.7 Training of employees

New employees shall be trained and ensure that they understand the instructions necessary for the operation and maintenance of fuel combustion devices and furnaces. In practical training, they shall also be provided - with the necessary knowledge and skills on the devices to be operated. They shall be retrained periodically according to a targeted training program to achieve the highest level of professional competence necessary for them. The training shall cover fuel pipelines, electrical pipelines, lighting, device shutdowns and combustions, emergency switches, combustion of fuel-air mixtures, causes and hazards of explosions, combustion sources, combustion temperatures, importance of the controller and safety valves.

4.7 Fuel Combustion Works

Introductory Definitions:

Dust: Particles of solids that are light to the extent that they float in the air but settle by gravity, often on horizontal surfaces, unless they are affected by air currents or other disturbances. Solid dusts are generated by industrial and operational processes, such as crushing, cutting, grinding, the impact of rapid collision forces, explosives, and work with organic or inorganic Materials, such as stones, metals, coal, wood, and grains (crushing, cutting, carving, etc.).

Dust Explosion: It is a very rapid combustion, up to the point and effect of explosion, of dust particles suspended in the air in a closed (confined) space, as a result of their presence in a suitable size and a specific percentage with a suitable combustion source within the closed space. Coal dust explosions are a frequent hazard in coal mines.

Sources of Explosive Dust: Many materials, usually known to oxidize, can generate a dust explosion such as magnesium dextrin, coal, and sawdust. However, many other materials familiar to our world can also lead to the formation of dangerous dust clouds such as grains, flour, milk, powdered sugar and pollen. Many metal powders (such as aluminum and titanium) can also form explosive dusts.

4.7.1 Preamble and General Requirements.

4.7.1.1 The dangers of dust explosions usually appear in starch mills, flour, sugar, dry milk, pesticides, fertilizers, wood miners, paper mills, plastics, industrial resins, rubber, coal, leather, sulfur, metals and similar places.

4.7.1.2 This chapter is concerned with industries that pose a potential threat of dust explosions, especially those that may not be subject to precautionary requirements in this regard, such as sugar and flour packing plants and grain mills.

4.7.1.3 This chapter provides the necessary information for specialists working in explosive dust, producing industries, including the factors contributing to the emergence of these dusts and the occurrence of their explosions in order to reduce them and the loss resulting from them.

4.7.1.4 This chapter does not include the detailed preventive requirements for each type of explosive dust, generating industry. Each industry is designed, operated and maintained according to the general requirements and engineering principles for each type of dust, practical experience, and laboratory experiments.

4.7.2 Requirements for Blast Dust Generating Industries Buildings

4.7.2.1 Construction Elements and Specifications:

4.7.2.1.1 Construction elements shall be of non-flammable or fire-resistant Materials.

4.7.2.1.2 Exterior and interior walls, ceilings and floors shall be designed in accordance with the Requirements of Chapter 1.

4.7.2.1.3 The internal walls, especially the fire-resistant ones that separate the fire areas, shall have a fire resistance of not less than 3 hours. The doors of these areas shall be fire-resistant for a period of not less than 2 hours and shall be automatically closed.

4.7.2.1.4 Doors leading to building stairs and internal elevators shall be fire resistant for a minimum of two hours and shall be automatically closed.

4.7.2.1.5 Floor and wall surfaces shall be smooth and free from cracks and cavities.

4.7.2.1.6 Internal Flammable finishes shall be treated with flame-resistant Materials that are approved for buildings of explosive dust- generating activities.

4.7.2.1.7 Horizontal surfaces and corridors that cannot be cleaned to avoid dust collection shall be minimized whenever possible, and if possible these surfaces shall be designed at a slope angle of 60 degrees, this shall be done.

4.7.2.2 Building Ventilation Requirements:

4.7.2.2.1 These buildings shall be designed, so that the potential explosion pressure is discharged through the practical openings of the building, such as windows and other ventilation outlets, in order to reduce the impact of the explosion on the building's resilience and to protect lives. The total areas of the explosion discharge outlets depend on the expected maximum pressure on the building and its rate of intensification (acceleration of its height).

4.7.2.2.2 Dust shall be flushed out of the building by mechanical spark- insulating towing fans, or other equipment for the same purpose, provided that they do not cause scattering, and shall be transported to specially prepared containers (outside the building) or collected in rooms isolated from the rest of the building to dispose of their contents in a safe place.

4.7.2.3 Electrical Installation Requirements:

4.7.2.3.1 All electrical fixtures, installations and lighting shall be of spark insulation type and shall not radiate heat according to specifications and standards approved for the purpose.

4.7.2.3.2 All equipment shall be earthed in place.

4.7.3 Equipment Requirements

4.7.3.1 Mills shall be installed at ground level and shall be isolated from warehouses and other manufacturing areas.

4.7.3.2 Each mill shall be equipped with equipment to separate unwanted impurities that constitute an combustion source.

4.7.3.3 Mechanical equipment shall be designed from metal, shall be sealed (dustproof), have explosion discharge ports and be designed to withstand maximum possible pressure.

4.7.3.4 The parts and component parts of the equipment shall be of a non-sparking type.

4.7.3.5 Storage silos shall be made of non-flammable Materials. They shall have sealed covers against dust and water release. They shall be free of any openings that allow air to enter into them.

4.7.3.6 Belts and conveyor equipment shall be of non-flammable Material and shall have covers, especially at their ends. It shall also be equipped with an automatic electrical breaker that operates when the electrical load is increased.

4.7.4 Special Requirements

4.7.4.1 The use of open flames and smoking is prohibited except in the authorized areas. It is also prohibited to carry out any welding or cutting operations for the purpose of installation or maintenance unless the area is completely free of dust.

4.7.4.2 It is prohibited to use internal combustion equipment, except as authorized for use and not to interfere with activity in those areas.

4.7.4.3 It is important to avoid the occurrence of the phenomenon of self-heating in order to avoid reaching the point of combustion.

4.7.4.4 It is prohibited to store any flammable solids in these explosive dust generating areas.

4.7.4.5 These places shall be provided with appropriate manual fire extinguishers in accordance with the General Directorate of Civil Defense Requirements.

4.7.4.6 All areas containing flammable materials shall be equipped with automatic water sprinklers. Milling areas shall not be equipped with such sprinklers.

4.7.4.7 Reducing the occurrence of the explosion can be controlled by pumping a gas that is not conducive to combustion at the site. This comes either with the use of carbon dioxide or nitrogen (etc.) in order to reduce the proportion of oxygen to the extent that does not allow an explosion to occur.

4.7.4.8 Employees shall be trained in safety and security rules regarding dust explosions. They shall be familiar with the principles of storage and the use of hand extinguishers and rubber hoses.

4.7.4.9 All extinguishers and Firefighting Equipment shall be periodically maintained and ensured of their safety.

4.7.4.10 It shall be fully ensured that there are no obstructions in front of the emergency exits.

4.8 Flammable Fibers

Introductory Definitions:

Textile Fabric: Flat structure of yarns or fibers.
Textile fabric: A woven material of natural (animal or plant) or synthetic fibers or yarns mainly used for the manufacture of clothing, upholstery, carpets, curtains, furniture, furniture supplies, upholstery, wall cladding, etc.

4.8.1 Preamble and General Requirements.

Textiles are a large and important part of our daily uses and needs such as clothing, seats, curtains, carpets and furnishings. Most of these Materials are flammable and pose a danger to lives and property in cases of fire. The mortality rate depends on the chemical composition of the fibers that make up these textiles, their final shape and weight, whether they are treated against fire or not. The fibers used are either animal (such as natural leather), vegetable (such as cotton) or artificial fibers (such as rayon, nylon and trillin).

The composition of animal fibers contains molecules of protein with a high content of nitrogen, carbon, hydrogen and sulfur. These fibers combust as hard as wool, and their combustion produces very toxic hydrogen cyanide gas.

Plant Fibers consist mainly of cellulose and include cotton, jute, hemp, linen and kabuk fibers. These fibers are characterized by the presence of a large air gap inside them that has the ability to absorb oxygen, which makes them easy to burn and produce large quantities of thick smoke, carbon dioxide and carbon monoxide. They also have the ability to absorb large quantities of water, which increases their size and weight.

4.8.1.1 This chapter deals with equipment and processes for the handling, storage, use and operation of flammable fibers.

4.8.2 Requirements for Flammable Fiber Locations

4.8.2.1 A license shall be obtained for sites containing flammable fibers and their activities from the General Directorate of Civil Defense if the quantity of stock exceeds 8 m3.

4.8.2.2 If the fibre store is within the building, it shall be isolated (from the rest of the activities) in one of the appropriate corners of the building.

4.8.3 Flammable Fibre Building Requirements

4.8.3.1 Construction Elements and Specifications:

4.8.3.1.1 The walls, partitions and ceilings of the building shall be of fire- resistant Material for a minimum of one hour.

4.8.3.1.2 All doors of the building shall be fire resistant for a minimum of one hour and shall be automatically closed.

4.8.3.2 Building Ventilation:

4.8.3.2.1 Natural ventilation shall be provided to refresh the air in the building at least 6 times per hour. In the event that natural ventilation is not possible or natural ventilation is insufficient at the above required rate, Separate mechanical ventilation shall be installed to refresh the air in the building at least 6 times per hour, provided that this mechanical ventilation works continuously and is of spark insulation type and that this ventilation is linked to the alarm system of the building (the main alarm panel of the building).

4.8.3.3 Electrical Wiring of the Building:

4.8.3.3.1 All wiring, equipment and switches shall be in accordance with the **Ministry of Electricity Requirements.**

4.8.3.3.2 All light bulbs shall be of the type that does not radiate heat and shall be equipped with protective covers and grilles and shall be installed in the ceiling or in the upper areas on the walls.

4.8.4 Flammable Fiber Storage Requirements

4.8.4.1 Flammable fibers shall be stored in a separate building if the storage quantity exceeds 125 m3. In all cases, the storage quantity shall not exceed 1000 m3 per mina.

4.8.4.2 The width of the storage rows shall not exceed 2 m.

4.8.4.3 The distance between the walls and the storage rows shall not be less than 1 m.

4.8.4.4 The distance between the storage rows shall not be less than 1 m.

4.8.4.5 The storage height shall not exceed 2.5 m.

4.8.4.6 As the fibres of Sisal, Hemp (of Jute) and other plants may naturally stretch when exposed to moisture, the fibres of these plants shall be stored in such a way as to allow them to stretch, so that they do not reach and do not come into contact with the walls, ceilings or columns of the building.

4.8.4.7 The warehouse shall be protected by a rubber hose network connected to a continuous water supply and suitable manual fire extinguishers.

4.8.4.8 The warehouse shall be protected by an automatic water sprinkler network if the warehouse is in the basement or if the storage quantity exceeds 64 m3.

4.8.4.9 Smoking is prohibited in all areas of storage and handling of flammable fibers. Warning signs shall be placed in this regard in large and clear letters and in visible places.

4.9 Commercial Cooking Equipment

Introductory Definitions:

Chimney Funnel (Discharge): A hat-like device mounted on cooking devices to collect and direct grease-laden vapors, exhaust gases, and excess heat to the outside with forced ventilation through smoke discharge channels.
Duct: A hollow pipe, duct, or column used to pass or discharge a liquid, gas, heat, air, or smoke etc.

4.9.1 Preamble and General Requirements.

This chapter applies to the forms and types of commercial cooking equipment - of various kinds, designed for use in restaurant kitchens, food processing companies, hotels and daily quantitative meal supply establishments.
Cooking equipment includes gas furnaces, kettles, grills, fryers, and flat cookers (and other high-temperature cooking equipment) that produce flammable grease and fat deposits, which necessarily require their permanent and periodic removal due to the high fire hazard they pose.
This equipment requires special care when installation and maintenance those to avoid overheating it may cause on adjacent flammable Materials, such as wood, paper and plastic building and decorative Materials.
Accordingly, concerned restaurant owners, companies and institutions shall maintain the cleanliness of cooking sites and ensure that they are completely free of deposits of flammable grease and fats, and take all necessary preventive arrangements, measures and precautions in these places, so that they are safe at all times from fire and explosion accidents. It shall also be subject to a license from the General Directorate of Civil Defense in accordance with the rules contained in this regard.

4.9.2 Requirements for the Design and Installation of Commercial Cooking Equipment

4.9.2.1 In the design and implementation of the installations of this equipment, appropriate fire protection precautions shall be taken, especially with regard to the ventilation necessary to discharge gases. Permanent periodic maintenance shall be carried out to remove grease from them and keep them away from any flammable Materials, while adhering to the requirements contained in Chapter (4.2.6).

4.9.2.2 The complete drawings and designs of this equipment shall be submitted to the General Directorate of Civil Defense in preparation for its study and approval before proceeding with its installation.

4.9.2.3 This equipment shall be installed by a specialized technical staff trained in the installation of commercial cooking equipment.

4.9.2.4 A space of at least ½ m shall be left between the cooking equipment (or vapour discharge cones and the resulting heat) and any adjacent flammable Materials. This distance can be reduced within the Requirements for General Directorate of Civil Defense, such as the protection of equipment (by separating them) by means of reflective or heat- insulating panels.

4.9.3 Requirements for the Intake and Discharge Channels of Cooking Fumes

4.9.3.1 Vapor and heat drainage channels shall be designed to minimize the accumulation of grease, provided that the air velocity within any of these channels shall not be less than 152 (m/min).

4.9.3.2 The discharge ducts and their supports shall be made of carbon steel with a thickness of not less than 1.5 mm or any other Material that is of the same strength and equivalence and that is resistant to fire and rust.

4.9.3.3 The connections between the parts of the discharge ducts shall be secured to prevent release, and shall be welded from the outside.

4.9.3.4 Drainage duct installations shall be carried out through fire rated walls or joints, if required.

4.9.3.5 It is prohibited to connect the cooking fume discharge ducts to any intake or discharge systems or ducts connected to other equipment.

4.9.3.6 Ducts shall be routed out of the building and without bends.

4.9.3.7 Discharge ducts shall be provided with openings (with doors) for detection, inspection, maintenance and cleaning purposes.

4.9.3.8 Exterior wall surfaces of drainage channels shall be protected (painted) with weatherproof Materials or (as an option) fabricated from stainless steel.

4.9.3.9 It is prohibited to install any internal breakers in the drainage channels unless they are required within the design of General Directorate of Civil Defense systems and requirements.

4.9.3.10 The end of the intake ducts shall be facing upwards away from the floor of the roof of the building with a height of not less than 1 m and shall be at least 3 m away from adjacent buildings.

4.9.3.11 Intake fans shall be selected according to their ability to retrieve the required amount of vapors, taking into account the amount of pressure drop (loss) as a result of friction.

4.9.3.12 The manual control switch of the intake fan shall be adjacent to the drain funnel. It is preferable to have a disconnect switch connected to a thermal fuse (with a fusion link) that is installed inside the drain funnel, so that it melts (disconnects electricity) at 232°C.

4.9.3.13 The air intake system shall be switched on and kept running continuously throughout the working life of the cooking equipment.

4.9.4 Cooking Grease Isolation and Removal Filters Requirements

4.9.4.1 All kitchen fume drainage systems shall be equipped with grease-insulating filters, such as filters with charcoal or filters made for their purpose.

4.9.4.2 The filtration tool shall be firmly installed inside the drainage system and shall be as far as possible from the cooking device and at a distance of not less than 1.5m away from gases and open flames. Its horizontal inclination angle shall not exceed 45 degrees.

4.9.4.3 The filter shall have a container for collecting liquid grease accumulations in it - and shall be connected to it, provided that its capacity shall not exceed 5 liters.

4.9.4.4 Cooking equipment (designed with a filter system) shall not be operated without the filtration device of such equipment.

4.9.5 Electrical Requirements for Cooking Equipment

4.9.5.1 All electrical equipment and works that may be exposed to cooking fumes, grease and heat shall be equipped and installed in accordance with the technical principles approved in this field and in accordance with the **Ministry of Electricity Requirements**.

4.9.5.2 It is prohibited to install any electrical devices inside the drainage channels unless they are originally designed and tested for the purpose of drainage. Otherwise, they shall be placed away from the path of the vapors (outside the discharge passage) and within a lighted panel completely isolated from the vapors.

4.9.6 Maintenance Requirements

4.9.6.1 Cooking equipment shall be fitted with suitable safety devices, degreased periodically, or at regular intervals, as stated in the following:

4.9.6.1.1 First: Large restaurants and huge cooking equipment:

1. Filters shall be cleaned and degreased daily.
2. Stack cones shall be cleaned and degreased twice a week.
3. The intake and discharge channels shall be cleaned and degreased once every three months.

4.9.6.1.2 Second: Restaurants - Kitchen Equipment - Small:

1. Filters shall be cleaned and degreased twice a week.
2. Stack cones shall be cleaned and degreased once every two weeks.
3. Intake and discharge channels shall be cleaned and degreased once every six months.

4.9.6.1.3 Third: All cooking equipment and its surroundings shall be cleaned (and degreased) daily.

4.9.6.2 The equipment mentioned in the previous clause (6.1) shall be cleaned using a chemical compound consisting of calcium hydroxide with a ratio of (⅓) and calcium carbonate with a ratio of (⅔) or the like, as these compounds dissolve grease (soapy), which facilitates their removal from the equipment and their cleanness from the intake and discharge channels.

4.9.6.3 It shall be taken into account to ensure that there is sufficient and effective continuous ventilation during the cleaning process.

4.9.6.4 The intake and discharge channels shall be sprayed with lime water after completing the grease cleaning process.

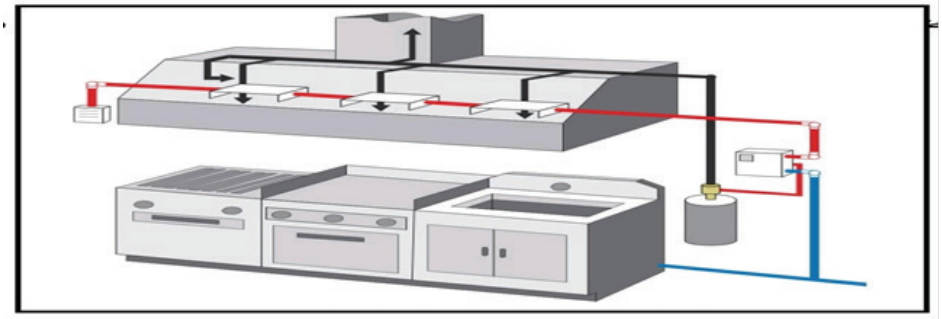
4.9.6.5 It is prohibited to use flammable solvents for degreasing in kitchens or cooking equipment.

4.9.6.6 It is prohibited to initiate cleaning operations before ensuring that the disconnection of electrical switches and detectors is completed and that the cylinders of extinguishing Materials and systems, if any, are closed so that they are restarted after the cleaning process, to ensure that the extinguishing systems are not accidentally activated during the cleaning process.

4.9.6.7 It is strictly prohibited to combust the grease of the intake and drainage channels for the purpose of disposal, even if (in terms of design), they withstand such work.

4.9.7 Fire Protection Requirements for Cooking Equipment

4.9.7.1 Cooking equipment (oil fryers) shall be protected by automatic fire extinguishing systems containing wet chemical agents longer than 120 cm or any other systems approved by the General Directorate of Civil Defense.



4.9.7.2 Fixed Firefighting Equipment shall be installed at permeable and effective locations to eject fire extinguishers directly onto the fire. The quality of Firefighting Equipment shall be determined in accordance with the General Directorate of Civil Defense Requirements.

4.9.7.3 Fixed Firefighting Equipment shall be connected to all extinguishing systems located around the cooking equipment, so that they are all operated at the same time.

4.9.7.4 Fusible Links (to operate Firefighting Equipment) and fire sprinkler heads shall be changed at least annually in order to ensure their proper and correct operation at fire.

4.9.7.5 Firefighting Equipment shall be connected (via its control panel) to systems that fuel cooking equipment, to ensure automatic shutdown of all fuel sources and combustion of all equipment in case of fire.

4.9.7.6 The guiding signs for the operation of extinguishing systems shall be in a conspicuous and visible place.

4.9.7.7 Fire extinguishing systems shall be inspected and maintained periodically by an entity approved for this purpose by the General Directorate of Civil Defense.

4.9.7.8 An inspection certificate shall be obtained by the authorized body for inspection of fire extinguishing systems, which shall be requested upon field inspection of General Directorate of Civil Defense.

4.10 Fire Prevention and Safety In Laboratories

Introductory Definitions:

Chemical Fumes Hood: an Enclosure (semi-enclosed box) with a transparent glass front, on top of a laboratory table (or work bench), designed to draw air into it by Separate mechanical ventilation to continuously draw air (from the cabinet) and drain it directly out, as specified in Figure (2-10-1).

Incompatible Materials: Incompatible Materials are Materials that pose a risk of hazardous reactions with other Materials present with them at the same storage site, especially in conditions of possible exposure to proximity, convergence, or accidental or intentional mixing resulting in hazardous reactions that may lead to combustion, explosion, generate toxic gases, or produce other hazardous Materials. The Appendix to this Part contains common incompatible Materials.

BS 476 and American ASTM E84 (Class A 0-25): The British Standard (of Tests BS 476 (Part 6 & 7)) provides evidence showing that the fire performance of the tested product is a Class 0 performance (i.e. the penetration and surface spread of flame into the product = 0) while the American Standard (from STM E84 test) provides evidence showing that the fire performance of the tested product is a Class A performance.

4.10.1 Preamble and General Requirements.

4.10.1.1 This chapter addresses the risks of common accidents in laboratories using chemicals, flammable liquids, compressed gases, corrosive Materials and other hazardous Materials that require certain preventive precautions due to the special danger they pose to workers and property, as well as the risks that may result from some equipment used in these laboratories.

4.10.1.2 When determining the protective Requirements for the laboratory, the Requirements for the structural elements and the laboratories design (such as considerations related to the purpose of the laboratory, the nature of its work and its operational specificity) shall be taken into account. Further, the Requirements for the equipment for fire extinguishing and the protective Requirements for the laboratory.

4.10.1.3 Laboratory equipment and apparatus shall be of approved types and intended for the purpose of each use.

4.10.1.4 Chemicals handled in the laboratory shall be taken into account in terms of the way they are used, stored, handled and disposed of, such as flammable liquids, compressed gases, the presence of experimental animals and radioactive Materials.

4.10. 1.5 Employees shall be fully familiar with the concepts and basics of operating laboratories, including following occupational safety procedures during work to reduce losses and injuries that may result from fire, explosion, release of hazardous chemicals, etc.

4.10.1.6 This chapter does not apply to laboratories that do not use hazardous chemicals or flammables (such as physics laboratories or electronics laboratories and the like), which may use small quantities of some hazardous Materials, for example, for cleaning purposes.

4.10.2 Laboratory Sites Requirements

4.10.2.1 The laboratory site shall be separated from other laboratories - or other parts of the building and adjacent - by fire- resistant walls for a minimum of two hours.

4.10.2.2 It is prohibited to establish laboratories in catacombs.

4.10.3 Labs' Requirements

The design and construction of laboratories varies according to the type and purpose of the laboratory and depending on the nature of the existing hazard (fire, explosion or otherwise), which is mainly related to the quality of the Materials handled in it.

4.10.3.1 The establishment of laboratories depends on two basic considerations:

1. The type and quantity of hazardous Materials present and/or circulating in the laboratory.
2. The area and location of the laboratory relative to adjacent buildings (or parts).

4.10.3.2 Construction Elements and Specifications:

4.10.3.2.1 All construction elements and components of the laboratory building shall be of non-flammable Materials.

4.10.3.2.2 The internal finishes of the surfaces of the walls and ceilings of the laboratory and the corridors leading to the laboratory shall be flame resistant in accordance with BS 476 or American Standard ASTM E84 (Class A 0- 25).

4.10.3.2.3 The Requirements for the escape routes in the laboratories shall be subject to the Building System in accordance with the General Directorate of Civil Defense Requirements mentioned in Chapter 1.

4.10.3.2.4 The number of laboratory exits shall not be less than two - provided that they lead directly out of the building or to passable escape corridors to the outside, if:

1. The laboratory area is more than 100 m2.
2. The area of the laboratory is more than 50 m2 and contains large quantities of flammable liquids, or the laboratory contains a chemical vapor cover next to the main entrance or contains compressed gas cylinders.

4.10.3.2.5 Doors shall be opened in the direction of escape and directly outside.

4.10.3.2.6 Emergency exits shall be signposted.

4.10.3.2.7 Room construction elements designed for storage, whether separate or in a separate space within the laboratory, shall be fire-resistant for a minimum of two hours with adequate ventilation.

4.10.3.3 Laboratory Ventilation:

4.10.3.3.1 Separate mechanical ventilation shall be installed to refresh the laboratory air at least 4 times per hour, taking into account when designing it to provide an internal pressure for the laboratory that is always negative in proportion to the adjacent side corridors and external areas to ensure that the vapors issued by the laboratory do not reach it and that this mechanical ventilation works continuously and is of spark insulation type and that this

ventilation is linked to the alarm system of the building (the main alarm panel of the building).

4.10.3.3.2 The location of the intake and discharge air systems shall be away from the air inlets to the laboratory and shall be sufficiently separated and elevated.

4.10.3.3.3 Air conditioning duct systems (heating and cooling) in laboratories may not be allowed nor adapted to withdraw and discharge vapors or gases rising in the laboratory.

4.10.3.3.4 Air withdrawn from laboratories (especially if loaded with germs or radioactive Materials) shall be passed through highly efficient and dedicated filters in order to trap harmful materials before they are discharged into the outside air.

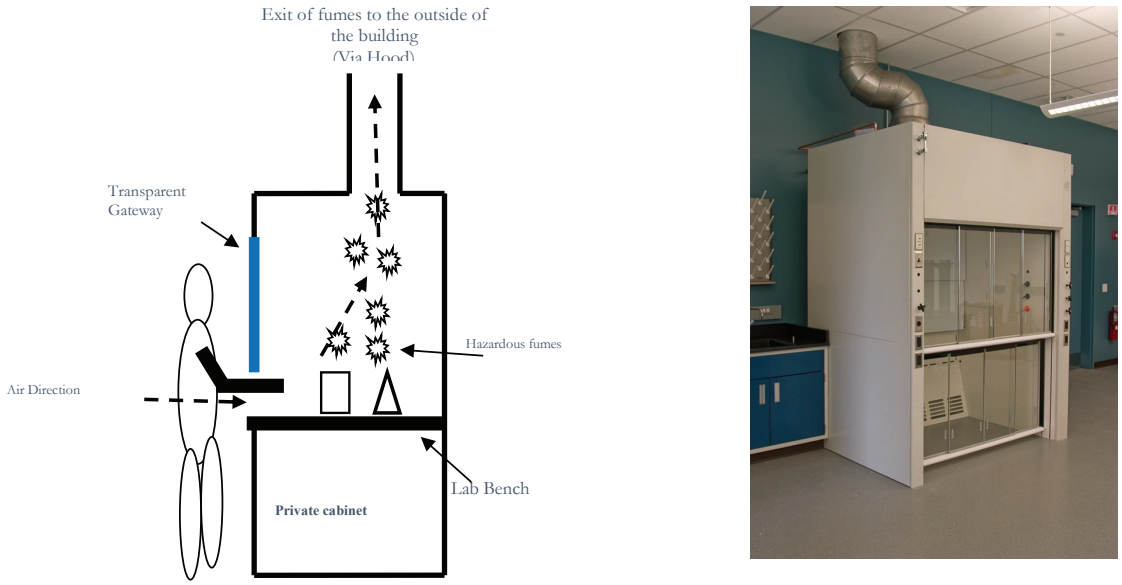


Figure:- F.1-F17: Chemical Fumes Hood

Figure:- F.1-F17: Chemical Fumes Hood

4.10.3.3.5 Chemical Fumes Hood:

The laboratory shall be equipped with a Chemical Fumes Hood (Figure 2- 10- 1) and flue ducts to eliminate hazardous gases, dust and vapors by permanently discharging them to reduce their concentration in the laboratory and work atmosphere.

3.10.3.3.6 The fume hood shall have a means of indicating the air flow rate.

3.10.3.3.7 In the event that there is more than one fume hood, their systems shall be designed and installed so that each of them is Separate of the rest, and the closure of one of them does not affect the rest of the system.

3.10.3.3.8 The fume hood shall be designed so that the air drawn back into the laboratory during operation is not allowed to return.

3.10.3.3.9 The fume hood shall be provided with an external sealing device and in a *prominent and* easily accessible place.

3.10.3.3.10 If per chloric acid is heated above room temperature, a separate, purpose-built per chloric acid vapor cap (special for per chloric acid operations) shall be used.

4.10.4 Safety Requirements for Laboratory Equipment

4.10.4.1 All equipment in the laboratory, including fixed and mobile as well as equipment for laboratory building services - shall be certified and intended for the intended purpose.

4.10.4.2 All laboratory personnel, as well as General Directorate of Civil Defense personnel, shall be informed of all types of equipment inside the laboratory, its use purposes and locations - including equipment for building services, so that it can be easily handled in emergency situations.

4.10.4.3 Electrical Installations shall be equipped in accordance with the specifications of the **Ministry of Electricity** taking into account the possible increase of loads and providing a sufficient number of suitable fuses.

4.10.4.4 All laboratory equipment shall be earthed to avoid faults and possible contact in electrical circuits. The earthing system shall be checked periodically by specialists, including the condition of cables or wires, stud nuts, etc.

4.10.4.5 An additional source of electricity shall be provided to operate the intake fans.

4.10.4.6 Locations of devices and equipment within the laboratory shall be selected, so that the place is safe and free of obstructions.

4.10.4.7 All equipment and Materials shall be returned to their designated places after use.

4.10.5 Occupational Prevention and Safety Requirements in Laboratories

4.10.5.1 The responsibility of the laboratory is entrusted to a chemist with considerable experience who is responsible for guiding the workers about the surrounding hazards within the laboratory.

4.10.5.2 It is prohibited for individuals to start work without permission and the presence of a laboratory official.

4.10.5.3 An individual in each working group, shall be identified in the laboratory to ensure the safety of the equipment before its departure, as well as to ensure that the gas valves are closed and that the electricity is disconnected from the laboratory equipment.

4.10.5.4 The laboratory shall be provided with extinguishing equipment according to its specific gravity, provided that it shall not be less than one manual fire extinguisher that is appropriate in terms of size and quality in addition to a manual alarm device.

4.10.5.5 Dedicated fire extinguishing blankets shall be provided in good condition in an accessible place close to the workbenches with clear instructions on how to use them.

4.10.5.6 Employees shall be instructed on how to use hand extinguishers and how to trigger (operate) alarms and close the main valves of gases used in the laboratory.

4.10.5.7 All escape routes in the laboratory shall be free of any obstructions (tables, equipment, fixtures, etc.).

4.10.5.8 Employees shall be trained on emergency evacuation plans, with the need for periodic evaluation of those plans to reduce application errors that may appear in them.

4.10.5.9 Laboratories may be provided with automatic water sprinklers, including attached warehouses, taking into account the possibility of the presence of chemicals that may interact with water, which may lead to adverse results. In these cases, these laboratories can be equipped with other appropriate fire protection systems.

4.10.5.10 The laboratory shall be provided with alarms that are clearly audible, connected to the main alarm panel and also connected to an automatic system to stop the work of the air conditioning in emergency situations.

4.10.5.11 Laboratories with more than two attached warehouses shall be provided with 1.5 "rubber hoses with a fire nozzle connected to a continuous water source.

4.10.5.12 Detection and periodic maintenance shall be carried out on firefighting equipment or alarms in the laboratory.

4.10.5.13 Laboratories shall be provided with manual fire extinguishers of the types suitable for class (A, B, C) fires.

4.10.5.14 In the case of flammable metals, or Metal Hydrides, within the Materials handled in the laboratory, hand extinguishers of the types suitable for Class D fires shall be recommended, as the type of extinguishing Material shall be determined according to the type of metal.

4.10.5.15 Hand extinguishers shall always be maintained in good condition and ensure that they function properly when needed, and shall be placed in an easily accessible and unobstructed place.

4.10.5.16 Warning signs shall be placed on the entrances to the laboratory and storage areas. Signboards shall be placed indicating the nature of the danger in the laboratory to determine the danger of the handled Materials.

4.10.5.17 At least one bucket containing dry and clean sand shall be provided for use in the suppression of chemical fires or as a means of absorbing leaks of hazardous Materials (by dispersing them and then reassembling and disposing of them in a safe manner by specialists), with the obligation to replace unused sand at least every three months to ensure its dryness and cleanliness.

4.10.5.18 Warning signs shall be placed on containers containing hazardous Materials (handled in the laboratory) to indicate the contents of these containers, with the need to repair and replace the damaged signs.

4.10.5.19 Unmarked containers indicating the quality of the Material or content shall be disposed of under the supervision and guidance of the laboratory official.

4.10.5.20 Baskets for transporting small containers and carts for transporting large containers circulating in the laboratory shall be provided.

4.10.5.21 Floors shall be kept clean of oil, grease, water and other Materials that may lead to slip accidents.

4.10.5.22 Material coolers (refrigerators) used in laboratories shall be of a sealed type, so as not to allow the release of liquid vapors from them. Preferably their Electrical Installations shall be of the spark insulation type.

4.10.5.23 The amount of organic peroxides in laboratories shall not exceed the amounts necessary for the completion of experiments.

4.10.5.24 Storage receptacles for flammable liquids and corrosive Materials shall be approved and designated for the purpose.

4.10.5.25 It is prohibited to keep more than the prescribed limit of hazardous Materials, for daily use in the laboratory with the surplus kept in special tanks for the purpose or placed in the Safety Cabinet to contain their vapors and potential spills.

4.10.5.26 Laboratory personnel shall be fully aware of the properties of the Materials they deal with and their hazardous properties in particular. The Material Safety Data Sheet (MSDS) for each Material - shall be provided and stored in a safe and easily accessible location.

4.10.5.27 Small containers shall be packed in a special room, containing mechanical ventilation suitable for air regeneration, or under the fume hood.

4.10.5.28 It is prohibited to carry out any work in the laboratory that produces harmful gases or vapors except inside the vapor cover space.

4.10.5.29 Spilled Materials shall be cleaned and removed immediately so that the acids are first diluted with water or neutralized with alkalis before being drained. The spilled oil shall be covered with a layer of absorbent Materials designated for this and then disposed of safely and according to the followed rules.

4.10.5.30 Contaminated Materials in oils, liquids, etc., such as fabrics, paper and other Materials used for cleaning shall be kept in closed containers designated for the purpose, so that they are safely discharged at the end of the day.

4.10.5.31 Incompatible Materials shall be separated to avoid accidental contact with each other.

4.10.5.32 All chemicals shall be disposed of in laboratories in a safe manner in accordance with the manufacturer's instructions and recommendations.

4.10.5.33 Hazardous waste shall be disposed of in laboratories by those who are experienced in this field and have full knowledge of the types of flammable liquids and hazardous Materials and how to dispose of them in a proper manner without causing pollution to water or soil and without causing any other damage.

4.10.5.34 Gas cylinders shall be stored and used in laboratories in accordance with the requirements for Part I of this Part. They shall be stacked and installed in regular rows and away from heat or any combustion sources.

4.10.5.35 It is prohibited to store and place gas cylinders of all kinds inside the laboratories that are in the upper floors. It is only permitted to place gas cylinders inside the laboratories that are in the ground floor and one of their walls, at least that looks directly outside and contains outlets for discharging the explosion.

4.10.5.36 The General Directorate of Civil Defense has the right to determine the types of gases and the number of their cylinders that are allowed to be placed inside the laboratory.

4.10.5.37 Flammable gas cylinders shall be stored away from oxidizing gases in particular and from any cylinders of other gases, or be separated from them by fire-resistant building elements for a period of not less than one hour.

4.10.5.38 When storing gas cylinders, the filled ones shall be separated independently from the empty cylinders.

4.10.5.39 It is prohibited to use compressed gas cylinders that are not equipped with pressure regulators, and the regulators shall be suitable for use for the type of each gas.

4.10.5.40 Gas cylinders in the laboratory shall be marked with signs indicating the quality of their content and the nature of their danger. Warning signs shall be placed outside the laboratory indicating the danger and quality of the used gas.

4.10.5.41 It is prohibited to use any pipelines for the transfer of gas unless the pipelines are intended for the transfer of the same gas.

4.10.5.42 It is prohibited to transport (compressed or liquefied) gases from one cylinder to another.

4.10.5.43 Care shall be taken when opening the valves of gas cylinders. They shall be tightly closed if they are not used.

4.10.5.44 Gas cylinders shall be kept away from Electrical Installations.

4.10.6 Safety and Prevention Requirements for the Risks of Private Laboratories

4.10.6.1 Biological Hazards:

4.10.6.1.1 Laboratories that conduct tests on animals and infectious and communicable diseases, or on toxic materials, pose many safety risks to laboratory workers, and to others present in and frequented by them for other reasons and purposes during emergency accidents. Fire and explosion incidents in such laboratories are particularly related to many associated hazards, the most important of which are:

1. The spread of biological risks represented by the spread of toxins, germs and viruses.
2. The exposure of General Directorate of Civil Defense men, and other emergencies, to the special dangers they face in the place, which requires them to have prior knowledge of the nature of the danger in biological laboratories and the skills to deal with it.

4.10.6.1.2 Respirators and personal protective equipment (such as vests, gloves, etc.) shall be provided and shall be fit and ready when needed.

4.10.6.1.3 Laboratories with special hazards shall be marked with international private and accredited marks, so that they are clear and indicate the nature of their seriousness and the special hazards associated with their accidents. There shall also be visible instructions for all workers in these laboratories with safety instructions and procedures to be followed in the event of an emergency.

4.10.6.2 Hazards of radioactive Materials:

4.10.6.2.1 Laboratories dealing with radioactive Materials are extremely dangerous for their workers, during emergency accidents, and for other people who are present and frequented for other reasons and purposes. Therefore, there shall be prior and permanent coordination between the safety staff in the laboratories and the General Directorate of Civil Defense personnel for emergencies.

4.10.6.2.2 In all cases, the workers in these laboratories shall permanently carry , the radiation dose measurement card during work, provided that these cards are subjected to periodic reading by the competent health department to verify the measurement of the amount of exposure of individuals to radiation.



Figure:- F.1-18 : Safety Sprinkler

4.10.7 Laboratory PPE

PPE is a necessity to achieve a safety program within a laboratory, which shall be provided and equipped for use to reduce the effects of accident injuries and emergencies in the laboratory. Educational and guidance programs shall be provided on the importance of wearing personal protective equipment (such as protective jackets, gloves, etc.) and methods of washing vessels, with the need to train workers to carry out first aid.

4.10.7.1 One or more Safety Showers used in emergencies shall be provided to protect persons from the hazards of acids, alkalis, toxic gases, fires, and other materials that require abundant amounts of water for the purpose of dilution, cooling, or rinsing chemicals or flammable clothing hazards. These sprinklers shall include two water outlets, one at the top for the entire body and the other side and special for the eyes as specified in Figure (2-10-2).

4.10.7.2 The location of the safety sprinkler shall be in a place free of obstacles and easily accessible, so that it is not more than 10m away from the entrance to the laboratory. Guiding signs shall be provided for the locations of the safety sprinklers.

4.10.7.3 The sprinkler opening lever shall be easy to operate (pulled down). There shall be a drainage duct to discharge contaminated water into the sprinkler floor.

4.10.7.4 Safety sprinkler locations shall be away from electrical power devices and sources.

4.10.7.5 Safety sprinklers shall be permanently tested and wired at least every six months to ensure their suitability in time of need.

4.10.7.6 Additional laboratory eyewash containers shall be provided in cases of accidental emergency injury, provided that these containers are in a clean condition and ready for use.

4.10.7.7 Employees are prohibited from wearing loose or unbuttoned clothing (open front).

4.10.7.8 Special suction tools shall be used to withdraw corrosive or toxic liquids. It is prohibited to suck them by mouth.

4.10.7.9 When handling corrosive Materials, workers shall wear gloves and a special gown for the purpose (corrosive-resistant bib).

4.10.7.10 Masks or respirators suitable for different types of danger shall be provided inside the laboratory. First aid equipment shall be provided in good condition and ready for immediate use.

Resources

Due to the diversity of hazardous materials and the specific requirements for their storage, handling and uses, refer to the specialized team for Hazardous materials in the General Directorate of Civil Defence, for comprehensive guidance and instructions.

Arabic References

1- Draft Fire Protection System in Buildings 1970, General Directorate of Firefighting, State of Kuwait.
2- Kuwait Municipality Building System 1985, State of Kuwait.

Foreign References

3- Draft Fire Safety System in Buildings 1979, General Directorate of Firefighting, prepared by Ralph Johnson, State of Kuwait.
4- Fire Protection Specification Standards, National Fire Codes NFC, National Fire Protection Association NFPA Inc., 1 Battery march Park, Quincy, MA, USA.
NFPA 30 Flammable And Combustible Liquids Code 2008 Edition.
NFPA 31 Standard for the Installation and Use of Oil- Burning Equipment 2006 Edition.
NFPA 33 Standard for Spray Application Using Flammable or Combustible Materials 2007 Edition.
NFPA 34 Standard for Dipping & Coating Processes Using Flammable or Combustible Liquids 2007 Edition.
NFPA 43C Oxidizers, Gaseous, Storage 1986 Vol.2.
NFPA 43D Pesticides In Portable Containers 1986 Vol.2.
NFPA 45 Standard on Fire Protection for Laboratories Using Chemicals 2004 Edition.
NFPA 51 Standard for the Design and Installation of Oxygen – Fuel Gas for Welding, Cutting, And Allied Processes 2007 Edition.
NFPA 51B Standard for Fire Prevention during Welding, Cutting, and Other Hot Work (Welding & Cutting) 2009Edition.
NFPA 55 Standard for the Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks 2005 Edition.
NFPA 58 Liquefied Petroleum Gases Code 2008 Edition.
NFPA 59A Standard for the Production, and Handling of Liquefied Natural Gas 2009 Edition.
NFPA 61C Feed Mills, Fire & Dust Explosion In 1989 Vol.2.
NFPA 86 Standard for Furnaces & Furnaces 2007.
NFPA 321 Flammable And Combustible Liquids, Classification 1991 Vol.6.
NFPA 385 Flammable And Combustible Liquids, Tank Vehicles for 1990 Vol.6.
NFPA 430 Code for the Storage of Liquid and Solid Oxidizers 2004 Edition.
NFPA 432 Code for the Storage of Organic Peroxide Formulations 2002 Edition.
NFPA 495 Explosive Materials Code 1990 Nol.7.
NFPA 801 Radio Active Materials 1991 Vol.6.
NFPA 1124 Fire Works, Manufacture, Transportation and Storage of 1988 Vol.8.

Appendix
(Part 4)

Classification of Hazardous Materials
Nine Classes of International Classification of Hazardous Material

Class (1)
Explosive Chemicals

Chemicals, (whether solid or liquid, or in the form of a mixture of different materials), are considered explosives if they are produced by their rapid chemical reaction a large amount of gases that generate extreme pressure and very high temperature, causing damage and destruction to the surroundings. Some of these Materials, when reacting, may generate light with a distinctive explosion sound as gases and/or smoke rise. Explosive chemicals fall under Class (1). Due to the different chemical properties of these Materials, their chemical reactions results in varying degrees of severity of the hazard and reaction products, which results in dividing them according to the severity of the hazard into six Sections as follows:

Severity Section 1.1: Explosives with very large destructive effects.
Severity Section 1.2: Explosives as dangerous as projectiles.
Severity Section 1.3: Explosives whose explosion is accompanied by a fire.
Severity Section 1.4: Explosives whose explosion is accompanied by negligible heat emission and has negligible destructive effects.
Severity Section 1.5: Explosives that are not fully sensitive to explosion but when exploded produce traces
It is very destructive.
Severity Section 1.6: Explosives that are not extremely sensitive to explosion and have no significant destructive effects.



Class (2)
Compressed or Liquefied Gases

Chemicals are classified as gases when the vapor pressure of the material (Vapor Pressure) at a temperature of 50°C is greater than 300 kPa or the material is in the gaseous state at a temperature of 20 °C and at an equivalent standard atmospheric pressure of 101.3 kPa, and the gas is described on basis of its natural state during transportation as follows:

Compressed Gas): The gas that is not dissolved in a solution and remains completely in its gaseous form when filled under pressure and at a temperature of 20 °C.
Liquefied Gas: The gas that partially converts to the liquid state when filled under pressure and at a temperature of 20°C.
Refrigerated Liquefied Gas: Gases that partially convert to the liquid state when cooled for filling.
Gas in Solution: Gases that are dissolved in solvents under high pressure when filled.

The gases under this category are divided into three Sections according to the nature of their danger during transport, which are as follows:
Severity Section (2.1): Flammable Gases: Gases that are flammable when mixed with air at a volume of 13% or less, or a range (the difference between the minimum and maximum) of flammability with air of not less than 12% by volume.
Severity Section (2.2): Non- flammable and non- toxic gases: They are gases that are pressurized at 280 kPa or more at a temperature of 20 °C. They may be gases of the type that dilute or replace oxygen in the air in the closed space, causing suffocation. They may also be of the type that causes or contributes to the combustion of other Materials by providing oxygen or the oxidizing agent necessary for the combustion process more effectively than atmospheric air. These gases are not classified in sections (2.1) and (2.3).
Severity Section (2.3): Toxic & Poisonous Gases: Gases whose their presence causes in a closed space at a concentration of 5000 (milliliters/ m3) or less by killing 50% of the experimental animals in this space (LC50≤ 5000 ml/m3), which are toxic or corrosive gases for humans.



Class (3)
Flammable liquids

Liquid chemicals, their mixtures, or solutions of solids dissolved in them are classified as Hazard No. (3), whose high temperature up to 61 °C or less results in flammable fumes (flashing on and off) when exposed to a standard flame in the closed test space. The Flash Point is the lowest temperature at which a liquid releases vapor when tested according to standard methods and in an amount sufficient for an instantaneous combustion to occur in the form of a flash by the test flame specified in this method. The flash point is different from the Fire Point. The Fire Point of any combustible liquid is the lowest temperature at which the liquid releases vapor and in an amount sufficient when tested according to standard methods of combustion, provided that the combustion remains for at least 5 seconds when using the test flame specified in this method.

Class (3) also includes chemicals that are transported or shipped for transport at a high temperature in their liquid phase, so that gases or vapors may be combusted at or below the maximum temperature of transport.
These flammable liquids are divided into Sections according to their severity as follows:
Severity Section 3.1: Liquids with a low flash point where the flash point is less than - 18°C.
Severity Section 3.2: Liquid with an intermediate flash point (Intermediate Flash Point), and whose flash point is - 18 °C and less than 23 °C.
Severity Section 3.3: Liquids with a high flash point (High Flash Point), and their flash point ranges from 23 °C to 61 °C.

The following liquid chemicals are excluded from this classification: -
Liquid chemicals that have been classified in other hazard classes due to their more hazardous properties than combustion.
Aqueous solutions of flammable liquids in which the weight ratio of water exceeds 90%.
Liquids with a flash point of not less than 23 °C and not more than 61°C but whose burning point is more than 100°C, or those that boil before the burning point.





Class (4)
Flammable Solids

Classification of solids in Class (4) when these materials are flammable, co- flammable or inflammable. These flammable solids are divided into the following Sections: -
Severity Section 4.1: Combustible solids include solids that are flammable and combustible when exposed to fire and those that can cause fire by friction. This Section also includes Materials whose decomposition at normal or high temperatures may cause exothermic reactions that cause fires.
Severity Section 4.2: Spontaneously Combustible Materials: This Section includes Materials (solid or liquid) that, during transport or exposure to air, generate self-heating of more than 300 J/g, up to the point of heating the Material itself, making it flammable and causing fires.

Severity Section 4.3: Water Reactive Materials (Water Reactive Materials): They are materials that are liable to spontaneous combustion or release of a toxic or flammable gas when in contact with water.







Class (5)
Oxidizing Agents and Organic Peroxides

Class (5) includes chemicals that produce oxygen as a result of their decomposition or reaction or that help to promote combustion with the absence of oxygen. These Materials are classified into two Sections, which are as follows:
Severity Section 5.1: It includes oxidizing Substances/ Agents: It includes Substances that, while not combustible, release oxygen or perform oxidation processes that would initiate or catalyze a fire in other surrounding Substances.
Severity Section 5.2: Organic Peroxides: These materials are derivatives of hydrogen peroxide. Organic peroxides are highly flammable, sensitive to impact and friction, and react strongly with other chemicals. These reactions may be explosive.





Class (6)
Toxic and Infectious Materials

Materials that fall under this Class are classified into two Sections, which are as follows:
Severity Section 6.1: It includes toxic materials: They are solids or liquids that cause death or severe damage to humans when swallowed, vapors inhaled, or in contact with skin. The material is classified as a toxic if its presence kills 50% of the organisms it consumes (according to experiments in the laboratory) as follows:
Oral at a dose of not more than 500 mg/kg for the liquid material (LD50≤ 500 mg/kg), and not more than 200 mg/kg for the solid material (LD50≤ 200 mg.kg). Percutaneously at a dose of no more than 1000 mg/kg (LD50≤ 1000 mg.kg).
By breathing (fog, aerosol) at a concentration of not more than 10 mg/l (LC50 ≤ 10 ml/m3).

This Section also includes toxic materials extracted from plants, animals or bacteria unless they contain infectious materials.
Severity Section 6.2: It includes infectious materials, which contain living microorganisms, such as bacteria, viruses and parasites and cause diseases to humans or animals.





Class (7)
Radioactive Materials

Any material or composition of materials that self-emit ionizing radiation having a specific activity greater than 0.002 microcuries per gram



Class (8)
Corrosive materials

Materials classified in this risk Class are liquid or solid materials that, by their chemical activity, cause severe damage to living tissue (skin) upon contact within a specified period of time, or cause corrosion of iron of the type (SAE 1020) by more than 6.25 millimeters per year.
These Materials also cause severe damage when they leak to the surrounding containers and other goods or means of transport. In many cases, this results in the escalation of gases, some of which are toxic and others may form a combustible and explosive mixture with atmospheric air. These Materials also have a damaging effect on metal materials and fabrics. When these Materials are mixed with water, they usually emit gases and vapors that irritate the mucous membranes and cause redness of the eyes. Mixing some of these materials with water is accompanied by the release of a large amount of heat resulting from the reaction associated with dissolution.
Strong acids and alkalis are classified into this Class, where the acid is strong when its PH value is 2 or less, and the alkali is strong when its PH value is 12.5 or more.
PH is a relative scale ranging from 0 to 14. Materials with PH from 0 to less than 7 are acidic. Materials with a value of more than 7 to 14 are alkaline. Neutral materials have a PH value of 7.



Class (9)
(Miscellaneous Hazardous Materials)

This hazard Class includes materials that are hazardous during transport or hazardous to the environment and do not fall within the classification of the previous eight classes. It also includes Materials that are provided for transport or transported at a temperature of 100 °C or more and are in the liquid state, as well as solids that are provided for transport or transported at a temperature of 240 °C or more.



Incompatible Materials

Material name	It is not allowed to be connected to the following Materials
Acetic Acid	chromic acid, nitric acid,hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates
Acetylene	chlorine, bromine, copper, fluorine, silver, mercury
Alkaline metals such as powdered aluminium, magnesium, sodium or potassium	Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, halogens
Anhydrous ammonia	Mercury, chlorine, hypochlorite, calcium, hydrofluoric acid
Ammonium nitrate	Acids, metal powders, flammable liquids, chlorates, nitrites, sulphur, powders of organic or combustible material
Clorine dioxide	Amonia, methane, phosphine, hydrogen sulphide, Acetylene, hydrogen peroxide
Copper	Acetylene, hydrogen peroxide
Cumenehydroperoxide	Acids, organic and inorganic materials Acids, organic or inorganic materials

Flammable Liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide
Flourine	Isolate from everything
Hydrocarbons (butane, propane, benzene, gasoline, turpentine.. etc.)	Flourine, chlorine, bromine, chromic acid, sodium peroxide
Hydrocyanic Acid	Nitric acid, alkalis
Aniline	Nitric acid, hydrogen peroxide
Bromine	Same as for chlorine (see chloride)
Carbon, activated	Calcium hypochlorite, all oxidizers Calcuimhypochorite, all oxidizing agents
Chlotares	Ammonium salts, acids, metal powders, sulphur, organic or combustible Material powders
Chromic Acid	Acetic acid.naphthaline, camphor, glycerin, turpentine, alcohol, flammable liquids in general.
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gasses), hydrogen, sodium carbide, turpentine, benzene, powdered metals
Perchloric Acid	Anydrus acetic acid, bismuth and it`s alloys, alcohol, paper, wood
Potassium	Carbon tetrachloride, carbon dioxide, water
Potassium Chlotare	Sulphuric acid and other acids
Pottasium Perchlorate	Sulphuric acid and other acids
Silver	Acetylene, Oxalic Acid, Tric acid, ammonia compounds
Pottasium Permanganate	Glycren, ethylene glycol, benzaldehyde, sulphuric acid
Sodium	Carbon tetrachloride, carbon dioxide, glacial acetic acid
Sodium Peroxide	Ethyle or methyl, alcohol, benzaldehyde, sulphur dioxide, glycerine, ethylene glycol, ethyl acetate, methyl acetate, furfural
Sulphuric Acid	Potassium chlorate, potassium perchlorate, potassium permanganate (or light metal compounds such as sodium, lithium)

Material name	It is not allowed to be connected to the following materials
Hydroflouric Acid, anhydrous	Ammonia, hydrous or anhydrous
Hydrogen Peroxide	Copper, chromium, iron, most metals and their salts, alcohols, acetone, organic materials, aniline, nitromethane, flammable liquids, combustibles
Hydrogen Sulphide	Fuming nitric acid,oxidizing gasses
Iodine	Acetylene, ammonia (hydrous or anhydrous), hydrogen
Mercury	Acetylene, fulminic acid, ammonia
Nitric acid(Conc.)	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulphide, flammable liquids, flammable gasses
Oxalic Acid	Silver, mercury

4.11 Material Test and Standards

Flammable and Combustible Liquid Storage Material Test Standards and Approvals.

Acceptable Test Standards and criteria

6.1.1. All the Materials, Systems, Assemblies, wiring, fittings, equipment, Products and Accessories, referred to in this chapter shall be Listed, Approved and Registered by General Directorate of Civil Defence.

6.1.2. There is no year of edition mentioned against any test standards. It is the intent of Civil Defence to convey to the customers seeking laboratory tests and the test laboratories to follow the "LATEST EDITION OF THE TEST STANDARD, AS AND WHEN THEY ARE UPGRADED/REVISED/AMENDED, TO THE DATE."

6.1.3. Storage Cabinets

i. NFPA 251, Standard Methods of Tests of Fire Endurance of Building Construction and Materials.

6.1.4. Atmospheric Tanks

i. API Specification 12B, Bolted Tanks for Storage of Production Liquids
ii. API Specification 12D, Field welded Tanks for Storage of Production Liquids
iii. API Specification 12F, Shop welded Tanks for Storage of Production Liquids
iv. API Specification 650, Welded steel tanks for oil storage
v. UL 58, Standard for Steel Underground Tanks for Flammable and Combustible Liquids
vi. ANSI/UL 80, Standard for Steel Tanks for Oil-burner fuels and other combustible liquids
vii. ANSI/UL 142, Standard for Steel Aboveground Tanks for Flammable and Combustible Liquids
viii. UL 1316, Standard for Glass-Fiber Reinforced Plastic Underground Storage tanks for Petroleum products, Alcohol, and Alcohol-Gasoline Mixture.
ix. ANSI/UL 1746, Standard for External Corrosion Protection Systems for steel Underground Storage Tanks
x. ANSI/UL 2080, Standard for Fire Resistant Tanks for Flammable and combustible liquids

xi. ANSI/UL 2085, Standard for protected Aboveground Tanks for Flammable and combustible liquids
xii. BS EN 14015, Specification for the design and manufacture of site built, vertical, cylindrical, flat-bottomed, above ground, welded, steel tanks for the storage of liquids at ambient temperature and above.

6.1.5. Low Pressure Tanks
i. API Specification 620, Recommended Rule for the design and construction of Large, Welded, Low-Pressure Storage Tanks
ii. ASME, Code for Unified Pressure Vessels, Section VIII, Division 1.

6.1.6. Vaults
i. UL 2245, Standard for below grade vaults for flammable liquid storage tanks

6.1.7. Powered Trucks and Forklifts
i. UL 558, Standard for Safety Industrial Trucks, internal combustion Engine powered.
ii. UL 583, Standard for Safety Electric– Battery powered Trucks.

6.1.8. Fuel Delivery Nozzles
i. Section 19 A of UL 842, Standard for Valves for Flammable Fluids.

LPG Systems Material Test Standards and Approval.

6.1.3. LPG Cylinders *Working pressure should not be less than 250 psi (17.57 Kg/Sq. cm) and design storage temperature shall be –42C to 55C.+

i. ASME Boiler and Pressure Vessel Code, Section VIII, "Rules for the Construction of Unfired Pressure Vessels," or the API-ASME Code for Unfired Pressure Vessels for Petroleum Liquids and Gases.
ii. EN 12245, Transportable gas cylinders. Fully wrapped composite cylinders.
iii. EN 14427, LPG equipment and accessories. Transportable refillable fully wrapped composite cylinders for LPG. Design and construction.
iv. EN 1442 - LPG equipment and accessories. Transportable refillable welded steel cylinders for LPG. Design and construction.
v. EN 12807 - LPG equipment and accessories. Transportable refillable brazed steel cylinders for liquefied petroleum gas (LPG). Design and construction.
vi. EN 13110 - LPG equipment and accessories. Transportable refillable welded aluminum cylinders for liquefied petroleum gas (LPG). Design and construction.
vii. EN 14140 - LPG equipment and accessories. Transportable refillable welded steel cylinders for LPG. Alternative design and construction.
viii. ISO 4706 - Gas cylinders. Refillable welded steel cylinders. Test pressure 60 bar and below.
ix. ISO 22991 - Gas cylinders. Transportable refillable welded steel cylinders for liquefied petroleum gas (LPG). Design and construction.
x. ISO 20703 - Gas cylinders. Refillable welded aluminum-alloy cylinders. Design, construction and testing.
xi. EN 14893 - LPG equipment and accessories. Transportable Liquefied Petroleum Gas (LPG) welded steel pressure drums with a capacity between 150 liters and 1 000 liters.
xii. ISO 10460 Gas cylinders -- Welded carbon-steel gas cylinders Periodic inspection and testing.
xiii. ISO 11119-2 Gas cylinders of composite construction. Specification and test methods. Part 2. Fully wrapped fiber reinforced composite gas cylinders and tubes with load-sharing metal liners.
xiv. UL 2003 Outline for LP-Gas Cylinder Assemblies.
xv. ANSI/UL 147A, Standard for Safety for No refillable (Disposable) Type Fuel Gas Cylinder Assemblies.
xvi. ANSI/UL 147B No refillable (Disposable) Type Metal Container for Butane.

xvii. UAE S/GSO ISO 22991, Gas Cylinders. Transportable refillable welded steel cylinders for liquefied petroleum gas (LPG). Design and construction.
xv. ISO 11119-3, Gas cylinders of composite construction. Specification and test methods. Part 3. Fully wrapped fiber reinforced composite gas cylinders and tubes with non-metallic and non-load-sharing metal liners.
xvi. UL 147B, Standard for No refillable (Disposal) Type Metal Container Assemblies for Butane.

6.1.4. LPG Cylinder Periodic Inspection
i. EN 1440, LPG equipment and accessories. Periodic inspection of transportable refillable LPG cylinders.
ii. EN 14912, LPG equipment and accessories - Inspection and maintenance of LPG cylinder valves at time of periodic inspection of cylinders.

6.1.5. LPG Cylinder Checking before and after filling
i. EN 1439, LPG equipment and accessories. Procedure for checking LPG cylinders before, during and after filling.

6.1.6. LPG Container Sealing Caps and Plugs
i. EN 16119, Sealing caps and plugs for LPG cylinder and pressure vessel valves. Specification and testing.

6.1.7. LPG Tanks *Working pressure should not be less than 250 psi (17.57 Kg/Sq. cm) And design storage temperature shall be –42C to 55C. +

i. Regulations of the U.S Department of Transportation (DOT), the "Rules for the Construction of Unfired Pressure Vessels", Section VIII, Division 1
ii. ASME Boiler and Pressure Vessel Code.
iii. API-ASME Code for Unfired Pressure Vessels for Petroleum Liquids and Gases.
iv. PD 5500 -Specification for unfired fusion welded pressure vessels
v. EN 14075, Static welded steel cylindrical tanks, serially produced for the storage of liquefied petroleum gas (LPG) having a volume not greater than 13 m3 and for installation underground. Design and manufacture
vi. EN 12542, LPG equipment and accessories. Static welded steel cylindrical tanks, serially produced for the storage of liquefied petroleum gas (LPG) having a volume not greater than 13 m3. Design and manufacture
vii. EN 14570, LPG equipment and accessories. Equipping of over ground and underground LPG vessels.
viii. UL 644, Container assemblies for LP Gas.
ix. EN 12493, LPG equipment and accessories. Welded steel pressure vessels for LPG road tankers. Design and manufacture.
x. EN 13445 Unfired Pressure vessel codes

6.1.8. Requalification of (Inspection) LPG Tanks
i. EN 12817, LPG equipment and accessories. Inspection and requalification of LPG tanks up to and including 13 m3
ii. EN 12819, LPG equipment and accessories. Inspection and requalification of LPG tanks greater than 13 m3.

6.1.9. Road Tankers
i. EN 14334, LPG equipment and accessories. Inspection and testing of LPG road tankers.
ii. EN 12493, LPG equipment and accessories. Welded steel pressure vessels for LPG road tankers. Design and manufacture.
iii. EN 12805, Automotive LPG components. Containers.

iv. ISO 20826, Automotive LPG components. Containers.
v. EN 13776 LPG equipment and accessories. Filling and discharge procedures for LPG road tankers.

6.1.10. Pressure Relief Device
i. UL 132, Standard on Safety Relief Valves for Anhydrous Ammonia and LP-Gas.
ii. EN 16631, LPG equipment and accessories. Pressure relief valves for LPG pressure vessels. Reconditioning requirements.
iii. EN 13953, LPG equipment and accessories. Pressure relief valves for transportable refillable cylinders for Liquefied Petroleum Gas (LPG).
iv. EN 14071, LPG equipment and accessories. Pressure relief valves for LPG pressure vessels. Ancillary equipment.
v. EN 14129, LPG Equipment and accessories. Pressure relief valves for LPG pressure vessels.
vi. EN 13175 - LPG Equipment and accessories. Specification and testing for Liquefied Petroleum Gas (LPG) pressure vessel valves and fittings.

6.1.11. Pressure Regulators
i. UL 144, Standard for LP-Gas Regulators.
ii. BS 3016, Specification for pressure regulators for liquefied petroleum gases.
iii. EN 12864, Low-pressure, nonadjustable regulators having a maximum outlet pressure of less than or equal to 200 mbar, with a capacity of less than or equal to 4 kg/h, and their associated safety devices for butane, propane or their mixtures.
iv. EN 16129, Pressure regulators, automatic change-over devices, having a maximum regulated pressure of 4 bar, with a maximum capacity of 150 kg/h, associated safety devices and adaptors for butane, propane, and their mixtures.
v. EN 13786, Automatic change-over valves having a maximum outlet pressure of up to and including 4 bar with a capacity of up to and including 100 kg/h, and their associated safety devices for butane, propane or their mixtures
vi. EN 88-1, Pressure regulators and associated safety devices for gas appliances. Pressure regulators for inlet pressures up to and including 50 kPa.
vii. EN 88-2, Pressure regulators and associated safety devices for gas appliances. Pressure regulators for inlet pressures above 500 mbar up to and including 5 bar.
viii. FM 3510, Flow and Pressure Safety Switches.

6.1.12. Pipes
i. Wrought iron — ASME B 36.10M, Welded and Seamless Wrought Steel Pipe.
ii. Steel pipe — ASTM A 53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
iii. Steel pipe — ASTM A 106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
iv. Brass pipe — ASTM B 43, Standard Specification for Seamless Red Brass Pipe, Standard Sizes.
v. Copper pipe — ASTM B 42, Standard Specification for Seamless Copper Pipe, Standard Sizes.
vi. Polyamide and polyethylene pipe — ASTM D 2513, Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing and Fittings, and shall be recommended by the manufacturer for use with LP-Gas.
vii. ASTM 1387, Specification for screwed and socketed steel tubes and tubulars and for plain end steel tubes suitable for welding or for screwing to BS 21 pipe threads.
viii. EN 16125. LPG equipment and accessories. Pipework systems and supports. LPG liquid phase and vapour pressure phase.

ix. EN ISO 16440. Petroleum and natural gas industries. Pipeline transportation systems. Design, construction and maintenance of steel cased pipelines.
x. EN 682 - Elastomeric seals. Materials requirements for seals used in pipes and fittings carrying gas and hydrocarbon fluids.
xi. ISO 17484-1 - Plastics piping systems. Multilayer pipe systems for indoor gas installations with a maximum operating pressure up to and including 5 bar (500 kPa). Specifications for systems.
xii. ISO 18225 - Plastics piping systems. Multilayer piping systems for outdoor gas installations. Specifications for systems.

6.1.13. Tubing

i. Steel tubing — ASTM A 539, Standard Specification for Electric-Resistance Welded Coiled Steel Tubing for Gas Fuel Oil Lines.
ii. Brass tubing — ASTM B 135, Standard Specification for Seamless Brass Tube
iii. Copper tubing (a) Type K or L — ASTM B 88, Specification for Seamless Copper Water Tube.
iv. Polyamide and polyethylene tubing — ASTM D 2513, Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing and Fittings, and shall be recommended by the manufacturer for use with LP-Gas.
v. Corrugated stainless steel tubing — ANSI/AGA LC1, Interior Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing.
vi. EN 1057, Copper and copper alloys. Seamless, round copper tubes for water and gas in sanitary and heating applications.
vii. EN 1254-1, Copper and copper alloys. Plumbing fittings. Fittings with ends for capillary soldering or capillary brazing to copper tubes.
viii. EN 1254-2, Copper and copper alloys. Plumbing fittings. Fittings with compression ends for use with copper tubes.
ix. BS 8537, Copper and copper alloys. Plumbing fittings. Specification for press ends of plumbing fittings for use with metallic tubes.
x. BS 7838, Specification for corrugated stainless steel semi-rigid pipe and associated fittings for low-pressure gas pipework of up to DN 50.
xi. EN 15266, Stainless steel pliable corrugated tubing kits in buildings for gas with an operating pressure up to 0,5 bar.
xii. EN 16617:2015 Pipework. Corrugated metal hose assemblies for combustible gas. Performance requirements, testing and marking.

6.1.14. PE Pipes

i. ASTM D 2683, Standard Specification for Socket-Type Polyethylene (PE) Fittings for Outside Diameter Controlled Polyethylene Pipe.
ii. ASTM D 3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
iii. ASTM F 1055, Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.
iv. ASTM F 1733, Standard Specification for Butt Heat Fusion Polyamide (PA) Plastic Fitting for Polyamide (PA) Plastic Pipe and Tubing.
v. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings.
vi. ISO 4437-3 - Plastics piping systems for the supply of gaseous fuels. Polyethylene (PE). Fittings.
vii. ISO 14531-2 - Plastics pipes and fittings. Cross-linked polyethylene (PE-X) pipe systems for the conveyance of gaseous fuels. Metric series. Specifications. Fittings for heat-fusion jointing.
viii. ISO 14531-3 Plastics pipes and fittings. Cross-linked polyethylene (PE-X) pipe systems for the conveyance of gaseous fuels. Metric series. Specifications.
Fittings for mechanical jointing (including PE-X/metal transitions).

ix. EN 1555-3 - Plastics piping systems for the supply of gaseous fuels. Polyethylene (PE). Fittings.
x. EN 13175 - LPG Equipment and accessories. Specification and testing for Liquefied Petroleum Gas (LPG) pressure vessel valves and fittings.

6.1.15. PE Fittings

i. BS ISO 4437-3, Plastics piping systems for the supply of gaseous fuels. Polyethylene (PE). Fittings.
ii. EN 1555-3, Plastics piping systems for the supply of gaseous fuels. Polyethylene (PE). Fittings.
iii. GIS/PL2-2, Polyethylene pipes and fittings for natural gas and suitable manufactured gas Part 2: Pipes for use at pressures up to 5.5 bar.
iv. GIS/PL2-4, Polyethylene pipes and fittings for natural gas and suitable manufactured gas Part 4: Fusion fittings with integral heating element(s).
v. GIS/PL2-6, Polyethylene pipes and fittings for natural gas and suitable manufactured gas Part 6: Spigot end fittings for electrofusion and/or butt fusion purposes.
vi. GIS/PL2-8, Polyethylene pipes and fittings for natural gas and suitable manufactured gas Part 8: Pipes for use at pressures up to 7 bar.
vii. ASTM D 2683, Standard Specification for Socket-Type Polyethylene (PE) Fittings for Outside Diameter Controlled Polyethylene Pipe.
viii. ASTM D 3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
ix. ASTM F 1055, Standard Specification for electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.
x. ASTM F 1733, Standard Specification for Butt Heat Fusion Polyamide (PA) Plastic Fitting for Polyamide (PA) Plastic Pipe and Tubing.

6.1.16. Flexible Hose /Pigtail

i. BS 4089 Specification for metallic hose assemblies for liquid petroleum gases and liquefied natural gases.
ii. BS 3212 type 1 flexible tubing for applications not exceeding 50 mbar working pressure.
iii. BS 669 part 1, part 2 for metallic flexible hose.
iv. EN 14800 Corrugated safety metal hose assemblies for the connection of domestic appliances using gaseous fuels.
v. ISO 2928 - Rubber hoses and hose assemblies for liquefied petroleum gas, LPG (liquid or gaseous phase) and natural gas up to 25 bar (2,5 MPa). Specification.
vi. ISO 11759 - Rubber hoses and hose assemblies for dispensing liquefied petroleum gas (LPG). Specification.
vii. ISO 8789. Rubber hoses and hose assemblies for liquefied petroleum gas in motor vehicles.
viii. EN 13766 - Thermoplastic multilayer (non-vulcanized) hoses and hose assemblies for the transfer of liquid petroleum gas and liquefied natural gas. Specification.
ix. EN 1762 - Rubber hoses and hose assemblies for liquefied petroleum gas, LPG (liquid or gaseous phase), and natural gas up to 25 bar (2,5 MPa). Specification.
x. ISO 27127 - Thermoplastic multi-layer (non-vulcanized) hoses and hose assemblies for the transfer of liquid petroleum gas and liquefied natural gas.
xi. UL 21 LP-Gas Hose, LP-Gas Hose Assemblies.
xii. UL 569 Pigtails and Flexible Hose Connectors.

6.1.17. Valves

i. FM 7400, Liquid and Gas Safety shut-off valves.
ii. EN 15069 safety gas connection valves for domestic appliances.
iii. EN 161 automatic shut-off valves for gas appliances.

iv. EN 14800 corrugated hose for domestic appliances.
v. EN 1106 manually operated taps for gas appliances.
vi. EN 331, Manually operated ball valves and closed bottom taper plug valves for gas installations for buildings.
vii. EN 15069, Safety gas connection valves for metal hose assemblies used for the connection of domestic appliances using gaseous fuel.
viii. EN 13774, Valves for gas distribution systems with maximum operating pressure less than or equal to 16 bar. Performance requirements.
ix. EN 13175, LPG Equipment and accessories. Specification and testing for Liquefied Petroleum Gas (LPG) pressure vessel valves and fittings.
x. EN 161, Automatic shut-off valves for gas burners and gas appliances.
xi. EN 1983, Industrial valves - Steel ball valves.
xii. EN 13547, Industrial valves - Copper alloy ball valves.
xiii. EN 13709 Industrial valves - Steel globe and globe stop and check valves
xiv. EN 13789 Industrial valves - Cast iron globe valves.
xv. UL 132, Standard for Pressure Relief Valves for LPG.
xvi. FM 7420, Gas Safety Control Cocks.
xvii. FM 7422, Electric Inter cocking fuel gas and fuel oil cocks.
xviii. ISO 14245, Gas Cylinders. Specifications and testing of LPG cylinder valves. Self-closing.
xix. ISO 15995, Gas Cylinders. Specifications and testing of LPG cylinder valves. Manually operated.
xx. UL 125 Flow Control Valves, LP-Gas Check valves, Shut-off valves, Hose nozzle valves, control manifolds.

6.1.18. Gas leak detector

i. EN 60079-29-1, Explosive atmospheres. Gas detectors. Performance requirements of detectors for flammable gases.
ii. EN 60079-29-4, Explosive atmospheres. Gas detectors. Performance requirements of open path detectors for flammable gases.
iii. EN 50402, Electrical apparatus for the detection and measurement of combustible or toxic gases or vapour or of oxygen. Requirements on the functional safety of fixed gas detection systems.
iv. EN 125 flame supervision devices for gas appliances.
v. FM 6320, Combustible Gas Detectors.
vi. UL 1484, Residential Gas Detectors.
vii. UL 2075, Standard for Gas and Vapor detectors.
viii. IEC 60335-1, Household and similar electrical appliances - Safety - Part 1: General requirements. (Kitchen only).
IIix. IEC 60079-0, Explosive atmospheres - Equipment - General requirements.
IIx. IEC 60079-1, Explosive atmospheres - Equipment protection by flameproof enclosures "d""
IIxi. IEC 60079-11, Explosive atmospheres Equipment protection by intrinsic safety "i"".

6.1.19. Gas Meters
i. EN 1359, Diaphragm gas meters
ii. EN 14236 Ultrasonic domestic gas meters.
iii. UL 25 Meters for Flammable and Combustible Liquids and LP-Gas, LP-Gas Meters.

6.1.20. Gas leak Detection Control Panel
i. EN 60079-29-1, Explosive atmospheres. Electrical installations design, selection and erection.

6.1.21. Vaporizers and Mixers
i. FM 7151, LP-Gas Vaporizers, Gas-air mixers and Vaporizer Mixers.

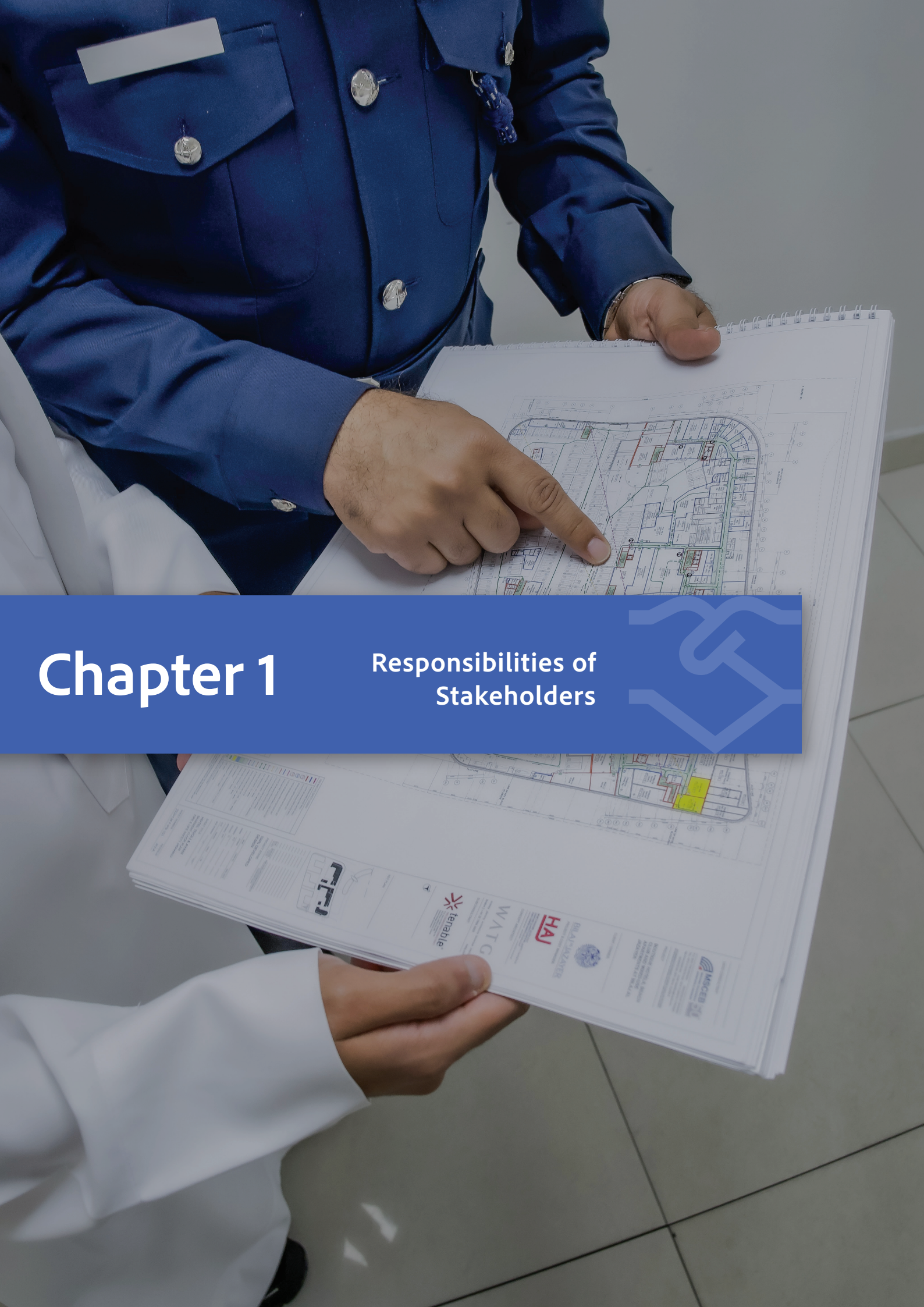
ii. UL 1349 Outline for LP-Gas Vaporizers.

6.1.22. Liquid Level gauging devices
i. UL 565 Liquid-Level Gauges.

6.1.23. Overfilling prevention devices
i. ANSI/UL 2227, Standard for Overfilling Prevention Devices.

6.1.24. Fire rated Cable, Certified for 120 minutes

i. EN 50200, Method of test for resistance to fire of unprotected small cables for use in emergency circuits
ii. UL 2196, Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control, and Data Cables
iii. BS 8434-2, Methods of test for assessment of the fire integrity of electric cables. Test for unprotected small cables for use in emergency circuits. BS EN 50200 with a 930° flame and with water spray .
iv. BS 7629-1, Electric cables. Specification for 300/500 V fire resistant screened cables having low emission of smoke and corrosive gases when affected by fire. Multicore and multipair cables.
v. BS 6387, Test method for resistance to fire of cables required to maintain circuit integrity under fire conditions.
vi. IEC 60331-1, Tests for electric cables under fire conditions.
vii. IEC 60331-2, Tests for electric cables under fire conditions.
viii. IEC 60332-2-2, Tests on electric and optical fibre cables under fire conditions.
ix. IEC 60332-3-10, Tests on electric and optical fibre cables under fire conditions.
x. IEC 60331-2, Tests for electric cables under fire conditions.
xi. UL 1724, Outline of Investigation for Fire Tests for Electrical Circuit Protective Systems.
xii. UL 1685, Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables.
xiii. UL 1666, UL 1666 Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts.



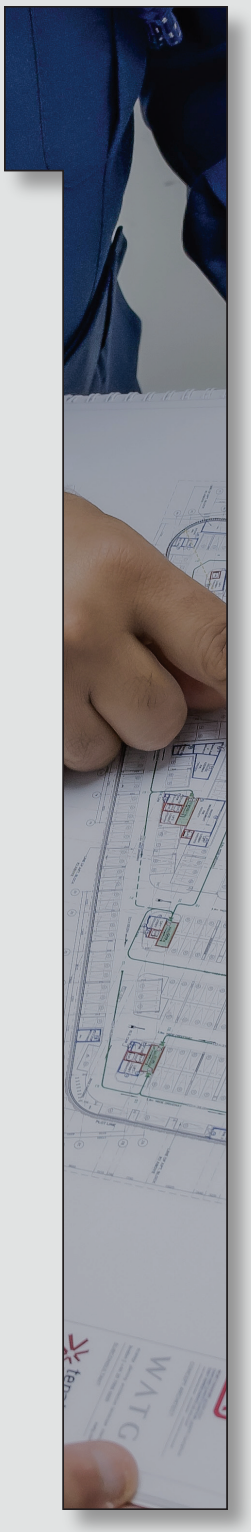
Chapter 1

Responsibilities of Stakeholders

Section G

Chapter 1

Responsibilities of Stakeholders



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1. Scope

1.1. To familiarize the stake holders of their responsibilities towards Fire and Life Safety
To create awareness of the mandatory duties of individual stake holders in their individual occupancies and their role in executing the regulations of General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain in creating a fire safe buildings and country.

1.2. Responsibilities of building Owners, Developers, Consultants, House of Expertise and Contractors.

1.3. Responsibilities of Material Manufacturers, Agents, Suppliers, Material Testing Laboratories and Conformity Certification Bodies.

1.4. Responsibilities of Assembly, Educational, Healthcare, Office, Detention and Mall Management.

2. Definitions

2.1. General

2.1.1. Shall
It is a mandatory requirement by General Directorate of Civil Defence (GDCD) -Kingdom of Bahrain.

2.1.2. Should
It is a suggested requirement recommended by General Directorate of Civil Defence (GDCD), but not mandatory.

2.1.3. Listed
Permitted and registered by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain, material department.

2.1.4. Gallon. U.S. Standard and Kilogram
1 U.S. gal = 3.785 L., 1 Kg = 1.8 Liter, Approx. (Units used in this chapter are either Kilograms or US Gallons. Conversion of Liter to Kg without knowing specific density, Liter conversion to Kg is approximate for the purpose of LPG cylinders quantities.)

2.1.5. Kilogram
1 Kg = 2.20.lb (Pounds)

2.1.6. Temporary
Wherever temporary arrangement arises with respect to fire and life safety.

2.1.7. Biannually or Semiannually
Twice a Year (Every six months)

2.1.8. Quarterly
Four times a Year (Every 3 months)

2.1.9. Annually
Once every year

2.1.10. Fortnight

Fourteen nights and fourteen days. Every 2 weeks.

2.2. Responsibilities of Stakeholders

2.2.1. Owner union /Stakeholder

In the context of this chapter, stakeholder is a collective term involving investor, owner, participating parties, service providers and owner union (architects, consulting engineers, installation contractors, inspection agencies, maintenance contractors etc.), profit makers, interested parties, third parties and caretakers involved in the project development, design, construction, installation, inspection and maintenance.

2.2.2. Responsibilities/ Responsible

The requirement of being liable to fulfill duties and answerable to fulfill accountability and local communities.

2.2.3. Owner

A person who is the proprietor and possesses the legal authority from government to own the particular land, property, assets, structure, businesses or material.

2.2.4. Owner's representative

A qualified and competent person or organization appointed or designated by the owner to perform owner's duties and responsibilities on owner's behalf. Owner is directly responsible for Owner's representative's conduct.

2.2.5. Developer (Property Developer)

A person or the organization who makes investments to purchase urban or suburban land and real estate, develops it into habitable spaces, especially by subdividing the land into building sites to sell or/and constructing buildings on those sites to sell.

2.2.6. Infrastructure (Urban and Suburban)

Fundamental features of an urban or suburban habitable spaces which provides for basic needs of modern living such as Roads to drive to places, electricity supply and power distribution for lighting, water supply and distribution, Fuel Supply and distribution for cooking, communication network, drainage network and public transportation facilities such as rail and bus networks.

However, General Directorate of Civil Defence (GDCD) concern and permitted scope with infrastructure is limited to Road Network and urban firefighting provision such as Public Yard Fire Hydrants and fire access routes (Roads).

2.2.7. Consultant and Technical officers that works in fire protection

A person or the organization who is a professional advisor, expert, specialist who offers his expertise in counseling, planning, designing, constructing and commissioning buildings, structures and infrastructure for a fee.

In context to General Directorate of Civil Defence (GDCD), "Consultant" is a professional, permitted by both Bahrain Municipality and General Directorate of Civil Defence (GDCD), authorized and "responsible" to design, including Fire and Life Safety Drawings and execute project construction work upon obtaining relevant formal permit and permit under his "responsibility", from Bahrain Municipalities and General Directorate of Civil Defence (GDCD).

However, Main consultant is not authorized to prepare Fire and Life Safety reports and risk assessments when initiated by General Directorate of Civil Defence (GDCD).

2.2.8. House of Expertise (Fire Consultant)

The organization registered and permitted by General Directorate of Civil Defence (GDCD), performs as a third party expertise in Fire and Life Safety aspects of the project for a fee.

When hired by the owner or Main Consultant, House of Expertise is "responsible" to review design, prepare Fire and Life Safety Drawings, prepare Fire and Life Safety reports, risk assessments and evaluations to be submitted to General Directorate of Civil Defence (GDCD) under the main consultant's umbrella and applications.

House of Expertise can also conduct inspections when hired by owner, consultants or contractors. However, House of expertise is not authorized to create applications directly with General Directorate of Civil Defence (GDCD) to take project permits. Creating applications with General Directorate of Civil Defence (GDCD) is under main consultant's scope.

2.2.9. Contractor

The organization registered and permitted by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain, executes specific scope of work of the project relevant to Fire and Life Safety aspect of the project, upon a contractual agreement with main consultant for a fee.

In context to General Directorate of Civil Defence (GDCD) contractors are limited to Fire and Life Safety aspects of the project such as Fire Detection and Alarm contractors, Fire fighting Contractors, Smoke control System contractors, Façade contractors, Fire door contractors, Fire stopping contractors, LPG/Natural gas contractors etc.

Contractors out of Fire and Life Safety aspect of the project, such as Civil Contractor, MEP Contractor, HVAC Contractor and Lighting contractor etc. are under the governance of Municipality.

2.2.10. Fit-out Contractor (Interior Designer)

The organization registered by General Directorate of Civil Defence (GDCD), executes interior design and fit-out work, including Fire and Life Safety aspect of the space, upon a contractual agreement with owner or main consultant or tenant for a fee.

In context to General Directorate of Civil Defence (GDCD), "Interior Designer Company" is a professional interior finish contractor, authorized and "responsible" to design and execute fit-out work upon obtaining relevant formal permit and permit under his "responsibility", from Bahrain municipality and General Directorate of Civil Defence (GDCD) –
Kingdom of Bahrain.

However, Interior Design company is not authorized to prepare Fire and Life Safety reports and risk assessments when General Directorate of Civil Defence (GDCD). It is House of Expertise' scope.

2.2.11. Contract

Contract is the mutual agreement between two parties, where one party is paid by the other to execute certain task. The "contract" when legally bound and valid, is a declaration by both parties that they will adhere to terms and conditions, including the requirements of Bahrain Fire and Life Safety Code of Practice, mentioned in the Contract document.

2.2.12. Manufacturer

A company which is registered and listed by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain, manufactures with machinery, technology and manpower, the products, goods, items which when installed, readily serve as Fire and Life Safety products.

Manufacturers of parts, components, ingredients, portions or sections which require assembling process to become whole products are not recognized or registered or listed by General Directorate of Civil Defence (GDCD).

Obtaining 100% parts and components from other manufacturers and assembling those parts to create an end product is not manufacturing and such activities are not registered by General Directorate of Civil Defence (GDCD) under manufacturers.

2.2.13. Installation and Maintenance

An establishment listed and permitted by General Directorate of Civil Defence (GDCD). To sell, install and maintain fire and life safety devices, equipment and materials, along with its accessories and fit outs, under commercial agency duly attested and the testing lab certificate, which is listed in the Bahrain.

2.2.14. Supplier or Distributor

An establishment listed and permitted by General Directorate of Civil Defence (GDCD) to sell fire and life safety devices, equipment and materials, along with its accessories and fit outs, under distribution agreement duly attested by an agent listed by the General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain.

2.2.15. Testing Laboratory

An accredited body or organization which performs tests and inspection of fire and life safety systems, devices, equipment and materials, listed and permitted by General Directorate of Civil Defence (GDCD), conformity certification bodies.

Test laboratory registration and listing with General Directorate of Civil Defence (GDCD) is limited to basically conducting tests “responsibly”, relevant to fire performance of materials and products such as ‘reaction to fire tests’. ‘Propagation of fire tests’ and ‘fire resistance tests’ where products and materials are tested, evaluated and documented (Test Report) for their ‘reaction’, ‘propagation’ or ’resistance’ when subjected to certain fire conditions as per particular test standard. Other material and product tests such as environmental protection tests, stress test, composition tests etc. are not validated by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain.

2.2.16. Conformity Certification Or Conformity Assessment Body

An accredited body which awards international safety certificates and is responsible for verifying conformity, monitor and audit the quality and efficiency of fire and life safety systems, devices, equipment and materials tested by General Directorate of Civil Defence permitted Testing laboratories.

Where accreditation scope permits, conformity assessment body can also create a scope of application, related to a test or series of tests, based on recognized industry assessment rules.

2.2.17. Cross Listing

Cross Listing refers to the certificate or conformity issued by the certification bodies to the primary manufacturer, where a material, product or system is manufactured in a certain primary factory at a certain primary location as a certain primary brand. And same certificate or conformity credentials are allowed and permitted to be used by a secondary manufacturer, in a secondary factory, at a secondary location, as a primary brand, claiming to abide by the quality, prerequisites, standards in an exact manner that were applicable to the primary manufacturer.

2.2.18. Multiple Listing

Multiple Listing refers to the certificate or conformity issued by the certification bodies to the primary manufacturer, where a material, product or system is manufactured in a certain primary factory at a certain primary location as a certain primary brand.
Same certificate or conformity credentials are allowed and permitted to be used by another non-manufacturer as a secondary brand, claiming to abide by the quality, prerequisites, standards in an exact manner that were applicable to the primary manufacturer and primary brand.

2.2.19. Facility Management Company

A General Directorate of Civil Defence (GDCD) permitted and registered company with manpower, hired by the owner, performs housekeeping, security, cleaning, maintaining, repairing, replacing activities and in general functions as care taker of the property. During emergencies, facility management personnel is usually the first responder.

3. Responsibilities of Stakeholders

3.1. Intention

3.1.1. General Directorate of Civil Defence (GDCD) intended Fire and Life Safety's success in the country depends on a collective effort by all the stakeholders involved.

3.1.2. This chapter provides minimum guidelines to all the stakeholders, of their role and commitment in achieving a Fire Safe environment in Kingdom of Bahrain.

3.2. Basic Commitment

3.2.1. Success of Fire and Life Safety is in Prevention. Prevention of Fire through awareness and commitment of every individual in everyday life will ensure fire safe country.

3.2.2. Owners are responsible for fire safety from the design stage. They should be actively involved in the planning stage to ensure that the end result of their project is in full compliance with General Directorate of Civil Defence (GDCD) regulations and provide a fire safe environment for the occupants.

3.2.3. The importance of consultants in creating fire-safe structures cannot be overstated. Professional commitment of consultants in planning, designing and executing projects successfully to provide fire safe environment is of utmost importance.

3.2.4. Similar commitment and professionalism is expected from contractors executing projects on site. Adherence to permitted drawings, permitted specifications, permitted material requirements obviously mandatory, such as, obtaining material permit must be carried at initial phase of any project and included in layout permit process.

3.2.5. Manufacturers and suppliers shall be strictly committed to trading individual General Directorate of Civil Defence (GDCD) permitted materials. Inferior material quality can compromise everybody's effort in creating fire safe environment.

3.2.6. The responsibilities required by this chapter are minimum guidelines and legally valid requirements to be fulfilled by the concerned parties and stakeholders. Violations of the requirements of this chapter are legally punishable. It is the responsibility of individual stakeholder to obtain further information, evaluate and assess legal implications, where these requirements are violated.

3.3. Owner's Responsibilities

3.3.1. Owner shall perform his responsibilities as per **Table: - G.01-T1.**

Table:- G.01-T1: Owner's Responsibilities

ITEMS	REQUIREMENTS
1. OWNER'S REPRESENTATIVE	i. Owner shall be responsible for nominating his representative to deliver owner's duties, as required by this section. Personnel having knowledge of Fire and Life safety, Bahrain Fire and Life Safety Code of Practice requirements will be an immense advantage to the owner. ii. Evaluation of owner's representative's qualification, capability and commitment shall be owner's responsibility and owner shall ensure that the represented personnel or the organization truly epitomizes of his own intentions. iii. Where owner has appointed his representative, the term "Owner" in this section shall also mean "Owner's representative".
2. CONTRACTS	i. Owner shall ensure and be responsible to include in his legal contract documents with Insurance companies, Developers, Architects, Consultants, Contractors, Manufacturers, Suppliers, Professionals and Facility management companies that **"Fire and Life Safety Requirements from General Directorate of Civil Defence shall be strictly followed as per latest edition of Bahrain Fire and Life Safety Code of Practice, and other rules and regulations from General Directorate of Civil Defence."** ii. It is owner's responsibility to evaluate Consultant, House of Expertise, contractor, interior designer, manufacturer, supplier, testing laboratories and certification body's qualification and valid permit from General Directorate of Civil Defence, before awarding any contracts and making any agreement with them. iii. It is owner's responsibility to ensure that contract documents clearly state that **"All materials relevant to Fire and Life Safety, shall be those permitted and listed by General Directorate of Civil Defence.".**
3. PLANNING	i. Owner shall be involved with his team of consultants and contractors in the planning stage to discuss, enquire and convey his clear thoughts on the project, fire safety requirements, estimated cost and its impact on the overall project execution process. ii. Inability to understand the General Directorate of Civil Defence regulations during planning stage, can cause exponential fluctuations in budgeting in the later stages of the project. iii. It is not civil defense responsibility for over design and it has the right to reject over designed plans approaches of consultants, which unnecessarily increases project costs. Similarly it is owner's responsibility to be aware of "Value Engineering/Cost Effective" approaches which could be non-complaint to code requirements.
4. PERMITS	i. General Directorate of Civil Defence permits for the projects shall be through owner appointed consultant. ii. It is owner's responsibility to ensure that all parties involved in his project adhere to authority regulations and relevant permits and building permits are obtained from concerned authorities. iii. Owner shall ensure that construction does not commence without valid relevant permits and building permits. iv. For construction accidents, fire accidents and such mishaps on construction sites where constructions have begun without authority permits, the owner shall be held responsible.

Table:- G.01-T1: Owner's Responsibilities

ITEMS	REQUIREMENTS
5. DURING CONSTRUCTION	i. Owner shall ensure, through appointed program manager, developers and consultants, the Fire Safety of life and property during construction. ii. Comply with the owner or owner's representative's (Program Manager) duties and responsibilities during construction, as required by **Section G. Chapter 02 - Under Construction, Table:- G.02-T1.** iii. Where owner feels the need to ensure that Fire and Life Safety Systems are being installed as per the design and permits, a General Directorate of Civil Defence permitted and registered House of Expertise shall be appointed and monitored.
6. INSPECTION AND COMMISSIONING	**1. PRE-COMMISSIONING AND INSPECTION** i. Where owner feels the need to appoint a third party to ensure the Fire and Life Safety systems of the facility are delivering their intended purpose, a General Directorate of Civil Defence registered and listed House of Expertise shall be appointed to inspect the final functioning of the Fire and Life Safety Systems. **2. ACCEPTANCE TEST** i. Owner shall appoint registered Facility Management Company during filed acceptance test stage. ii. Field acceptance test witnessing shall be owner's responsibility, through his appointed program manager, ensuring facility management personnel's familiarity with facility and Fire and Life Safety aspects of the facility.
7. EMERGENCY EVACUATION PLAN	i. It is owner's responsibility to ensure consultant hands over Emergency Evacuation Plans, prepared as per **Section C. Chapter 05 - Table:- C.05-T1.8** ii. It is owner's responsibility to ensure facility management and consultant jointly commission the emergency evacuation plans, verifying the authenticity and applicability of such evacuation plan as per site conditions, furniture layouts etc., as per **Section C. Chapter 05 – Sub Section 5.**
8. EMERGENCY EVACUATION PROCEDURES OR EMERGENCY ACTION PLAN	i. It is owner's responsibility to develop customized, facility specific Emergency Evacuation Procedures and Emergency Action Plans through General Directorate of Civil Defence permitted House of Expertise, in accordance with **Section H. Chapter 02. Emergency Evacuation Procedures.** ii. Such Emergency Action plan shall take into consideration the personnel to be assigned for particular task, for particular actions to be taken, particular method of evacuation to be followed, decision to use elevators, coordination with General Directorate of Civil Defence personnel, assistance to be offered to old and disabled people etc. during emergency situations. Emergency Action Plan shall be as per minimum guidelines of **Section H. Chapter 02 - Table:- H.02-T1.**
9. OCCUPYING	i. Owner shall not let any occupants occupy the building, in part or whole, without 'General Directorate of Civil Defence' final commissioning and clearance to do so will subject the owner to legal implications. ii. Owner shall not let any occupants occupy the building, in part or whole, without fully functional Fire and Life Safety Systems in the facility with required power backup, sufficient water supply and accessories.

Table:- G.01-T1 : Owner's Responsibilities

ITEMS	REQUIREMENTS
10. INSPECTION AND MAINTENANCE	**1. ANNUAL MAINTENANCE CONTRACT** i. Owner shall be responsible to appoint a 'General Directorate of Civil Defence' permitted and listed installation and maintenance contractor, immediately upon commissioning to periodically inspect and maintain the Fire and Life Safety systems of the facility in accordance with **Table:- G.01-T1.10.2.** ii. Full record of periodic inspection and maintenance shall be documented and stored in the facility with facility management. iii. Up to date inspection stickers shall be placed on equipment and systems to satisfy random inspections from General Directorate of Civil Defence.
11. MODIFICATIONS OR CHANGE OF USAGE	i. It is owner's responsibility to ensure that usage of an permitted building is not altered or changed from one type of occupancy to another without formal application and approval from General Directorate of Civil Defence, through a consultant. ii. No modifications, alterations to structure, facility, layout or Fire and Life Safety systems and equipment shall be allowed without formal approval from 'General Directorate of Civil Defence' through consultants.
12. MULTIPLE OWNERS	i. Where there is a possibility that the project will be sold to multiple entities' ownership, it is primary owner's responsibility that the ownership and accountability for Fire and Life Safety Systems are not disputed. ii. Where common Fire and Life Safety Systems serve multiple owners, such as Hydrant network, LPG network, Fire water tanks and fire pump room, the inspection and maintenance shall be primary owner's responsibility.

3.4. Developer's Responsibilities

3.4.1. Developer shall perform his responsibilities as per **Table:- G.01-T2.**

Table:- G.01-T2: Developer's Responsibilities

ITEMS	REQUIREMENTS
1. IN-HOUSE FIRE ENGINEER	i. Developer shall be responsible for appointing and designating at least one Fire Engineer or similar who is qualified and experienced in, Fire and Life Safety, Bahrain Fire and Life Safety Code of Practice, General Directorate of Civil Defence Laws and Regulations.
2. CONTRACTS	i. Developer shall ensure and be responsible to include in his legal contract documents with Insurance companies, Architects, Consultants, Contractors, Manufacturers, Suppliers, Professionals and Facility management companies that **"Fire and Life Safety Requirements from General Directorate of Civil Defence shall be strictly followed as per latest edition of Bahrain Fire and Life Safety Code of Practice, and other rules and regulations from General Directorate of Civil Defence."** ii. It is developer's responsibility to evaluate Consultant, House of Expertise, Contractor, Interior Design contractors, Manufacturer, Supplier, Testing laboratories and Certification body's qualification and valid permit from General Directorate of Civil Defence, before awarding any contracts and making any agreement with them. iii. It is developer's responsibility to ensure that contract documents clearly state that **"All materials relevant to Fire and Life Safety, shall be permitted and listed by General Directorate of Civil Defence."**.
3. PLANNING	i. Developer shall ensure that the above said in-house Fire engineer is involved in the project from very initial stages of brainstorming, planning, drafting, budgeting and preparing the scope of the project to highlight the Fire and Life Safety aspect and extent of the project. ii. Inability to understand the General Directorate of Civil Defence regulations during planning stage, can cause exponential fluctuations in budgeting in the later stages of the project. iii. Developer shall have to meet before design stage of his overall project scope and shall introduce the project to General Directorate of Civil Defence for initial understanding of General Directorate of Civil Defence requirements which must be met based on the total area of the project, the location of the development, the vicinity of General Directorate of Civil Defence Fire Station from the project, the connectivity of the project land to the access roads etc. iv. It is developer's responsibility to monitor and police the "Over Design" approaches of consultants, which unnecessarily increases project costs. Similarly it is developer's responsibility to be aware of "Value Engineering/Cost Effective" approaches which could be non-complaint to code requirements.
4. MULTIPLE OWNERS	i. Where there is a possibility that the development will be sold to multiple owners, it is developer's responsibility that the ownership and accountability for Fire and Life Safety Systems are not disputed. ii. Where common Fire and Life Safety Systems serve multiple owners, such as Hydrant network, LPG network, Fire water tanks and fire pump room, the inspection and maintenance shall be developer's responsibility.

Table:- G.01-T2: Developer's Responsibilities

ITEMS	REQUIREMENTS
5. INFRASTRUCTURE	i. Provision of Infrastructure in the intended development shall be the responsibility of the developers. ii. Scope of the Developer shall essentially include the following. a. Road network, satisfying the Fire Access Road requirements, in accordance with **Section A. Chapter 01. Fire Access.** b. Private Yard Fire Hydrant System throughout the development complete with Fire Pump room and Fire Water Tank in accordance with **Section C. Section 4.10.** c. Cooking fuel network such as LPG or Natural Gas Supply and Distribution throughout, where required for cooking, heating and manufacturing purposes, in accordance with **Section F. Chapter 02.**
6. MASTER FIRE WATER TANK	i. Developer shall provide a "master fire water tank" having capacity of 2 hour operating duration and providing tapping facility to cater to all buildings in entire development. ii. This arrangement will save the cost of individual fire water tanks in each building in the development.
7. FIRE STATION	i. Where development area span exceeds General Directorate of Civil Defence criteria or the development is critical in terms of its distance from existing fire stations, it is the responsibility of the developer to provide a fire station in accordance with **Section A. Chapter 01- Sub. Section 5**. ii. The criteria for the requirement of a fire station shall be discussed with General Directorate of Civil Defence during the introduction stage of the project, as mentioned in **Table:- G.01-T2.3.iii.**
8. APPROVALS	i. General Directorate of Civil Defence approvals for the infrastructure projects shall be through developer appointed consultant. ii. It is developer's responsibility to ensure that all parties involved in his project adhere to authority regulations and relevant approvals and building permits are obtained from concerned authorities. iii. Developer shall ensure that written message to consultant is clear that construction does not commence without valid relevant approvals and building permits for the infrastructure. iv. For construction accidents, fire accidents and such mishaps on construction sites where constructions have begun without authority approvals, the developer shall be held responsible.
9. DURING CONSTRUCTION	i. Developer shall ensure that appointed consultant is responsible for the Fire Safety of life and property during construction. Developer shall ensure that his representative (Program Manager) comply with duties and responsibilities during construction, as required by **Section G. Chapter 02 - Under Construction, Table:- G.02-T1.** ii. Where developer or General Directorate of Civil Defence feels the need to ensure that Fire and Life Safety Systems are being installed as per the design and approvals, a General Directorate of Civil Defence permitted and registered House of Expertise shall be appointed and monitored.
10. FINAL SIGN OFF	i. Developer shall sign off final acceptance documents from the consultants, undertaking that all the Fire and Life Safety aspect of the infrastructure are as per permitted drawings and are in full compliance with Bahrain Fire and Life Safety Code of Practice. ii. This signed undertaking conformity from developer shall be submitted to General Directorate of Civil Defence along with final inspection, testing and acceptance documents for General Directorate of Civil Defence completion certificate.

3.5. Consultant's Responsibilities

3.5.1. Consultant shall perform his responsibilities as per **Table:- G.01-T3.**

Table:- G.01-T3: Consultant's Responsibilities

ITEMS	REQUIREMENTS
1. IN-HOUSE FIRE ENGINEERS	i. Consultant shall appoint permanent fire engineers or similar, qualified, competent and experienced in Fire and Life Safety. ii. Such a Fire engineers shall be well verse with the latest edition of Bahrain Fire and Life Safety Code of Practice. iii. Such a fire engineers or similar shall be well verse with "Drawing Submission" format, and online submission requirements, as required by **Section H. Chapter 03 - Drawing Submission Requirements.** iv. Consultant engineers shall be licensed by General Directorate of Civil Defence, based on their qualifications, training certificates and written examinations.
2. CONTRACTS	i. Consultant is responsible to include in his legal contract documents with Insurance companies, Owners, Developers, Architects, House of Expertise, Contractors, Manufacturers, Suppliers, Professionals and Facility management companies that **"Fire and Life Safety Requirements from General Directorate of Civil Defence shall be strictly followed as per latest edition of Bahrain Fire and Life Safety Code of Practice, and other rules and regulations from General Directorate of Civil Defence."** ii. It is consultant's responsibility to evaluate House of Expertise, contractors, Interior Design contractors, manufacturers, suppliers, testing laboratories and certification body's qualification and valid permit from General Directorate of Civil Defence, before awarding any contracts and making any agreement with them. iii. It is consultant's responsibility to ensure that contract documents clearly state that **"All materials relevant to Fire and Life Safety, shall be permitted and listed by General Directorate of Civil Defence.".** iv. It is consultant's responsibility to verify material test certificates and specifications in accordance with latest edition of Bahrain Fire and Life Safety Code of Practice.
3. PLANNING	i. It is consultant's responsibility to clearly convey to the owners and developers about Fire and Life Safety requirements of the project in the early stages of project planning. ii. Inability to understand the General Directorate of Civil Defence regulations during planning stage, can cause exponential fluctuations in budgeting in the later stages of the project. The consultant's shall be held responsible for such deviations. iii. It is consultant's responsibility to approach General Directorate of Civil Defence to clarify any complicated issues very early in the planning stage.
4. PERMITS	i. Consultant alone is responsible and authorized to apply to General Directorate of Civil Defence for project permits. ii. It is consultant's duty to submit full details for fire and life safety systems, cladding, roofing, fire doors etc. in the submission. iii. It is consultant's responsibility and scope of work to comply in full to the "Drawing Submission" requirements as per **Section H. Chapter 03 - Drawing Submission Requirements.** iv. It is consultant's responsibility to comply with online drawing submission procedures **(Refer to user manuals of General Directorate of Civil Defence - Kingdom of Bahrain.)** v. Non-compliance with "Drawing Submission" requirements such as colour coding, appropriate occupancy selection, drawings without scale etc. will unnecessarily delay the project review by General Directorate of Civil Defence – Kingdom of Bahrain. vi. Resubmissions without rectifying the drawings and revising the project as per General Directorate of Civil Defence recommendations and comments will cost the consultants fines and time.

Table:- G.01-T3: Consultant's Responsibilities

ITEMS	REQUIREMENTS
APPROVALS	vii. General Directorate of Civil Defence approval is obtained through submission of either one time package (design NOC) or two packages (Design NOC and shop drawing approval) as required by General Directorate of Civil Defence viii. Incomplete drawing submissions shall not be reviewed by General Directorate of Civil Defence and consultant shall be accountable for delays arising from such submissions. ix. Where consultant has hired General Directorate of Civil Defence permitted house of expertise, it shall be the consultant's responsibility to submit house of expertise stamped drawings. House of expertise is not authorized to submit drawings to General Directorate of Civil Defence. x. It is consultant's duty to ensure that construction does not commence without valid relevant approvals and building permits. xi. For construction accidents, fire accidents and such mishaps on construction sites where constructions have begun without authority approvals, the consultant shall be held responsible.
5. INTERACTION WITH GENERAL DIRECTORATE OF CIVIL DEFENCE	i. It is consultant's responsibility and prerequisite to understand the fire and life safety code requirements through courses and training. It is not General Directorate of Civil Defence responsibility to educate consultants on Fire and Life safety basics. ii. It is consultant's responsibility to arrange fire engineers or similar, architects, and fire systems engineers to discuss projects and code issues with General Directorate of Civil Defence, and not expect General Directorate of Civil Defence to conduct project meetings with non-professionals and office Public Relations Officer(PRO) who lack fire safety expertise to understand the discussions. iii. Consultant's shall fully explore the code compliance options before seeking General Directorate of General Directorate of Civil Defence involvement in decision making.
6. DURING CONSTRUCTION	i. Consultant, in coordination with owner's program manager shall be responsible to ensure the Fire Safety of life and property during construction. ii. Consultant shall coordinate with the Owner or owner's representative to prepare written (Program Manager's) duties and responsibilities during construction, as required by **Section G. Chapter 02 - Under Construction, Table:- G.02-T1.** iii. It is consultant's responsibility to ensure every contractor has appointed dedicated fire safety supervisor to monitor the onsite work by their team of workers. iv. It is consultant's responsibility to inspect construction and installation work and supervise contractors to ensure that the onsite proceedings are in compliance with General Directorate of Civil Defence permitted drawings and specifications. v. It is consultant's responsibility to verify the materials and components being used in construction and installation are same as specified and permitted. vi. Consultant shall inspect Fire stopping, cladding voids, concealed piping, underground installations etc. while they are exposed for inspections and certify before concealing permanently. vii. Where consultant feels the need to ensure that Fire and Life Safety Systems are being installed as per the design and approvals, and materials are as specified in approvals, a General Directorate of Civil Defence permitted and registered House of Expertise shall be appointed and monitored.

Table:- G.01-T3: Consultant's Responsibilities

ITEMS	REQUIREMENTS
	viii. Where consultant feels the need to ensure that Fire and Life Safety Systems are being installed as per the design and approvals, and materials are as specified in approvals, a civil Defense permitted and registered House of Expertise shall be appointed and monitored.
7. INSPECTION, COMMISSIONING AND HANDING OVER	**1. PRE-COMMISSIONING AND INSPECTION** i. It is consultant's duty to perform pre-commissioning inspection and testing to confirm the readiness of the building for final inspection and commissioning, before inviting General Directorate of Civil Defence team for inspection. ii. Consultant shall inspect and verify each and every aspect of Fire and Life Safety features of the building and shall document the same. iii. Where consultants appoint a third party to ensure the Fire and Life Safety systems of the facility are delivering their intended purpose, a General Directorate of Civil Defence registered and listed House of Expertise shall be appointed to inspect the final functioning of the Fire and Life Safety Systems, before inviting General Directorate of Civil Defence for commissioning.
2. ACCEPTANCE TEST AND HANDING OVER	
	i. Consultant shall ensure that commissioning of Fire and Life safety aspect of the building shall be in whole and not part by part or in phases, unless General Directorate of Civil Defence inspection team consent is obtained. ii. It is consultant's duty to ensure that all fire and Life safety systems are functioning as intended before handing over. iii. Consultant shall ensure that hand Fire and Life Safety System permitted drawings from General Directorate of Civil Defence, operating manual, maintenance manuals and required spare parts from contractors are handed over to owner or owner or owner's representatives. iv. Consultant shall ensure Fire and Life Safety Systems' Software along with required passwords from respective contractors are handed over to owner representatives. v. Consultant shall verify that Means of egress components such as Doors, Stairs and exits are as per acceptance criteria of **Section A. Chapter 03. Sub. Section 7.** vi. Consultant shall verify that Fire extinguishers are as per acceptance criteria of **Section D Chapter 01. Table:- D.01-T4.1.** and **Manufacturer's instructions.** vii. Consultant shall verify that Exit Signs are acceptable as per **Section C Chapter 05, Sub-Section 5.** and **Manufacturer's instructions.** viii. Consultant shall verify that Emergency Lighting system is acceptable as per **Section C. Chapter 04, Sub-Section 7.** and **Manufacturer's instructions.** ix. Consultant shall verify that Voice evacuation system, if any, is acceptable as per **Section C. Chapter 03, Sub-Section 5.** and **Manufacturer's instructions.** x. Consultant shall verify that Fire Detection and Alarm system is acceptable as per **Section C Chapter 01, Sub-Section 6.5.** and **Manufacturer's instructions.** xi. Consultant shall verify that Fire Protection systems are acceptable as per **Section D. Chapter 01, Sub-Section 5.** and **Manufacturer's instructions.**

Table:- G.01-T3: Consultant's Responsibilities

ITEMS	REQUIREMENTS
INSPECTION, COMMISSIONING AND HANDING OVER	xii. Consultant shall verify that Smoke Control System, if any, is acceptable as per **Section E Chapter 01, Sub-Section 5, Section 6.** and **Manufacturer's instructions.** xiii. Consultant shall verify that LPG system, if any, is acceptable as per **Section F. Chapter 02, Sub-Section 6.** and **Manufacturer's instructions.** xiv. Consultant shall verify that Kitchen hood Suppression Systems, if any, is accepted as per **Manufacturer's instructions.**
8. EMERGENCY EVACUATION PLAN	i. Preparation of Emergency Evacuation Plan is consultant's responsibility and scope of work. ii. Emergency Evacuation Plan shall comply with **Section C. Chapter 05 - Table:- C.05-T1.8** iii. It is consultant's responsibility to ensure facility management is involved in commissioning the emergency evacuation plans, verifying the authenticity and applicability of such evacuation plan as per site conditions, furniture layouts etc., as per **Section C. Chapter 05 – Sub Section 5.**
9. MODIFICATIONS TO GENERAL DIRECTORATE OF CIVIL DEFENCE PERMITTED DRAWINGS	i. Any modifications on site, to buildings or Fire and Life Safety systems or change of usage of the building, shall require re-permit by General Directorate of Civil Defence. It is consultant's responsibility to make changes to permitted drawings as per modifications on site and reapply to General Directorate of Civil Defence as "revised" for revision permits.
10. CODE COMPLIANCE	i. The overall code compliance of a project is complete responsibility of the consultant, in coordination with owner and contractors. ii. Permit from General Directorate of Civil Defence for any project drawings is based on minimum requirements and it does not relief consultant from his responsibility to verify and explore additional code compliance requirements from latest edition of **Bahrain Fire and Life Safety Code of Practice** and **The International Codes and Standards** referred within. iii. It is consultant's responsibility not to "Over Design" Fire and Life Safety aspects in a project, which unnecessarily increases project costs to the owner. Similarly it is consultant's responsibility to be cautious when adopting "Value Engineering/Cost Effective" approaches which could be noncompliant to code requirements. A careful in-depth analysis of Code requirements in the initial planning stage will save consultant valuable time and money. if not then GDCD has the right to take action against consultant in case of obvious over design.
11. FINAL SIGN OFF	i. Consultant shall sign off final handing over documents to the owner, undertaking that all the Fire and Life Safety aspect of the building are as per permitted drawings and are in full compliance with Bahrain Fire and Life Safety Code of Practice. ii. This signed undertaking conformity from consultant shall be submitted to General Directorate of Civil Defence along with final inspection, testing and handing over documents for General Directorate of Civil Defence completion certificate to occupy the building.

3.6. Contractor's (Installation and Maintenance) Responsibilities

3.6.1. Contractor shall perform his responsibilities as per **Table:- G.01-T4.**

Table:- G.01-T4: Contractor's (Installation and Maintenance) Responsibilities

ITEMS	REQUIREMENTS
1. MANPOWER	i. Contractors shall have qualified and experienced engineers and technicians, who are well versed in their respective Fire and Life Safety Systems' Design, Installation and Inspection. ii. Contractor engineers shall be well verse with latest edition of Bahrain Fire and Life Safety Code of Practice. iii. Contractor engineers and technicians shall have valid training certificates from specialized training bodies and also registered and permitted within GDCD laws and regulations. iv. Contractor shall be registered in the applicable category and permitted by General Directorate of Civil Defence as per applicable **decrees and regulations.** v. Contractor engineers and technicians shall be licensed by General Directorate of Civil Defence, based on their qualifications, training certificates and written examinations. vi. Each engineer is licensed by the crpep. vii. Each technician is licensed by EWA Technician license. viii. The required number of engineers and technicians shall as per applicable **decrees and regulations.** ix. Each engineer and technician shall be familiar with 2 system subjects. x. **However, these requirements are subject to changes in applicable laws, decrees and regulations of General Directorate of Civil Defence. It is Installation and Maintenance contractor's responsibility to verify the latest requirements with General Directorate of Civil Defence.**
2. SCOPE OF WORK	**1. GENERAL** i. When the contracting companies obtain the General Directorate of Civil Defence registration and license, they shall be authorized to install, inspect, issue installation certificates, and perform periodical maintenance works through annual maintenance contracts. ii. The experience requirements for engineers and technicians shall be as per applicable **decrees and regulations.** (Please verify with General Directorate of Civil Defence for latest version) iii. Contracting companies are licensed based on categorized **Table:- G.01-T4a**.

Table:- G.01-T4a: Contractor's (Installation and Maintenance) Responsibilities

CATEGORY	AUTHORISED HEIGHT LIMITATION	AUTHORISED AREA LIMITATION	AUTHORISED SYSTEM TO WORK	ENGINEERS REQUIRED		TECHNICIANS REQUIRED	
				MECHANICAL or EQUIVALENT	ELECTRICAL or EQUIVALENT	MECHANICAL or EQUIVALENT	ELECTRICAL or EQUIVALENT
CATEGORY A	**Any**	**Any**	-Fire Protection -Fire Alarm & Voice evacuation -Emergency Lighting -Exit Signage -Ventilation & Smoke Control (Optional)	3	3	12	12
CATEGORY B	**Less than 46 m**	**Less than 15,000 m^2**	-Fire Protection -Fire Alarm & Voice evacuation -Emergency Lighting -Exit Signage -Ventilation & Smoke Control (Optional)	2	2	8	8
CATEGORY C	**Less than 23 m**	**Less than 6500 m^2**	-Fire Protection -Fire Alarm & Voice evacuation -Emergency Lighting -Exit Signage -Ventilation & Smoke Control (Optional) -Non-Water based/Gas Suppression System (Optional)	2	2	4	4
CATEGORY D	**Any**	**Any**	- LPG/ Natural Gas	1	1	3	3
CATEGORY E	**Any**	**Any**	-Ventilation and Smoke Control	1	1	3	3
CATEGORY F	**Any**	**Any**	-Fire Door/ Fire Windows/ Fire and Smoke Barrier/ Partitions	6 (Specialist experienced in the fields of license)			
CATEGORY G	**Any**	**Any**	-Fire Stopping system -Penetration Seals -Perimeter Fire Stopping -Curtain wall Fire Stopping	2 (Specialist in Fire Stopping)		6(Technician in Fire Stopping)	
CATEGORY H*	**Any***	**Any***	-Exterior Wall Façade and Exterior Wall Covering -Glazing and Roofing	1*	1*	3*	3*

Category A,B,C company has an option of including or excluding the system mentioned as (Optional) from their scope of work.

*Category H company requires 1 Façade/Glazing/Roofing Specialist, 1 Civil Engineer, 3 Façade/Glazing/Roofing Technicians and 3 Mechanical or Fabrication Technicians.

Table:- G.01-T4: Contractor's (Installation and Maintenance) Responsibilities

ITEMS	REQUIREMENTS
3. CONTRACTS	i. Contractor is responsible to include in his legal contract documents, be it installation or maintenance or both, with Insurance companies, Owners, Consultants, other Contractors, Manufacturers, Suppliers, Professionals and Facility management companies that **"Fire and Life Safety Requirements from General Directorate of Civil Defence shall bestrictly followed as per latest edition of Bahrain Fire and Life Safety Code of Practice, and other rules and regulations from General Directorate of Civil Defence."** ii. It is contractor's responsibility to verify that suppliers of fire and life safety systems, devices, equipment and materials have valid license for products and company registration from General Directorate of Civil Defence, before placing order for products and making any agreement with them. iii. It is contractor's responsibility to ensure that contract documents clearly state that **"All the materials relevant to Fire and Life Safety, shall be permitted and listed by General Directorate of Civil Defence.".** iv. It is contractor's responsibility to verify material test certificates and specifications in accordance with latest edition of **Bahrain Fire and Life Safety Code of Practice.** v. Maintenance contracts' periodic activity and required repetitions annually shall be as per **Table:- G.01-T4.8.3.**
4. PLANNING	**1. INSTALLATION** i. It is contractor's responsibility to verify scope of work clearly with consultant and ensure that consultant's scope of work document addresses all the aspects of Fire and Life Safety Systems, in depth and in accordance with Bahrain Fire and Life Safety Code of practice. ii. Inability to understand the General Directorate of Civil Defence regulations during execution planning stage, can cause exponential fluctuations in budgeting in the later stages of the project. For such deviations contractors shall be held responsible. iii. It is contractor's responsibility to approach consultant to clarify any complicated issues very early in the execution planning stage. **2. MAINTENANCE** i. It is contractor's responsibility to verify scope of work, spare parts availability, repair and replacement issues clearly with owners during annual maintenance contract agreement.
5. APPROVALS	**1. INSTALLATION** i. It is contractor's duty to understand that there will be no shop drawing approvals for fire and life safety systems, or cladding or fire doors approvals through contractors. However, General Directorate of Civil Defence might have different approaches to shop drawing approvals for contractors. It is contractor's duty to verify this requirement with General Directorate of Civil Defence. ii. Consultant alone is responsible and authorized to apply to General Directorate of Civil Defence for project approvals. Thus it is contractor's responsibility to insist on execution of work only upon receiving final General Directorate of Civil Defence permitted drawings from consultant. iii. It is contractor's responsibility to insist on detailed material specifications, in accordance with Bahrain Fire and Life Safety Code of Practice, from consultant. iv. Contractor shall not start executing work on site with construction, earthwork, installation, programming, or any such activity related to Fire and Life Safety without final General Directorate of Civil Defence permitted drawings from consultant.

Table:- G.01-T4: Contractor's Responsibilities

ITEMS	REQUIREMENTS
6. PRODUCTS/ MATERIALS/ SYSTEMS	i. Selection of materials, systems, products and components required for the project or maintenance is contractor's responsibility and it shall comply to consultant's specifications based on General Directorate of Civil Defence permitted drawings. ii. Contractors are prohibited to install or use any materials, products and components that are not registered and listed by General Directorate of Civil Defence. iii. It is contractor's responsibility to verify supplier's valid registration, license and approvals from General Directorate of Civil Defence. iv. Contractors are prohibited to procure materials, products and systems from suppliers who do not have license or whose license from General Directorate of Civil Defence is not valid or expired.
7. DURING INSTALLATION OR MAINTENANCE	i. Contractor shall be responsible for the Fire Safety of life and property during execution of his scope of work. ii. Contractor shall coordinate with the Owner or owner's representative to observe (Program Manager's) duties and responsibilities during construction or maintenance, as required by **Section G. Chapter 02 - Under Construction, Table:- G.02-T1.** iii. It is contractor's responsibility to appoint dedicated fire safety supervisor to monitor the onsite work by their team of workers. iv. It is contractor's responsibility to coordinate and cooperate with consultant during construction and installation to ensure that the onsite proceedings are in compliance with General Directorate of Civil Defence permitted drawings and specifications. v. It is contractor's responsibility to verify the materials and components supplied and being used in construction and installation or maintenance are same as specified and permitted. vi. It is contractor's responsibility to initiate inspection request and seek clearance from consultant for fire stopping, cladding voids, concealed spaces, underground works etc. before closing concealed spaces, voids or backfilling. vii. Any onsite changes, discrepancies or deviations or non-compliances arise during construction and installation, it is contractor's responsibility to bring the matter immediately to consultant's notice to resolve the matter. viii. It is each contractor's responsibility to cooperate and coordinate with other contractors and their scope and systems, where interfacing or interaction arises between different types of systems and different parties involved in execution. ix. It is contractor's responsibility to store their materials, products and components in accordance with manufacturer's and supplier's guidelines and to observe care with storage temperatures, humidity, dust, impact and vibration such that materials, products and components to be installed are not damaged or impaired.
8. CODE COMPLAINCE	i. General Directorate of Civil Defence permitted drawings from consultants do not relief contractors from adhering to detailed installation requirements in accordance with latest edition of **Bahrain Fire and Life Safety Code of practice and the International Codes and Standards referred** within. ii. It is contractor's responsibility to comply with complete installation guidelines from manufacturers along with full compliance of installation guidelines from **Bahrain Fire and Life Safety Code of Practice**. iii. During maintenance, it is contractor's responsibility to highlight to the owner, any non-compliances existing in the systems for owner's action and decisions to rectify.

Table:- G.01-T4: Contractor's Responsibilities

ITEMS	REQUIREMENTS
9. INSPECTION, COMMISSIONING AND HANDING OVER	**1. PRE-COMMISSIONING AND INSPECTION** i. It is contractor's duty to perform pre-commissioning inspection and testing to confirm the readiness of the building for final inspection and commissioning, before inviting consultant for inspection. ii. Contractor shall inspect and verify each and every aspect of Fire and Life Safety features of the building and shall document the same in detailed reports. iii. It is contractor's responsibility to coordinate and cooperate with consultants, owner's representatives and house of expertise, if on board, to jointly inspect Fire and Life Safety Systems to ensure Fire and Life Safety Systems are installed successfully as intended. iv. It is contractor's responsibility to rectify, revise and rework on any short comings pointed out during such joint inspections before inviting General Directorate of Civil Defence for final inspection and commissioning.
2. ACCEPTANCE TEST AND HANDING OVER	
	i. Each contractor shall ensure that commissioning of his scope of Fire and Life safety aspect of the building shall be in whole and not part by part or in phases. ii. Contractors shall thoroughly test their scope of Fire and Life Safety Systems and demonstrate that all systems are functioning as per the manufacturer's specification and as intended by the General Directorate of Civil Defence permitted consultant drawings. iii. It is contractor's responsibility to coordinate and cooperate with consultant in handing over Fire and Life Safety System operating manual, maintenance manuals, testing reports and required spare parts to the consultant. iv. It is contractor's responsibility to coordinate and cooperate with consultant in handing over Fire and Life Safety Systems' Software along with required passwords to the consultant. v. Respective contractors shall test and demonstrate that Means of egress components such as Doors, Stairs and exits are as per acceptance criteria of **Section A. Chapter 03. Sub. Section 7.** vi. Respective contractors shall verify and demonstrate that Fire extinguishers are as per acceptance criteria of **Section D Chapter 01. Table:- D.01-T4.1.** and **Manufacturer's instructions.** vii. Respective contractors shall verify and demonstrate that Exit Signs are acceptable as per **Section C Chapter 05, Sub-Section 5.** and **Manufacturer's instructions.** viii. Respective contractors shall test and demonstrate that Emergency Lighting system is acceptable as per **Section C. Chapter 04, Sub-Section 7.** and **Manufacturer's instructions.** ix. Respective contractors shall test and demonstrate Voice evacuation system, if any, is acceptable as per **Section C. Chapter 03, Sub-Section 5.** and **Manufacturer's instructions.** x. Respective contractors shall test and demonstrate that Fire Detection and Alarm system is acceptable as per **Section C Chapter 01, Sub-Section 6.5.** and **Manufacturer's instructions.** xi. Respective contractors shall test and demonstrate that Fire Protection systems are acceptable as **Section D. Chapter 01, Sub-Section 5.** and **Manufacturer's instructions.**

Table:- G.01-T4: Contractor's Responsibilities

ITEMS	REQUIREMENTS
INSPECTION, COMMISSIONING AND HANDING OVER	xii. Respective contractors shall test and demonstrate that Smoke Control System, if any, is acceptable as **Section E Chapter 01, Sub-Section 5, Section 6.** and **Manufacturer's instructions.** xiii. Respective contractors shall test and demonstrate that LPG system, if any, is acceptable as per **Section F. Chapter 02, Sub-Section 6.** and **Manufacturer's instructions.** xiv. Respective contractors shall test and demonstrate that Kitchen hood Suppression Systems, if any, is accepted as per **Manufacturer's instructions.**
3. MAINTENANCE	
	i. Doors, Exits, Stairs shall be maintained as per **Section A.Chapter 03. Sub-Section 7.** ii. Fire extinguishers shall be maintained as per **Section D. Chapter 01. Table:- D.01-T4.1.** iii. Exit Signs shall be maintained as per **Chapter 5, Section 4.** iv. Emergency Lighting system shall be maintained as per **Section C. Chapter 04, Sub-Section 7.** v. Voice evacuation system, if any, shall be maintained as per **Section C. Chapter 03, Sub-Section 5.** vi. Fire Detection and Alarm system shall be maintained as per **Section C Chapter 01, Sub-Section 6.5** vii. Fire Protection systems shall be maintained as per **Section D. Chapter 01, Sub-Section 5** viii. Smoke Control System, if any, shall be maintained as per **Section E Chapter 01, Sub-Section 5 and Section 6.** ix. LPG system, if any, shall be maintained as per **Section F. Chapter 02, Sub-Section 6** x. Kitchen hood suppression system, if any, shall be maintained as per **Manufacturer's instructions.** xi. Fire stopping systems shall be maintained as per **Section A. Chapter 02, Sub-Section 4.**
10. FINAL SIGN OFF	i. Contractor shall sign off final handing over documents to the consultant, undertaking that all the Fire and Life Safety aspect of the building are as per permitted drawings, permitted material and product specifications and are in full compliance with Bahrain Fire and Life Safety Code of Practice. ii. It is contractor's responsibility to sign off and handover "Installation Certificates" to the consultant, when installation is the contractual agreement. iii. It is contractor's responsibility to sign off and handover "Maintenance Certificate" to the owner, when maintenance is the contractual agreement. iv. This signed undertaking conformity from contractor shall be submitted to General Directorate of Civil Defence along with final inspection, testing, warranty documents and handing over documents for General Directorate of Civil Defence NOC to occupy the building.

3.7. Interior Design Contractor's (Fit-Out Contractor) Responsibilities

3.7.1. **Interior Design** Contractor shall perform his responsibilities as per **Table:- G.01-T5.**

Table:- G.01-T5: Interior Design Contractor's Responsibilities

ITEMS	REQUIREMENTS
1. ENGINEERS	i. Interior Design Contractors shall have qualified and experienced engineers, who are well verse in the Fire and Life Safety aspects of the tenant space and fit-out work. ii. Such engineers shall be well verse with the latest edition of Bahrain Fire and Life Safety Code of Practice. iii. Such engineers shall be well verse with "Drawing Submission" format, and online submission requirements as required by **Section H. Chapter 03. Drawing Submission Requirements**. iv. Interior Design contracting engineers shall be licensed by General Directorate of Civil Defence, based on their qualifications, training certificates and written examinations.
2. CONTRACTS	**i.** Interior Design Contractor is responsible to include in his legal contract documents with Insurance companies, Owners, Consultants, other Contractors, Manufacturers, Suppliers, Professionals and Facility management companies that **"Fire and Life Safety Requirements from General Directorate of Civil Defence shall be strictly followed as per latest edition of Bahrain Fire and Life Safety Code of Practice, and other rules and regulations from General Directorate of Civil Defence."** ii. It is Interior Design contractor's responsibility to evaluate manufacturers' and suppliers' qualifications, valid permit for their products and their company registration by Civil Defence, before placing order for products and entering any agreement with them. iii. It is Interior Design contractor's responsibility to ensure that contract documents clearly state that **"All the materials relevant to Fire and Life Safety, shall be permitted and listed by General Directorate of Civil Defence.".** **iv.** It is Interior Design contractor's responsibility to verify material test certificates and specifications in accordance with latest edition of **Bahrain Fire and Life Safety Code of Practice.**
3. PLANNING	i. It is Interior Design contractor's responsibility to clearly convey to the owners and consultants about Fire and Life Safety requirements of the project in the early stages of project planning. ii. Inability to understand the General Directorate of Civil Defence regulations during planning stage, can cause exponential fluctuations in budgeting in the later stages of the project. For such deviations Interior Design contractor shall be held responsible. iii. It is Interior Design contractor's responsibility to approach consultant and owner to clarify code compliance issues very early in the planning stage.
4. PERMITS	i. Interior Design contractor is responsible and authorized to apply to General Directorate of Civil Defence for fit-out and Interior Design project permits. ii. It is Interior Design contractor's duty to understand that there will be no shop drawing permits for fire and life safety systems, or cladding or fire doors permits through contractors. iii. It is Interior Design contractor's responsibility and scope of work to comply in full to the "Drawing Submission" requirements as per **Section H. Chapter 03. Drawing Submission Requirements**. iv. It is Interior Design contractor's responsibility to comply with online drawing submission procedures **(Refer to user manuals of General Directorate of Civil Defence)** v. Noncompliance with "Drawing Submission" requirements such as colour coding, appropriate occupancy selection, drawings without scale etc. will unnecessarily delay the project review by General Directorate of Civil Defence.

Table:- G.01-T5: Décor Contractor's Responsibilities

ITEMS	REQUIREMENTS
APPROVALS	vi. Resubmissions without rectifying the drawings and revising the project as per General Directorate of Civil Defence recommendations and comments will cost the Décor contractor fines and time. vii. General Directorate of Civil Defence approval is "one time" approval for complete design package with full details of involved fire and life safety systems in the project, including material specifications. viii. Incomplete drawing submissions shall not be reviewed by General Directorate of Civil Defence and Décor contractor shall be accountable for delays arising from such submissions. ix. It is Décor contractor's duty to ensure that site work/construction/installation does not commence without valid relevant approvals from General Directorate of Civil Defence and building permits. x. The décor contractor shall be held responsible for construction accidents, fire accidents and such mishaps on construction sites where site work/construction/ installation have begun without authority approvals.
5. INTERACTION WITH GENERAL DIRECTORATE OF CIVIL DEFENCE(GDCD)	i. It is Décor contractor's responsibility and prerequisite to understand the fire and life safety code requirements through courses and trainings. It is not General Directorate of Civil Defence responsibility to educate Décor contractors on Fire and Life safety basics. ii. It is Décor contractor's responsibility to arrange fire engineers, architects, and fire systems engineers to discuss projects and code issues with General Directorate of Civil Defence, and not expect General Directorate of Civil Defence to conduct project meetings with non-professionals and office PRO's who are unable to understand the discussions. iii. Décor contractor's shall fully explore the code compliance options before seeking General Directorate of Civil Defence involvement in decision making.
6. DURING CONSTRUC-TION	i. Décor contractor shall be responsible for the Fire Safety of life and property during fit-out construction. ii. Décor contractor shall coordinate with the Owner or owner's representative to prepare written (Program Manager's) duties and responsibilities during construction, as required by **Section G. Chapter 02 - Under Construction, Table:- G.02-T1.** iii. It is Décor contractor's responsibility to appoint dedicated fire safety supervisor to monitor the onsite work by their team of workers. iv. It is Décor contractor's responsibility to interact and coordinate with consultant to inspect construction and installation work to ensure that the onsite proceedings are in compliance with General Directorate of Civil Defence permitted drawings and specifications. v. It is Décor contractor's responsibility to verify the materials and components being used in construction and installation are same as specified and permitted by consultant and General Directorate of Civil Defence. vi. Décor contractor shall inspect Fire stopping, cladding voids, concealed piping, underground installations etc. while they are still exposed for inspections and take clearance from consultant before concealing permanently. vii. Where Décor contractor feels the need to ensure that Fire and Life Safety Systems are being installed as per the design and approvals, and materials are as specified in approvals, the General Directorate of Civil Defence permitted and registered House of Expertise shall be appointed and monitored.

Table:- G.01-T5: Interior Design Contractor's Responsibilities

ITEMS	REQUIREMENTS
7. INSPECTION, COMMISSIONING AND HANDING OVER	**1. PRE-COMMISSIONING AND INSPECTION** i. It is Interior Design contractor's duty to ensure that Fire and Life Safety aspect of their scope of work is inspected and testing to confirm the readiness, before inviting General Directorate of Civil Defence team for inspection. ii. It is Interior Design contractor's responsibility to coordinate and cooperate with Consultants and contractors to inspect and verify satisfactory functionality of each and every aspect of Fire and Life Safety features of the building and shall document the same. iii. Where Interior Design contractors appoint a third party to ensure the Fire and Life Safety systems of the facility are delivering their intended purpose, a General Directorate of Civil Defence registered and listed House of Expertise shall be appointed to inspect the final functioning of the Fire and Life Safety Systems, before inviting Bahrain' General Directorate of Civil Defence for commissioning.
	2. ACCEPTANCE TEST AND HANDING OVER
	i. Interior Design contractor shall ensure that commissioning of Fire and Life safety aspect of the tenant space shall be in whole and not part by part or in phases, unless General Directorate of Civil Defence inspection team consent is obtained. ii. Interior Design contractor shall involve owner, owner's representatives, owner appointed facility management and consultant for the acceptance test and acceptance test reports shall be signed by all parties jointly. iii. Interior Design contractor shall hand over Fire and Life Safety System permitted drawings from General Directorate of Civil Defence, operating manual, maintenance manuals and required spare parts, if any. iv. Interior Design contractor shall handover Fire and Life Safety Systems' Software, if any, along with required passwords. v. Interior Design contractor, where means of egress was scope of work, shall verify that Means of egress components such as Doors, Stairs and exits are as per acceptance criteria of **Section A. Chapter 03. Sub. Section 7.** vi. Interior Design contractor shall verify that Fire extinguishers are as per acceptance criteria of **Section D Chapter 01. Table:- D.01-T4.1.** and **Manufacturer's instructions.** vii. Interior Design contractor shall verify that Exit Signs are acceptable as per **Section C Chapter 05, Sub-Section 5.** and **Manufacturer's instructions.** Interior Design contractor shall verify that Emergency Lighting system is acceptable as per **Section C. Chapter 04, Sub-Section 7.** and **Manufacturer's instructions.** viii. Interior Design contractor shall verify that Voice evacuation system, if any, is acceptable as per **Section C. Chapter 03, Sub-Section 5.** and **Manufacturer's instructions.** ix. Interior Design contractor shall verify that Fire Detection and Alarm system is acceptable as per **Section C Chapter 01, Sub-Section 6.5.** and **Manufacturer's instructions.** Interior Design contractor shall verify that Fire Protection systems are acceptable as per **Section D. Chapter 01, Sub-Section 5.** and **Manufacturer's instructions.** x. Interior Design contractor shall verify that Smoke Control System, if any, is acceptable as per **Section E Chapter 01, Sub-Section 5, Section 6.** and **Manufacturer's instructions.** xi. Interior Design contractor shall verify that LPG system, if any, is acceptable as per **Section F. Chapter 02, Sub-Section 6.** and **Manufacturer's instructions.** xii. Interior Design contractor shall verify that Kitchen hood Suppression Systems, if any, is accepted as per **Manufacturer's instructions.**

Table:- G.01-T5: Interior Design Contractor's Responsibilities

ITEMS	REQUIREMENTS
8. EMERGENCY EVACUATION PLAN	i. Interior Design contractor shall coordinate with consultant to ensure that Emergency Evacuation Plan confirms to site conditions, furniture layout etc. ii. Emergency Evacuation Plan shall comply with **Section C. Chapter 05 - Table:- C.05-T1.8**
9. MODIFICATIONS TO GENERAL DIRECTORATE OF CIVIL DEFENCE PERMITTED DRAWINGS	i. Any modifications on site, to construction or Fire and Life Safety systems or change of usage of the building, which are not as per General Directorate of Civil Defence permitted drawings automatically invalidates the General Directorate of Civil Defence permitted drawings. It is Interior Design contractor's responsibility to make changes to permitted drawings as per modifications on site and reapply to General Directorate of Civil Defence as "revised" for revision permits.
10. CODE COMPLIANCE	i. The overall code compliance of a fit-out work is complete responsibility of the Interior Design contractor. ii. Permit from General Directorate of Civil Defence for any project drawings is based on minimum requirements and it does not relief Interior Design contractor from his responsibility to verify and explore additional code compliance requirements from latest edition of **Bahrain Fire and Life Safety Code of Practice** and **The International Codes and Standards** referred within.
11. FINAL SIGN OFF	i. Interior Design contractor shall sign off final handing over documents to the owner, undertaking that all the Fire and Life Safety aspect of the fit-out work are as per permitted drawings and are in full compliance with Bahrain Fire and Life Safety Code of Practice. ii. This signed undertaking conformity from Interior Design contractor shall be submitted to General Directorate of Civil Defence along with final inspection, testing and handing over documents for General Directorate of Civil Defence NOC.

3.8. House of Expertise Responsibilities

3.8.1. House of Expertise shall perform his responsibilities as per **Table:- G.01-T6.**

Table:- G.01-T6.: House of Expertise Responsibilities

ITEMS	REQUIREMENTS
1. ENGINEERS	i. House of Expertise category is subdivided into, a. House of Expertise for Fire and Life Safety in buildings and establishments. ii. House of Expertise shall have qualified and experienced fire engineers, who are well verse in the Fire and Life Safety as per the scope of their license. iii. Such Fire engineers shall be well verse with the latest edition of Bahrain Fire and Life Safety Code of Practice. iv. House of Expertise shall be registered, licensed and permitted by General Directorate of Civil Defence. v. House of Expertise engineers shall be licensed by General Directorate of Civil Defence, based on their qualifications, experience, training certificates and written examinations. vi. Fire and Life Safety Engineers, along with written examinations, shall also have practical tests of reviewing and assessing projects. vii. Each engineer must pass internal accreditation, in their respective chosen fields as mentioned in **Section A. Chapter 02 - Table:- A.02-T6.a.** with minimum score of 80 marks out of 100. viii. Required House of Expertise engineers, in their respective fields shall be as per **Applicable decrees and regulations.** ix. It is House of Expertise' responsibility to inform and take permission from General Directorate of Civil Defence to execute their scope of work, when General Directorate of Civil Defence permitted and licensed engineers from the organization leave the organization. It is House of Expertise responsibility, to hire new qualified engineers for General Directorate of Civil Defence registration within 45 days of such permission granted by General Directorate of Civil Defence. x. Additional certifications to the organization such as ISO/IEC 17020, IAS AC 291, IAS AC 98 or additional qualifications of engineers such as Professional Engineer (PE) or chartered engineer are added value to House of Expertise. xi. However, these requirements are subjected to change in laws and policies, of General Directorate of Civil Defence. It is House of expertise responsibility to verify the requirements with General Directorate of Civil Defence.
2. SCOPE OF WORK	**1. HOUSE OF EXPERTISE FOR FIRE AND LIFE SAFETY** i. House of Expertise are permitted and licensed by General Directorate of Civil Defence to deliver expertise in Fire and Life Safety as counselor, advisor or expert, where hired by owners, lead consultants, contractors and insurance companies. ii. House of expertise for Fire and Life safety scope of work and proficiency shall be a. Fire and Life Safety design drawings and reports. b. Fire Protection and Suppression System design, inspection and evaluation. c. Fire Detection and alarm system and Voice Alarm System design, inspection and evaluation. d. Emergency Lighting and sign system design, inspection and evaluation. e. Risk assessment of new and existing facilities. f. Preparation of Emergency Action Plans and procedures. iii. House of expertise for Fire and Life safety shall have manpower in accordance with **applicable decrees and regulations.**

Table:- G.01-T6.: House of Expertise Responsibilities

ITEMS	REQUIREMENTS
3. RESPONSIBILITIES	**1. PERMITS** i. House of Expertise are not authorized to create and submit permit applications to General Directorate of Civil Defence. They shall perform their responsibilities through main consultant or Interior Design contractor. ii. House of Expertise are not authorized to submit Risk assessment reports, Cladding reposts, Fire stopping reports, CFD reports or Inspection reports directly to General Directorate of Civil Defence. All submissions shall be through consultants. iii. Where appointed by consultants or Interior Design contractors to prepare Fire and Life Safety drawings, it is House of Expertise' responsibility and scope of work to comply in full to the following. a. Drawings prepared by House of Expertise shall comply with "Drawing Submission" requirements as per **Section H. Chapter 03 - Drawing Submission Requirements.** Noncompliance with "Drawing Submission" requirements such as colour coding, inappropriate occupancy selection, drawings without scale etc. shall be fined to House of Expertise. b. House of Expertise submissions through consultant shall be complete with occupancy risk assessments, occupant load calculations, code references, evaluations and justifications in a professional manner. c. Where risk assessment is scope of work, House of Expertise shall comply with **Section H. Chapter 01. RA Studies.** d. Where installation assessment is scope of work, House of Expertise shall evaluate design, installation methods, products and manufacturer's test certificates' compliance with latest edition of **Bahrain Fire and Life Safety Code of Practice requirements**. e. House of Expertise shall review project and ensure code compliance thoroughly, in accordance with **Bahrain Fire and Life Safety Code of Practice**, before submitting to General Directorate of Civil Defence through consultant or Interior Design contractors. f. It is House of Expertise' responsibility to highlight non compliances, if any, and insist on revisions to consultant's proposals before approving consultant's project proposals to be submitted to General Directorate of Civil Defence. g. House of Expertise shall stamp drawings as "reviewed and permitted" before submitting to General Directorate of Civil Defence through consultant. h. Where design drawings are prepared, assessed and endorsed by House of Expertise, they shall be held responsible, when non-compliant proposals from consultant are submitted to General Directorate of Civil Defence. Resubmissions bearing the review and permit stamp of the House of Expertise without rectifying the drawings and revising the project as per General Directorate of Civil Defence recommendations and comments will be fined to House of Expertise. i. It is House of Expertise responsibilities to join the consultant, where meetings with General Directorate of Civil Defence are initiated.

Table:- G.01-T6: House of Expertise Responsibilities

ITEMS	REQUIREMENTS
RESPONSIBILITIES	c. House of Expertise shall ensure that commissioning of Fire and Life safety aspect of the building shall be in whole and not part by part or in phases, un- less General Directorate of Civil Defence inspection team consent is obtained. d. House of Expertise shall involve owner, owner's representatives, owner appointed facility management for the acceptance test and acceptance test reports shall be signed by all parties jointly. e. It is House of Expertise' duty to ensure that all fire and Life safety systems are functioning as permitted and intended. f. House of Expertise shall verify that Means of egress components such as Doors, Stairs and exits are as per acceptance criteria of **Section A.Chapter 03. Sub-Section 7.** i. House of Expertise shall verify that Fire extinguishers are as per acceptance criteria of **Section D. Chapter 01. Table:- D.01-T4.1.** g. House of Expertise shall verify that Exit Signs are acceptable as per **Section C Chapter 05, Sub-Section 5.** and **Manufacturer's instructions.** House of Expertise shall verify that Emergency Lighting system is acceptable as per **Section C. Chapter 04, Sub-Section 7.** and **Manufacturer's instructions.** h. House of Expertise shall verify that Voice evacuation system, if any, is acceptable as per **Section C. Chapter 03, Sub-Section 5.** and **Manufacturer's instructions.** i. House of Expertise shall verify that Fire Detection and Alarm system is acceptable as per **Section C Chapter 01, Sub-Section 6.5.** and **Manufacturer's instructions.** House of Expertise shall verify that Fire Protection systems are acceptable as per **Section D. Chapter 01, Sub-Section 5.** and **Manufacturer's instructions.** j. House of Expertise shall verify that Smoke Control System, if any, is acceptable as per **Section E Chapter 01, Sub-Section 5, Section 6.** and **Manufacturer's instructions.** k. House of Expertise shall verify that LPG system, if any, is acceptable as per **Section F. Chapter 02, Sub-Section 6.** and **Manufacturer's instructions.** l. House of Expertise shall verify that Kitchen hood Suppression Systems, if any, is accepted as per **Manufacturer's instructions.** m. House of Expertise appointed to inspect the Fire stopping Systems, shall coordinate with consultant to arrange for progressive inspections during installations and shall be inspected at each stage of the installation process, before the fire stopping systems are concealed. Fire stopping systems shall be inspected as per **Chapter 1. Section 3.3** and **Section 3.4.** **2. INSPECTIONS** i. Where appointed by Owners, consultants or Interior Design contractors to conduct inspections of Fire and Life Safety aspects of the project, it is House of Expertise' responsibility to comply to the following, as applicable, within the extent of their scope of contract. a. It is House of Expertise duty to ensure that contractors perform precommissioning inspection and testing to confirm the readiness of the building for final inspection and commissioning, before inviting General Directorate of Civil Defence team for inspection. b. House of Expertise shall inspect and verify each and every aspect of Fire and Life Safety features of the building and shall document the same.

Table:- G.01-T6: House of Expertise Responsibilities

ITEMS	REQUIREMENTS
RESPONSIBILITIES	**3. REPORTS** i. Where House of Expertise are appointed by consultants to evaluate Cladding Systems, full installation methods, material specifications, product and system test certifications, installer's qualifications etc. shall be evaluated for compliance in accordance with **Bahrain Fire and Life Safety Code of Practice**, and submitted to General Directorate of Civil Defence through consultant, only when cladding systems are complaint. Non Compliant cladding systems shall not be submitted to General Directorate of Civil Defence. ii. Where House of Expertise are appointed by consultant to evaluate Smoke Control Systems, full design criteria, CFD analysis, if any, design intent, material specifications, product and system test certifications, installer's qualifications etc. shall be evaluated for compliance in accordance with Bahrain Fire and Life Safety Code of Practice, and submitted to General Directorate of Civil Defence through consultant, only when smoke control systems are complaint. Non-Compliant smoke control systems shall not be submitted to General Directorate of Civil Defence.
4. CODE COMPLIANCE	i. The overall code compliance evaluation of the project is primary responsibility of the House of Expertise, when appointed to do so. ii. Permit from General Directorate of Civil Defence for any project drawings is based on minimum requirements and it does not relief consultant or House of Expertise from his responsibility to verify and explore additional code compliance requirements from **Bahrain Fire and Life Safety Code of Practice** and **The International Codes and Standards** referred within. iii. Though performance based designs from House of Expertise are acceptable, it is House of Expertise' responsibility not to compromise the Fire and Life Safety aspects of the project or the intent of the requirements of prescriptive codes while having "Performance Based Design" approaches or conducting "Engineering Judgments".
5. FINAL SIGN OFF	i. Where appointed by consultants or Interior Design contractors, House of Expertise shall sign off final Fire and Life Safety evaluation and inspection documents to the owner, undertaking that all the Fire and Life Safety aspect of the building are as per permitted drawings and are in full compliance with **Bahrain Fire and Life Safety Code of Practice**. ii. This signed undertaking conformity from House of Expertise shall be submitted to General Directorate of Civil Defence along with final inspection, testing and handing over documents for General Directorate of Civil Defence completion certificate to occupy the building.

3.9. Local Manufacturer's Responsibilities

3.9.1. Local Manufacturing Companies shall perform their responsibilities as per **Table:- G.01-T7.**

Table:- G.01-T7: Local Manufacturer's Responsibilities

ITEMS	REQUIREMENTS
1. PERMITS	i. It is local manufacturer's responsibility to apply to individual General Directorate of Civil Defence to register the factory and his fire and life safety materials, devices, equipment, systems and products. ii. Manufacturers shall not sell any material, product or systems without General Directorate of Civil Defence permit and registration. iii. It is local manufacturer's responsibility to identify and understand that registration and permit in Kingdom of Bahrain, does not automatically provides right to sell in Kingdom of Bahrain. It is manufacturer's responsibility to verify and comply with laws, decrees and regulations of General Directorate of Civil Defence. iv. It is local manufacturer's responsibility to understand the requirements of **Table:- G.01-T7.9.**
2. ASSEMBLING	i. Assembling, repackaging, relabeling, re-aligning etc. shall not be acceptable as manufacturing and shall not be registered by General Directorate of Civil Defence as "manufacturers". ii. Where the manufacturer has outsourced part of his work, activity, or process of manufacturing to other parties through subcontracting. the "manufacturer" shall be responsible and accountable for the subcontractor's quality, control, conformity, certifications, and management.
3. MATERIAL TESTS	i. It is manufacturer's responsibility to test all their material, product or systems, only through General Directorate of Civil Defence registered and permitted Material Test Laboratories. ii. It is manufacturer's responsibility to obtain test certifications for all their material, product or systems, only through General Directorate of Civil Defence registered and permitted Certification Bodies. iii. It is manufacturer's responsibility to understand that material test reports alone, without Third party certificate from General Directorate of Civil Defence permitted certification body, is not valid. iv. It is manufacturer's responsibility to understand that materials, products and systems tested in his own premises, in-house laboratories or in-house workshops are not acceptable, unless evaluated and permitted by General Directorate of Civil Defence. v. It is manufacturer's responsibility to revise the conformity for his material, product or systems where modifications and alterations to design, components, compositions, performance criteria have been executed. Any changes to his material, product or systems arising from such actions, invalidates the existing test reports, existing test certificates and existing General Directorate of Civil Defence permits.

Table:- G.01-T7.: Local Manufacturer's Responsibilities

ITEMS	REQUIREMENTS
4. TEST STANDARDS	i. It is manufacturer's responsibility to identify and understand the required test standards for their materials, products or systems, as per **Bahrain Fire and Life Safety Code of Practice.** ii. Required test standards might revise or change as per the laws, policies and code revision requirements of the General Directorate of Civil Defence and international codes and standards amendments. And it is manufacturer's responsibility to verify the required test standards, periodically, before registration renewal with General Directorate of Civil Defence. iii. It is manufacture's responsibility to verify the latest edition of test standards, before approaching material test laboratories for any tests. iv. Materials, products or systems tested with older editions of test standards shall not be acceptable to 'General Directorate of Civil Defence'.
5. THIRD PARTY CERTIFICATE	i. It is manufacturer's responsibility to produce "Certificate of Conformity" for their material, product or systems to General Directorate of Civil Defence in a required format as per General Directorate of Civil Defence requirement to be registered and licensed. ii. The certificate of compliance shall clearly state the following. a. Name, address, phone and fax numbers of manufacturer. b. Country of origin of the manufacturer. c. Name, location, address, phone and fax numbers of the factory. d. Brand name e. Logo on the product f. Laboratory name and address, where test was conducted. g. Test standards, the test was conducted to. h. Test Certification body name and address. i. Test Certificate number. j. Validity Date.
6. CROSS LISTING	i. It is manufacturer's responsibility to understand that "cross listing" is not acceptable to General Directorate of Civil Defence. Please see this chapter's **Section 2.2.17**. "Cross listing" definition. ii. Each manufacturer has to obtain his individual certificate of conformity, based on his material, product or system for his factory, under his name.
7. MULTIPLE LISTING	i. Multiple listing shall be permitted by General Directorate of Civil Defence. Please see this chapter's **Section 2.2.18**. "Multiple listing" definition. ii. It is manufacturer's responsibility to understand that "Multiple Listing" is acceptable to General Directorate of Civil Defence, provided that the primary manufacturer's name, location of factory, address and name of the secondary brand are mentioned in the certificate of conformity.
8. SPECIFICATIONS AND MANUALS	i. It is manufacturer's responsibility to provide technical specifications, operating environmental conditions, end application, user manuals, operating manuals, installation guidelines, specific maintenance manuals and required schematics, along with their material, product or systems. ii. It is manufacturer's responsibility to provide warnings, safety precautions, user cautions, inapplicability, non-suitability, expiry duration, if any, and such information in a clear documentation to the end user.

Table:- G.01-T7.: Local Manufacturer's Responsibilities

ITEMS	REQUIREMENTS
9. PROSECUTION	i. It is manufacturer's responsibility not to sell any material, product or system, with respect to Fire and Life Safety Systems in Bahrain, that is not listed, not registered and not valid by General Directorate of Civil Defence, in accordance with the latest edition of **Bahrain Fire and Life Safety Code of Practice.** ii. Violation of the requirement of **Table 1.7.9.i.,** shall hold manufacturer as responsible and it is punishable by law. iii. It is manufacturer's responsibility to abide by the requirement of **Table 1.7.9.i.,** irrespective of **"Market Demand and Supply"** circumstances.
10. WARRANTY	i. The Fire and Life Safety products and systems manufactured, supplied and installed in Kingdom of Bahrain shall ensure the availability of spare parts, compatibility with upgraded parts, components, systems, software and hardware such that the continuity of Fire and Life Safety systems' functionality is ensured by upgrading without replacing or discarding the entire system in totality.

3.10. Agent's Responsibilities

3.10.1. Agents shall perform their responsibilities as per **Table:- G.01-T8.**

Table:- G.01-T8 : Agent's Responsibilities

ITEMS	REQUIREMENTS
1. REGISTRATION	i. It is Agent's responsibility to apply to General Directorate of Civil Defence to register the company and products he represents. ii. Agents shall not sell any material, product or systems without General Directorate of Civil Defence permit and registration. iii. It is agent's responsibility to identify and understand that registration and permit in Kingdom of Bahrain, does not automatically provides right to sell Kingdom of Bahrain. It is agent's responsibility to verify and comply with requirements and policies of Kingdom of Bahrain and their registration process. iv. Agent shall produce exclusive "Agency" contract with the manufacturer for documentation, along with full credentials of the manufacturer to be registered with General Directorate of Civil Defence. v. It is agent's responsibility to understand the requirements of **Table:- G.01-T8.** and sign off an undertaking letter to General Directorate of Civil Defence as documentation for registration.
2. MANPOWER	i. Agents shall have qualified and experienced engineers, who are well verse in their respective Fire and Life Safety Systems' Design, Installation and Inspection. ii. Agent engineers and technicians shall be well verse with latest edition of Bahrain Fire and Life Safety Code of Practice. iii. Agent engineers and technicians shall have valid training certificates from respective system and product manufacturers. iv. Agent engineers and technicians shall be licensed by General Directorate of Civil Defence, based on their qualifications, training certificates and written examinations. v. Each engineer must pass General Directorate of Civil Defence examinations, in their respective chosen fields as per required passing marks. vii. Each technician must pass General Directorate of Civil Defence examinations, in their respective chosen fields as per required passing marks. viii. Required number of engineers and technicians shall be as per **Table 1.8.a.** ix. However, these requirements are subject to changes in applicable laws, decrees and regulations of General Directorate of Civil Defence. It is Installation and Maintenance Company's responsibility to verify the requirements with General Directorate of Civil Defence.

Table:- G.01-T8.: Agent's Responsibilities

ITEMS	REQUIREMENTS
3. CONTRACTS	i. Agent is responsible to include in his legal contract documents with Insurance companies, Owners, Consultants, Installation and maintenance Contractors, Manufacturers, Suppliers, Professionals and Facility management companies that **"Fire and Life Safety Requirements from General Directorate of Civil Defence shall be strictly followed as per latest edition of Bahrain Fire and Life Safety Code of Practice, and other rules and regulations from General Directorate of Civil Defence."** ii. It is agent's responsibility to evaluate manufacturers and suppliers qualifications and valid permit for products and company registration from General Directorate of Civil Defence, before placing order for products and making any agreement with them. iii. It is agent's responsibility to ensure that contract documents clearly state that **"All the materials relevant to Fire and Life Safety, shall be permitted and listed by General Directorate of Civil Defence.".** iv. It is agent's responsibility to verify material test certificates and specifications pin accordance with latest edition of Bahrain Fire and Life Safety Code of Practice.
4. SCOPE OF WORK	i. Agents, once registered and permitted by General Directorate of Civil Defence, are authorized to sell only the products they represent. ii. Agents must qualify with their number of required manpower. iii. It is the responsibility of the agent to understand that without required manpower as per **applicable decrees and regulations** they are not allowed to work in categories of buildings they are not qualified to.
5. ASSEMBLING	i. Assembling parts imported or procured from manufacturers, repackaging, relabeling, realigning etc. shall not be acceptable as agent's scope of work and shall not be registered with General Directorate of Civil Defence as "agents". ii. It is agent's responsibility to represent the manufacturer's materials, products and systems such that, which when installed, readily serve as Fire and Life Safety products, without assembling, adjusting, re-aligning, re-casing, re-programming, re-wiring or any of such process.
6. MATERIAL TESTS	i. It is not agent's responsibility to test products, materials or systems, and not acceptable to General Directorate of Civil Defence that agents test materials, products or systems on behalf of manufacturers. ii. It is not agent's responsibility to obtain test certification for products, materials or systems, and test certifications for materials, products or systems in agent's name are not acceptable to General Directorate of Civil Defence for registration. iii. It is agent's responsibility to identify and understand the test requirements for materials, products and systems in accordance with latest edition of **Bahrain Fire and Life Safety Code of Practice**, before evaluating or representing manufacturer in the Kingdom of Bahrain. iv. It is agent's responsibility to coordinate and insist the manufacturer to revise the conformity for his material, product or systems where modifications and alterations to design, components, compositions, performance criteria have been executed. v. It is the responsibility of agent to understand that any changes to material, product or systems arising from actions such as alterations to design, components, compositions, performance criteria etc., invalidates the existing test reports, existing test certificates and existing General Directorate of Civil Defence permits.

Table:- G.01-T8.: Agent's Responsibilities

ITEMS	REQUIREMENTS
7. SPECIFICATIONS AND MANUALS	i. It is agent's responsibility to provide manufacturer's technical specifications, operating environmental conditions, end application, user manuals, operating manuals, installation guidelines, specific maintenance manuals and required schematics, along with their material, product or systems. ii. It is agent's responsibility to provide manufacturer's warnings, safety precautions, user cautions, inapplicability, non-suitability, expiry duration, if any, and such information in a clear documentation to the end user.
8. PROSECUTION	i. It is agent's responsibility not to sell any material, product or system, with respect to Fire and Life Safety Systems in Kingdom of Bahrain, that is not listed, not registered and not valid by General Directorate of Civil Defence, in accordance with the latest edition of **Bahrain Fire and Life Safety Code of Practice.** ii. Violence of the requirement of **Table 1.8.8.i.,** shall hold agent as responsible and it is punishable by law. iii. It is agent's responsibility to abide by the requirement of **Table 1.8.8.i.,** irrespective of **"Market Demand and Supply"** circumstances.
9. WARRANTY	i. The Fire and Life Safety products and systems manufactured, supplied and installed in Kingdom of Bahrain shall ensure the availability of spare parts, compatibility with upgraded parts, components, systems, software and hardware such that the continuity of Fire and Life Safety systems' functionality is ensured by upgrading without replacing or discarding the entire system in totality.

3.11. Testing Laboratory Responsibilities

3.11.1. Testing Laboratory shall perform their responsibilities as per **Table:- G.01-T9.**

Table:- G.01-T9.: Testing Laboratory Responsibilities

ITEMS	REQUIREMENTS
1. REGISTRATION	i. It is laboratory's responsibility to apply to General Directorate of Civil Defence to register the company and the list of accredited tests relevant to Fire and Life Safety Systems. ii. Laboratory shall not test any material, product or systems intended for General Directorate of Civil Defence Permit with respect to Fire and Life Safety Systems, without General Directorate of Civil Defence permit and registration. iii. It is laboratory's responsibility to comply to requirements of **Table:- G.01-T9.** and sign off an undertaking letter to General Directorate of Civil Defence as documentation for registration.
2. QUALIFICATION	i. Laboratory shall be accredited by the international accreditation bodies. ii. Laboratory shall have valid ISO 17025 accreditation, general requirements for the competence of testing and calibration laboratories. iii. Where Laboratory is also involved in inspections, such laboratory shall have valid ISO 17020 accreditation, conformity assessment requirements for the operation of various types of bodies performing inspection. iv. It is laboratory responsibility to be in full compliance with the accreditation schemes mentioned above with up to date auditing reports available to General Directorate of Civil Defence, regarding the organization management, staff qualification, test documentation, calibration of equipment and instrumentation, Health and Safety of the work environment etc. v. Laboratory shall have a confidential directory website in English, where all the test reports performed at Laboratory, intended for General Directorate of Civil Defence permit, shall be documented, such that General Directorate of Civil Defence is permitted with confidential access to be able to search the data base by report summaries, products, companies and test standards. vi. Laboratories shall have valid and permitted environmental protection and management program which addresses the laboratory responsibility towards environmental impact s of the fire testing activities.
3. SCOPE OF WORK	i. Laboratory shall only conduct the tests that they are accredited for, if it is to be acceptable for General Directorate of Civil Defence. It is laboratory responsibility not to issue any reports to customers, for the tests that the laboratory is not accredited for, if customer is seeking General Directorate of Civil Defence permit. ii. Laboratory shall perform tests in full, in accordance with test standards, they are accredited for partial tests shall not be conducted, where General Directorate of Civil Defence permit is customer's intent. iii. However, unaccredited tests, research and development tests, partial tests and modified tests for institutions, R&D bodies or in-house experimentation shall be permitted, provided the reports issued for such tests clearly have the headline highlighting the purpose of tests as "For Research and Development Only" and such reports shall not be submitted for General Directorate of Civil Defence permits. iv. Test Laboratories shall be completely independent of the conformity certification bodies, as management, as staff, as office and as signatory.

Table:- G.01-T9.: Testing Laboratory Responsibilities

ITEMS	REQUIREMENTS
4. ISO GUIDE 67	i. The different certification systems covered in ISO Guide 67 are tabulated below. But the one which has been adopted by General Directorate of Civil Defence is **System 5.**

PROCEDURE (CARRIED OUT BY THE CERTIFICATION BODY)	ISO GUIDE 67 COMMON SYSTEM TYPES						
	1a	1b	2	3	4	5 (Adopted System)	6
1. Selection (sampling), as applicable	✓	✓	✓	✓	✓	✓	✗
2. Determination of characteristics, as applicable by:							
a) Testing	✓	✓	✓	✓	✓	✓	✓
b) Inspection	✓	✓	✓	✓	✓	✓	✓
c) Design appraisal	✓	✓	✓	✓	✓	✓	✓
d) Assessment of services	✓	✓	✓	✓	✓	✓	✓
3. Review (evaluation)	✓	✓	✓	✓	✓	✓	✓
4. Decision on certification	✓	✓	✓	✓	✓	✓	✓
5. Licensing (attestation)	✗	✓	✓	✓	✓	✓	✓
6. Ongoing surveillance, as applicable by:							
a) Testing of samples selected from the open market	✗	✗	✓	✗	✓	✓	✗
b) Inspection of samples selected from the open market	✗	✗	✓	✗	✓	✓	✗
c) Testing of samples selected from the factory	✗	✗	✗	✓	✓	✓	✗
d) Inspection of samples selected from the factory	✗	✗	✗	✓	✓	✓	✗
e) Quality system audits combined with random tests or inspections	✗	✗	✗	✗	✗	✓	✓
f) Assessment of the production process or service	✗	✗	✗	✓	✓	✓	✓

Table:- G.01-T9.: Testing Laboratory Responsibilities

ITEMS	REQUIREMENTS
5. SCOPE OF WORK	i. It is laboratory responsibility to be aware of the regulatory requirements, policies and test standards required by the General Directorate of Civil Defence in accordance with latest edition **of Bahrain Fire and Life Safety Code of practice**, for fire and life safety materials, products and systems. vi. It is laboratory responsibility to educate and inform the customer about the test standards required by the Bahrain General Directorate of Civil Defence for fire and life safety materials, products and systems.
6. TEST STANDARDS	i. It is laboratory responsibility to identify and understand the required test standards for fire and life safety materials, products or systems, as per **Bahrain Fire and Life Safety Code of Practice.** ii. Required test standards might revise or change as per the laws, policies and code revision requirements of the General Directorate of Civil Defence and international codes and standards amendments. And it is laboratory responsibility to verify the required test standards, periodically. iii. Test standards for testing shall be latest edition of the standard. Tests shall not be conducted with older edition of invalid standards. Laboratory shall be held responsible and accountable for such invalid test reports issued to customers. iv. It is laboratory responsibility to be aware and up to date with test standards, revisions, amendments and corresponding required revisions to their test equipment, calibration and instrumentation. v. Test standards shall be latest editions and shall be followed in full requirements regarding specimen specification, test equipment specifications, test criteria, performance criteria, instrumentation specifications etc. and tests shall not be modified or deviated from the test standards.
7. TEST REPORTS	i. Test reports shall contain full information as per the test standards. Partial information, partial assessment and selective performance statements shall not be part of the test reports. ii. Customer demands and requested information, deviating from test standard report information shall not be entertained. Laboratory shall be held responsible and accountable for such altered information on the reports. iii. Test reports shall be in accordance with the "General Directorate of Civil Defence format" containing minimum information as **Table:- G.01-T8.7.iv.** as follows. iv. The test reports shall clearly state the following. a. Name, address, phone and fax numbers of manufacturer. b. Country of origin of the manufacturer. c. Name, location, address, phone and fax numbers of the factory. d. Brand name e. Logo on the product (Optional) f. Laboratory name and address, where test was conducted. g. Test standards, test standard edition and full description of the test. h. Test report number. i. Validity Date (If Applicable) v. Test reports shall not be issued to customers without stamp and signature of the responsible individual of the laboratory.
8. SUB CONTRACTING	i. Subcontracting laboratories or outsourced laboratories shall be General Directorate of Civil Defence registered, listed and permitted laboratories. ii. Test laboratories shall be responsible and accountable for such outsourced activities, staff, supervision. It is Laboratory responsibility to understand that all the requirements of **Table:- G.01-T9.** apply to the outsourced test laboratories.

3.12. Conformity Certification Or Conformity Assessment Body's Responsibilities

3.12.1. Test Conformity Certification Body shall perform their responsibilities as per **Table:- G.01-T10.**

Table:- G.01-T10.: Conformity Assessment (Certification) Body Responsibilities

ITEMS	REQUIREMENTS
1. REGISTRATION	i. It is Conformity Certification Body's responsibility to apply to General Directorate of Civil Defence to be registered as permitted laboratories and certification bodies, relevant to Fire and Life Safety Systems. ii. Conformity Certification Body shall not issue test certifications to any material, product or systems with respect to Fire and Life Safety Systems without General Directorate of Civil Defence permit and registration. iii. It is Conformity Certification Body's responsibility to comply to requirements of **Table:- G.01-T10** and sign off an undertaking letter to General Directorate of Civil Defence as documentation for registration.
2. QUALIFICATION	i. Conformity Certification Body shall be accredited by the international accreditation bodies. ii. Conformity Certification Body shall have valid ISO 17065 certification, conformity assessment-requirements for bodies certifying products, processes and services as applicable. iii. Conformity Certification Body shall have valid ISO 17020 certification, conformity assessment-requirements for the operation of various types of bodies performing inspection. iv. Conformity Certification Body shall be in full compliance with the accreditation schemes mentioned above and up to date auditing reports available to General Directorate of Civil Defence, regarding the organization management, staff qualification, certification documentation, etc. v. Conformity Certification Body shall have a directory website in English, where all the test certifications and assessments performed at Laboratory shall be documented, such that General Directorate of Civil Defence is able to search the data base by products, companies and test standards.
3. SCOPE OF WORK	i. Conformity Certification Body shall be completely independent of the Test Laboratory, as management, as staff, as office and as signatory. ii. It is Conformity Certification Body responsibility to be aware of the regulatory requirements, policies and test standards required by the General Directorate of Civil Defence in accordance with latest edition of **Bahrain Fire and Life Safety Code of practice**, for fire and life safety materials, products and systems. iii. It is Conformity Certification Body responsibility to educate and inform the customer about the test standards required by the General Directorate of Civil Defence for fire and life safety materials, products and systems. iv. It is Conformity Certification Body's responsibility to issue test certifications in full compliance to their accreditation scheme requirement.

Table:- G.01-T10: Conformity Assessment (Certification) Body Responsibilities

ITEMS	REQUIREMENTS
SCOPE OF WORK	v. It is Conformity Certification Body's responsibility to be aware of the General Directorate of Civil Defence listed and registered laboratories, which is updated periodically. vi. Conformity Certification Body shall not issue test certifications for the laboratories that are not listed and registered by General Directorate of Civil Defence. vii. Conformity Certification Body shall not issue any test certifications to agents, suppliers, distributors or resellers. viii. Conformity Certification Body shall issue certifications only to the manufacturers. ix. It is Conformity Certification Body's responsibility to understand that assembling, repackaging, realigning, reprogramming, labeling of materials, products and systems is not a manufacturing activity and certifications shall not be issued to such activities or companies. x. It is Conformity Certification Body's responsibility to inspect the manufacturer's facility, production line, process line and perform auditing physically to confirm the authenticity of the production at the factory and that ongoing production is conducted under an effective quality management system and conforms exactly with what was tested. xi. It is Conformity Certification Body's responsibility not to issue test certifications for products that are not tested and reported by General Directorate of Civil Defence permitted and listed test laboratories.
4. TEST STANDARDS	i. It is Conformity Certification Body's responsibility to identify and understand the required test standards for fire and life safety materials, products or systems, as per **Bahrain Fire and Life Safety Code of Practice.** ii. Required test standards might revise or change as per the laws, policies and code revision requirements of the General Directorate of Civil Defence and international code amendments. And it is laboratory responsibility to verify the required test standards, periodically. iii. It is Conformity Certification Body's responsibility not to issue test certificates for test reports of tests conducted with older edition of test standards, unless clear assessment and undertaking is provided that extent of revisions in standards have no impact on the existing test reports of tests from older edition of standards. iv. It is Conformity Certification Body's responsibility to ensure that Test standards for testing are latest edition of the standard and customers are aware of it. v. It is Conformity Certification Body's responsibility not to issue test certifications for partial tests, partial test reports. Certifications shall only be issued to test reports for tests of materials, products or systems, conducted as per latest editions of standards following full requirements regarding specimen specification, test equipment specifications, test criteria, performance criteria, instrumentation specifications etc. and tests shall not be modified or deviated from the test standards.
5. CERTIFICATE OF CONFIRMITY	i. Test Certification shall only be to full system assemblies where required by Bahrain Fire and Life Safety Code of Practice. Test certifications to components, parts, hardware, segments shall not be acceptable to General Directorate of Civil Defence, where full assembly tests are required by the code. ii. It is Conformity Certification Body's responsibility to issue certificates which contain full information as per the test standards. Partial information, partial assessment and selective performance statements shall not be part of the certification. iii. Customer demands and requested information, deviating from test standard report information shall not be entertained by Conformity Certification Body. Conformity Certification Body shall be held responsible and accountable for such altered information on the reports or certification.

Table:- G.01-T10 : Conformity Assessment (Certification) Body Responsibilities

ITEMS	REQUIREMENTS
CERTIFICATE OF CONFIRMITY	iv. In addition to the Certification certificate and documentation, a Certificate of Conformity (CoC), in accordance with the "General Directorate of Civil Defence format" , shall be issued. v. The certificate of conformity shall clearly state the following. a. Name, address, phone and fax numbers of manufacturer. b. Country of origin of the manufacturer. c. Name, location, address, phone and fax numbers of the factory. d. Name, location, address, phone and fax numbers of the Certification Body. e. Test Certificate Number f. Brand name g. Logo on the product h. Model Number of the product. i. Laboratory name and address, where test was conducted. j. Test standards, test standard edition and full description of the test. k. Test report number. l. Validity Date. m. The Pass criteria of the test standard, if any. n. Fire Performance criteria, if any. o. Category of Fire performance evaluation, if any. p. End application, End use of the material, product or the system. vi. Test Certifications or certificate of conformity shall not be issued to customers without stamp and signature of the responsible individual of the Test Conformity Certification Body.
6. CROSS LISTING	i. It is Conformity Certification Body's responsibility to understand that "cross listing" is not acceptable to General Directorate of Civil Defence. Please see this chapter's **Section 2.2.17**. "Cross listing" definition. ii. Conformity Certification Body shall not issue certification for cross listed materials, products or systems, it is validated with separate test from the secondary manufacturer, in his own name.
7. MULTIPLE LISTING	i. Multiple listing shall be permitted by General Directorate of Civil Defence. Please see this chapter's **Section 2.2.18**. "Multiple listing" definition. ii. It is Conformity Certification Body's responsibility to understand that "Multiple Listing" is acceptable to General Directorate of Civil Defence, provided that the primary manufacturer's name, location of factory, address and name of the secondary brand, logo and name of the secondary owner are mentioned in the Certificate of Conformity.
8. ISO GUIDE 67	i. The ISO Guide 67 procedure adopted by General Directorate of Civil Defence is **System 5. Please see Table:- G.01-T9.4.**

3.13. Facility Management Company Responsibilities

3.13.1. Facility Management Company responsibilities shall comply with **Table:- G.01-T11.**

Table:- G.01-T11 : Facility Management Company Responsibilities

ITEMS	REQUIREMENTS
1. MAN-POWER	i. 10% of every facility management personnel appointed in a building, shall obtain training from General Directorate of Civil Defence, when initiated by General Directorate of Civil Defence. ii. 1 of such trained facility management personnel shall be designated as "Safety Supervisor" and shall take the responsibility of leading the entire team of facility management. iii. It is facility management company responsibility to apply to General Directorate of Civil Defence formally for the training request, when initiated by General Directorate of Civil Defence. iv. Such training by General Directorate of Civil Defence shall be with the basics of Fire and Life Safety aspects of the building, usage of fire extinguishers and routine daily visual inspections of the Fire and Life Safety Systems. v. 100% of facility management personnel shall be familiar with Fire extinguisher usage. vi. Trained Facility Management company personnel shall be permitted and licensed by General Directorate of Civil Defence.
2. RESPONSI-BILITIES	i. Facility management personnel responsibilities, along with everyday routine house keeping, security and maintenance tasks, Fire and Life Safety duties shall comply with the **Table:- G.01-T11.** ii. Facility management company shall appoint a manager in each facility to supervise the team and such manager shall be licensed by General Directorate of Civil Defence in accordance with **Table:- G.01-T11.1.** iii. The facility manager shall clearly assign specific duties to his team members with regard to Fire and Life Safety aspects of the facility**.** iv. It is Facility Management Company's responsibility to realize their role in Fire and Life Safety of the facility is of very high importance. v. It is Facility Management Company's responsibility to inform owner and maintenance companies, where abnormal conditions exist for Fire and Life Safety Systems in the building, including balcony and window railings. It is facility management company duty to ensure that corrective actions are immediately implemented by owner.
3. PLANNING	i. It is facility Management Company's responsibility to insist building owners to include the participation of facility management team in the building fire and life safety systems inspection, testing, commissioning and handing over. ii. It is facility Management Company's responsibility to get involved in familiarizing the facility Fire and Life Safety Systems.
4. EMERGEN-CY ACTION PLAN	i. It is facility Management Company's responsibility to familiarize themselves with building Emergency Action plans and understand their role as individuals and as a team. ii. Facility management personnel shall clearly draft out their specific role, in accordance with **Section H. Chapter 02. Emergency Evacuation Procedures,** such as but not limited to, as follows a. Assigning particular person to confirm fire alarm by actually verifying at the location of the building. b. Assigning particular person to inform General Directorate of Civil Defence and coordinate with them when they arrive. c. Assigning particular personnel to assist elderly and disabled to execute building evacuation smoothly. d. Assigning particular personnel or team to manage evacuation and leading evacuees to designated assembly points. e. Assigning particular team or personnel to evaluate and assess initial stages of fire and use extinguishers and hose reel system, if it is assessed as safe to do so. f. Assigning particular personnel to understand the elevator operation during emergencies and who can manage elevator evacuation, if it is safe to do so.

Table:- G.01-T11.: Facility Management Company Responsibilities

ITEMS	REQUIREMENTS

5. STORAGE	i. It is Facility Management Company's responsibility to ensure that flammable, hazardous and dangerous material are not stored in the facility except where it is permitted, in a designated place and specific quantity. ii. It is facility management company's responsibility to ensure that means of egress components such as doors, stairs, corridors and exits are not blocked by stored items, toys, sports items, exercise equipment, articles, boxes, cycles, waste materials, items intended to be disposed, signboards, plants, decoration items, banners, advertisements, pet cages etc. It is facility management personnel duty to ensure that emergency exit routes are freely accessible at all times. iii. It is facility management company's responsibility to ensure that balconies are not used as storage space. Balcony storage item fires can spread to building facades and can be catastrophic. iv. It is facility management company's responsibility to monitor occupant's storage practices and ensure safe storage habits are practiced.
6. FIRE EXTINGUISHERS	i. Fire Extinguishers are the most efficient first line of Defence during initial stages of fire and it is facility management company's responsibility to familiarize the various types of extinguishers and their application on various types of fires, in accordance with **Section D Chapter 01 Fire Extinguishers** and periodic training. ii. It is facility management company's responsibility to visually inspect fire extinguishers every week for their normal working condition and pressure gauges. Where low pressure, damages, dents etc. are found, facility management shall immediately inform owner and maintenance company. iii. It is facility management company's responsibility to ensure that extinguishers are not obstructed and are placed securely as commissioned in designated location with appropriate signs.
7. FIRE DETECTION AND ALARM SYSTEM	i. It is facility management company's responsibility to visually inspect the Fire detection and alarm system everyday. ii. Fire detection and Alarm control panel shall be visually inspected everyday for power "ON" condition, trouble signals, abnormal conditions, low battery conditions, damages etc. and bring to owner or owner's representative's attention immediately and take further action of informing responsible maintenance company. iii. It is facility management company's responsibility to visually check for detectors normal working condition by verifying the blinking LED's., accumulation of dust, open wiring, damaged detectors etc. and bring the matter to owner's attention immediately. iv. It is facility management personnel responsibility to ensure that detectors and manual call points are free of obstruction. v. It is facility management company's responsibility not to ignore any alarms on the Fire Detection and Alarm System. Any alarms shall be immediately verified by physically cross checking the location and confirming the alarm authenticity, before declaring it as "false alarm" or resetting the Fire Detection and Alarm System. vi. Log of annual inspection and maintenance dates shall be maintained and followed up regularly with inspection and maintenance companies.

Table:- G.01-T11.: Facility Management Company Responsibilities

ITEMS	REQUIREMENTS

8. FIRE PROTECTION SYSTEMS	i. Fire Protection Systems such as Fire Hose Reels, Hydrants, Sprinkler Systems, Fire Pump Systems shall be visually inspected to ensure their normal working condition. ii. Fire Pump room shall be inspected visually everyday to ensure that all valves are in normal position as commissioned and pressure gauges are reading normal pressures as commissioned. iii. It is facility management company responsibility to ensure pump control panel is in normal working condition with power "ON", without trouble signals, abnormal conditions, low battery conditions, damages etc. Any abnormal condition shall be brought to owner's attention and maintenance companies shall be informed immediately. iv. Pump room, piping shall be free of leakages. v. Fire water tank shall be inspected every day to ensure "Fire Reserve" is always available. vi. It is facility management company's duty to ensure sprinklers, hydrants and hose reels are not blocked and are in good working condition without leaks, damages and tampering. vii. It is facility management company's duty to visually inspect the fire protection systems to ensure nozzles, hose reels, and tools are not missing from the designated cabinets or location.
9. EMERGENCY LIGHTING AND SIGNS	i. It is facility management company's responsibility to visually inspect the Emergency Lighting system control unit and luminaries every day. ii. Emergency Lighting control panel shall be visually inspected every day for power "ON" condition, trouble signals, abnormal conditions, low battery conditions, damages etc. and bring to owner or owner's representative's attention immediately and take further action of informing responsible maintenance company. iii. It is facility management company's responsibility to visually check for proper exit signs and ensure they represent actual direction of available exits.
10. EMERGENCY EVACUATION PLAN	i. It is facility management company's responsibility verify emergency evacuation plans and ensure that the building, furniture, artifact etc. arrangements have not altered the exit routes and exit access ways. ii. Modifications in terms of partitions, demolitions, new arrangement of equipment, relocations of doors, interior/exterior landscaping, interior Interior Design and such activities in a building can alter the exit routes and direction of exit routes and emergency evacuation plans should be updated and verified accordingly.
11. DRILLS	i. Facility management shall conduct emergency fire drills for their staff every 6 months and whole facility management team shall actively participate in emergency fire drill management. **See Section H. Chapter 02. Emergency Evacuation Procedures.** ii. The Fire and Life Safety manager, facility management and designated personnel shall practice emergency drills and their role without the entire occupancy evacuation, every month, where the efficiency of the emergency action plan and evaluation of their performance during fire, emergency, panic and dangerous situations to execute smooth evacuation of the occupants to safety of exterior or point of safety shall be conducted and recorded for assessment. iii. Short comings in emergency management, scope of improvement in smooth evacuation, occupants' behavior during evacuation etc. shall be explored through the drills and improvisation measures shall be implemented by bringing it to owner's attention and coordination.

3.14. Assembly Occupancy Management Responsibilities

3.14.1. Assembly occupancy management responsibilities shall be as per **Table:- G.01-T12.**

Table:- G.01-T12 : Assembly Occupancy Management Responsibilities

ITEMS	REQUIREMENTS
1. FACILITY MANAGEMENT	i. It is Assembly occupancy management's responsibility to ensure that their facility management company complies with the following requirement**.** ii. Assembly occupancy facility management responsibilities shall comply with the full requirements of **Table:- G.01-T11. Facility Management Company Responsibilities.**
2. CROWD MANAGERS	i. Every assembly occupancy, including Theme Parks, Amusement Parks, Mall Play Areas, Food Courts, Bars, Discos, Night Clubs, Event Halls, Concert Halls, Exhibition Halls, Casinos, Stadiums, Theaters, Amphitheaters, Cinemas, Museums, Prayer Halls, Churches, Mosques etc. shall appoint or designate minimum of 2 Fire and Life Safety managers and 2 crowd managers, when initiated by General Directorate of Civil Defence ii. It is assembly facility management's responsibility to formally General Directorate of Civil Defence for their crowd manager's training, when initiated by General Directorate of Civil Defence.
3. CROWD MANAGER'S RESPONSIBILI-TIES	i. Crowd manager shall have understanding of the Fire and Life Safety hazards involved in the area. ii. Crowd manager shall be aware of the dangers and security hazards that can endanger the public assembly. iii. Crowd manager shall be fully aware of the facility or area exit routes, emergency evacuation plans and emergency evacuation strategies and procedures. iv. Crowd managers shall be responsible to familiarize themselves with facility and area. Such areas can be permanent in nature or temporary and unpredictable arrangements such as in events or concerts. v. Crowd managers shall have fair knowledge of Fire and Life Safety equipment and systems. vi. Crowd managers shall be well verse with emergency reporting and coordinating procedures.
4. FIRE SAFETY SUPERVISOR	i. It is Fire and Life Safety manager's responsibility to monitor, record and ensure that facility management company executes their responsibilities professionally in accordance with **Table:- G.01-T11. Facility Management Company Responsibilities.** ii. It is Fire and Life Safety manager's responsibility coordinate with the Fire and Life safety managers, crowd managers and facility management team to prepare a written Emergency Action Plan iii. Fire and Life Safety managers shall have understanding of the Fire and Life Safety hazards involved in the area. iv. Fire and Life Safety manager shall be aware of the dangers and security hazards that can endanger the people safety. v. Fire and Life Safety managers shall be fully aware of the facility or area exit routes, emergency evacuation plans and emergency evacuation strategies and procedures. vi. Fire and Life Safety manager shall have fair knowledge of Fire and Life Safety equipment and systems in the facility. vii. Fire and Life Safety manager shall be well versed with emergency reporting and coordinating with General Directorate of Civil Defence.

Table:- G.01-T12 : Assembly Occupancy Management Responsibilities

ITEMS	REQUIREMENTS

5. EMERGENCY ACTION PLAN	i. Assembly occupancy management shall coordinate with the Fire and Life safety managers, crowd managers and facility management team to prepare and maintain written Emergency Action Plan, where individuals duties and responses during emergency situations is clearly mentioned and assigned. ii. Assembly occupancy management personnel shall know their specific role such as but not limited to, as follows a. Confirmation of fire alarm by physically verifying at the location of the building or area. b. Informing, reporting emergency incident to General Directorate of Civil Defence and coordinate with them when they arrive. c. Assisting elderly and disabled to execute building evacuation smoothly. d. Coordination and planning with crowd manager to manage evacuation and leading evacuees to designated assembly points. e. Evaluation and assessment of initial stages of fire and usage of extinguishers and hose reel system, if it is assessed as safe to do so. f. Understanding of the elevator operation during emergencies and managing elevator evacuation, if it is safe to do so. iii. Where assembly occupancies are located in the high-rise portion of a building, the emergency action plan shall include egress procedures, methods, and preferred evacuation routes for each event considered to be a life safety hazard that could impact the building, including the appropriateness of the use of elevators. iv. For guideline on preparation of Emergency Action Plans and Emergency Drills, see **Section H. Chapter 02 - Emergency Evacuation Procedures.**
6. DRILLS	i. Assembly occupancy management shall conduct emergency fire drills for their staff every 6 months and whole facility management team shall actively participate in emergency fire drill management. **See Section H. Chapter 02. Sub-Section 5.** ii. It is assembly occupancy management's responsibility to involve all the employees in emergency drills to familiarize their role and response to emergency situations. iii. Assembly occupancy employees, attendants, facility management team, supervisor, crowd manager and all such designated personnel shall participate in emergency drills to explore the efficiency of the emergency action plan and to evaluate their performance during fire, emergency, panic and dangerous situations to execute smooth evacuation of the crowd to safety of exterior or point of safety. iv. Drills shall not be required to involve general public of the assembly occupancy. However, the time duration it takes for the occupants to fully reach the safety of exterior shall be evaluated and improvised. v. Communication between the designated personnel, decision making, understanding of specific roles without hampering others assigned duties etc. shall be evaluated and recorded for assessment. vi. Drills should be conducted only for employees and designated personnel of the assembly occupancy, without causing unnecessary panic and chaos among the uninformed and unsuspecting public crowd.
7. MAINTENANCE	i. It is assembly occupancy management's responsibility to ensure that facility management company inspect and maintain the seating, railing, guards, grandstands etc. used by public and crowd to ensure that the crowd is accident free and safe in using these features.

3.15. Educational Occupancy Management Responsibilities

3.15.1. Educational occupancy management responsibilities shall be as per **Table:- G.01-T13.**

Table:- G.01-T13.: Educational Occupancy Management Responsibilities

ITEMS	REQUIREMENTS
1. FACILITY MANAGEMENT	i. It is educational occupancy management's responsibility to ensure that their facility management company complies with the following requirement**.** ii. Educational occupancy facility management responsibilities shall comply with the full requirements of **Table:- G.01-T11. Facility Management Company Responsibilities.**
2. FIRE AND LIFE SAFETY MANAGERS	i. Every Educational occupancy, including Schools, Nurseries, Universities, Talent grooming centers, Training centers etc. shall appoint or designate minimum of 2 Fire and Life Safety Managers from their own management staff, when initiated by General Directorate of Civil Defence. Fire and Life Safety Managers shall obtain training from General Directorate of Civil Defence and shall be certified and licensed by General Directorate of Civil Defence. ii. It is educational occupancy management's responsibility to formally request General Directorate of Civil Defence for their fire and life safety manager's training, when initiated by General Directorate of Civil Defence.
3. FIRE AND LIFE SAFETY MANAGER'S RESPONSIBILITIES	i. It is Fire and Life Safety manager's responsibility to monitor, record and ensure that facility management company executes their responsibilities professionally in accordance with **Table:- G.01-T11. Facility Management Company Responsibilities.** ii. It is Fire and Life Safety manager's responsibility to coordinate between educational occupancy management, teachers, attendants and the facility management company to prepare a written Emergency Action Plan. iii. Fire and Life Safety managers shall have understanding of the Fire and Life Safety hazards involved in the area. iv. Fire and Life Safety manager shall be aware of the dangers and security hazards that can endanger the students' safety. v. Fire and Life Safety managers shall be fully aware of the facility or area exit routes, emergency evacuation plans and emergency evacuation strategies and procedures. vi. Fire and Life Safety manager shall have fair knowledge of Fire and Life Safety equipment and systems in the facility. vii. Fire and Life Safety manager shall be well verse with emergency reporting and coordinating with General Directorate of Civil Defence.
4. EMERGENCY ACTION PLAN	i. Emergency action plan shall clearly draft out the duties of Fire and Life Safety manager's, Principal's, Teacher's, attendant's and facility management team's respective duties and responses during fire and emergency situations. ii. Designated personnel, as per written Emergency action plan shall be familiar with their specific role such as but not limited to, as follows a. Confirmation of fire alarm by physically verifying at the location of the building or area before triggering evacuation alarm. b. Informing, reporting emergency incident to General Directorate of Civil Defence and coordinate with them when they arrive. c. Assisting nursery, kindergarten and disabled children to execute building evacuation smoothly. d. Coordination and planning to manage evacuation and leading evacuees to designated assembly points. e. Evaluation and assessment of initial stages of fire and usage of extinguishers and hose reel system, if it is assessed as safe to do so.

Table:- G.01-T13 : Educational Occupancy Management Responsibilities

ITEMS	REQUIREMENTS

EMERGENCY ACTION PLAN	iii. Teachers, instructors and attendants shall actively take part in familiarizing themselves with written Emergency action plans and their role during emergency situations. iv. For guideline on preparation of Emergency Action Plans and Emergency Drills, see **Section H. Chapter 02 - Emergency Evacuation Procedures.**
5. DRILLS	i. Emergency Drills shall be conducted once every 6 months for the entire educational occupancy occupants with every occupant's participation in smooth and full evacuation as per Emergency Action Plan. ii. Such emergency drills shall be conducted with total evacuation alarm, triggered by the "full evacuation alarm" button located at principal's room, in accordance with **Section C Chapter 01. Fire Detection and Alarm System.** iii. Such emergency drill shall be conducted within 30 days of the commencement of the new session. iv. Drills shall emphasize on orderly and smooth evacuation of students, rather than speed, chaos and panic. v. Great care should be taken to assist and protect the preschool and nursery children during emergency drills for their safety from older students and injuries from stampedes. vi. However, every month, the Fire and Life Safety manager, facility management and designated personnel shall practice emergency drills and their role without the entire education occupancy evacuation, where the efficiency of the emergency action plan and evaluation of their performance during fire, emergency, panic and dangerous situations to execute smooth evacuation of the crowd to safety of exterior or point of safety shall be conducted and recorded for assessment.
6. TEACHERS AND STAFF RESPONSIBILITY	i. It shall be the duty of principals, teachers and staff to inspect all exit facilities daily to ensure that all stairways, doors, corridors and other exits are in proper condition, free of blockages. ii. It is teachers and staff duty to be aware of unsafe or dangerous situations arising from student's ignorance and take corrective actions immediately. iii. It is teachers responsibility to observe fire safety and care in laboratories while conducting experiments with open flame, flammable liquids and electricity. iv. Warning signs of the fire hazards of open flames, hazardous chemicals and electrical fires shall be provided in the laboratories. v. All teachers and staff shall be trained to use appropriate fire extinguishers. vi. It is teachers and staff duty to immediately inform the Fire and Life Safety manager of the unsafe conditions in the facility, if any. vii. It is teachers responsibility to educate students and create awareness of fire safety to ensure that students implement the necessary precautions and practices of fire safety in their everyday lives.
7. MAINTENANCE	i. It is Educational occupancy management's responsibility to inspect and maintain the sports equipment, laboratory equipment, seating, railing, guards, stairs etc. used by students to ensure that the students are accident free and safe in using these features.

3.16. High-rise Building Management Responsibilities

3.16.1. Every High-rise building management, irrespective of the type of occupancy, shall perform their responsibilities as per **Table:- G.01-T14.**

Table:- G.01-T14 : High-rise Building Management Responsibilities

ITEMS	REQUIREMENTS

1. FACILITY MANAGEMENT	i. It is every High-rise building management's responsibility to ensure that their facility management company complies with the following requirement**.** ii. High-rise building's facility management company shall comply with the full requirements of **Table:- G.01-T11. Facility Management Company Responsibilities.**
2. FIRE AND LIFE SAFETY MANAGERS	i. Every High-rise building facility management company shall appoint or designate minimum of 2 Fire and Life Safety Managers, when initiated by Civil Defence. ii. Every High-rise building facility management company employees shall be trained in appropriate Fire extinguisher usage. iii. Fire and Life Safety Managers shall obtain training from General Directorate of Civil Defence and shall be certified and licensed by General Directorate of Civil Defence. iv. It is every High-rise building facility management's responsibility to formally request General Directorate of Civil Defence for their fire and life safety manager's training, when initiated by General Directorate of Civil Defence.
3. FIRE AND LIFE SAFETY MANAGER'S RESPONSIBILITIES	i. It is Fire and Life Safety manager's responsibility to monitor, record and ensure that facility management company executes their responsibilities professionally in accordance with **Table:- G.01-T11. Facility Management Company Responsibilities.** ii. It is Fire and Life Safety manager's responsibility to prepare a written Emergency Action Plan. For guidelines on preparation of Emergency Action Plans, see **Section H. Chapter 02. Emergency Evacuation Procedures.** iii. Fire and Life Safety managers shall have understanding of the Fire and Life Safety hazards involved in the area. iv. Fire and Life Safety manager shall be aware of the dangers and security hazards that can endanger the occupant safety. v. Fire and Life Safety managers shall be fully aware of the facility or area exit routes, emergency evacuation plans and emergency evacuation strategies and procedures. vi. Fire and Life Safety manager shall have fair knowledge of Fire and Life Safety equipment and systems in the facility. vii. Fire and Life Safety manager shall be fully aware of operation of Fire and Life Safety system controls, smoke control system controls, LPG/Natural gas sys- tem controls and elevator system controls of the building. viii. Fire and Life Safety manager shall be well verse with emergency reporting and coordinating with General Directorate of Civil Defence.

Table:- G.01-T14: High-rise Building Management Responsibilities

ITEMS	REQUIREMENTS

4. EMERGENCY ACTION PLAN	i. Emergency action plan shall clearly draft out the duties of Fire and Life Safety manager's and his facility management team's respective assigned duties and responses during fire and emergency situations. ii. Designated personnel, as per written Emergency action plan shall be familiar with their specific role such as but not limited to, as follows a. Confirmation of fire alarm by physically verifying at the location of the building or area before triggering evacuation alarm. b. Informing, reporting emergency incident to General Directorate of Civil Defence and coordinate with them when they arrive. c. Assisting children, elderly and physically challenged to execute building evacuation smoothly. d. Coordination and planning to manage evacuation and leading evacuees to designated assembly points. e. Evaluation and assessment of initial stages of fire and usage of extinguishers and hose reel system, if it is assessed as safe to do so. iii. Where High-rise building elevator is part of evacuation component, it is Fire and Life Safety Manager's responsibility to understand the operation and suitability of elevators to be used during emergency situations. A detailed procedure for the same shall be incorporated into the Emergency Action Plans. iv. Evacuating an entire High-rise building is a complex and time consuming procedure. Emergency Action Plans shall address and incorporate phased evacuation procedures, where floors in the immediate vicinity of fire accidents are evacuated to lower floors of safety and based on the assessment of situation, the upper floors evacuation follows and then the rest of the floors. v. For guideline on preparation of Emergency Action Plans and Emergency Drills, see **Section H. Chapter 02. Emergency Evacuation Procedures.**

Table:- G.01-T14: High-rise Building Management Responsibilities

ITEMS	REQUIREMENTS

5. DRILLS	**1. BUSINESS OCCUPANCY** i. Emergency Drills shall be conducted once every 6 months for the entire business occupancy occupants with every occupant's participation in smooth and full evacuation as per Emergency Action Plan. ii. Such emergency drills shall be conducted with total evacuation alarm, triggered by the "full evacuation alarm" in accordance with **Section C Chapter 01 - Fire Detection and Alarm System.** iii. Every business occupancy tenant shall have a designated Fire and Life Safety volunteer from his staff, who shall be responsible to coordinate with the facility management's Fire and Life Safety manager to understand the emergency action plan. iv. It is every business occupancy tenant's responsibility to maintain such an emergency action plan copy in his office and familiarize all the employees of orderly evacuation in coordination with his in-house Fire and Life Safety volunteer and the building facility Fire and Life Safety manager's leadership. v. Drills shall emphasize on orderly and smooth evacuation of occupants, rather than speed, chaos, panic and time frame. vi. However, every month, the emergency drills procedures shall be practiced by the building's Fire and Life Safety manager, facility management team and every business occupancy tenant's designated volunteer, in accordance with **Table:- G.01-T11. Facility Management Company Responsibilities**. They shall practice their role without the entire occupancy evacuation, where the efficiency of the emergency action plan and evaluation of their performance during fire, emergency, panic and dangerous situations to execute smooth evacuation of the occupant's to safety of exterior or point of safety shall be conducted and recorded for assessment. **2. HOTEL OCCUPANCY** i. Emergency Drills involving hotel guests shall not be required. However, the hotel staff shall perform their responsibility in accordance with this chapter **Table:- G.01-T15.** **3. RESIDENTIAL OCCUPANCY** i. Emergency Drills involving residents shall not be required. However, the building facility management shall perform their responsibility and drills in accordance with **Table:- G.01-T11. Facility Management Company Responsibilities.** ii. However, Emergency instructions, as per Emergency Action Plans, shall be provided annually to each dwelling unit to indicate the location of alarms, egress paths, and actions to be taken, both in response to a fire in the dwelling unit and in response to the sounding of the building alarm system.

3.17. Hotel Management Responsibilities

3.17.1. Every Hotel management, irrespective of the height of the building, shall perform their responsibilities as per **Table:- G.01-T15.**

Table:- G.01-T15 : Hotel Management Responsibilities

ITEMS	REQUIREMENTS

1. FACILITY MANAGEMENT	i. It is every Hotel management's responsibility to ensure that their facility management company complies with the following requirement**.** ii. Hotel building's facility management company shall comply with the full requirements of **Table:- G.01-T11. Facility Management Company Responsibilities.**
2. HOTEL EMERGENCY RESPONSE TEAM	i. Every Hotel management shall have "Emergency Response Team" consisting of trained professionals in Fire and Life Safety, security and first responders for emergency situations. ii. Every Hotel Emergency Response Team shall consist of minimum of 2 Fire and Life Safety Managers from their own staff, when initiated by General Directorate of Civil Defence. iii. Every Hotel employees shall be trained in appropriate Fire extinguisher usage. iv. Fire and Life Safety Managers shall obtain training from General Directorate of Civil Defence and shall be certified and licensed by General Directorate of Civil Defence. v. It is every Hotel management's responsibility to formally request General Directorate of Civil Defence for their fire and life safety manager's training, when initiated by General Directorate of Civil Defence.
3. FIRE AND LIFE SAFETY MANAGER'S RESPONSIBILI-TIES	i. It is Fire and Life Safety manager's responsibility to monitor, record and ensure that facility management company executes their responsibilities professionally in accordance with **Table:- G.01-T11. Facility Management Company Responsibilities.** ii. It is Fire and Life Safety manager's responsibility to prepare a written Emergency Action Plan. For guidelines on preparation of Emergency Action Plans, see **Section H. Chapter 02. Emergency Evacuation Procedures.** iii. Fire and Life Safety managers shall have understanding of the Fire and Life Safety hazards involved in the area. iv. Fire and Life Safety manager shall be aware of the dangers and security hazards that can endanger the hotel guests' safety. v. Fire and Life Safety managers shall be fully aware of the facility or area exit routes, emergency evacuation plans and emergency evacuation strategies and procedures. vi. Fire and Life Safety manager shall have fair knowledge of Fire and Life Safety equipment and systems in the facility. vii. Fire and Life Safety manager shall be fully aware of operation of Fire and Life Safety system controls, smoke control system controls, LPG/Natural gas system controls and elevator system controls of the building. viii. Fire and Life Safety manager shall be well verse with emergency reporting and coordinating with General Directorate of Civil Defence.
4. EMERGENCY ACTION PLAN	i. Emergency action plan shall clearly draft out the duties of Fire and Life Safety manager's, Emergency Response Team's and facility management team's respective assigned duties and responses during fire and emergency situations.

Table:- G.01-T15.: Hotel Management Responsibilities

ITEMS	REQUIREMENTS
4. EMERGENCY ACTION PLAN	ii. Designated personnel, as per written Emergency action plan shall be familiar with their specific role such as but not limited to, as follows a. Confirmation of fire alarm by physically verifying at the location of the building or area before triggering evacuation alarm. b. Informing, reporting emergency incident to General Directorate of Civil Defence and coordinate with them when they arrive. c. Assisting children, elderly and physically challenged to execute Hotel evacuation smoothly. d. Coordination and planning to manage evacuation and leading evacuees to designated assembly points. e. Evaluation and assessment of initial stages of fire and usage of extinguishers and hose reel system, if it is assessed as safe to do so. iii. Every High-rise Hotel building elevator could be part of evacuation component. It is Fire and Life Safety Manager's responsibility to understand the operation and suitability of elevators to be used during emergency situations. A detailed procedure for the same shall be incorporated into the Emergency Action Plans. iv. For guideline on preparation of Emergency Action Plans and Emergency Drills, see **Section H. Chapter 02 - Emergency Evacuation Procedures.**
5. DRILLS	i. Every 6 months, the Emergency drills procedures shall be practiced by the Hotel Emergency Response Team, Fire and Life Safety manager and facility management team, in accordance with **Table:- G.01-T11. Facility Management Company Responsibilities.** They shall practice their role with- out the entire occupancy evacuation, where the efficiency of the emergency action plan and evaluation of their performance during fire, emergency, panic and dangerous situations to execute smooth evacuation of the guests to safety of exterior or point of safety shall be conducted and recorded for assessment. ii. Emergency Response Team shall also practice the operation of First Aid equipment. iii. The testing devices to alert guests in various locations such as guest rooms, gymnasium, swimming pools, restaurants etc. shall be tested and practiced. iv. Drills shall emphasize on orderly and smooth evacuation of occupants, rather than speed, chaos, panic and time frame.
6. INSTRUCTIONS TO HOTEL GUESTS	i. An Emergency Evacuation plan in accordance with **Section C Chapter 05. Table:- C.05-T1.8.** depicting the actual floor arrangement, exit locations and room identification shall be posted immediately adjacent to, every guest room door of the hotels and in every resident room in dormitories and hostels. ii. Fire safety information in accordance with Emergency Action Plans and Hotel Fire strategies shall be provided to allow guests to understand and follow their role during Emergency Situations.

3.18. Healthcare Occupancy Management Responsibilities

3.18.1. Every Healthcare occupancy management, irrespective of the height of the building, shall perform their responsibilities as per **Table:- G.01-T16.**

Table:- G.01-T16.: Healthcare Occupancy Management Responsibilities

ITEMS	REQUIREMENTS
1. FACILITY MANAGE-MENT	i. It is every Healthcare occupancy management's responsibility to ensure that their facility management company complies with the following requirement**.** ii. Healthcare facility management company shall comply with the full requirements of **Table:- G.01-T11. Facility Management Company Responsibilities.**
2. HEALTHCARE EMERGENCY RESPONSE TEAM	i. Every Healthcare Administration shall have "Emergency Response Team" consisting of trained professionals in Fire Safety, security and first responders for emergency situations. ii. Such an Emergency Response Team shall involve healthcare staff from each specialized department and from each floor of the building. iii. Every Healthcare Emergency Response Team shall consist of minimum of 2 Fire and Life Safety Managers from their own staff, when initiated by General Directorate of Civil Defence. iv. Every member of healthcare Emergency Response Team shall be trained in appropriate Fire extinguisher usage. v. Fire and Life Safety Managers shall obtain training from General Directorate of Civil Defence and shall be certified and licensed by General Directorate of Civil Defence. vi. It is every Healthcare occupancy management's responsibility to formally request General Directorate of Civil Defence for their fire and life safety manager's training, when initiated by General Directorate of Civil Defence.
3. FIRE AND LIFE SAFETY MANAGER'S RESPONSI-BILITIES	i. It is Fire and Life Safety manager's responsibility to monitor, record and ensure that facility management company executes their responsibilities professionally in accordance with **Table:- G.01-T11. Facility Management Company Responsibilities.** ii. It is Fire and Life Safety manager's responsibility to prepare a written Emergency Action Plan. For guidelines on preparation of Emergency Action Plans, see **Section H. Chapter 02 - Emergency Evacuation Procedures.** iii. Fire and Life Safety managers shall have understanding of the Fire and Life Safety hazards involved in the healthcare occupancy, such as Medical gases, chemicals, LPG, flammable cleaning solvent storage, bedding and clothing storage, large scale Kitchen etc. iv. Fire and Life Safety manager shall be aware of the dangers, safety and security hazards that can endanger the patient's and visitors safety. v. Fire and Life Safety managers shall be fully aware of the facility or area exit routes, Refuge Areas, Safety of Horizontal Exits, emergency evacuation plans, emergency evacuation strategies and procedures. vi. Fire and Life Safety manager shall have fair knowledge of Fire and Life Safety equipment and systems in the facility. vii. Fire and Life Safety manager shall be fully aware of operation of Fire and Life Safety system controls, smoke control system controls, LPG/Natural gas system controls, elevator system controls, Medical gas supply controls, Emergency equipment for healthcare etc. of the building. viii. Fire and Life Safety manager shall be well verse with emergency reporting and coordinating with General Directorate of Civil Defence.

Table:- G.01-T16 : Healthcare Occupancy Management Responsibilities

ITEMS	REQUIREMENTS
4. EMERGENCY ACTION PLAN	i. Emergency action plan shall clearly draft out the duties of Fire and Life Safety manager's, Emergency Response Team's and facility management team's respective assigned duties and responses during fire and emergency situations. ii. All employees shall be aware of the healthcare emergency action plans and shall be instructed every 6 months to familiarize their role during the emergency situations. iii. Copy of the Emergency Evacuation Plan in accordance with **Section C Chapter 05. Table:- C.05-T1.8.**, and written Emergency Action Plan, specific duties of Emergency Response Team members from specific departments such as intensive care units, physiotherapy units, sleeping patients section etc. shall be available with respective section staff and they shall be aware of their specific predesignated roles, both fire safety roles and medical roles. iv. The written Emergency Action Plan shall be based on the following essential provisions and requirements. a. Selection of Emergency Response Team from each department from each floor. b. Duties of Emergency Response Team. c. Duties of Fire and Life Safety manager. d. Duties and extent of involvement of facility management company personnel e. Fire Alarm message transmission to General Directorate of Civil Defence as well as in-house Fire and Life Safety manager. f. Response to Fire Alarms. g. Isolation of Fire. h. Isolation of Smoke. i. Evacuation of immediate affected area. j. Evacuation of smoke compartment. k. Preparation of floors and building for evacuation. l. Alternative arrangements for Medical Emergencies. m. Relocation of patients. n. Extinguishment of Fire. v. For guideline on preparation of Emergency Action Plans and Emergency Drills, see **Section H. Chapter 02 - Emergency Evacuation Procedures.**

Table:- G.01-T16.: Healthcare Occupancy Management Responsibilities

ITEMS	REQUIREMENTS
5. PROTECTION OF PATIENTS	i. Protection of patients needs a very careful, prompt and effective response from the Emergency Response Team and healthcare professionals. ii. The basic priority and response shall be to remove all occupants directly involved with fire emergency, immediately by the respective department emergency response team member along with the staff. iii. Designated personnel such as central command center, Fire and Life Safety manager or designated emergency response team personnel shall be alerted through nurse station telephone or emergency push button to trigger the “evacuation alarm”. iv. Designated personnel, upon confirmation of the fire and situation, shall immediately inform General Directorate of Civil Defence. v. Emergency Response Team, under the leadership of Fire and Life Safety manager shall confine the fire by closing doors of the rooms and by isolating section of the corridor by closing horizontal exits. vi. Patients in the vicinity of fire shall be immediately relocated to safer sections of the building, in the same floor or other floors, in accordance with pre-planned Emergency Action Plans and strategies, until the assistance and decision making of General Directorate of Civil Defence personnel is available.
6. DRILLS	i. Emergency Drills shall be conducted once every 6 months, where Emergency Response Team, Healthcare building facility management and designated personnel shall participate to evaluate their emergency preparedness. ii. Such emergency drills shall be conducted without any evacuation alarm, and without patients or visitors evacuation. iii. Emergency drill shall be practiced by the Healthcare Emergency Response Team, Fire and Life Safety manager and facility management team, every month and they shall practice their role, communication between departments, the efficiency of the emergency action plan and evaluation of their performance during fire, emergency, panic and dangerous situations to execute smooth relocation of patients to point of safety and recorded for assessment. iv. Emergency Response Team shall also practice the continuation of medical care for the patients under emergency situations. v. The testing devices at nurse stations, supervisor rooms etc. to transmit fire alarm shall be tested and practiced.

3.19. Detention and Correctional Occupancy Management Responsibilities

3.19.1. Detention and Correctional occupancy management responsibilities shall comply with **Table:- G.01-T17.**

Table:- G.01-T17.: Detention and Correctional Occupancy Management Responsibilities

ITEMS	REQUIREMENTS
1. FACILITY MANAGEMENT	i. It is every Detention and Correctional occupancy administration's responsibility to ensure that their facility management company complies with the following requirement**.** ii. Detention and Correctional occupancy facility Management Company shall comply with the full requirements of **Table:- G.01-T11. Facility Management Company**
2. DETENTION AND CORRECTIONAL OCCUPANCY EMERGENCY RESPONSE TEAM	i. Every Detention and Correctional occupancy Administration shall have "Emergency Response Team" consisting of trained professionals in Fire Safety, security and first responders for emergency situations. ii. Every Detention and Correctional occupancy Emergency Response Team shall consist of minimum of 2 Fire and Life Safety Managers from their own staff, when initiated by General Directorate of Civil Defence. iii. Every member of Detention and Correctional occupancy Emergency Response Team and staff shall be trained in appropriate Fire extinguisher usage, with refresher trainings annually. iv. Every new staff shall be trained in the usage of appropriate fire extinguishers, upon commencement of the duty. v. Fire and Life Safety Managers shall obtain training from General Directorate of Civil Defence and shall be certified and licensed by General Directorate of Civil Defence. vi. It is every Detention and Correctional occupancy Administration's responsibility to formally request General Directorate of Civil Defence for their fire and life safety manager's training, when initiated by General Directorate of Civil Defence.
3. FIRE AND LIFE SAFETY MANAGER'S RESPONSIBILITIES	i. It is Fire and Life Safety manager's responsibility to monitor, record and ensure that facility management company executes their responsibilities professionally in accordance with **Table:- G.01-T11. Facility Management Company Responsibilities.** ii. It is Fire and Life Safety manager's responsibility to prepare a written Emergency Action Plan. For guidelines on preparation of Emergency Action Plans, see **Section H. Chapter 02. Emergency Action Plans.** iii. Fire and Life Safety managers shall have understanding of the Fire and Life Safety hazards involved in the Detention and Correctional occupancies, such as Arson, sabotage, riots, tampering of Fire and Life Safety equipment, LPG, flammable cleaning solvent storage, bedding and clothing storage, large scale Kitchen etc. iv. Fire and Life Safety manager shall be aware of the dangers and security hazards that can endanger the prison inmates, staff and visitors safety. v. Fire and Life Safety managers shall be fully aware of the facility or area lockups, secured exits, access controlled exits, confined assembly areas, refuge areas, exit routes, emergency evacuation plans, emergency evacuation strategies and procedures. vi. Fire and Life Safety manager shall have fair knowledge of Fire and Life Safety equipment and systems in the facility. vii. Fire and Life Safety manager shall be fully aware of operation of Fire and Life Safety system controls, smoke control system controls, LPG/Natural gas sys- tem controls, elevator system controls, Access control system controls etc. of the building. viii. Fire and Life Safety manager shall be well verse with emergency reporting and coordinating with General Directorate of Civil Defence.

Table:- G.01-T17.: Detention and Correctional Occupancy Management Responsibilities

ITEMS	REQUIREMENTS
4. EMERGENCY ACTION PLAN	i. Detention and Correctional occupancy shall have staff attending to facility and the management 24 hours. ii. 10% of such staff from every shift, shall be members of Emergency Response Team. iii. Such Emergency Response Team staff shall be within 91 m horizontal distance of the access doors of each resident lockups, cells and living areas, unless the lock release mechanism is remotely operated. iv. Such staff shall release the locks necessary to emergency evacuate the inmates to a safe confined assembly area, within 2 minutes of the fire alarm. v. Emergency action plan shall clearly draft out the duties of Fire and Life Safety manager's, Emergency Response Team's and facility management team's respective assigned duties, restrictions and responses during fire and emergency situations. vi. All employees shall be aware of the Detention and Correctional occupancy emergency action plans and shall be instructed every month to familiarize their role during the emergency situations. vii. Copy of the written emergency action plan, specific duties of Emergency Response Team members from specific departments shall be available to the staff at all times and they shall be aware of their specific pre-designated roles, both fire safety roles and policing roles during emergency situations. viii. For guideline on preparation of Emergency Action Plans and Emergency Drills, see **Section H. Chapter 02 - Emergency Action Plans.**
5. PRECAUTIONS	i. It is Detention and Correctional occupancy administration's responsibility to educate, encourage inmates to report unsafe practices, flammable and hazardous materials storage and suspicious activities to the Supervising staff. ii. It is Detention and Correctional occupancy administration's responsibility to inform the dangers of fire and constrained evacuation of inmates to limited safety of confined and restricted environment. iii. Books, clothing and other combustible personal property allowed in sleeping rooms shall be stored in closable metal lockers or an permitted fire-resistant container. iv. The number of heat producing appliances such as toasters and hot plates, and the overall use of electrical power within a sleeping room shall be controlled by facility administration. v. Portable space-heating devices shall be prohibited in all detention and correctional occupancies. vi. All keys necessary for unlocking doors installed in a means of egress shall be individually identified by both touch and sight. vii. Doors and door hardware in means of egress shall be inspected monthly by an appropriately trained person. The inspection shall be documented.
6. DRILLS	i. Emergency Drills shall be conducted once every 6 months, where Emergency Response Team, Detention and Correctional building facility management and designated personnel shall participate to evaluate their emergency preparedness. ii. Such emergency drills shall be conducted without any evacuation alarm, and without inmates or visitors evacuation**.** iii. Emergency drill shall be practiced by the Detention and Correctional occupancy Emergency Response Team, Fire and Life Safety manager and facility management team, every month and they shall practice their role, communication between departments, the efficiency of the emergency action plan and evaluation of their performance during fire, emergency, panic and dangerous situations to execute smooth relocation of inmates to point of safety shall be conducted and recorded for assessment. iv. The testing devices, unlocking devices, access control devices etc. to transmit fire alarm and initiate inmate evacuation shall be tested and practiced.

3.20. Mall Management Responsibilities

3.20.1. Mall management responsibilities shall comply with **Table:- G.01-T18.**

Table:- G.01-T18: Mall Management Responsibilities

ITEMS	REQUIREMENTS
1. FACILITY MANAGEMENT	**i.** It is every Mall management's responsibility to ensure that their facility management company complies with the following requirement**.** **ii.** Mall facility management company shall comply with the full requirements of **Table:- G.01-T11. Facility Management Company Responsibilities.**
2. MALL EMERGENCY RESPONSE TEAM	i. Every Mall Administration shall have "Emergency Response Team" consisting of trained professionals in Fire Safety, security and first responders for emergency situations. ii. Every Mall Emergency Response Team shall consist of minimum of 2 Fire and Life Safety Managers from the Mall management staff, when initiated by General Directorate of Civil Defence. iii. Every Mall Emergency Response Team shall consist of minimum of 2 Crowd Managers, when initiated by General Directorate of Civil Defence. iv. Every member of Mall Emergency Response Team and staff shall be trained in appropriate Fire extinguisher usage, with refresher trainings annually. v. Fire and Life Safety Managers and Crowd managers shall obtain training from General Directorate of Civil Defence and shall be certified and licensed by General Directorate of Civil Defence. vi. It is every Mall Administration's responsibility to formally request General Directorate of Civil Defence for their fire and life safety manager's and crowd manager's training, when initiated by General Directorate of Civil Defence.
3. FIRE AND LIFE SAFETY MANAGER'S RESPONSIBILI-TIES	i. It is Fire and Life Safety manager's responsibility to monitor, record and ensure that facility management company executes their responsibilities professionally in accordance with **Table:- G.01-T11. Facility Management Company Responsibilities.** ii. It is Fire and Life Safety manager's responsibility to prepare a written Emergency Action Plan. For guidelines on preparation of Emergency Action Plans, see **Section H. Chapter 02. Emergency Evacuation Procedures.** iii. Fire and Life Safety managers shall have understanding of the Fire and Life Safety hazards involved in the Mall, such as storages, LPG, flammable cleaning solvent storage, heavy crowd movement, etc. iv. Fire and Life Safety manager shall be aware of the dangers and security hazards that can endanger people safety. v. Fire and Life Safety managers shall be fully aware of the facility or area exits, corridors, parking levels, assembly areas, refuge areas, exit routes, emergency evacuation plans, emergency evacuation strategies and procedures. vi. Fire and Life Safety manager shall have fair knowledge of Fire and Life Safety equipment and systems in the facility. vii. Fire and Life Safety manager shall be fully aware of operation of Fire and Life Safety system controls, smoke control system controls, LPG/Natural gas system controls, elevator system controls, Access control system controls etc. of the Mall. viii. Fire and Life Safety manager shall be well verse with emergency reporting and coordinating with General Directorate of Civil Defence.
4. CROWD MANAGERS	i. Every Mall have a minimum of 2 trained Crowd Managers. ii. Where occupant load is more than 250 people, there shall be additional 1 crowd manager for every 250 people. iii. Crowd mangers shall be fully aware and familiar with Mall Emergency Evacuations plans and Emergency evacuation procedures. iv. Crowd managers shall coordinate with Fire and Life Safety managers, facility management, tenant staff, food court staff, supermarket staff, play area staff to pre-plan the specific roles and duties of each tenants and incorporate the crowd management strategies into the Emergency Action plans.

Table:- G.01-T18.: Mall Management Responsibilities

ITEMS	REQUIREMENTS
	v. Crowd manager shall have control over the occupant load and capacity of the Mall and shall have strategies to control crowd entry into Mall or specific areas, when crowd exceeds the safety level and exit capacities.
5. EMERGENCY ACTION PLAN	i. Mall management shall coordinate with the Fire and Life Safety managers, crowd managers, Emergency response team and facility management team to prepare and maintain written Emergency Action Plan, where individuals duties and responses during emergency situations is clearly mentioned and assigned. ii. Mall management personnel and their emergency response team shall know their specific role such as but not limited to, as follows a. Confirmation of fire alarm by physically verifying at the location of the building or area. b. Informing, reporting emergency incident to General Directorate of Civil Defence and coordinate with them when they arrive. c. Evacuating section of the Mall, retail or assembly areas d. Assisting elderly and disabled to evacuate smoothly, using buggies and other acceptable means. d. Coordination and planning with crowd manager to manage evacuation and leading evacuees to designated assembly points. e. Evaluation and assessment of initial stages of fire and usage of extinguishers and hose reel system, if it is assessed as safe to do so. f. Understanding of the elevator and escalator operation during emergencies and managing elevator evacuation, if it is safe to do so. iii. All Mall employees, including retail, supermarket, paly area, food court employees shall be aware of the Mall emergency action plans and shall be instructed every month to familiarize their role during the emergency situations. Various occupancy management responsibilities as mentioned in other parts of this chapter shall also be referred to, for specific area management team members. iv. Copy of the written emergency action plan, specific duties of Emergency Response Team members from specific departments and role of individual tenants shall be available to the staff at all times and they shall be aware of their specific predesignated roles during emergency situations. v. For guideline on preparation of Emergency Action Plans and Emergency Drills, see **Section H. Chapter 02 - Emergency Action Plans.**
6. DRILLS	i. Emergency Drills shall be conducted once every 6 months, where Emergency Response Team, Crowd managers, Fire and Life Safety managers, Mall facility management and designated personnel shall participate to evaluate their emergency preparedness. ii. Such emergency drills shall be conducted without any evacuation alarm, and without Mall people or staff evacuation. iii. Drill shall be conducted to explore the efficiency of the emergency action plan and to evaluate their performance during fire, emergency, panic and dangerous situations to execute smooth evacuation of the crowd to safety of exterior or point of safety. iv. The time duration it takes for the occupants to fully reach the safety of exterior shall be evaluated and improvised. v. Communication between the designated personnel, decision making, understanding of specific roles without hampering others' assigned duties etc. shall be evaluated and recorded for assessment. vi. Drills should be conducted only for designated personnel of the Mall, without causing unnecessary panic and chaos among the uninformed and unsuspecting public crowd.

3.21. Event Organizer's Responsibilities

3.21.1. Event organizer's responsibilities shall comply with **Table:- G.01-T19.**

Table:- G.01-T19.: Event Organizer's Responsibilities

ITEMS	REQUIREMENTS
1. PERMITS	i. Event organizers shall be registered at General Directorate of Civil Defence. ii. Every event, outdoor or indoor shall require General Directorate of Civil Defence NOC. iii. It is event organizer's responsibility to obtain General Directorate of Civil Defence permits a mini- mum of 7 days before the event. iv. It is event organizer's responsibility to prepare the application for the event NOC from General Directorate of Civil Defence, complete with event details, layouts, occupant load, provision of location for electrical generators, ambulances, fire trucks etc. in accordance with "Event Permission Application and Drawing Submission requirement" in compliance with **Section H. Chapter 03, A2.8. Event proposal Submission Requirements.** v. **Please refer to Section H. Chapter 03 - A2, Table A2.7., for number of exits, Fire and Life Safety requirements for events. Event applications not complying to those requirements shall not be acceptable to General Directorate of Civil Defence.**
2. COOKING/LPG	i. It is event organizer's responsibility to comply with all the LPG/Natural gas requirements, if LPG/Natural gas is intended in the event either for cooking or for flame shows or any of such activities. ii. It is event organizer's responsibility to allow only General Directorate of Civil Defence permitted Food Trucks. iii. It is event organizer's responsibility to appoint General Directorate of Civil Defence permitted and listed LPG/Natural gas contractor to design, install, inspect and maintain the LPG/Natural gas applications in compliance with **Section F. Chapter 02. Liquid Petroleum Gas Requirements**. iv. It is event organizer's responsibility to ensure that General Directorate of Civil Defence listed LPG/ Natural gas contractor obtains formal permit for LPG installations from General Directorate of Civil Defence, a minimum of 7 days before the event. v. Event organizer shall ensure that LPG related installations shall be installed and supplied only by General Directorate of Civil Defence permitted companies and not by MEP, electrical, general or Interior Design contractors.
3. FIRE TRUCK AND FIRE APPARATUS	i. It is event organizer's responsibility to discuss the event with General Directorate of Civil Defence Operations Department to jointly evaluate the nature of event, number of people involved in organizing the event, number of people gathering in the event and the risk involved. ii. Where, General Directorate of Civil Defence evaluation of the event requires the presence of General Directorate of Civil Defence fire trucks and apparatus, it is event organizer's responsibility, to formally apply for the General Directorate of Civil Defence trucks and apparatus.

Table:- G.01-T19.: Event Organizer's Responsibilities

ITEMS	REQUIREMENTS
3. HARZARDOUS	**1. GENERAL** i. It is event organizer's responsibility to provide full details of the pyrotechnics /flame show/fireworks, if any, to General Directorate of Civil Defence in the application for General Directorate of Civil Defence NOC. ii. No pyrotechnics or flame shows or fireworks shall be permitted General Directorate of Civil Defence approvals. iii. Where, pyrotechnics or flame shows use LPG/Natural gas, the LPG/Natural gas contractor shall obtain General Directorate of Civil Defence NOC as required by **Table:- G.01-T19.2.** in compliance with **Section F. Chapter 02. Table:- F.02-T12.** iv. It is event organizer's responsibility to obtain flame shows/pyrotechnics equipment approval certificates from supplier and manufacturer and shall be submitted to General Directorate of Civil Defence along with NOC application. v. Where fireworks are intended, it is event organizer's responsibility to include full details and duration and timings of the show, company executing the fireworks display etc. shall be submitted to General Directorate of Civil Defence along with NOC application. **2. OPERATOR QUALIFICATION AND RESPONSIBILITY** i. Operator of the fireworks display shall be a qualified, trained and experienced person with valid license from General Directorate of Civil Defence – Kingdom of Bahrain. ii. General Directorate of Civil Defence permit and NOC for the event of fire display is mandatory. Every operator must have this permit well in advance of the event date. iii. All the equipment, material, fuses, electrical wiring, safety features, handling, assembly, testing, and operational manual shall be in compliance with NFPA 1123 and permitted by international testing and certification bodies. iv. Fireworks, shells, equipment shall be labeled as per manufacturers and certification guidelines. v. Warning signs conveying safety warnings, as declared by manufacturer shall be posted on all products, product containers and storage arrangements. (For example, "Explosives") vi. Storage, or transportation of fireworks materials and devices intended for outdoor display prior to their delivery to the display site shall be in compliance with Bahrain Municipality and General Directorate of Civil Defence hazardous and dangerous goods storage and transport guidelines. vii. Preparation of firework equipment and material for display shall be carried out a minimum of 30 m away from public access. viii. Repairing of firework shells shall not be done on the display preparation site. ix. Fireworks materials shall not be stored or displayed in any containers or methods, other than as supplied by manufacturer. x. Installation, inspection and testing shall be done in compliance with manufacturer's guidelines and NFPA 1123. xi. The display site plan shall be submitted to GDCD for formal approval. Such a site plan shall include the dimensions of the discharge site, spectator viewing area, parking areas, and the fallout area and the associated separation distances. xii. Operator shall ensure that any underground installation of mortars or cables are not interfering with existing underground installations such as electrical cables, LPG piping or any service trenches.

Table:- G.01-T19 : Event Organizer's Responsibilities

ITEMS	REQUIREMENTS
5. ELECTRICAL SAFETY	i. It is event organizer's responsibility to ensure that all electrical installations, cables, lighting, generators etc. are installed by professional electrical contractor in accordance with electrical safety regulations of "Utility Provision Authority".
6. STRUCTURE	i. It is event organizer's responsibility to ensure that the structural aspect of the event such as Tents, Stages, Grandstands, Seating arrangements, Platforms etc. are installed by experienced professionals. It is event organizer's responsibility to obtain material test certificates from the suppliers of tents, pre-engineered grandstands and kiosks, to be submitted to General Directorate of Civil Defence along with permission application, in accordance with **Section H. Chapter 03 - Drawing Submission Requirements.**
7. MANPOWER	i. Every event organizer shall have "Emergency Response Team" consisting of trained professionals in Fire Safety, security and first responders for emergency situations. ii. Every event organizer Emergency Response Team shall consist of minimum of 2 Fire and Life Safety Managers from the event organizing staff, when initiated from General Directorate of Civil Defence. iii. Every event organizer Emergency Response Team shall consist of minimum of 2 Crowd Managers, when initiated from General Directorate of Civil Defence. iv. Every member of event organizing Emergency Response Team and staff shall be trained in appropriate Fire extinguisher usage, with refresher trainings annually. v. Fire and Life Safety Managers and Crowd managers shall obtain training from General Directorate of Civil Defence and shall be certified and licensed by General Directorate of Civil Defence. vi. It is every event organizer's responsibility to formally request General Directorate of Civil Defence for their fire and life safety manager's and crowd manager's training, when initiated from General Directorate of Civil Defence.
8. FIRE AND LIFE SAFETY MANAGER'S RESPONSIBILITIES	i. It is Fire and Life Safety manager's responsibility to prepare a written Emergency Action Plan for the event. For guidelines on preparation of Emergency Action Plans, see **Section H. Chapter 02. Emergency Evacuation Procedures.** ii. Fire and Life Safety managers shall have understanding of the Fire and Life Safety hazards involved in the event, such as Arson, LPG, heavy crowd movement, electrical accidents etc. iii. Fire and Life Safety manager shall be aware of the dangers and security hazards that can endanger people safety. iv. Fire and Life Safety managers shall be fully aware of the area exits, corridors, assembly areas, refuge areas, exit routes, emergency evacuation plans, emergency evacuation strategies and procedures. v. Fire and Life Safety manager shall have full knowledge of selection and operation of Fire extinguishers. vi. Fire and Life Safety manager shall be well verse with emergency reporting and coordinating with General Directorate of Civil Defence.
9. CROWD MANAGERS	i. Every event organizer shall have a minimum of 2 trained Crowd Managers. ii. Where occupant load is more than 250 people, there shall be additional 1 crowd manager for every 250 people. iii. Crowd mangers shall be fully aware and familiar with event Emergency Evacuations plans and Emergency evacuation procedures. iv. Crowd managers shall coordinate with Fire and Life Safety managers to preplan the specific roles and duties of each member and incorporate the crowd management strategies into the Emergency Action plans. v. Crowd manager shall have control over the occupant load and pre-planned maximum capacity of the event, and shall have strategies to control crowd entry into event and specific areas, when crowd exceeds the safety level and exit capacities.

3.22. Resident's and Tenant's Responsibilities

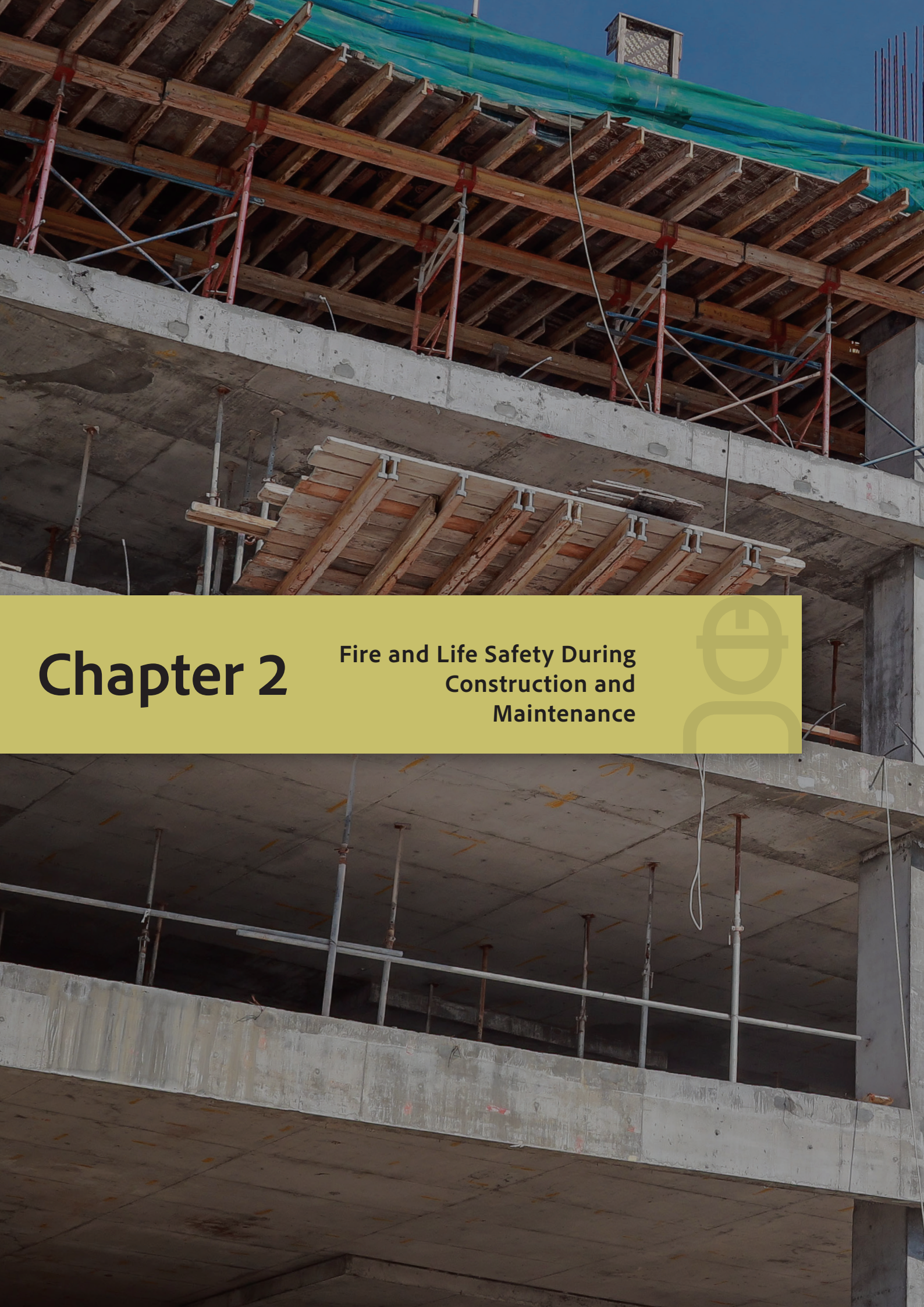
3.22.1. Residential building and Apartment Residents and Tenants shall adhere to their responsibilities in accordance with **Table:- G.01-T20.**

Table:- G.01-T20.: Residents' and Tenants' Responsibilities

ITEMS	REQUIREMENTS
1. AWARENESS	i. It is every resident's responsibility to follow fire safety rules and regulations and participate actively in safeguarding the premises from fire accidents. ii. Residents shall be aware of fire strategy of the building through dialogue with facility management. iii. Residents shall be familiar with emergency evacuation plans of the building to know their exits, exit access corridors, stairs to outside and assembly points of the building. iv. It is resident's responsibility to inform the facility management about presence of any disabled and mentally unstable members in the family. v. Residents shall familiarize themselves with building fire fighting equipment such as location of extinguishers and usage of such extinguishers appropriately during initial stages of fire. vi. It is resident's responsibility to report to the facility management when any discrepancies and violations of fire safety in the building are witnessed. vii. It is resident's responsibility to educate their children about potential fire risks and observing fie safety at home and at the building.
2. BALCONY, WINDOWS, TERRACES, SWIMMING POOLS	i. Residents shall never leave children, special needs people, mentally challenged and unstable or elderly people unattended and unsupervised near the balconies, near windows, at railings or terraces. ii. Residents shall be fully aware of the dangers of balcony accidents and shall never be ignorant in furniture arrangements in living spaces. Furniture, bedding, articles or climbable objects such as plant pots, landscaping, Interior Design items, play items, exercise items near balconies and windows which could be used as ladders by innocent and unwary children. iii. Access to balconies, windows and terraces shall be locked when children, special needs people, mentally challenged and unstable people, elderly people are left unattended at home. iv. Alcohol, medication, drugs and intoxication can cause fatal accidents for self and others. As responsible individuals, observe safe behavior near balconies, windows, terraces and railings. v. Inspect your balconies, railings and windows for any signs of damage and inform facility management immediately demanding corrective actions. vi. Provide safety locks for balcony access, sliding windows and window panes opening more than 125 mm. vii. It is residents responsibility not to leave children, special needs people, mentally people with disabilities or elderly people at the swimming pools unattended. Accidents occur in seconds.
3. FESTIVALS AND CELEBRATIONS (PYROTECHNICS/ FIRE WORKS/ OPEN FLAMES/ CANDLES)	i. Observe fire safety during festivals and celebrations, where electrical decorative string lighting, open flames, candles, fire works etc. when mishandled, can compromise building fire safety catastrophically. ii. Pyrotechnics, fire works and open flames shall not be activated in balconies and terraces. Lighting of pyrotechnics and fire works in places other than designated locations is illegal and punishable by law. iii. Lighting of open flames during festivals shall be carried out responsibly and under adult supervision in safe locations other than balconies and terraces. iv. Faulty wires, connections and devices of electrical decorative string lighting can cause fires. Care shall be taken to use permitted and labeled materials which shall be installed only by professional electricians. v. Burning of incense shall be done by adults responsibly.

Table:- G.01-T20.: Residents' and Tenants' Responsibilities

ITEMS	REQUIREMENTS
4. BARBEQUE	i. BBQ is not permitted in balconies, basements, indoors and on flammable surfaces. Residents shall not cook and BBQ either with open flames or with electrical appliances at balconies, terraces, basements, parking and on flammable surfaces. ii. Barbequing and cooking at balconies, terraces, basements and parking is against the General Directorate of Civil Defence regulation and is punishable.
5. SMOKING	i. Smoking shall be permitted only at designated smoking areas. ii. Discarding cigarette butts in public areas, on roads and throwing cigarette butts from balconies is against the General Directorate of Civil Defence regulation and is punishable.
6. LPG AND COOKING	i. LPG (Liquid Petroleum Gas) used for cooking is highly flammable and extreme care shall be taken to prevent fire accidents from kitchen. ii. Residents shall never attempt multi-tasking such as attending to children and babies while cooking. iii. Children shall be prevented from playing in the kitchen and near cooking appliances. iv. Cooking shall never be left unattended. v. Faulty piping, flexible hose connections and cooking appliances shall be replaced or repaired immediately. vi. Main valve for the LPG supply shall be closed every night after the use. vii. Pressurized aerosols, insect repellents, insect killers, sprays, air fresheners are highly flammable and explosive in the pressurized cans and shall never be applied on live cooking appliances and open flames. viii. LPG connections, transport or repair shall only be done by professionals. ix. Home makers shall be familiar with usage of fire extinguishers and fire blankets to tackle the initial stages of kitchen fires.
7. ELECTRICAL APPLIANCES	i. It is residents responsibility to use the electrical appliances safely and responsibly. User manuals shall be followed for safe usage of electrical appliances. ii. Overloading of electrical sockets and extension cords causes electrical fires. iii. Faulty electrical appliances such as cooking range, microwave, grills, fryers, heaters, grinders, blowers, vacuum cleaners, ironing devices, air-conditioning units, lamps etc. can cause not only fires but can also be sources of electrical shocks. It is resident's responsibility to replace or repair such appliances immediately. iv. Water shall not be used on live electrical connections, sockets and wires.
8. HOUSE KEEPING	i. It is resident's responsibility to maintain the vicinity clean and free of flammable materials. Unattended garbage is a source of fuel for fire. ii. Flammable liquids and materials shall not be stored in bulk quantities or in unauthorized or unlabeled containers. iii. Cleaning solvents are flammable and shall not be stored in bulk quantities. iv. It is resident's responsibility not to block exits, stairs and exit corridors with stored items. Exits, stairs and corridors shall be free of obstacles at all times for smooth evacuation during sudden emergencies. v. Children play items, cycles, plants, unwanted furniture, exercise equipment, shoe racks etc. shall not be stored in the stair, at the exits and at exit access corridors. vi. Sprinkler heads smoke and heat detectors shall not be tampered or blocked.
9. FIRE ALARMS	i. It is resident's responsibility to take every fire alarm and fire sounders seriously. Though there are false alarms sometimes, it is resident's responsibility to verify the fire alarm without neglecting and communicating with facility management. ii. Where there is a real fire alarm intimation, it is resident's responsibility to leave the home without delay and evacuate the building in an orderly and smooth manner without panicking or causing stampede or obstructing fire and rescue operations by General Directorate of Civil Defence. iii. See **Section H. Chapter 02. Table:- G.01-T19.2.3.6., for Emergency Evacuation Drills.**



Chapter 2

Fire and Life Safety During Construction and Maintenance

Chapter 2

Fire and Life Safety During Construction and Maintenance



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1. Scope

1.1. Provide minimum requirements to safeguard construction, modification or demolition operations from Fire accidents and ensure safety to life and property. Implementing safe work practices, providing means of egress and providing Fire Systems during construction phase.

1.2. Responsibilities of building Owners, Owner's representative and Main Consultants.

1.3. Identifying the Risk factors in construction sites.

2. Definitions

2.1. General

2.1.1. Shall
It is a mandatory requirement by General Directorate of Civil Defence (GDCD) -Kingdom of Bahrain

2.1.2. Should
It is a suggested requirement recommended by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain but not mandatory.

2.1.3. Listed
Permitted and registered by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain.

2.1.4. Means of Egress
A continuous and unobstructed way of travel from any point in a building or structure to a public way consisting of three separate and distinct parts: (1) the exit access, (2) the exit, and (3) the exit discharge.

2.1.5. Means of Escape
A way out of a building or structure that does not conform to the strict definition of means of egress but does provide an alternate way out.

2.2. During Construction

2.2.1. Under Construction
Any building, structure, equipment that is being built or installed or altered or being demolished and is not ready to occupy or use, is defined as 'Under Construction'.

2.2.2. Hot Work
Work involving burning, welding, or a similar operation that is capable of initiating fires or explosions.

2.2.3. Thermal Spraying
A group of welding or allied processes in which finely divided metallic or nonmetallic materials are deposited in a molten or semi molten condition to form a coating. The coating material shall be permitted to be in the form of a powder, a ceramic rod, a wire, or molten materials.

2.2.4. Thermal Welding
A welding process that produces coalescence of metals by heating them with superheated liquid metal resulting from a chemical reaction between a metal oxide and aluminum, with or without the application of pressure. Filler metal, where used, is obtained from the liquid metal.

2.2.5. Torch –Applied Roofing System
A bituminous roofing system using membranes that are adhered by heating with a torch and melting an asphalt back coating instead of mopping hot asphalt for adhesion.

2.2.6. Thermit Welding
Thermit welding (TW), or exothermic or thermit welding, is a welding that employs molten metal to permanently join the conductors.

3. Fire Safety during Construction, Modification, Alteration and Demolition

3.1. Intention

3.1.1. Fire Safety requirements in this chapter are to accomplish the following.

- Provide minimum requirements and safety guidelines to be followed during construction or maintenance, on site, to minimize construction and maintenance related fire accidents which can claim life and property.
- To provide minimum prescriptions on safe work practices, safe storage practices, safe equipment handling and operations procedures to prevent fire accidents.
- Provide construction sites with minimum features to enable workers to achieve safe egress and evacuation during fire emergencies during construction.

3.2. General Requirements

3.2.1. No construction activity shall be assumed small scale and low risk. All construction activities shall comply with this chapter.

3.2.2. No modifications, alterations, extensions and change of usage to a building or structure shall be carried out unless such proposals have been permitted by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain

3.2.3. No under construction buildings or structures shall be occupied in whole or in part unless such proposals have been designed, permitted, inspected and completion certificate is obtained as per General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain requirements.

3.2.4. It is the owner, owner's representative and main consultant's responsibility to comply with this chapter by identifying the risk factors and preparing risk management and emergency preparedness studies for the construction site from the design stage itself.

3.2.5. Every worker on site shall be briefed of the requirements of this chapter and shall be trained to adhere to fire safety prescriptions of this chapter and usage of fire extinguishers as first responders.

3.2.6. Guidelines of this chapter may not cover all risk factors of the construction consultant's activity. It is consultant's responsibility to evaluate risk factors involved in the type of construction activity and prepare safety guidelines for such construction operations.

3.2.7. Guidelines of this chapter have been extracted from **NFPA 241, IBC** and **HSE Documents.**

3.2.8. The owner, owner's representative should comply by local relevant laws, relevant ministerial orders concerning health and safety, such as, Minister of Labor Decision No. (8) of 2013 regarding the regulation of occupational safety and health in establishments.

4. Application of Fire Safety During Construction, Modification, Alteration and Demolition

4.1. Responsible Entities

4.1.1. Implementation of fire safety during construction, modification, alteration and demolition activities shall be the responsibilities of building owner and main consultant per **Table G.02-T1.**

Table:- G.02-T1: Responsibilities of Owner and Consultant for Construction Fire Safety

ITEMS	REQUIREMENTS
1. BUILDING OWNER'S RESPONSIBILITIES	i. The owner shall designate a person (Program Manager) who shall be responsible for the fire prevention program and who shall ensure that it is carried out to completion. ii. Building owner shall emphasize the main consultant's role and responsibilities in implementing the guidelines of this chapter and code in his contract documents to the consultant. iii. Such contract document between building owner and consultant shall include a fire safety program to be implemented in all construction, alteration or demolition contracts and the right of the owner to administer and enforce this program, even if the building is entirely under the jurisdiction of the contractor.
2. PROGRAM MANAGER	i. Program manager shall be responsible to ensure the fire safety plan is prepared by the consultant in accordance with **Section 4.2., Section 4.3., Section 4.4., and Section 4.5., Section 4.6., Section 4.7., and Section 4.8. of this chapter** and is implemented on construction site. ii. The manager shall be responsible for ensuring that the written fire safety plan is distributed to all contractors involved in the construction. iii. The program manager shall ensure that the general contractor's adequate number of individuals are trained in the proper use of portable fire extinguishers, which are first aid of firefighting. iv. The manager shall be responsible for ensuring that proper training in the use of protection equipment has been provided. v. The manager shall be responsible for the presence of adequate numbers and types of fire protection devices and appliances and for their proper maintenance. vi. The manager shall be responsible for supervising the permit system for hot work operations. vii. A weekly self-inspection program shall be implemented, with records maintained and made available. viii. Impairments to the fire protection systems or fire alarm, detection, or communications systems shall be authorized only by the fire prevention program manager. ix. Temporary protective coverings used on fire protection devices during renovations, such as painting, shall be removed promptly when work has been completed in the area. x. Where there is General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain or a private fire brigade, the manager shall be responsible for the development of pre-fire plans in conjunction with such fire agencies. xi. The manager must provide sufficient number of licensed fire protection to ensure the implementation of plan on site

Table:- G.02-T1: Responsibilities of Owner and Consultant for Construction Fire Safety	
ITEMS	**REQUIREMENTS**
3. CONSULTANT'S RESPONSIBILITY	1. **CONSULTANT'S RESPONSIBILITIES** i. The Consultant and also GDCD shall be the point of contact to owner and his appointed representative, 'The Program Manager'. ii. It is consultant's responsibility to prepare all written fire safety strategies, training programs, safety checklists and Fire Systems to be implemented during construction, modification, alteration and demolition operations in accordance with guidelines of **Section 4.2., Section 4.3., Section 4.4., and Section 4.5., Section 4.6., Section 4.7., and Section 4.8. of this chapter.** iii. A written Fire Protection plan shall be developed for prior to proceeding past foundation work for new buildings or commencement of demolition work in alteration or modification projects. The written plan shall be consistent with the Fire safety precautions as specified in this chapter and code. iv. It is consultant's responsibility to ensure that the general contractor is implementing and carrying out provisions of the Fire Protection Plan. v. The fire safety plan shall include but not limited to the following. a. Minimizing hazardous and flammable storage in construction site. b. Maintaining robust housekeeping practices to keep the site free of combustibles and flammable rubbish. c. Maintaining safe work practices. d. Procedures for Hot work operations, management of hazardous materials. e. Floor plans identifying the locations of exits, exit stairs, exit routes and portable fire extinguishers. f. Site plans identifying required fire apparatus access roadways and on-site fire hydrants. g. Site plans identifying the designated exterior assembly areas for each evacuation route. h. The name and contact phone number of person(s) responsible for compliance with the Fire Protection Plan. i. Procedures for reporting emergencies to General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain. j. Procedures for emergency notification, evacuation and/or relocation of all persons in the building under construction and on the site. vi. The overall under construction, modification, alteration and demolition work fire safety plan shall implement the following. a. Good housekeeping practices. b. On-site security. c. Installation of temporary and new fire protection systems as construction work progresses. d. Preservation of existing fire systems in their good working condition during building alteration. e. Formation and training of an on-site, in-house fire brigade (as first responders). f. Communication with General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain about fire safety plans and emergency preparedness. g. Protection of existing structures and equipment, protection of neighboring structures and equipment.

Table:- G.02-T1: Responsibilities of Owner and Consultant for Construction Fire Safety	
ITEMS	**REQUIREMENTS**
CONSULTANT'S RESPONSIBILITY	**2. PREPARATION OF FIRE SAFETY AND EVACUATION PLAN FOR BUILDINGS UNDER CONSTRUCTION OR RENOVATION OR MODIFICATION OR DEMOLITION** The consultant shall ensure that constructor, general contractor or project manager implement a fire safety and evacuation plan before work starts. The plan should be prepared by consultant in writing and distributed to all workers and contractors on project, including site visitors. The plan shall include but not limited to, i. Procedures for reporting emergencies to General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain. ii. Procedures for emergency notification, evacuation and/or relocation of all persons in the building under construction and on the site. iii. Procedure for hot work operations, management of hazardous materials and removal of combustible debris and maintenance of emergency access roads. iv. Floor plans identifying the locations of exits, exit stairs, exit routes and portable fire extinguishers and fire hose cabinets. v. Site plan identifying the designated exterior assembly areas for each evacuation route. vi. Site plan identifying required fire apparatus access roadways and on-site fire hydrants. vii. Document and post the name and phone numbers of all personnel responsible for managing the fire safety evacuation plan, including afterhours contact information. viii. Appointment of fire warden(s) to ensure that everyone evacuates work areas when a fire alarm is activated. ix. Post contact information for the security company that oversees "Hot Work" requirements as part of the fire code. Ensure that all construction employees are made aware of the "Hot Work" requirements. x. Evacuation plan of already occupied portion of the building. Ensure evacuation plan for occupied portion and portion under construction or renovation are compatible. xi. Records of all fire safety meetings with project management, workers, foremen, subcontractors, suppliers and others who may be on site. xii. Records of fire drills involving the existing alarm system or on alternative such as compressed air horns, shouts of "fire" etc. Conduct a postmortem on response, performance and awareness of personnel. xiii. Procedure in notifying the shutdown of a certain fire safety system to General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain and also measures to isolate it from the rest of the system which must be in service. xiv. Measures to provide a 24-hour fire watch until the system is fully restored and in service.

4.2. Fire Risk Assessment

4.2.1. Fire Risk assessment of under construction operations shall be as per **Table:- G.02-T2.**

Table:- G.02-T2: Requirements for Fire Risk Assessment of Construction Operations

ITEMS	REQUIREMENTS
1. IDENTIFICATION OF HAZARDS	Coming together of Ignition, Fuel and Oxygen is the recipe for any fire to start. Any RISK ASSESSMENT should start from identifying these sources. Sources of Ignition, sources of Fuel and sources of Oxygen on construction site that need attention are as follows. **1. SOURCES OF IGNITION** i. Smoking, matches and cigarette lighters. ii. Naked flames from fuel gas or liquid fired, open flame equipment. iii. Faulty Electrical equipment, over loaded electrical sockets and misused electrical equipment, overcrowded electrical cables heating up. iv. Hot work processes, welding, cutting and sand blasting. v. Lighting fixtures installed close to flammable material or stored products. vi. Air conditioning and heating installations. vii. Heat sources such as cooking equipment. viii. Friction generated heat and sparks from mechanical equipment and tools. ix. Static charge from equipment. x. Oxygen fuel fired equipment. xi. Lightening. xii. Arson. **2. SOURCES OF FUEL** i. Any material that burns is fuel. ii. Stored packaged and cartooned new products. iii. Plastic and wooden storage pallets. iv. Flammable construction Material such as wood, plastic, rubber, Paint, Oil, Lubricant, insulation etc. v. Flammable chemicals. vi. Wall panels, composite panels, timber. vii. Protective covers and sheets. viii. Stored fuel for vehicles and equipment. ix. Liquid Petroleum Gas stored on site, used in cylinders for hot work. **3. SOURCES OF OXYGEN** i. Natural airflow through narrow gaps on tall wall systems and facades can cause chimney effect and feed the fire. ii. Oxidizing agents. iii. Oxygen used in welding processes.

4.3. Preventive Actions

4.3.1. Once the responsible entities understand their role and responsibilities as per **Section 4.1** and Identify the sources contributing to the fire accident as per **Section 4.2.,** preventive actions need to be taken.

4.3.2. Preventive actions to be taken at under construction or alteration or modification or demolition sites shall be as per **Table G.02-T3.**

Table:- G.02-T3: Required Preventive Actions to be taken

ITEMS	REQUIREMENTS
1. SITE SECURITY	i. Security Guard service shall be provided to the construction site to safeguard the construction premises from arson, vandalism, unauthorized entries, and uninformed people using equipment and tools which all can compromise construction activity safety and could be causes of fire accidents. ii. The guard(s) shall be trained in the following: a. Notification procedures that include calling General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain, Program Manager and Management personnel. b. Usage of Fire Alarm, Notification and fire protection equipment. c. knowledge of various fire hazards d. Usage of construction elevators. iii. Guards shall be informed of any special status of emergency equipment or hazards. iv. Security fences shall be provided where required. v. Entrances (e.g., doors and windows) to the structure under construction, alteration, or demolition shall be secured. vi. Provision of CCTV system should be considered to assist security guards and enhance their efficiency.
2. SMOKING	i. Smoking shall be prohibited at or in the vicinity of hazardous operations or Combustible/flammable materials. “NO SMOKING” signs shall be posted in these areas. ii. Smoking shall be permitted strictly only in designated areas, away from storage, construction activity, garbage disposal areas and flammable materials. iii. Where smoking is permitted, safe receptacles for smoking materials shall be provided. iv. Appropriate cigarette butt disposal ‘Ash trays’, ‘sand cans’ shall be provided at the designated smoking areas. v. Garbage cans shall not be used to dispose of the cigarette butts.
3. WASTE DISPOSAL	i. Accumulations of combustible waste material, dust, and debris shall be removed from the structure and its immediate vicinity at the end of each work shift or more frequently as necessary for safe operations. ii. Rubbish shall not be burned on the construction premises. iii. Materials susceptible to spontaneous ignition, such as oily rags, shall be stored in a listed disposal container. iv. Trash chutes shall be used responsibly and for the purpose. Reactive materials, reactive chemicals, oxidizers shall not be disposed into trash chute.

Table:- G.02-T3: Required Preventive Actions to be taken	
ITEMS	**REQUIREMENTS**
4. TEMPORARY OFFICES, ACCOMODATIONS, STORAGE SHEDS (MODULAR/ MANUFACTURED HOMES)	i. Consultant shall prepare drawings for temporary offices, accommodations, sheds etc. as per General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain regulations, drawing submission requirements and submit to General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain for formal approval as any other project. See **Section H Chapter 03. Drawing Submission Requirements.** ii. Temporary/Modular Housing/Manufactured Homes/Modular Offices shall be made of non-combustible material and shall comply with **Section A. CH-02.** iii. Separation distances between buildings under construction and construction related structures, such as modular offices, modular housing, temporary offices, trailers, sheds, and other facilities for the storage of tools and materials having combustible construction or contents, shall be in accordance with **Table G.02-T3.a.** iv. Adequate detachment between temporary structures shall be provided to minimize spread of fire. v. Adequate temporary fire detection, fixed fire protection systems and portable firefighting equipment shall be provided as required by the consultant's General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain approved layout of temporary and modular homes/ offices. vi. Clearance shall be provided around stoves, heaters, and all chimney and vent connectors to prevent ignition of adjacent combustible materials. vii. Vertical positioning of manufactured homes. Manufactured homes shall not be positioned vertically, stacked with one over the other, in whole or in part, unless the structure is designed and approved for such installation and permitted by the authority having jurisdiction. viii. The location of underground electrical cables, gas piping, water piping, and sewer lines that are buried within 1.2 m of the perimeter of the site's largest planned manufactured home shall be indicated by an aboveground sign (s) or underground marker tapes identifying the proximity of the lines. ix. A plot plan showing the "as built" location of underground utility lines shall be available for installations in multiple-site facilities. x. Installation of all manufactured homes, including the installation of the support system and the connection of structural, electrical, mechanical, and plumbing systems to the site utilities or between sections in the case of multiple section homes, shall be performed in accordance with printed installation instructions provided by the manufacturer of the home (Data Sheet). xi. All manufactured homes, accessory buildings, structures, and community buildings shall be located and maintained in such a manner that required egress windows or doors are not blocked.

Table:- G.02-T3.a.: Separation Distances for Temporary Modular Homes, Offices and structures

TEMPORARY STRUCTURE'S EXPOSING WALL LENGTH	MINIMUM SEPARATION DISTANCE FROM BUILDING UNDER CONSTRUCTION
1. Up to 6 m	9 m
2. 9 m	11 m
3. 12 m	12 m
4. 15 m	14 m
5. 18 m	15 m
6. More than 18 m	18 m

Table:- G.02-T3: Required Preventive Actions to be taken	
ITEMS	**REQUIREMENTS**
5. TEMPORARY ENCLOSURES	i. Only noncombustible panels, flame-resistant tarpaulins or approved materials of equivalent fire-retardant characteristics shall be used. ii. Any other fabrics or plastic films used shall be certified as conforming to the requirements of Test Method #2 contained in NFPA 701, Standard Methods of Fire Tests for Flame Propagation of Textiles and Films. See **Section A. CH-02.** iii. Where used to enclose structures, forming equipment and similar items, the enclosing material shall be fastened securely or guarded by construction so it cannot be blown by the wind against heaters or other sources of ignition. iv. Temporary enclosures shall be equipped with at least one fire extinguisher suitable for all classes of Fires that are expected in that enclosure. Extinguishers shall comply with **Section D. CH-01. Fire Extinguishers.**
6. EQUIPMENT/ MOTORIZED EQUIPMENT	i. Internal combustion engines and associated equipment, such as air compressors, hoists, derricks, generators, pumps and similar devices shall be located so that the exhausts discharges well away from combustible materials. ii. Where the exhausts are piped outside the structure under construction, alteration, or demolition, a clearance of at least 230 mm shall be maintained between such piping and combustible material. iii. Internal combustion engines and associated equipment shall be shut down and allowed to cool sufficiently prior to refueling. iv. Service areas for equipment shall not be located within structures under construction, alteration, or demolition. v. Fuel for internal combustion engines shall not be stored within structures under construction, alteration, or demolition.
7. TEMPORARY HEATING EQUIPMENT	i. Temporary heating equipment such as LPG fueled, Oil-fired heaters shall be listed and shall be installed, used, and maintained in accordance with the manufacturer's instructions. ii. Chimney or vent connectors, where required from direct-fired heaters, shall be maintained at least 460 mm from combustibles. iii. Heating equipment shall be secured properly and kept clear from combustible materials. Refueling operations shall be conducted in approved manner. iv. Heating devices shall not be used in areas where flammable liquids are being sprayed. Propane and kerosene heaters are prohibited inside buildings. Heating equipment shall not be kept unattended when it is operating. v. Heating equipment shall be located a minimum of 1 m away from combustibles and in an area where it is not likely to overturn. vi. Temporary heating equipment, where utilized, shall be monitored for safe operation and maintained by properly trained personnel.
8. CONSTRUCTION MATERIALS	i. Construction materials (drop clothes, tarps etc.) shall be non-combustible or fire retardant with a maximum flame spread of 25, as tested in accordance with ASTM E-84 or UL 723. ii. Plastic sheeting shall be fire retardant type. iii. Wood used in temporary or permanent construction shall be fire retardant pressure impregnated. iv. All materials used for temporary or permanent construction shall comply with SD410 requirements.

Table:- G.02-T3: Required Preventive Actions to be taken	
ITEMS	**REQUIREMENTS**
9. ASPHALT TAR KETTLES	i. Asphalt kettles shall not be located within 6.1m of any combustible material, combustible building surface or building opening. ii. With the exception of thermostatically controlled kettles, an attendant shall be within 30m of a kettle when the heat source is opening. iii. Ladders or similar obstacles shall not form a part of the route between the attendance and the kettle. Kettles shall be equipped with tight fitting covers. iv. Mops and rags soaked with tar have potential to ignite spontaneously and therefore must be thoroughly cleaned and stored away from the structure and combustibles. v. A 10 pound ABC-type portable fire extinguisher shall be provided within 9.1m of the kettle. Water extinguishers shall not be used. vi. A minimum 20-B:C (5 pound) rated portable fire extinguisher shall be located within 9.1 m of each asphalt kettle when the heat source is operating. vii. Minimum 20-B:C (5 pound) rated portable fire extinguishers also shall be located on roofs during asphalt coating operations.
10. VEHICLE PARKING	i. All vehicles shall be parked a minimum of 20 feet (6.1m) from new buildings under construction with following exceptions. ii. Vehicles that are parked temporarily for loading/unloading or other construction related operations. However such vehicles shall not be left unattended. iii. Private vehicles maybe parked in parking garages of construction site if the automatic fire sprinkler system is in service and vertical openings are protected.



MARCH 2014, CALIFORNIA, BUILDING UNDER CONSTRUCTION
FOR ILLUSTRATION



FEBRUARY 2016, FIRE AT CONSTRUCTION SITE, KAZAKHSTAN
FOR ILLUSTRATION

4.4. Work Permit Culture

4.4.1. Every type of work conducted on construction site such as Hot Work, Cold Work, Confined Space Work, Electrical Work etc. shall be through work permit procedure, where authorized safety team and supervisor issues work permits to contractor team leader upon enquiring nature of work involved and safety measures that are in place and need to be taken, including personal protective equipment, associated equipment shut-offs and work site inspection. Such work permit practices shall be followed as required by **Table G.02-T4.**

Table:- G.02-T4: Work Permit Requirements

ITEMS	REQUIREMENTS
1. HOTWORK	**1. WORK PERMIT CULTURE** i. Hot work includes any work involving operations capable of initiating fires or explosions, including cutting, welding, brazing, soldering, grinding, thermal spraying, thawing pipe, torch applied roofing or any other similar activity. ii. The use of hot work equipment shall be in accordance with the following requirements, including a pre-site inspection, fire watch and post inspection procedures. iii. Written permission shall be obtained 24 hours in advance of work from the contracting officer's technical representative or team leader and building operation manager. iv. Internal permit shall be issued on a daily basis for all welding, cutting, brazing and other open flame producing operations when it is determined that the a. Work can be done safely at the requested location. b. Combustibles have been separated from the work area. c. The atmosphere is not flammable d. A fire watch is posted for the work period and 30 minutes thereafter. v. An inspection of the hot work site shall be conducted by the general contractor or his/her designee prior to hot work operations to ensure the following. a. The hot work site is clear of combustibles or that combustibles are protected. b. Exposed construction is of non-combustible materials or that combustible materials are protected. c. Openings are to be protected. d. There are no exposed combustibles on the opposite side of the partitions, walls, ceilings, floors etc. e. Fire extinguishers are available, fully charged and operable. f. Fire watch personnel are assigned, equipped and trained. vi. The fire watch shall be maintained a minimum of 30 minutes after the conclusion of the work to look out for leftover sparks, slag or smoldering combustibles. vii. "Work Permit" culture shall be strictly followed. viii. The Hot Work Permit Tag shall be available on work location at all times.

Table:- G.02-T4: Work Permit Requirements

ITEMS	REQUIREMENTS
HOTWORK	**2. FIRE WATCH** i. The sole duty of fire watch personnel shall be to watch for occurrence of fire during and after hot work operations. Individuals designated to fire watch duty shall have fire extinguishing equipment readily available and shall be trained in the use of such equipment. Personnel assigned to fire watch shall be responsible for extinguishing spot fires and communicating an alarm. **3. THERMIT WELDING** i. In Thermit welding, the mold shall be dried thoroughly before the charge is ignited and provided with a cover. ii. Bulk storage of Thermit welding materials shall be maintained in a detached shed at least 15 m from the main buildings. iii. Storage sheds shall be maintained dry, posted as a “no smoking” area, and kept locked. iv. Containers for the starting material shall be closed tightly immediately after each use. v. The molds shall not be removed until sufficient cooling has taken place in accordance with the manufacturer’s published instructions. vi. Smoking shall not be permitted in areas where Thermit welding material is being used.



SAMPLES OF HOT WORK PERMIT/HOT WORK PERMIT TAG
FOR ILLUSTRATION

4.5. Safe Storage and Handling Practices

4.5.1. Safe Storage and handling Practices shall be followed by all the contractors and suppliers as required by **Table G.02-T5.**

Table:- G.02-T5.: Safe Storage and Handling Practices

ITEMS	REQUIREMENTS
1. FLAMMABLE AND COMBUSTIBLE LIQUIDS/ GASES	**1. STORAGE** i. The following requirements shall apply to storage areas for flammable and combustible liquids and flammable gases ii. Storage areas shall be kept free of weeds and extraneous combustible material. iii. Open flames and smoking shall be prohibited in storage areas. iv. Storage of Class I and Class II liquids shall not exceed 227 L (60 gal) within 15 m of the structure. v. Storage areas shall be kept free of weeds, debris, and combustible materials not necessary to the storage. vi. Open flames and smoking shall not be permitted in flammable and combustible liquids storage areas. vii. Such storage areas shall be appropriately posted as "No Smoking" areas. viii. Tanks and containers shall be marked with the name of the product and sign, **"FLAMMABLE – KEEP FIRE AND FLAME AWAY"** **ix.** Tanks (i.e. containers in excess of 60 gallons) shall also be labeled. **"KEEP 50 FEET (15m) FROM BUILDINGS"** x. Overnight storage of combustible paints and liquids inside or within 15m of a building shall not exceed 10 gallons, unless stored within an approved flammable liquids storage cabinet in a location approved by building management. **2. HANDLING** i. At least one portable fire extinguisher (10 pound ABC type or 20-B (9.5L) type) shall be located no less than 3m and no more than 15m from the flammable liquids storage area. ii. Class I and Class II liquids shall be kept in approved safety containers iii. Metal containers for Class I or Class II liquids shall be in accordance with NFPA 30, 30A requirements or shall be of an approved design. Discharge devices shall not cause an internal pressure on the container. Individual containers shall not be interconnected and shall be kept closed when not in use iv. Secondary containment or means of spill control, drainage control and diking shall be required for containers and tanks as approved by the Fire Department and if applicable, local hazardous materials program agency v. Means shall be provided to dispose of leakage and spills promptly and safely. vi. Class I liquids shall be dispensed only where there are no open flames or other sources of ignition within the possible path of vapor travel. vii. Plans for the installation/use of any aboveground storage tank (i.e. container greater than 60 gallons) shall be submitted to The General Directorate of Civil Defence (GDCD) and if applicable, to local hazardous material program agency for review and permit prior to proposed tank arriving at the site.

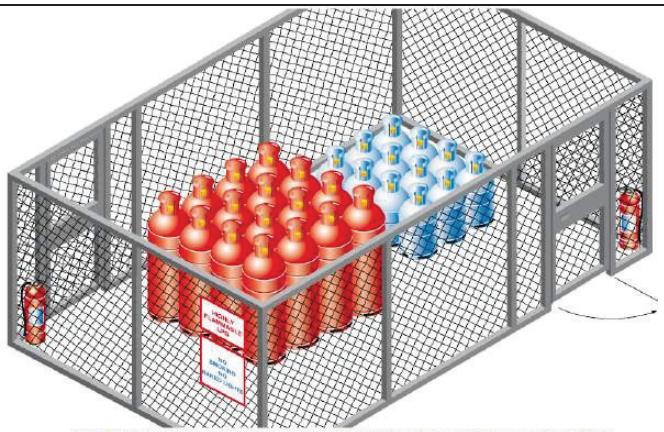
Table:- G.02-T5.: Safe Storage and Handling Practices	
ITEMS	**REQUIREMENTS**
2. EXPLOSIVE MATERIALS	**1. STORAGE AND HANDLING** i. The storage, handling, and use of explosive materials shall be in accordance with NFPA 495, Explosive Materials Code and 'Code of Practice for the Management of Dangerous Goods in the Bahrain' issued by Bahrain Municipality. ii. All blasting operations shall be under the direct supervision of an individual who is legally licensed to use explosives and who possesses the required permits.
3. COMBUSTIBLE MATERIALS	i. Combustible construction materials shall be stored a minimum of 6m from buildings under construction or undergoing remodel, except for a. Materials that are staged for installation on a floor level. b. When approved by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain, materials may be stored in parking garages of Type I construction if the automatic fire sprinkler system is in service and vertical openings are protected. ii. Wood, cardboard, packing material, forms lumber and similar combustible debris shall not be accumulated within buildings. Such debris, rubbish and waste material shall be removed from buildings on a daily basis. iii. Oily rags and similar material shall be stored in metal or other approved containers equipped with tight fitting covers.
4. COMPRESSED GASES	**1. STORAGE AND HANDLING** i. Combustible materials shall be kept a minimum of 3m from gas containers. ii. Cylinders shall be protected against physical damage. iii. Cylinders shall be stored upright and secured to prevent falling. iv. Cylinders shall not be placed near elevators, unprotected platform edges or other areas where they drop more than 0.61m. v. Cylinders shall not be placed in areas where they may be damaged by falling objects. vi. When cylinders are not in use, valve protective caps shall be in place. vii. Ropes, chains or slings shall not be used to suspend gas cylinders, unless the cylinder was manufactured with appropriate lifting attachments. viii. When stored, gas cylinders shall be separated from each other based on their hazard classes. ix. Gas cylinders shall be marked with the name of the contents.
 SAFE STORAGE PRACTICE OF COMPRESSED GAS CYLINDERS FOR ILLUSTRATION	

Table:- G.02-T5.: Safe Storage and Handling Practices	
ITEMS	**REQUIREMENTS**
5. LPG (Liquefied Petroleum Gas)	**1. STORAGE** i. LPG Cylinder storage shall comply with **Section F. CH-02. Liquefied Petroleum Gas Design and Installation** of this code and **NFPA 58. Liquefied Petroleum Gas Code**. **2. HANDLING** i. Heating elements (other than integral heater-container units) shall be located at least 1.8 m from any LP-Gas container. ii. Integral heater-container units specifically designed for the attachment of the heater to the container, or to a supporting standard attached to the container, maybe used provided they are designed and installed so as to prevent direct or radiant heat application to the LP-Gas container. iii. Blower and radiant type units shall not be directed toward any LP-Gas container within 6m. iv. Heat producing equipment shall be installed with clearance to the combustible in accordance with the manufacturer's installation instructions. v. Cylinders shall comply with General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain approval specifications as per **Section F. CH-02. Liquefied Petroleum Gas Design and Installation. Sub. Section 7.** And shall be secured in an upright position. vi. Regulators shall be approved for use with LP-Gas. Fittings shall be designed for at least 250 psi service pressures. vii. Hose shall be designed for a working pressure of at least 350 psi (unless limited to 5 psi) and shall be a maximum of 6 feet (1.8m) in length. viii. Portable heaters shall be equipped with an approved automatic device to shut off the flow of gas to the main burner and to the pilot in the event of flame extinguishment or combustion failure. Portable heaters with an input of more than 50,000 Btu/hr shall be equipped with either a pilot that must be proved before the main burner can be turned on or an approved electronic ignition system. ix. In addition to the above, for LPG storage/use in buildings undergoing alteration and that are fully or partially occupied, specific approval must be obtained from The General Directorate of Civil Defence (GDCD) prior to bringing LP-Gas containers on-site. x. The maximum water capacity of individual containers shall be 45 kg and number of containers in the building shall not exceed the number of workers assigned to using the LP-Gas. xi. LPG Containers shall not be left unattended and shall be stored in dedicated lockable storage open space after the usage.

4.6. Electrical Safety

4.6.1. Electrical Safety during construction shall be as per **Table G.02-T6.**

Table:- G.02-T6.: Electrical Safety Requirements

ITEMS	REQUIREMENTS
1. ELECTRICAL SAFETY	**1. ELECTRICAL DEVICES** i. All electric work must be carried and followed by licensed personnel from EWA - Kingdom of Bahrain ii. All construction-operation electrical wiring and equipment for light, heat or power purposes shall be in accordance with the applicable provisions of NFPA 70, National Electrical Code. iii. Electrical devices shall be maintained in a safe condition. iv. Extension cords shall be maintained free from damage. v. Damaged equipment and cords shall be removed from service until rendered safe. **2. WIRING** i. All branch circuits shall originate in an approved power outlet or panel board. ii. Conductors shall be permitted within multi-conductor cord or cable assemblies or as open conductors. iii. All conductors shall be protected by overcurrent devices rated for the ampacity of the conductors. iv. Runs of open conductors shall be located where the conductors are not subject to physical damage, and the conductors shall be fastened at intervals not exceeding 3m. v. Each branch circuit that supplies receptacles or fixed equipment shall contain a separate equipment grounding conductor where run as an open conductor. vi. Wiring, junction boxes, electrical devices, electrical equipment, panel boards etc. shall not be located where water flooding is a possibility. **3. LIGHTING** i. Temporary lights shall be equipped with guards to prevent accidental contact with the bulb unless the construction of the reflector is such that the bulb is deeply recessed. ii. Temporary lighting fixtures, such as quartz, that operate at temperatures capable of igniting ordinary combustibles shall be fastened securely so that the possibility of their coming in contact with such materials is precluded. iii. Temporary lights shall be equipped with heavy-duty electrical cords with connections and insulation maintained in safe condition. iv. Temporary lights shall not be suspended by their electrical cords unless such cords and lights have been designed for that purpose. v. Splices shall have insulation equivalent to that of the cable. vi. Temporary wiring shall be removed immediately upon the completion of the construction or purpose for which the wiring was installed.

4.7. Safe Work Practices

4.7.1. Construction work shall be performed by various contractors involved in a professional and safe manner as required by **Table G.02-T7.**

Table:- G.02-T7.: Safe Work Practices

ITEMS	REQUIREMENTS
1. SCAFFOLDING, SHORING AND FORMS	i. Accumulations of unnecessary combustible forms or form lumber shall be prohibited. ii. Combustible forms or form lumber shall be brought into the structure only when needed. iii. Combustible forms or form lumber shall be removed from the structure as soon as stripping is complete. iv. Those portions of the structure where combustible forms are present shall not be used for the storage of other combustible building materials. v. During forming and stripping operations, portable fire extinguishers or charged hose lines shall be provided to protect the additional combustible loading adequately. vi. Yard storage of equipment to be installed or combustible construction materials shall not be stored closer than 9 m from the structure under construction or alteration.
2. LPG AND NATURAL GAS	i. The installation of gas piping for construction purposes, or modifications to existing gas piping, gas utilization equipment, or accessories, shall be performed only by a service provider with certified people. ii. All such work shall be in accordance with **Section F. CH-02. Liquefied Petroleum Gas Design and Installation** of this code, **NFPA 58. Liquefied Petroleum Gas Code** and **NFPA 54. National Fuel Code**. iii. All modifications to existing gas piping systems shall be performed with the gas turned off. iv. Hot taps shall be permitted to be made, provided they are installed by a trained and experienced crew utilizing equipment specifically designed for such purpose.
3. COMPART-MENTATION	i. Fire resistance rated walls and exit stairways, where required for the completed building, shall be given priority for execution. ii. Fire doors with approved closing devices and hardware shall be installed as soon as is practicable and preferably before combustible material is introduced. iii. Fire doors, after installation shall not be obstructed from closing. iv. Protection shall be provided to separate an occupied portion of the structure from a portion of the structure undergoing alteration, construction, or demolition operations when such operations are considered as having a higher level of hazard than the occupied portion of the building. v. Walls shall have at least a 1-hour fire resistance rating. vi. Opening protectives shall have at least a 45-minute fire protection rating. vii. Nonrated walls and opening protectives shall be permitted when an approved automatic sprinkler system is installed.

Table:- G.02-T7.: Safe Work Practices

ITEMS	REQUIREMENTS
4. ROOFING	**1. ASPHALT AND TAR KETTLES** i. Asphalt and tar kettles shall not be located on roofs. ii. A lid that can be closed by means of gravity shall be provided on all roofing kettles. iii. The tops and covers of all kettles shall be close-fitting and constructed of steel having a thickness of not less than No. 14 manufacturer's standard gauge 2 mm. iv. Used roofing mops and rags shall be cleaned of excessive asphalt and stored away from the building and combustible materials. v. Discarded roofing mops and rags shall not be in contact with combustibles. vi. Kettles shall be constantly attended when in operation by a minimum of one employee knowledgeable of the operations and hazards. The employee shall be within 7600 mm of the kettle and have the kettle within sight. vii. Roofing kettles shall not block exits, means of egress, gates, roadways, or entrances. In no case shall kettles be closer than 3000 mm from exits or means of egress. **2. SINGLE PLY AND TORCH APPLIED ROOFING SYSTEMS** i. Single-ply and torch-applied roofing systems shall be installed using extreme caution. ii. Torches or hot-air guns used to secure roofing membranes shall be used in accordance with the manufacturer's recommendations. iii. In order to prevent smoking or ignition of roofing membranes, they shall not be overheated. **3. WORKING NEAR OPENINGS, PENETRATIONS AND FLASHINGS** i. Caution shall be used where working near roof openings, penetrations, or flashings. ii. The flame of the torch shall not come in direct contact with wood nailers, cant strips, or metal flashing. iii. Small torches shall be used to heat the underside of the membrane at a distance from these areas before securement. iv. Hot trowels shall be used to feather seams at laps and flashings. v. The torch shall not be used in areas where the flame impingement cannot be fully viewed. vi. Open flames shall not be left unattended. **4. FLAME CONTACT PROTECTION** i. The torch flame shall not be applied to a combustible substrate for the membrane. ii. Base ply shall be used to cover wooden decks, combustible insulation (such as foam plastic, Kraft faced glass fiber, or wood fiber), small crevices, cant strips, plastic fastener plates, or any other combustible surface. iii. Base ply shall be permitted to consist of either glass fiber felts or minimum 18 kg (40 lb) organic felts. iv. Torch flames shall not come in contact with exposed plastic roofing cement.

Table:- G.02-T7: Safe Work Practices	
ITEMS	**REQUIREMENTS**
ROOFING	**5. TORCH APPLIED ROOFING IS HOTWORK** i. The installation of torch-applied roofing and, in some cases, single-ply roofing systems is hot work and shall comply with **Section 4.4**., of this chapter, except where otherwise noted. ii. Torch-applied roofing shall be exempt from the requirement in NFPA 51B, Standard for Fire Prevention during Welding, Cutting, and Other Hot Work, that combustibles shall be kept 11 m from hot work, commonly referred to as the "35 Foot Rule." **6. EQUIPMENT** i. Proper equipment shall be used to heat roofing membranes. ii. Torches shall be equipped with a pilot adjustment, a flame height adjustment, a minimum of 7600 mm to a maximum of 15 m of listed hose, a pressure gauge, and a regulator. iii. A spark igniter shall be used. iv. Torch trolleys and multiple torch head machines shall be equipped with listed safety valves. v. Equipment shall be inspected thoroughly and repaired or replaced as needed prior to use. **7. FUEL GAS CYLINDERS** i. Fuel gas cylinders shall not be hoisted by their valves. ii. Straps placed around the cylinders shall be utilized. iii. Carts used to transport fuel gas cylinders shall be stable. iv. Safety caps shall be attached to all fuel gas cylinders and installed on the valves whenever cylinders are not in use. v. The fuel gas cylinder shall be sized for the torch used. **8. FROST BUILDUP** i. If frost buildup occurs on fuel gas cylinders and the rate of vapor withdrawal is no longer adequate for operating conditions, the cylinder shall not be placed on its side or heated with the torch flame. ii. The hose shall be disconnected and a larger cylinder shall be used. **9. FIRE EXTINGUISHERS FOR ROOFING OPERATIONS** i. There shall be at least one portable fire extinguisher having a rating of not less than 20-B (2kg Co2) no closer than 1500 mm and no more than 7600 mm of horizontal travel distance from every kettle at all times while such kettle is in operation. ii. Fire extinguishers shall be located in an accessible, visible, or identified location. iii. There shall be at least one multipurpose 2-A:20-B:C (5Lbs) or 13A 70B (2kg) iv. Portable fire extinguisher on the roof being covered or repaired, or other fire protection shall be provided as determined by the authority having jurisdiction. v. There shall be at least one multipurpose 2-A:20-B:C (5Lbs) or 13A 70B (2kg) portable fire extinguisher within 6100 mm) of horizontal travel distance from torch-applied roofing equipment. vi. All kettle operators and torch applied roof installers shall be trained in the use of fire extinguishers.

Table:- G.02-T7: Safe Work Practices	
ITEMS	**REQUIREMENTS**
ROOFING	**10. FUEL FOR ROOFING OPERATIONS** i. Fuel containers, burners, and related appurtenances of roofing equipment in which liquefied petroleum gas is used for heating shall comply with all the applicable requirements of NFPA 58, Liquefied Petroleum Gas Code. ii. Fuel containers having capacities greater than 0.45 kg (1lb) shall be located at least 3000 mm from the burner flame or at least 600 mm there from where properly insulated from heat or flame. iii. Solid fuel or Class I liquids shall not be used as fuel for roofing kettles. iv. LP-Gas cylinders shall be secured to prevent accidental tip over. v. Where in the opinion of the authority having jurisdiction, there is danger of physical damage to the fuel containers, protection shall be provided.
5. DEMOLITION OPERATIONS	**1. SPECIAL PRECAUTIONS** i. Special precautions shall be taken where demolition work is performed in areas where floors are soaked with oil or other flammable liquid; where dust accumulations are present; or where combustible insulation is present in floors, walls, or ceilings/roofs where hot work is being performed. In these situations, charged fire hose lines of an adequate number shall be provided. ii. Flammable and combustible liquids shall be drained from tanks and machinery reservoirs in a safe manner and removed from the building immediately. iii. Particular attention shall be paid to the removal of residue and sludge accumulations if hot work operations are involved. **2. DEMOLITION USING EXPLOSIVES** i. If explosives are used in demolition work (implosion), fire hose lines at least two of 38 mm (1.5 in.) diameter or one 64 mm (2.5 in.) diameter] shall be provided in the immediate vicinity of the demolition site during the actual detonation. ii. The required fire hose lines shall be of sufficient length to be capable of extinguishing any small fire anywhere on the demolition site after detonation. **3. FUEL GAS SUPPLY** i. Prior to demolition, gas supplies shall be turned off and capped at a point out-side the building. ii. Gas lines within the building shall be purged after capping.
6. FIRE PROTECTION SYSTEMS	i. Where construction site fire protection systems are provided as per **Section 4.8.** and building is equipped with sprinklers, the sprinkler protection shall be retained in service as long as the condition requiring the use of sprinklers exists. ii. The operation of sprinkler control valves shall be permitted only by properly authorized personnel and shall be accompanied by the notification of designated parties. iii. Where the sprinkler protection is regularly turned off and on to facilitate removal and capping of segments, the sprinkler control valves shall be checked at the end of each work shift to ascertain that protection is in service. iv. Standpipes shall be maintained in conformity with the progress of construction activity in such a manner that they are always ready for fire department use.

Table:- G.02-T7.: Safe Work Practices

ITEMS	REQUIREMENTS
7. UNDER GROUND OPERATIONS	**1. SPECIFIC REQUIREMENTS** i. In addition to the specific requirements of this section, the provisions of all the sections of this chapter shall apply to the underground operations unless otherwise modified by this chapter. ii. Drainage systems shall be properly designed and installed to remove water from sprinkler discharge and fire hose streams. iii. Fire safety for existing, operating, fixed guideway underground transportation systems undergoing alteration or renovation shall be in accordance with **NFPA 130, Standard for Fixed Guideway Transit and Passenger Rail Systems.** iv. Means of egress for existing, operating, underground structures shall be in accordance with **Section A. CH-03. Means of Egress.** **2. SECURITY** i. At each above ground entrance, underground operations shall have a check-in/ check-out system, supervised by a qualified individual at all times, that provides an accurate record of each person who is underground. ii. The location of the check-in/check-out system shall be within 7600 mm of the entrance and shall be easily identified. iii. Completed or unused sections of the underground facility shall be barricaded, properly marked and made off limits. iv. Compartmentation by means of the installation of fire and smoke barriers shall be at intervals that limit the extent and severity of the fire and that provide areas of refuge for occupants. **3. WATER SUPPLY** i. A fire protection water supply system shall be provided as per **Section 4.8.** ii. No minimum water supply can be specified due to the wide range of construction types, sites, and sizes. However, unless combustibles are essentially nonexistent in the completed structure and occupancy, a minimum of 1893 L/min (500 gpm) should be provided. In most instances, the required supply is greater and the consultant's proposal shall be submitted to General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain for approval. iii. The fire hose outlets shall be provided so that travel distance does not exceed 46 m. **4. EVACUATION PLANS** i. A written fire prevention, fire suppression and emergency evacuation plan shall be developed, maintained and kept current. ii. Special attention shall be given to rescue and smoke-venting procedures, to means of ingress/egress and to training and orientation of employees and visitors. iii. All personnel, including visitors, shall be trained in emergency and evacuation procedures and informed of the hazards prior to going underground.

Table:- G.02-T7.: Safe Work Practices	
ITEMS	**REQUIREMENTS**
UNDER GROUND OPERATIONS	**5. EMERGENCY DRILLS** i. Underground operations shall conduct disaster and evacuation drills for each shift at least once at the start of underground operations and every 6 months, or more frequently as appropriate. ii. A record of such drills shall be maintained. **6. SAFETY, FIRE DETECTION AND PROTECTION SYSTEMS** i. Fire protection extinguishing equipment applicable to the hazard shall be provided at the head, tail, drive, and take-up pulley areas of belt conveyors and at intervals along belt conveyor lines that shall not exceed 91 m. ii. Belt conveyors installed in underground locations, other than belts that carry the load of the belt on a low-friction metal deck without rollers, shall meet the following minimum requirements. a. Conveyor belting shall be approved. b. Entrances in which belt conveyors are installed shall be kept free of accumulations such as muck, debris, and combustibles. c. All belt conveyors shall be equipped with an approved slippage switch system designed to shut down the belt when sliding friction develops between the drive pulley(s) and the belt. d. The slippage switch system shall be tested weekly. e. On each new installation, the slippage switch system shall be tested before the conveyor is used. iii. All conveyor belt systems shall be equipped with approved interlock systems that shut down belt conveyors when any conveyor in the system stops or reduces its normal speed or upon activation of any required fire protection system. iv. Fixed combustible materials such as posts, cribbing, and roof supports shall be either guarded from contact by the belt using metal or located at a distance of at least ½ the width of the belt from any idler or pulley. a. An alternate method for minimizing potential frictional ignition is the use of alignment switches at intervals sufficient to prevent the belt from contacting such materials. b. Guarding for machinery in the drive area and at other points along the belt shall be of noncombustible material. v. New installations of belt conveyors shall utilize a structure that does not provide a deck between the upper and lower strands of the belt. vi. Suitable fire extinguishers shall be installed so that travel distance from any one point in a tunnel does not exceed 91 m (300 ft.) on a horizontal plane. vii. Audible and visible alarm and emergency lighting for safe evacuation shall be required. viii. Two means of communications with the surface shall be available at all times from all areas of the underground facility. ix. All communications systems shall be tested weekly.

Table:- G.02-T7.: Safe Work Practices

ITEMS	REQUIREMENTS
UNDER GROUND OPERATIONS	**7. ELECTRICAL CONDUCTORS** i. All electrical work must be carried in accordance to EWA standards – Kingdom of Bahrain. ii. Electrical cords and plugs shall be heavy duty and suitable for use in damp locations. iii. Conductors shall be located or guarded so as to be protected from physical damage. Multi-conductor portable cable shall be permitted to supply mobile equipment. iv. An equipment grounding conductor shall be run with circuit conductors inside the metal raceway or inside the multi-conductor cable jacket. v. The equipment grounding conductor shall be permitted to be insulated or bare. vi. Oil-filled transformers shall only be used underground where located in a fire resistant enclosure suitably vented to the outside and surrounded by a dike to retain the contents of the transformers in the event of rupture. **8. ELECTRICAL ENCLOSURES** i. Bare terminals of transformers, switches, motor controllers, and other equipment shall be enclosed to prevent accidental contact with energized parts. ii. Enclosures for use in tunnels shall be rain tight, rainproof, or watertight as defined in NFPA 70, National Electrical Code, where necessitated by the environmental conditions. iii. Special attention shall be given to maintaining clear access and adequate work space around electrical equipment in accordance with NFPA 70E, Standard for Electrical Safety in the Workplace. Proper housekeeping shall be maintained to avoid fire hazards. iv. All non-energized metal parts of electrical equipment and metal raceways and cable sheaths shall be effectively grounded and bonded to all metal pipes and rails at the portal and at intervals not exceeding 300 m (1000 ft.) throughout the tunnel. **9. HAZARDOUS OPERATIONS AND PROCEDURES** i. Hot work operations shall be in accordance with NFPA 51B, Standard for Fire Prevention during Welding, Cutting, and Other Hot Work. ii. A suitable fire extinguisher or other fire control device shall be ready for instant use in any location where hot work is performed. iii. Acetylene, liquefied petroleum gas (LPG), liquefied oxygen (LOX), and methyl acetylene propadiene stabilized gas (MPS) shall be permitted to be used underground only for welding, cutting, and hot work and only if the quality of air is within permitted limits in accordance with the ACGIH Threshold Limit Values and Biological Exposure Indices for 1992–1993. iv. The quantity of combustible materials to be used underground shall be kept to a minimum. Advance planning shall provide for the use of materials having the most favorable combination of high ignition points, low rates of combustion, and low emissions of smoke and harmful gases.

Table:- G.02-T7.: Safe Work Practices

ITEMS	REQUIREMENTS
UNDER GROUND OPERATIONS	**10. FLAMMABLE AND COMBUSTIBLE LIQUIDS** i. Class I flammable liquids shall not be taken, stored, or used underground or within 30 m of a tunnel portal or shaft opening. ii. Class II and Class III liquids shall be transported and stored in approved closed containers, safety cans, or tanks. iii. Quantities shall be limited to those necessary for one work shift. iv. Lubricating oils, greases, and rope dressings taken underground shall be in closed and re-closable approved containers that do not allow the contents to leak or spill. v. Oil, grease, and diesel fuel stored underground shall be kept in tightly sealed containers in fire-resistant areas located at least 30 m from shafts and inclines. vi. Storage areas shall be positioned or diked so that the contents of ruptured or overturned containers cannot flow from the storage area. vii. Areas within 7600 mm of major electrical installations and unburied tanks for storage of combustible liquids shall be free of transient combustible materials. viii. No combustible structure shall be erected and no combustible materials shall be stored within 30 m (100 ft.) of an access shaft, shaft hoist, or other entry. ix. Metal containers with self-closing lids shall be provided and used to store combustible waste and debris and shall be removed and taken to the surface daily. **11. EQUIPMENT** i. Less hazardous hydraulic fluids that are listed shall be used in underground machinery and equipment unless the machinery and equipment are protected by an approved fire suppression system or by approved multipurpose fire extinguishers rated at least 4-A:40-B:C (10Lbs) or 34A 183B (6kg). ii. Wherever self-propelled equipment is used underground, a fire suppression system or a fire extinguisher rated at least 4-A: 40-B: C (10Lbs) or 34A 183B (6kg) shall be provided on the equipment. **12. VENTILATION** i. Where single-entry shafts/tunnel ventilation systems are used, they shall be reversible from a location outside and in close proximity to the shaft/tunnel. ii. The ventilation system shall be sufficient for the number of personnel and equipment underground. iii. Air-sampling logs shall be maintained. Air tests shall be conducted before or after each shift. iv. Air-sampling logs shall be available to the authority having jurisdiction. v. Fan houses, fan bulkheads for main and booster fans and air ducts connecting main fans to underground openings shall be constructed of noncombustible materials.

4.8. Fire Access, Means of Egress, Fire Detection and Fire Protection System Requirements

4.8.1. Fire access road for General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain approach, Means of Egress for evacuation, Fire Detection and Alarm Systems and Fire protection Systems for under construction, alteration, modification or demolition sites shall be as per **Table G.02-T8.**

Table:- G.02-T8.: Fire Access, Means of Egress, Fire Alarm and Fire Protection Requirements

ITEMS	REQUIREMENTS
1. FIRE ACCESS	i. All construction sites shall be accessible by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain apparatus by means of roadways having an all-weather driving surface of not less than 6.1m of unobstructed width. ii. The roads shall have the ability to withstand the live loads of fire apparatus of 80 tons of distributed load and have a minimum 4.5 m of vertical clearance. iii. Fire access shall not be through basements, underpasses of the building under construction. iv. Dead end fire access roads in excess of 45m in length shall be provided with approved turnarounds in accordance with **Section A. CH-01. Fire Access.** v. A suitable location at the site shall be designated as a command post and provided with plans, emergency information, keys, communications and equipment, as needed. vi. The person in charge of fire protection shall respond to the location command post whenever fire occurs. vii. Where access to or within a structure or an area is unduly difficult because of secured openings or where immediate access is necessary for life-saving or fire-fighting purposes, General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain personnel shall be permitted to require a key box to be installed in an accessible location. viii. Access for use of General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain apparatus shall be provided to the immediate job site at the start of the project and maintained until completion. ix. The required width of access roadways shall not be obstructed in any manner, Including obstruction by parked vehicles, storage material and assembly points. x. Signs or other appropriate notices, or both, prohibiting obstruction shall be installed and shall be maintained. xi. The access roadway shall be extended to within 46 m of all portions of the exterior walls of the first story of any building under construction. xii. Where an access roadway cannot be provided, an approved fire protection system or systems shall be provided and approved by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain. xiii. Where a bridge is required to be used as access, it shall be constructed and maintained using design live loading sufficient to carry the imposed loads of the fire apparatus in accordance with **Section A. CH-01. Fire Access.**

Table:- G.02-T8.: Fire Access, Means of Egress, Fire Alarm and Fire Protection Requirements	
ITEMS	**REQUIREMENTS**
2. MEANS OF EGRESS	**1. MINIMUM NUMBER OF EXITS** i. All new buildings under construction shall have at least two unobstructed exits. All exits shall be identified in the Fire Protection Plan. ii. Where stairs and exit routes of the building are under construction, exterior temporary steel stairs and exits shall be provided which lead directly to ground floor to the safety of outside the building. iii. In multi-story constructions, each level above the first story shall be provided with at least two usable exit stairs after the floor decking is installed. The stairways shall be continuous and discharge to grade level. iv. Stairways serving more than two floor levels shall be enclosed (with openings adequately protected) after exterior walls/windows are in place. Exit stairs shall be lighted and maintained clear of debris and construction materials at all times except when one of the required exit stairs is under construction (i.e. installation of gypsum board, painting, flooring etc.), but not more than two continuous floors. v. All exit stairs shall be provided with stair identification signs to include the floor level, stair designation, and exit path direction as required to provide for safe egress. vi. Night time construction work shall not be performed without adequate lighting in exits, exit stairs and escape routes to safety outside the building. **2. HOISTS AND ELEVATORS** i. Where hoists and elevators provide the only efficient means of transporting hose and other cumbersome fire-fighting equipment to upper floors, they shall be available to General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain at all times. **3. ASSEMBLY POINTS** **i.** Designated exterior assembly points shall be established for all construction personnel to relocate to upon evacuation. The assembly points shall also be identified in Fire Protection Plan.
 EXTERIOR STEEL STAIR FOR UNDER CONSTRUCTION BUILDING FOR ILLUSTRATION	

Table:- 1.8.: Fire Access, Means of Egress, Fire Alarm and Fire Protection Requirements	
ITEMS	**REQUIREMENTS**
3. FIRE PROTECTION SYSTEMS	**1. YARD HYDRANT SYSTEM** i. Where the building under construction requires Yard Fire Hydrants as per General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain approved consultant's drawings, the Hydrants either temporary or part of the permanent hydrant network shall be installed based on the hazard evaluation of the construction site, in compliance with **Section D. CH-04.** ii. Fire Pump and water tanks are permitted to be non-listed when they are temporarily installed to safeguard construction activity. iii. Temporary Fire pump capacity shall be permitted to be 500gpm. iv. Permanent fire pump capacity shall be as per General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain approved consultant drawings. v. Temporary fire water tank shall be permitted to be of 60 minutes duration. vi. Permanent fire water tank shall be as per General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain approved consultant drawings. vii. Free access from the street to fire hydrants and to outside connections for stand pipes, sprinklers, or other fire extinguishing equipment, whether permanent or temporary, shall be provided and maintained at all times. viii. Protective pedestrian walkways shall be constructed such that they do not impede access to hydrants. ix. No stored material, debris or construction activity shall interfere with access to hydrants, Siamese connections, or fire extinguishing equipment. **2. WET/DRY RISER SYSTEM** i. Where the consultant design NOC requires dry risers with hose reel system for the completed building, the building under construction shall be provided with temporary dry risers with hose reel system as per **Section D. CH-03,** with 50gpm non listed pump and 60 minutes duration fire water tank. ii. Where the consultant design NOC requires wet risers for the completed building, the temporary Wet riser shall be installed when the progress of construction is not more than 10.7 m in height above the lowest level of The General Directorate of Civil Defence (GDCD) access. iii. Fire Pump and water tanks are permitted to be non-listed when they are temporarily installed to safeguard construction activity, when building height is less than 23 m from fire access level. iv. Temporary Fire pump capacity for wet risers shall be permitted to be 500gpm, with single wet riser serving two hose outlets located near the exit stair. v. Temporary fire water tank shall be permitted to be of 60 minutes duration. vi. When the under construction building height crosses 23 m, permanent wet riser system, as per consultant's approved drawing, shall be in place and in working condition. vii. Permanent fire pump capacity and number of wet risers shall be as per General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain approved consultant drawings and subject to civil defense permit. viii. Permanent fire water tank shall be as per The General Directorate of Civil Defence (GDCD) approved consultant drawings. ix. Standpipes shall be provided with breeching inlets, General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain hose connections and outlets at accessible locations adjacent to usable stairs. x. The standpipe system shall be extended as construction progresses to within one floor of the highest point of construction having secured decking or flooring. xi. Each floor shall be provided with 2 ½ in. (64mm) valve outlet for General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain use. xii. In all new buildings in which standpipes are required or where standpipes exist in buildings being altered or demolished, such standpipes shall be maintained in conformity with the progress of building construction in such a manner that they are always ready for use. xiii. All the hose outlets shall be in hose cabinet as per **Section D. CH-03.**

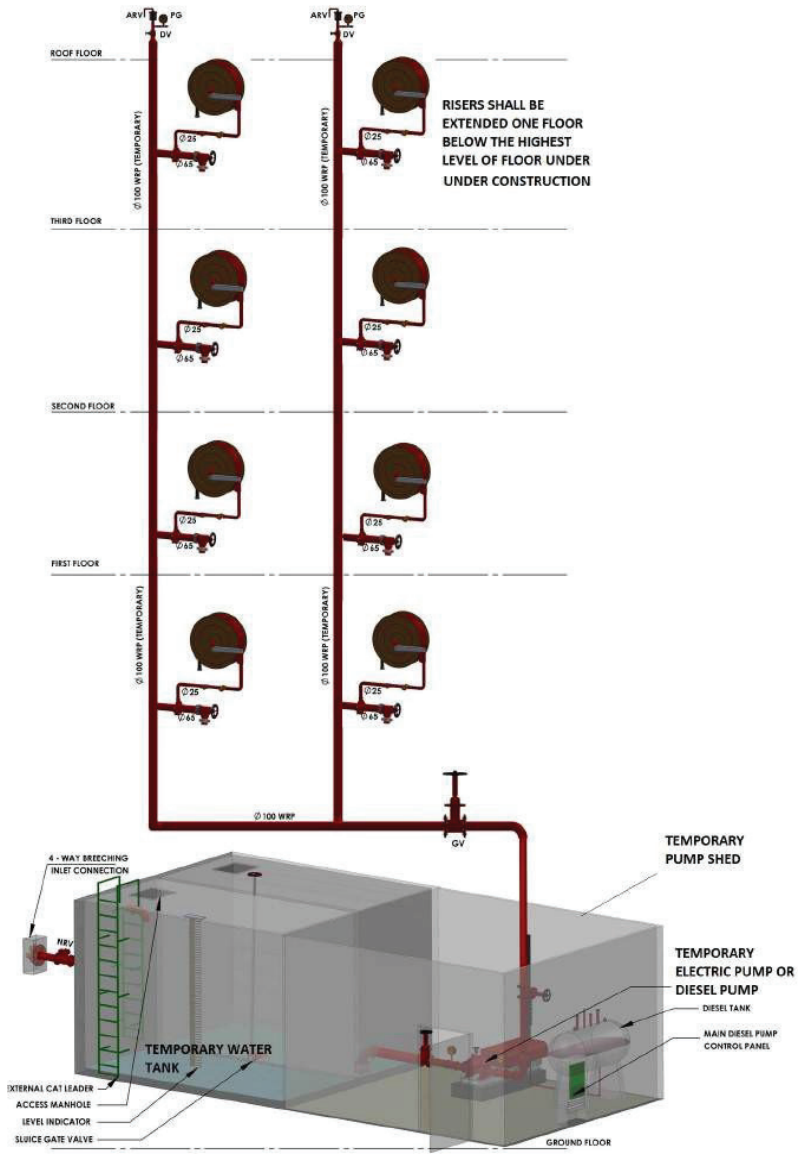


Figure:- G.02-F1: Fire Protection Systems for Under Construction Buildings

Table:- G.02-T8.: Fire Access, Means of Egress, Fire Alarm and Fire Protection Requirements	
ITEMS	**REQUIREMENTS**
FIRE PROTECTION SYSTEMS	**3. AUTOMATIC SPRINKLER SYSTEMS** i. Where temporary automatic sprinkler systems are considered to be provided for under construction buildings, 500gpm temporary fire pump with 30 minutes operation fire water tank shall be permitted. ii. Where permanent automatic Fire Sprinkler systems are required to be installed in new buildings as per consultant's approved drawing from General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain, the system shall be placed in service as soon as it is feasible and before interior finish work commences. iii. Immediately upon the completion of sprinkler pipe installation on each floor level, the piping shall be hydrostatically tested and inspected. After inspection approval from General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain each floor level of sprinkler piping shall be connected to the system supply riser and placed into service. iv. For system activation notification, an exterior alarm bell can be installed and connected to the sprinkler water flow device prior to installation of the monitoring system. v. For buildings equipped with fire sprinkler systems that are undergoing alterations, the sprinkler system(s) shall remain in service at all times except when system modifications are necessary. vi. Fire sprinkler systems undergoing modifications shall be returned to service at the end of each workday unless otherwise approved by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain. vii. The general contractor or his/her designee shall check the sprinkler control valve (s) at the end of each work day to confirm that system has been restored to service. viii. New building or building undergoing modifications shall not be occupied until the sprinkler installation has been entirely completed, tested and in service as per **Section D. CH-05.** ix. The provision of Table 12.8.3.5.vii. shall not prohibit occupancy of the lower floors of a building, even where the upper floors are in various stages of construction or protection, provided the following conditions are satisfied: a. The sprinkler protection of the lower occupied floors is completed, tested and in service. b. The sprinkler protection of the upper floors is supplied by entirely separate systems and separate control valves so that the absence or incompleteness of protection in no way impairs the sprinkler protection of the occupied lower floors. c. Where the sprinkler protection is regularly turned off and on to facilitate connection of newly completed segments, the sprinkler control valves shall be checked at the end of each work shift to ascertain that protection is in service. **4. FIRE EXTINGUISHERS** i. Portable Fire Extinguishers shall be provided and shall be mounted on a wall or post at each usable stairway, such that the travel distance to any extinguisher does not exceed 23 m. ii. Mounting height to the top of the extinguisher shall not exceed 1.5m. Extinguishers shall not have less than a 2A10BC rating (5 pound) or as per **Section D. CH-01, Fire Extinguishers.** iii. Wherever a tool house, storeroom, or other shanty is located in or adjacent to the building under construction or demolition or where a room or space within that building is used for storage, a dressing room or a workshop, at least one approved extinguisher shall be provided and maintained in an accessible location. iv. At least one approved fire extinguisher also shall be provided in plain sight on each floor at each usable stairway as soon as combustible material accumulates. v. Suitable fire extinguishers shall be provided on self-propelled equipment. vi. Free access to permanent, temporary or portable first aid General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain shall be maintained at all times.

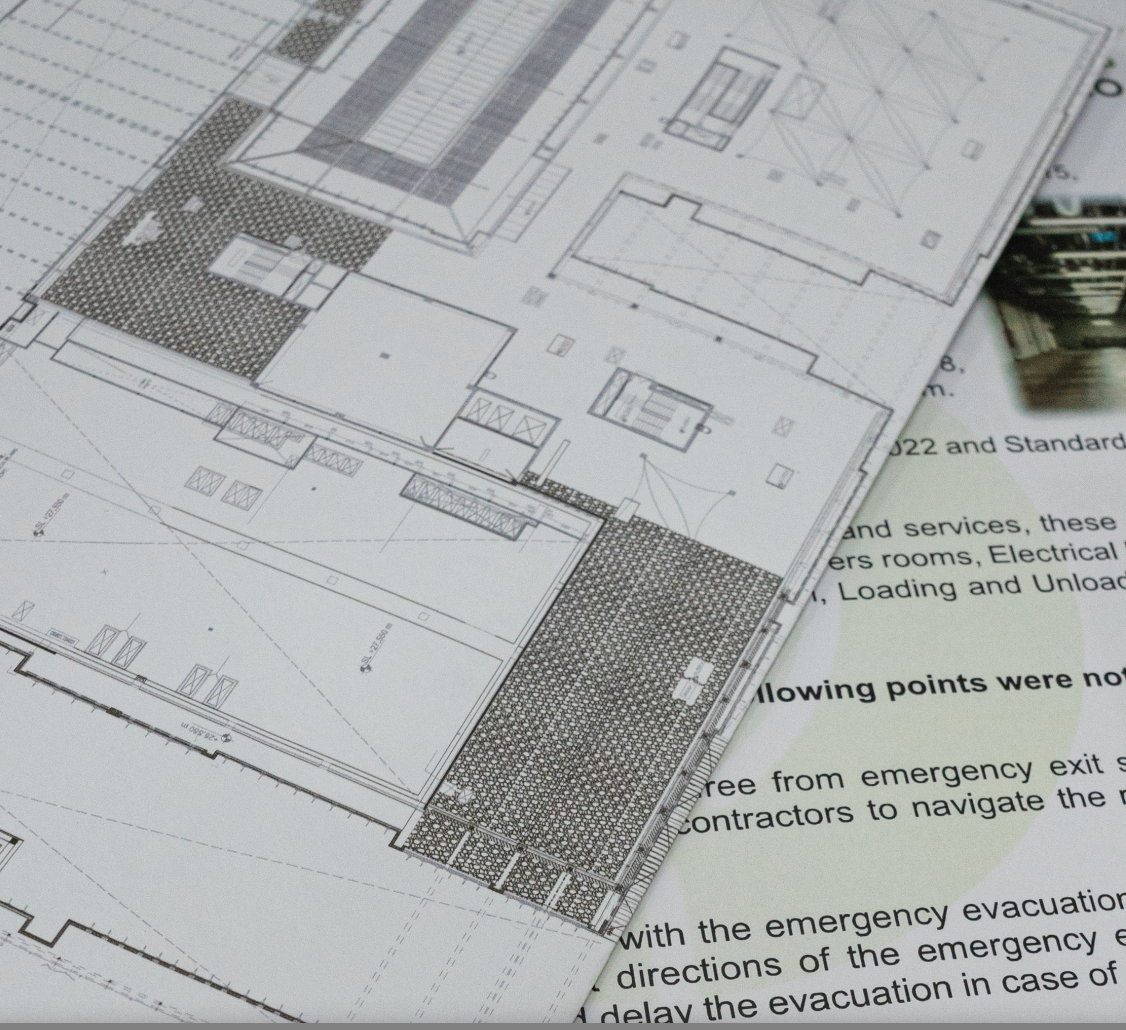
Table:- G.02-T8.: Fire Access, Means of Egress, Fire Alarm and Fire Protection Requirements	
ITEMS	**REQUIREMENTS**
4. FIRE DETECTION AND ALARM SYSTEM	**1. DURING CONSTRUCTION** i. Temporary Fire Detection and Alarm System, with same features as permanent Fire Detection and Alarm System as per **Section C. CH-01**, to cover the floors that have been constructed is highly recommended. ii. Manual Fire Detection and Alarm System as per **Section C. CH-01, Sub. Section 5.10.** Shall be permitted. iii. Wireless/Low powered Radio frequency based Fire Detection and Alarm System as per **Section C. CH-01, Sub. Section 5.11.** Shall be permitted and shall communicate with 24X7 signaling of General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain where available. iv. Wireless/Low powered radio frequency based fire Detection and Alarm System are best suited for construction sites, as they can be installed on temporary basis without wiring. v. Alarm notification shall be such that affected area construction site shall be notified with sound and visual devices. Audio devices shall have sound level of 15 dB more than the ambient sound level. **2. DURING ALTERATION OR MODIFICATION** i. Fire alarm systems shall be maintained operational at all times during building alterations. When an alteration requires modifications to a portion of the fire alarm system, the portion of the system requiring work shall be isolated and the remainder of the system shall be kept in service whenever practical. ii. When it is necessary to shut down an entire fire alarm system, a fire watch or other mitigation approved by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain shall be implemented by the Consultant and Program Manager until the system is returned to full service. iii. Where the automatic Fire Detection and Alarm System is regularly turned off and on to facilitate connection of newly completed segments, the System shall be checked at the end of each work shift to ascertain that completed are Fire Detection and Alarm System is in service.
5. TELEPHONE AND COMMUNICATION SYSTEMS	i. There shall be a readily available public fire alarm box near the premises, telephone service to the responding General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain or equivalent communications facilities. ii. Instructions shall be issued for the immediate notification of General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain in case of a fire emergency. iii. Where telephone service is employed, General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain number (999) and site address shall be conspicuously posted near each telephone.

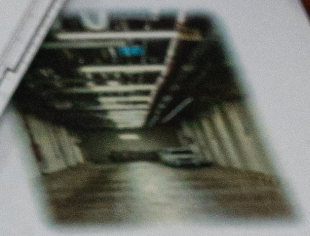


WIRELESS / LOW POWERED RADIO FREQUENCY BASED FIRE ALARM SYSTEM FOR UNDER CONSTRUCTION BUILDING FOR ILLUSTRATION

Chapter 1

Risk Assessment Methodology







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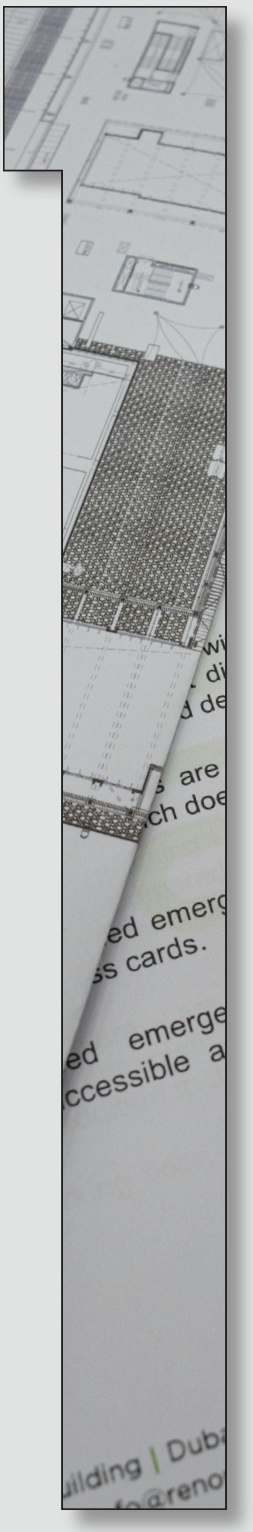
Section H

Chapter

Risk Assessment Methodology



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1.0 Scope

1.1 The scope of this code is to provide an overview of methods of conducting Fire Risk Assessment (FRA) studies.

1.2 To provide guideline for analysis and evaluation of Fire Risk Assessment (FRA) for a given fire safety problem.

1.3 Various RA models and report requirements

1.4 Operation and maintenance for RA Validity.

2. Definitions

2.1. General

2.1.1. Shall
It is a mandatory requirement by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain

2.1.2. Should
It is a suggested requirement recommended by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain but not mandatory.

2.1.3. Listed
Permitted and registered by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain's material department.

2.1.4. Permitted
Permitted and registered by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain material department.

2.2. Risk Assessment

2.2.1. Fire Risk Assessment (FRA)
A process to characterize the risk associated with fire that addresses the fire scenario or fire scenarios of concern, their probability, and their potential consequences.

2.2.2. Acceptance Criteria
Acceptance criteria are the units and threshold values against which a fire risk assessment is judged.

2.2.3. Consequence
The outcome of an event, which may be expressed qualitatively or quantitatively.

2.2.4. Event
The occurrence of a particular set of circumstances, whether certain or uncertain and whether singular or multiple.

2.2.5. Fire Scenario
A fire scenario is a set of conditions and events that characterize the development of fire, the spread of combustion products, the reactions of people, and the effect of combustion products.

2.2.6. Hazard
A condition that presents the potential for harm or damage to people, property, environment, mission, or cultural heritage.

2.2.7. Frequency
The average number of times an event is repeated in a given period.

2.2.8. Probability
The likelihood of an occurrence as expressed as a number between 0 and 1, and the basis of which is often expressed over a period of time or number of trials.

2.2.9. Likelihood
Frequency, probability, or their combination.

2.2.10. Risk
The paired probabilities and consequences for possible undesired events, hazard outcome associated with a given facility or process.

2.2.11. Model
Simulation of an event.

2.2.12. Method
A process or technique to help resolve a model.

2.2.13. Probabilistic Method
A model whose outputs are probabilities or probability distributions.

2.1.14. Deterministic Model
A model whose outputs are not probabilities or probability distributions; that is, they do not quantify uncertainty.

2.1.15. Semi quantitative Methods
Methods that are based on the ability or need to quantify either the likelihood or the consequence of a fire event or events.

2.1.16. Scenario Cluster
A group of scenarios having some, but not all, defining characteristics in common.

2.1.17. Stakeholder
Any individual, group, or organization that might affect, be affected by, or perceive itself to be affected by the risk.

2.1.18. Validation
The process of determining the correctness of the assumptions and governing equations implemented in a method.

3. Fire Risk Assessment (FRA) Studies and Reports

3.1. Defining the problem

3.1.1. The purpose of conducting the RA should be identified and documented. The purpose might be to identify the level of risk present in an existing building or facility, to identify methods of lowering the risk in an existing building or facility, or to identify methods of providing a level of risk deemed acceptable in a new or renovated building or compartment or section.

3.1.2. The objectives of the RA might be associated with the risk to life (occupants or fire fighters), the risk to property, the risk to operations (e.g., the cost of business interruption), the risk to the environment, or the risk of loss of cultural resources.

3.2. Elements of Risk

3.2.1. The elements at risk should be identified. Elements could be any or all of the following.

3.2.1.1. People (occupants, employees, general public, emergency responders).

3.2.1.2. Property (structures, systems, components of the built environment)

3.2.1.3. Environment (national parks, monuments, hazardous materials)

3.2.1.4. Mission (heritage, business continuity, information/ communication)

3.3. Guidelines for Conducting Risk Assessment

3.3.1. Risk analysis should be based on various hazard assessment methods. The RA documentation should include a brief description of these methods of solution, numerical computations (including identification of units used), and identification the source or derivation of all equations that are not in common usage.

3.3.2. Methods may include a variety of elements based on the problem definition. These elements may be qualitative or quantitative and may involve deterministic or probabilistic models.

3.3.3. As a general guideline, **Table:- H.01-T1**. should be followed for risk assessment methods.

3.3.4. **NFPA 550, NFPA 551, NFPA Handbooks, SFPE handbook, Performance Based Design,** have been referred for this chapter. Consultants and House of Expertise shall refer to these documents for further details and RA methodology.

	Table:- H.01-T1: Guidelines for Risk Assessment
OCCUPANCY	**REQUIRMENTS**
1. **GENERAL**	i. As a first step in Risk Assessment, PHA (Preliminary Hazard Analysis) shall be carried out followed by detailed examination by other known hazard analysis method such as HAZOP studies. ii. The Risk Assessment Study should evaluate all possible risks arising within the premises/operations and/or off- site due to the operations and recommend necessary mitigation measures. iii. A detailed evaluation of regular/irregular operations, activities, tasks and main installations, including physical-chemical characteristics of materials being stored/handled/processed, quantitative data on amounts, volumes, production/storage conditions etc. shall be carried out. iv. Site suitability with regard to wind, flooding etc. shall be evaluated. v. FAULT TREE and EVENT TREE analysis shall be carried out to provide a graphic description of the accident sequences associated with plant operations and storage. vi. Evaluate/Clarify risks (Frequency, Severity and Probability) using accepted Risk Assessment Technique and Criteria leading to determination of risks to be eliminated or controlled. vii. Accident Consequence Analysis and its effects on human, environment and nearby installations and site shall be analyzed. viii. Provide for clarification of risks and identification of those to be eliminated or controlled. ix. Evaluate (Fire & Explosion) hazard using F & EI Index. x. Evaluate Fire Protection System, Alarm System and Ventilation systems. xi. Evaluate Hazardous materials classification based on internationally accepted standards such as NFPA, U.N. or International Maritime Dangerous Goods (IMDG) code, etc. xii. Hazardous Area Classification and identification with mapping of the proposed facility shall be carried out. xiii. Effects of emergency situations/major environmental events such as lightning, flooding and acts of mischief or sabotage shall be analyzed. xiv. Evaluate occupational health hazards & environmental risks involved in process and operations. xv. For all of the above, measures should be developed and recommended for technical and organizational protection to bring down risks AS LOW AS REASONABLY PRACTICABLE. xvi. Develop ON SITE & OFF SITE emergency action plan in coordination with General Directorate of Civil Defence (GDCD) which must be approved by stake holders. xvii. Wherever a risk/operation/situation cannot be managed feasibly, it shall be the duty of the consultant to highlight the same in the report.
2. LIKELIHOOD AND CONSEQUENCE	i. The evaluation of likelihood may be based on past experience (e.g., statistics) for well-understood events or on a combination of available knowledge and accepted mathematical treatment (subjective) for less-understood events and where uncertainty and variability are high. ii. The evaluation of consequences may be based on expert knowledge (e.g., risk indices), probabilistic modeling (e.g., life safety tree to arrive at safe or unsafe conditions), or deterministic modeling (e.g., fire growth, Smoke spread, and occupant evacuation to arrive at safe or unsafe conditions).

Table:- H.01-T1: Guidelines for Risk Assessment

OCCUPANCY	REQUIRMENTS
3. FIRE SCENARIOS	**1. GENERAL** i. The RA should address the risk contribution from all potentially significant fire scenarios. When approximations are used (e.g., the risk contribution from a single fire scenario is used as a basis for estimating the risk from a wider range of fire scenarios), the approximations should be justified in the context of the decision problem. ii. The objective in selecting the fire scenarios to be analyzed is to find a set of scenarios that are sufficiently diverse and representative such that analyzing the risk for these scenarios captures the overall fire risk for the facility. **2. FIRE SCENARIO 1** Design Fire Scenario 1 shall be described as follows: i. It is an occupancy-specific fire representative of a typical fire for the occupancy. ii. It explicitly accounts for the following: a. Occupant activities b. Number and location of occupants c. Room size d. Contents and furnishings e. Fuel properties and ignition sources f. Ventilation conditions g. Identification of the first item ignited and its location **3. FIRE SCENARIO 2** Design Fire Scenario 2 shall be described as follows: i. It is an ultrafast-developing fire, in the primary means of egress, with interior doors open at the start of the fire. ii. It addresses the concern regarding a reduction in the number of available means of egress. **4. FIRE SCENARIO 3** Design Fire Scenario 3 shall be described as follows: i. It is a fire that starts in a normally unoccupied room, potentially endangering a large number of occupants in a large room or other area. ii. It addresses the concern regarding a fire starting in a normally unoccupied room and migrating into the space that potentially holds the greatest number of occupants in the building. **5. FIRE SCENARIO 4** Design Fire Scenario 4 shall be described as follows: i. It is a fire that originates in a concealed wall or ceiling space adjacent to a large, occupied room. ii. It addresses the concern regarding a fire originating in a concealed space that does not have either a detection system or a suppression system and then spreading into the room within the building that potentially holds the greatest number of occupants.

Table:- H.01-T1: Guidelines for Risk Assessment

OCCUPANCY	REQUIRMENTS
FIRE SCENARIOS	**6. FIRE SCENARIO 5** Design Fire Scenario 5 shall be described as follows: i. It is a slowly developing fire, shielded from fire protection systems, in close proximity to a high occupancy area. ii. It addresses the concern regarding a relatively small ignition source causing a significant fire. **7. FIRE SCENARIO 6** Design Fire Scenario 6 shall be described as follows: i. It is the most severe fire resulting from the largest possible fuel load characteristic of the normal operation of the building. ii. It addresses the concern regarding a rapidly developing fire with occupants present. **8. FIRE SCENARIO 7** Design Fire Scenario 7 shall be described as follows: i. It is an outside exposure fire. ii. It addresses the concern regarding a fire starting at a location remote from the area of concern and either spreading into the area, blocking escape from the area, or developing untenable conditions within the area. **9. FIRE SCENARIO 8** Design Fire Scenario 8 shall be described as follows: i. It is a fire originating in ordinary combustibles in a room or area with each passive or active fire protection system independently rendered ineffective. ii. It addresses concerns regarding the unreliability or unavailability of each fire protection system or fire protection feature, considered individually. iii. * It is not required to be applied to fire protection systems for which both the level of reliability and the design performance in the absence of the system are acceptable to the authority having jurisdiction. **10. FIRE IGNITION** i. Often based on the most probable event in a particular setting, for example, cigarette ignition of a couch in a living room. Prevention education would reduce the probability of occurrence of this event and the consequential risks.

Table:- H.01-T1: Guidelines for Risk Assessment	
OCCUPANCY	**REQUIRMENTS**
FIRE SCENARIOS	**11. FIRE GROWTH** i. Based on all probable developments of a fire, from smoldering to flashover fires. Fire protection systems such as sprinklers, compartmentation and door closers may help to contain these fires and to reduce their consequential risks. The reduction in risk depends on the reliability and effectiveness of the fire control systems. **12. SMOKE GROWTH** i. Based on smoke spread to critical egress routes and other parts in a building. Fire protection systems such as smoke control and stairwell pressurization may help to contain the smoke and to reduce its consequential risks. The reduction in risk depends on the reliability and effectiveness of the smoke control systems. ii. Proposed smoke control measures should be expressed via CFD or numerical and quantitative means to GDCD. **13. EXPOSURE OF OCCUPANTS** i. Based on smoke and fire blocking egress routes. Fire protection systems such as fire alarms, voice communication, clear egress routes, and refuge areas may help to provide early warning to occupants and to direct them either to evacuate the building or to seek refuge in certain areas. The reduction in risk depends on the reliability and effectiveness of the warning and evacuation systems. Thus, its essential to carry an egress calculation or simulation charted against fire and smoke exposure in a given scenario. **14. NO EARLY EMERGENCY RESPONSE SCENARIO.** i. Based on no response or late response. Proper notification procedure and adequate fire department resources would help to rescue the trapped occupants or to control the fire. The reduction in risk depends on the reliability of the notification procedure and the adequacy of fire department resources.

Table:- H.01-T1: Guidelines for Risk Assessment	
OCCUPANCY	**REQUIRMENTS**
4. RA METHODS	i. 5 RA methodologies mentioned below are defined in **Table:- H.01-T1.a.** a. Qualitative method. b. Semi quantitative likelihood method. c. Semi quantitative consequence method d. Quantitative method. e. Cost benefit risk methods.

Table:- H.01-T1.a: RA Methodology

CATEGORY	DEFINITION	TYPE OF OUTPUT	EXAMPLES
1. QUALITATIVE METHOD	Treats both likelihood and consequences qualitatively.	Tabulations of outcome and relative likelihood of various fire scenarios and how they are affected by various protection options.	i. What-if analyses ii. Risk matrices iii. Risk indices iv. Fire safety concepts tree
2. SEMI QUALITATIVE METHOD	Treats likelihood quantitatively and consequences qualitatively	Determination of frequency of occurrence of different types of fires and/or fires with different types of protection.	i. Actuarial /loss statistical analyses ii. Stand-alone event tree analyses
3. SEMI QUANTITAIVE CONSEQUENCE METHOD	Treats consequences quantitatively and likelihood qualitatively.	Deterministic fire model outputs with qualitative representation of likelihood	i. Enclosure fire models for selected challenging fire scenarios.
4. QUANTITATIVE METHOD	Combines quantitative estimates of likelihood and consequences.	i. Determination of loss expectancy **OR** ii. Determination of probability of flashover **OR** iii. Determination of probability of fatalities in other rooms or floors of building **OR** iv. Plot of frequency versus number of fatalities **OR** v. Plot of frequency versus size of loss **OR** vi. Determination of likely hood of injuries, fatalities, property damage, and business interruption **OR** vii. Determination of individual risk (to building occupants) and of societal risk (to entire population)	i. FRAs to determine probability of reactor-core melt due to fire at a nuclear power plant Event tree analysis combined with fire models.
5. COST BENEFIT RISK METHODS	Include determination of costs of alter-native approaches to limit consequences and/or likelihoods	i. Determination of costs required to achieve various levels of risk reduction **OR** ii. Determination of "optimum" level of fire protection based on minimizing "overall risk" or some other risk criterion	i. Computational models that incorporate probability, consequences, and cost data in an integrated manner

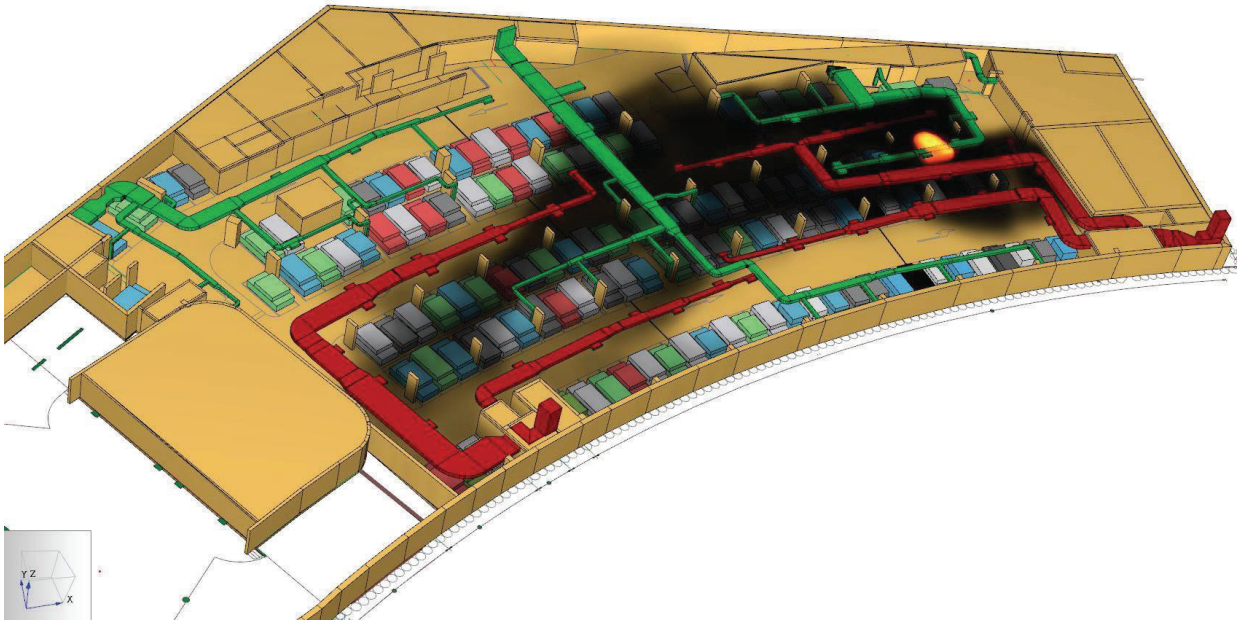
Table:- H.01-T1: Guidelines for Risk Assessment	
OCCUPANCY	**REQUIRMENTS**
6. FIRE MODELS	**1. GENERAL** i. Fire Models are generally computer models that implement a mathematical model simulating a process or phenomenon based on the input parameters. ii. These computer fire models can provide a faster and more accurate estimate of the impact of a fire and the measures used to prevent or control the fire than many of the methods previously used. Thus, they serve as important tool is RA studies. iii. Fire Models can be categorized broadly into two interrelated types. a. Physical. b. Mathematical. **2. PHYSICAL MODELS** i. Physical models attempt to reproduce fire phenomena in a simplified physical situation. Scale models are a widespread form of modeling, as full-scale experiments are expensive, difficult, and sometimes not feasible. Often the goal of physical models is to uncover laws governing the behavior of physical/ chemical systems. **3. MATHEMATICAL MODELS** i. Mathematical models are sets of equations that describe the behavior of a physical system. The resulting mathematical model can then be used to predict the behavior of real physical systems. Mathematical models can be further classified into two types. a. Deterministic Models b. Probabilistic Models **3.a. DETERMINISTIC MODELS** i. In a deterministic model, the quantities being modeled are treated as being completely certain — the purpose of the model is to provide an estimate of these quantities. For example, in a conventional deterministic zone model for compartment fires, the average hot gas layer temperature at any given point in time is computed as having a single, known value. ii. Deterministic fire models can range from simple one-line correlations of data to highly complex models requiring weeks of computing time using dozens of computers. The unifying aspect of these models is that the course of a fire is fixed by the variables that establish the environment in which it occurs. The physical conditions that determine the progress and outcome of the fire are dependent on the fire scenarios, discussed earlier. iii. Deterministic models can incorporate our empirical knowledge of fire phenomena and the calculations focus on the interaction of objects, such as fire sources and layers through equations describing conservation of mass and energy. These models are relatively simple so that very large buildings can be modeled using these techniques. The most identifiable field model is the computational fluid dynamics (CFD) model.

Table:- H.01-T1: Guidelines for Risk	
OCCUPANCY	REQUIRMENTS
FIRE MODELS	**3.b. PROBABILISTIC MODELS** i. In a probabilistic model, the quantities being modeled are treated as being uncertain - the purpose of the model is to quantify the degree of uncertainty in these quantities. For example, in addressing the availability of a fire suppression system, it is uncertain whether the system is operational at any given point in time. A state transition model representing the various states of the suppression system may be used to quantify the time-dependent likelihood that the system is operational (or not). ii. Probabilistic models deals with the uncertainties associated with fire growth processes. They are further classified as a. Network b. Statistical c. Simulation **3.b.a. NETWORK MODELS** i. Network models are fire growth models in which the transition from one fire stage to another and the effectiveness of fire suppression systems, manual firefighting, passive fire protection, and so on are governed by user-assigned probabilities that are based on historical data, engineering evaluations, or both. In some cases, these probabilities are single values, and in other models, the probabilities are time dependent. **3.b.b. STATISTICAL MODELS** i. Statistical models represent the probability of an occurrence as it is determined from historical data. A classic example of a statistical model is the occurrence of fire alarms. Within specific bounds, fire alarms are random occurrences with a uniform nature. In other words, there is an equal chance that a fire or fire alarm will go off at any time. **3.b.c. SIMULATION MODELS** i. Simulation models may predict outcomes for a given set of conditions by using other physical, probabilistic, or deterministic models. In the latter case, simulation models regard fires as deterministic once the fire is fully defined. However, the inputs to the models are assumed to follow probabilistic models.

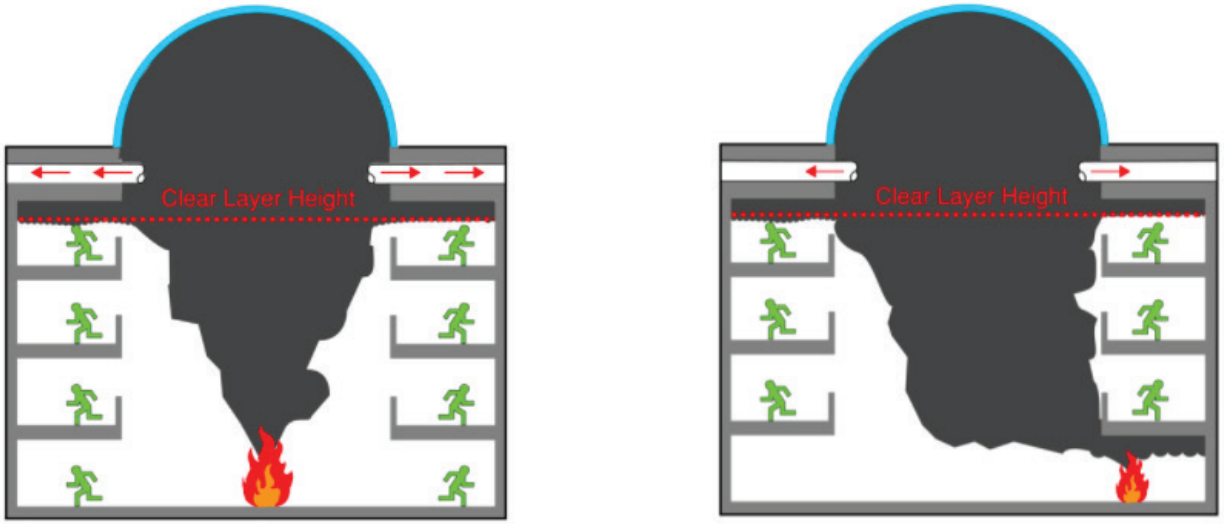
Table:- H.01-T1: Guidelines for Risk	
OCCUPANCY	**REQUIRMENTS**
FIRE MODELS	**4. ZONE FIRE MODELS** i. Fire environment in a room is quite complex. Major insights into fire behavior have been achieved by a simple conceptual construct called zone modeling. In essence, a zone model assumes that the compartment may be idealized as consisting of uniform conditions in single or multiple regions or zones. In a two-zone model, these regions are a. An upper region, filled with hot combustion gases b. A lower region, filled with cooler, more nearly ambient air. ii. Each region or zone is idealized to have uniform temperatures and gas concentrations. The plane dividing the two zones is the hot layer interface that may move vertically during fire. iii. The two-zone model concept simplifies the room fire thermal environment to two temperatures and an interface height rather than a three-dimensional temperature field. Major simplifications are realized both mathematically and computationally. These simplifications have made many fire problems tractable and have allowed significant progress to be made. iv. Zone models by definition will always be approximate. The key is whether the predictions are "close enough" to yield significant insight for the situation under study. Zone modeling yields useful insight into many fire problems. **4.a. ASET** i. ASET (Available Safe Egress Time) is a program for calculating the temperature and position of the hot smoke layer in a single room with closed doors and windows. ii. ASET can be used to determine the time to the onset of hazardous conditions for both people and property. The required program inputs are the heat loss fractions, the height of the fuel above the floor, criteria for hazard and detection, the room ceiling height, the room floor area, a heat release rate, and a species generation rate of the fire (optional). iii. The program outputs are the temperature, thickness, and (optional) species concentration of the hot smoke layer as a function of time and the time to hazard and detection. iv. ASET can examine multiple cases in a single run. ASET-B is a compact version of ASET designed to run on personal computers. Species concentrations and time to hazard and detection calculated by ASET are not calculated in the compact ASET-B version.

Table:- H.01-T1: Guidelines for Risk Assessment

OCCUPANCY	REQUIRMENTS
FIRE MODELS	**4.b. CFAST** I CFAST (Consolidated Model of Fire Growth and Smoke Transport) is a multiroom fire model that predicts the conditions resulting from a user-specified fire within a structure. ii The required program inputs are the geometrical data describing the rooms and connections, the thermos physical properties of the ceiling, walls, and floors, the fire as a rate of mass loss and the generation rates of the products of combustion. iii The program outputs are the temperature, species concentrations, and thickness of the hot upper layer and the cooler lower layer in each compartment. Also given are surface temperatures, heat transfer, and mass flow rates. iv CFAST has very limited mechanical ventilation capabilities and can accommodate multiple fires, sprinklers, and detectors. FAST provides the data-editing and reporting tools for the CFAST model. **4.c. LAVENT** i LAVENT (Link-Actuated VENT) is a two-zone model developed to simulate the environment and the response of sprinkler links in compartment fires with draft curtains and fusible-link-actuated ceiling vents. ii The model used to calculate the heating of the fusible links includes the effects of the ceiling jet and the upper layer of hot gases beneath the ceiling. iii The required program inputs are the geometrical data describing the compartment, the thermos-physical properties of the ceiling, the fire elevation, the time- dependent energy release rate of the fire, the fire diameter or energy release rate per area of the fire, the ceiling vent area, the fusible-link response time index (RTI) and fuse temperature, the fusible-link positions along the ceiling, the link assignment to each ceiling vent, and the ambient temperature. A maximum of five ceiling vents and ten fusible links are permitted in the compartment. iv The program outputs are the temperature, mass and height of the hot upper layer, the temperature of each link, the ceiling jet temperature and velocity at each link, the radial temperature distribution along the interior surface of the ceiling, the radial distribution of the heat flux to the interior and exterior surfaces of the ceiling, the fuse time of each link, and the vent area that has been opened.



A SET SIMULATION OF SMOKESPREAD FOR ILLUSTRATION

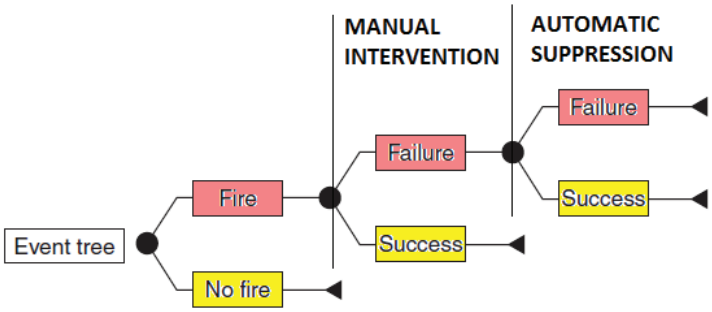


SMOKE SPREAD FOR ILLUSTRATION

OCCUPANCY	REQUIRMENTS
FIRE MODELS	**4.d. CONTAM** i. CONTAM is a single-zone model originally designed to track the movement of non fire contaminants through a building. ii. In includes extensive HVAC system model components and includes stack effect flows. Fire smoke sources can be modeled, though the temperatures in the building are set solely by the user, rather than being calculated as is done in most fire models. iii. This modeling approach has been applied to the tallest buildings in the world to evaluate the potential for smoke movement and to design smoke management systems. Calculations are quite rapid, even for the largest buildings. **4.e. FISSIM** i. FSSIM is a single-zone model originally designed for fire hazard analysis of ships. It includes most of the features of the popular two-zone models but within a single-zone fire environment description. ii. It includes extensive HVAC system model components, stack effect, prediction of compartment temperatures, smoke and gas concentrations, as well as Compartment-to-compartment fire spread, detection, and suppression. iii. It has been applied to ships and buildings with several thousand compartments. iv. Calculations are slower than CONTAM but still much faster than two-zone models and CFD models. **5. COMPUTATIONAL FLUID DYNAMICS (CFD) MODELS** i. Computational fluid dynamics (CFD) models avoid the simplifications inherent in zone models. The physical aspects of any fluid flow are governed by three fundamental principles: **1.** Mass is conserved; **2**. Newton's second law [force = (mass) × (acceleration)]; and **3.** Energy is conserved. ii. These fundamental principles can be expressed as generalized mathematical equations in the form of integral or partial differential equations and are generally referred to as the Naiver Stokes equations. iii. CFD is the technique of replacing the integrals and partial derivatives with discretized algebraic forms, which are solved to obtain numeric values at discrete points in time and/or space. iv. Using an appropriate solving technique, the CFD model solves the fundamental equations of mass, momentum, and energy at each grid point in the computational domain that has been divided into a number of grid points that produce small elements. v. Imagine an enclosure filled with a three-dimensional grid of tiny cubes. A CFD model will calculate the physical conditions in each cube as a function of time. vi. The CFD model program uses an iterative solver to calculate the physical changes in the cube at the current time step as a result of physical changes in the surrounding cubes from the previous time step. Depending on the size of the cubes, this model permits the user to determine the conditions (e.g., temperature, velocity, gas concentrations) at almost any point in the computational field.

Table H.C01-T1: Guidelines for Risk Assessment	
OCCUPANCY	**REQUIRMENTS**
FIRE MODELS	**5.a. FDS (Fire Dynamics Simulator) MODELS** i. FDS allows for "Direct Numerical Simulation" or Large Eddy Simulations (LES)" of fire effects. ii. The LES approach most readily lends itself to solving the types of fire problems typically found in fire engineering design and forensic applications. LES uses a low Mach number approximation for the Navier-Stokes equations and a formulation of the complex governing equations to provide a very efficient solution. iii. Under the LES mode, the user inputs the parameters of the fire in terms of heat release rate and species generation. iv. Although FDS includes algorithms for flame spread, burning rate, and suppression, these have not been developed and validated so as to allow their application to problems in these areas. v. FDS calculates the temperature, pressure, species concentrations and flow field in relation to the prescribed fire. FDS provides for calculating the activation of heat detectors and sprinklers. In addition, the sprinklers can dispense droplets, which yield evaporative cooling and prewetting. vi. The model supports prediction of multiple sprinkler activations. FDS also has the built-in capability of predicting the response of smoke detectors. vii. The major geometric limitation of FDS is its exclusive use of rectilinear computational meshes, which effectively limits the model to "stair stepped" approximations for curved or sloped geometries. viii. Although there are commercial CFD packages that allow better definition of realistic geometries, these are much less efficient and there has been limited validation of commercial CFD codes for use in fire applications. ix. Heat transfer is treated as one-dimensional and is calculated by using thermally thin or thermally thick elements, but heat is not conducted through wall portions to other parts of the domain. The model also supports heat-activated vents that "open," allowing flow through the vent. x. Smoke view is the companion software that is designed to visualize the numerical predictions generated by FDS. **5.b. RANS (Reynolds Averaged Navier-Stokes) MODELS** i. There are many commercially available CFD models. These general-purpose CFD models are designed to solve a wide range of flow phenomena including steady and transient, laminar and turbulent and incompressible and compressible. ii. Model features include heat transfer (convection, conduction, and radiation), mass transfer and chemical reaction (including combustion), porous media, scalar transport equations, discrete particle transport, multiple fluid streams, and multiphase flows. iii. Commercial codes include graphical user interfaces (GUI) to aid the user in mesh generation, variable input, and post processing of results. iv. These codes allow for body-fitted coordinates, structured and unstructured grids, as well as adaptive and moving grids. v. Output displays of variables include perspective views, contour mapping, vector diagrams, particle tracks, and gradients. The most widely used commercially available and general-purpose CFD codes for the simulation of combustion and fire include STAR*CD, Fluent, and CFX.

	Table:- H.01-T1: Guidelines for Risk Assessment
OCCUPANCY	**REQUIRMENTS**
FIRE MODELS	**5.c. ASCOS (Analysis of Smoke Control Systems) MODELS** i. ASCOS is a program for steady air flow analysis of smoke control systems. This program can analyze any smoke control system that produces pressure differences with the intent of limiting smoke movement in building fire situations. ii. The program is also capable of modeling the stack effect created in taller buildings during extreme temperature conditions. iii. The program input consists of the outside and building temperatures, a description of the building flow network and the flows produced by the ventilation or smoke control system. iv. The output consists of the steady state pressures and flows throughout the Building.
7. EVENT TREE	i. Event trees, as the name suggests, represent fires as a sequence of events. An event may correspond to a change in the size or character of the fire, a change in the status or performance of various active systems or passive features, or a change in the status or behavior of occupants or first responders. ii. An event tree is a visual representation of all the events that can occur in a system. As the number of events increases, the picture fans out like the branches of a tree. iii. The goal of an event tree is to determine the probability of an event based on the outcomes of each event in the chronological sequence of events leading up to it. iv. The event tree displays the sequences of events involving success and/or failure of the system components. By analyzing all possible outcomes, one can determine the percentage of outcomes that lead to the desired result make a model as complete as possible, the tree must represent all possible events as accurately as possible. v. The initiating event, which is generally a fire, is what starts the sequence of events detailed in the event tree. All subsequent events stem from the initiating event. vi. As a simplistic example, an event tree can be constructed to analyses the possible outcomes of a fire. The system has two strategic components designed to handle this event: manual intervention by staff and an automatic suppression system. If the fire is too large to be controlled by staff, it will be mostly contained by the suppression system. If the suppression system fails as well, the loss is unacceptable. vii. Event trees show all possible event options and chance events with a branching structure. They proceed chronologically, left to right, showing events as they occur in time. All outcomes along with the values and probabilities associated with them can be shown directly on the tree. viii. There is very little ambiguity as to the possible outcomes and events the tree represents. Any node gives all possible outcomes resulting from the node and the events that follow.

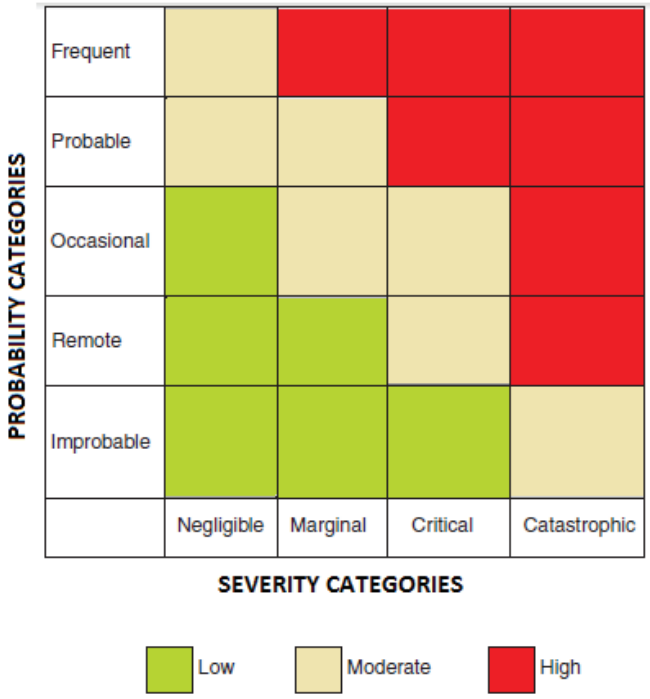


A SIMPLE EVENT TREE FOR ILLUSTRATION

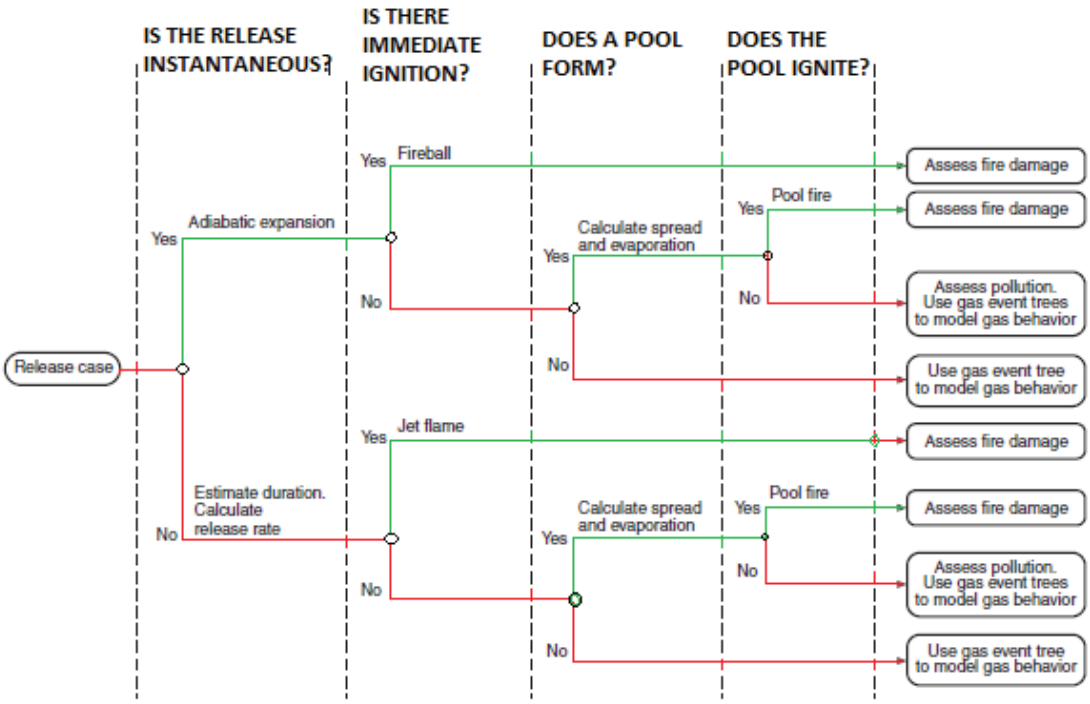
Table:- H.01-T1: Guidelines for Risk Assessment	
OCCUPANCY	**REQUIRMENTS**
8. FAULT TREE	i. Fault or success trees are organized to deliver a probability of failure or success, respectively, as the outcome measure. For this reason, such trees are most useful in estimating probabilities such as the probability of ignition for use in a larger model with a different format. ii. The advantages of fault tree analysis (FTA) include, but are not limited to, the following: a. Fault trees provide the logic of how fires start and develop in a graphic format that is easy to understand. b. Fault trees show how different features, systems, and elements interact or act independently to affect fire ignition and development. c. It is easy to compute probabilities from a fault tree. iii. The disadvantages of FTA include, but are not limited to, the following: a. A fault tree explores only those faults and conditions that lead to a single specified event b. It may be difficult to identify all contributing factors. c. The fault tree can become very large
9. RISK MATRIX	i. A risk matrix utilizes probability levels and severity categories to represent the axis of a two-dimensional risk matrix. The matrix indicates that improbable hazards with negligible consequences represent a low risk and that frequently occurring hazards with greater consequences represent high-risk levels. ii. The probability levels are as mentioned in **Table:- H.01-T1.b.** iii. The severity categories are mentioned in **Table:- H.01-T1.c.**

Table:- H.01-T1.b.: Probability Levels	
PROBABILITY	**DEFINITION**
1. FREQUENT	i. Likely to occur frequently, experienced, (p>0.1)
2. PROBABLE	i. Will occur several times during system life, (p>0.001)
3. OCCASIONAL	i. Unlikely to occur in a given system operation, (p>10^{-6})
4. REMOTE	i. So improbable, may be assumed this hazard will not be experienced, (p<10^{-6})
5. IMPROBABLE	i. Probability of occurrence not distinguishable from zero, (p ~ 0.001)

Table:- H.01-T1.c.: Severity Categories	
SEVERITY	**IMPACT**
1. NEGLIGIBLE	i. The impact of loss will be so minor that it would have no discernible effect on the facility, its operations, or the environment
2. MARGINAL	i. The loss will have impact on the facility, which may have to suspend some Operations briefly. Some monetary investments may be necessary to restore the Facility to full operations. Minor personal injury may be involved. The fire could cause localized environmental damage.
3. CRITICAL	i. The loss will have a high impact on the facility, which may have to suspend Operations. Significant monetary investments may be necessary to restore to Full Operations. Personal injury and possibly deaths may be involved. The fire could cause significant reversible environmental damage.
4. CATASTROPHIC	i. The fire will produce death or multiple deaths or injuries, or the impact on Operations will be disastrous, resulting in long-term or permanent closing. The Facility would cease to operate immediately after the fire occurred. The fire could cause significant irreversible environmental damage.



RISK MATRIX FOR ILLUSTRATION



FLAMMABLE LIQUID EVENT TREE FOR ILLUSTRATION

Table:- H.01-T1: Guidelines for Risk Assessment

OCCUPANCY	REQUIRMENTS
9. FIRE AND EXPLOSION INDEX (F&EI) SYSTEM MATERIAL FACTOR (MF) FOR PROCESS AND STORAGE HAZARD EVALUATION	**1. MATERIAL FACTOR (MF)** i. The MF is the measure of the intrinsic potential energy released by the combustion, explosion or chemical reaction of the substances restrained in the equipment under study. The MF is calculated from the NF and NR. Those parameters are NFPA rating expressing the flammability and reactivity of the substance respectively. ii. The flammability, or in generally, the reactivity of substances rises with the temperature. If the process condition are different from the ambient temperature, a corrective factor must be adopted defined as "Temperature Adjustment of Material Factor". An example of Material factor is shown in **Table:- H.01-T1.d.** **2. GENERAL HAZARDS (GH)** i. General process Hazards are factors that play a primary role in determining the magnitude of a loss incident. The factors are, a. Chemical Processes b. Storage, Handling, Transfer and Manufacturing c. Confinement d. Access e. Drainage f. Total General Hazards Factor are investigated as contributing hazards. **3. SPECIFIC HAZARDS (SH)** i. The specific hazards are a. Quantities of Materials Involved b. Pressure Conditions c. Toxic Materials Involved d. Explosion Potential/ Flammable Range e. Total Specific Hazards Factor that indicate existence of specific conditions as a major contributing factor in fire and explosion incidents are investigated. **4. FIRE AND EXPLOSION INDEX (F&EI)** i. The F&EI calculation is calculated by giving credit for both general and specific hazards to the materials involved. The formula used is **F&EI = MF x (1 + GH) x (1 + SH),** Where MF—Material Factor, GH– General Hazard, SH– Specific Hazard ii. The resulting F&EI values are ranked into four categories. a. 1-45 **Light Hazard.** b. 46-60 **Moderate Hazard.** c. 61-95 **High Hazard.** d. 96-above **Severe Hazard**

Table:- H.01-T1.d.: Material Factor (MF)

Flammability	Reactivity N_r=0	N_r=1	N_r=2	N_r=3	N_r=4
N_f = 0	1	14	24	29	40
N_f = 1	4	14	24	29	40
N_f = 2	10	14	24	29	40
N_f = 3	16	16	24	29	40
N_f = 4	21	21	24	29	40

Table:- H.01-T1: Guidelines for Risk

OCCUPANCY	REQUIRMENTS
9. FIRE AND EXPLOSION INDEX (F&EI) SYSTEM MATERIAL FACTOR (MF) FOR PROCESS AND STORAGE HAZARD EVALUATION	**5. TOXICITY NUMBER (Th)** i. The toxicity number (Th) is derived from the NFPA health factor Nh (NFPA 704, 325M or 49). Nh is an integer number ranging from 0 to 4. The five degrees of hazards are related to the protective equipment normally available to fire fighters. The example of Toxicity numbers are shown in **Table 17.1.e.** **6. PENALTY FACTOR (Ts)** i. The Penalty Factor (Ts) is the second toxicity parameter used to determine the TI. The Ts value is derived from the 'Threshold Limit Values (TLV)'. ii. The TLV-values are drawn up by the American Conference of Governmental Industrial Hygienists. iii. TLV represents a time weighted average (TWA) air concentration to which workers can be exposed during a normal working week without ill effects. TLV is often indicated as a TWA-value, both are the same. iv. The penalty factor is determined from the **Table:- H.01-T1.f.** **7. TOXICITY INDEX** i. The Toxicity Index is then calculated from Th and Ts plus the hazard factors of fire & Explosion Index (F&EI). The TI is found from the following formula $TI = \frac{Th + Ts\ \{1 + GH + SH\}}{100}$ Where MF—Material Factor, GH– General Hazard, SH– Specific Hazard i. The resulting TI values are ranked into three categories. a. 1-5 **Light** b. 6-9 **Moderate** c. 10-Above **High**

Table:- H.01-T1.e.: Material Factor (MF) Example

Nh	Th
0	0
1	50
2	125
3	250
4	325

Table:- H.01-T1.f.: Material Factor (MF) Example

Threshold Limit Values (TLV)	Penalty Factor (Ts)
< 5	0
5-50	50
> 50	125

3.4. Documentation of Risk Assessment Studies

3.4.1. Risk Assessment Studies and reports shall be documented as per **Table:- H.01-T2.**

Table:- H.01-T2: Risk Assessment Reports and Documentation

ITEMS	REQUIRMENTS
1. RISK ASSESSMENT REPORT	**1. GENERAL** i. The documentation shall include the fire protection engineering brief, the analysis documentation and operation and maintenance manual. ii. The purpose of the fire risk assessment concept report shall facilitate agreement on the approach that is proposed for the risk assessment. iii. There might be multiple parties involved in a risk analysis, with each party bringing a different perspective to the risk analysis. Possible stakeholders in the risk analysis include the risk analyst, building or facility owners and managers, General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain tenants, building operators or maintainers, emergency responders, insurance providers, and members of a construction team. iv. The Fire Risk Assessment shall only be submitted by General Directorate of Civil Defence permitted House of Expertise for General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain permit. v. Where consultants, experienced field experts, non-registered parties prepare Risk Assessment reports, General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted House of Expertise shall be permitted to submit such reports on their behalf. **2. STAKE HOLDERS** i. The fire risk assessment concept report should include a listing of all of the stakeholders involved in the preparation of the risk assessment and their qualifications, such as educational background, past experience in FRA, and registration license copy from General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain as “House of Expertise”. **3. PROJECT SCOPE** i. Project scope shall be clearly indicated. The project scope is an identification of the limits of the risk analysis and the purpose for conducting the risk analysis. The limits might include a building, part of a building, individual components or pieces of equipment, or processes. The purpose might be to identify the level of risk present in an existing building or facility, to identify methods of lowering the risk in an existing building or facility, or to identify methods of providing a level of risk deemed acceptable in a new or renovated building or facility. **4. FIRE SAFETY GOALS** i. Fire safety goals should be clearly stated. The goals of the FRA may be associated with the risk to life (occupants or fire fighters), the risk to property, the risk to operations, or the risk to the environment. ii. Goals are typically qualitative and should be in a form that will be easily understood by Common people. **5. HAZARDS** i. A risk assessment is based on a set of hazards that might occur. The hazards that are contemplated should be included in the concept report.

Table:- H.01-T2: Risk Assessment Reports and Documentation

ITEMS	REQUIRMENTS
RISK ASSESSMENT REPORT	**6. ACCEPTANCE CRITERIA** i. The acceptance criteria proposed to be used to judge the acceptability of the risk should be documented. ii. Documentation of the assumptions made in deriving the required performance ensures that future modifications can be captured. These modifications, which could inadvertently change the key elements or features critical to the intended performance of the building and its systems, such as changes in specified maintenance procedures, have to be accounted for in order to maintain the level of safety before the implementation of the detrimental modifications. iii. Results may be either relative (e.g., compared to a baseline or comparing alternative options) or absolute (e.g., deaths per year). Within this context, they may be qualitative or quantitative. iv. The acceptance criteria may be in the form of a quantitative risk value, a comparative value, or other values as agreed to by the stakeholders and General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain. The form of the acceptance criteria should be dependent on the risk problem and should influence the selection of appropriate FRA methods. v. Acceptance criteria should be established during preplanning. vi. Acceptance criteria may be based on one of the following: a. Prescriptive regulations b. Performance regulations c. Other agreed to criteria d. Standards and guides. **7. SCENARIOS** i. All scenarios or scenario clusters that are proposed to be used in the analysis should be documented. Where like scenarios are clustered, the basis for clustering should also be included in the documentation. ii. The documentation should state why the scenarios or scenario clusters used are representative of all scenarios to which the building or facility could be exposed. iii. The types of scenarios that are not considered because they either are unrealistically severe or sufficiently unlikely should be documented with cause for exclusion. **8. METHOD OF RISK ANALYSIS** i. The method that is proposed to be used to conduct the risk analysis should be documented. The documentation should address why the method is appropriate for the fire risk analysis **9. DATA COURCES** i. Data, reference to the sources of the data, and assumptions with justification should be provided.

Table:- H.01-T2: Risk Assessment Reports and Documentation

ITEMS	REQUIRMENTS
2. ANALYSIS OF METHODS USED	**1. QUALITATIVE METHODS** **1. a. RESULTS** i. The results of a qualitative method will be qualitative, such as tabulations of outcomes or relative likelihoods and consequences of fire scenarios and how they could be affected by protection options. Results should be provided for consequence and likelihood of one or more scenarios. **1. b. LIMITATIONS** i. The limitations of the fire risk analysis should be provided. A limitation of this type of method would be that the results are only suitable for ranking of risks or comparisons of risks. In many cases qualitative methods do not address total risk, which would also be a limitation. **1. c. CONCLUSIONS** i. The results of the FRA, including a comparison to the pass/fail threshold if applicable, should be summarized. A description should be provided of the degree to which the purpose and objectives have been met along with information on the appropriateness and completeness of the results for the intended purpose. **1. d. REFERENCES** i. The sources of the input data and how the input data are appropriate for the FRA should be identified. Examples of references include drawings, reports, manuals, publications, codes, and standards. The revision number or the publication date should be provided, if available. **2. SEMIQUALITATIVE LIKLIHOOD METHODS** **2. a. RESULTS** i. Since semi quantitative likelihood models calculate the likelihood of a fire scenario based on qualitatively defined consequence, the results should provide a probability of a type of scenario occurring within a defined period of time. **2. b. LIMITATIONS** i. The limitations of the fire risk analysis should be provided. A limitation of this type of method would be that it provides a numerical estimate of probability of a scenario occurring, but only a qualitative estimate of the consequences of a scenario occurring. Semi quantitative likelihood models' methods might not address total risk, which would also be a limitation. **2. c. CONCLUSIONS** i. The results of the FRA, including a comparison to the pass/fail threshold if applicable, should be summarized. A description should be provided of the degree to which the purpose and objectives have been met along with information on the appropriateness and completeness of the results for the intended purpose.

Table:- H.01-T2: Risk Assessment Reports and Documentation

ITEMS	REQUIRMENTS
ANALYSIS OF METHODS USED	**2. d. REFERENCES** i. The sources of the input data and how the input data are appropriate for the FRA should be identified. Examples of references include drawings, reports, manuals, publications, codes, and standards. The revision number or the publication date should be provided, if available. **3. SEMIQUANTITATIVE CONSEQUENCE METHODS** **3. a. RESULTS** i. Semi quantitative consequence models provide a qualitative estimate of the probability of a scenario occurring and a quantitative prediction of the consequences. The most common type would be the calculation results of a fire model coupled with an estimate of the probability of the event occurring. **3. b. UNCERTAINTY ANALYSIS** i. Possible sources of uncertainty in the predictions of consequences, and how they were addressed, should be identified in the documentation. **3. c. SOFTWARE AND MODEL EVALUATION** i. The documentation should address why the models and software used are appropriate for the situation modeled. **3. d. LIMITATIONS** i. The limitations of the fire risk analysis should be provided. A limitation of this type of method would be that it provides a quantitative estimate of the consequences of a scenario, but the probability of the scenario is only estimated qualitatively. Semi quantitative consequence models' methods do not address total risk, which would also be a limitation. **3. e. CONCLUSIONS** i. The results of the FRA, including a comparison to the pass/fail threshold if applicable, should be summarized. A description should be provided of the degree to which the purpose and objectives have been met along with information on the appropriateness and completeness of the results for the intended purpose. **3.f. REFERNCES** i. The sources of the input data and how the input data are appropriate for the FRA should be identified. Examples of references include drawings, reports, manuals, publications, codes, and standards. The revision number or the publication date should be provided, if available.

Table:- H.01-T2: Risk Assessment Reports and Documentation

ITEMS	REQUIRMENTS
ANALYSIS OF METHODS USED	**4. QUANTITATIVE METHODS** **4.a. RESULTS OF FREQUENCY OR PROBABILITY ANALYSIS** i. The documentation should include the results of the frequency and/or probability analysis. For each scenario or cluster of scenarios that are identified, the associated probabilities or frequencies should be documented. If probabilities are used, the time frame associated with the probability should be identified. **4.b. RESULTS OF CONSEQUENCE ANALYSIS** i. The results of the consequence analysis for each scenario or scenario cluster should be documented. If scenario clusters are used, the documentation should address how the consequence was determined to be representative for the scenario cluster. **4.c. CALCULATED RISK** i. The calculated risk should be documented. This calculated risk should be the summation of the probabilities/frequencies and consequences for each scenario or scenario cluster. ii. The document should also address why the risk analyst believes that the scenario used are representative of the spectrum of scenarios that could occur. **4.d. UNCERTAINTY ANALYSIS** i. Possible sources of uncertainty in the predictions of probabilities, frequencies, and consequences, and how they were addressed, should be identified in the documentation. **4.e. SOFTWARE AND MODEL EVALUATION** i. The documentation should address why the models used are appropriate for the situation modeled. **4.f. LIMITATIONS** i. Any limitations of the analysis should be addressed. Limitations might arise from the models used in the analysis or from the scope of the analysis. **4.g. CONCLUSIONS** i. The results of the FRA, including a comparison to the pass/fail threshold if applicable, should be summarized. A description should be provided of the degree to which the purpose and objectives have been met along with information on the appropriateness and completeness of the results for the intended purpose.

Table:- H.01-T2: Risk Assessment Reports and Documentation

ITEMS	REQUIRMENTS
ANALYSIS OF METHODS USED	**5. COST BENEFIT FRA METHODS** **5.a. RESULTS OF FREQUENCY OR PROBABILITY ANALYSIS** i. The documentation should include the results of the frequency and/or probability analysis. For each scenario or cluster of scenarios that are identified, the associated probabilities or frequencies should be documented. If probabilities are used, the time frame associated with the probability should be identified. **5.b. RESULTS OF CONSEQUENCE ANALYSIS** i. The results of the consequence analysis for each scenario or scenario cluster should be documented. If scenario clusters are used, the documentation should address how the consequence was determined to be representative for the scenario cluster. **5.c. RESULTS OF COST ANALYSIS** i. The results of the cost analysis should be documented. The documentation should include information as to how the costs were determined for the consequences identified and for any protection measures that were contemplated. **5.d. CALCULATED RISK** i. The calculated risk should be documented. This calculated risk should be the summation of the probabilities/frequencies and consequences for each scenario or scenario cluster. The documentation should also address why the risk analyst believes that the scenarios or scenario clusters used are representative of the spectrum of scenarios that could occur. **5.e. UNCERTAINTY ALANLYSIS** i. Possible sources of uncertainty in the predictions of probabilities, frequencies, consequences and costs, and how they were addressed, should be identified in the documentation. **5.f. SOFTWARE AND MODEL EVALUATION** i. The documentation should address why the models used are appropriate for the situation modeled. **5.g. LIMITATIONS** i. Any limitations of the analysis should be addressed. Limitations might arise from the models used in the analysis or from the scope of the analysis. **5.h. CONCLUSIONS** i. The results of the FRA, including a comparison to the pass/fail threshold if applicable, should be summarized. A description should be provided of the degree to which the purpose and objectives have been met along with information on the appropriateness and completeness of the results for the intended purpose.

4.0. Operation and Maintenance Manual

4.1. The operation and Maintenance manual shall be handed over to the owner, operator, tenant or the stakeholder responsible for the facility management. The operations and maintenance manual is to identify conditions that must be maintained for decisions made during the fire risk assessment to remain valid. These conditions might include the limitations on use or inspection, testing, and maintenance requirements.

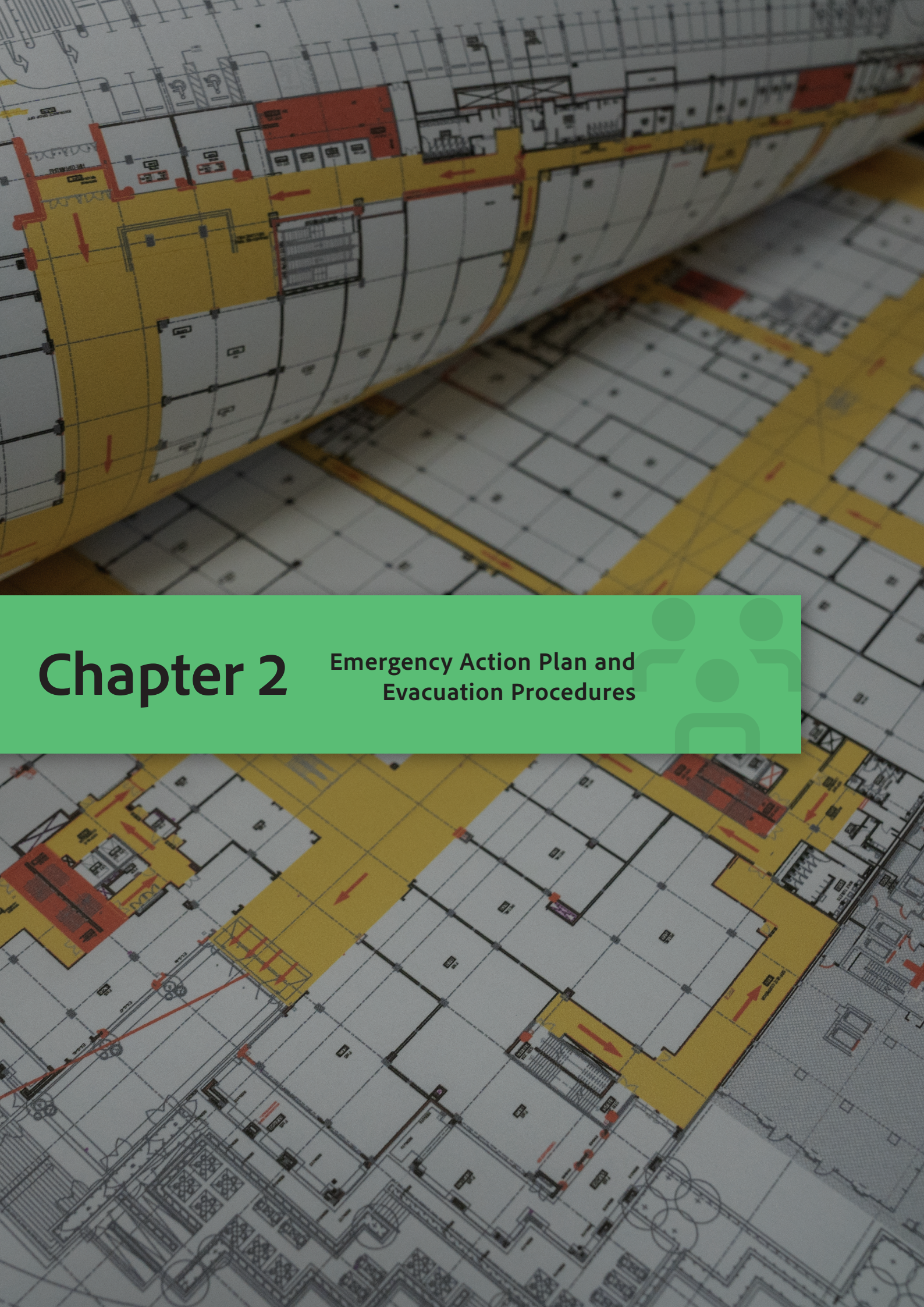
4.2. The operation and maintenance shall be documented as per **Table:- H.01-T3.**

Table:- H.01-T3: Risk Assessment Reports and Documentation

OCCUPANCY	REQUIRMENTS
1. OPERATION AND MAINTENANCE MANUAL	**1. LISTING OF LIMITATIONS AND ASSUMPTIONS MADE** i. In the interest of time, money, and/or simplicity, the engineering methods and models used to simulate system performance or to evaluate the fire risk are usually simplified. These simplifications carry limitations and assumptions, which should be explicitly listed. ii. Administrative controls and programs to protect these limitations and assumptions should be addressed and described. iii. The following topics should be reviewed to ensure that the operation of the facility does not inadvertently violate the limitations and assumptions of the FRA during normal and emergency situations. a. Engineering specifications, procurement documentation, work priorities, equipment replacement practices, rigorousness of equivalency evaluations, process monitoring instrument accuracies, electrical fault design practices, fuse replacement programs, and so forth. b. Operating procedures (both normal and emergency), communications system availability, local response for emergency, emergency plans, and respondent training. c. Labeling and storage practices, inventory control, packing/unpacking practices, material control, and vehicle use and control. d. Housekeeping, hot work control, and combustible and flammable material control practices. e. Training programs. f. System design, reliability, maintenance, testing, and configuration control. **2. CHANGE IN MANAGEMENT PROGRAM AND ORGANIZATION EVOLUTION** i. Organizations and processes evolve continually. The elements of change include the following. a. Knowledge changes. b. Product obsolescence c. Labor force mix and quality changes. d. Increasing internationalization, which changes the character and the quality of products. e. Formal organization changes, which produce functional efficiency changes and realign departmental interfaces. f. Jurisdictional criteria.

Table:- H.01-T3: Risk Assessment Reports and Documentation

OCCUPANCY	REQUIRMENTS
1. OPERATION AND MAINTENANCE MANUAL	**3. VALIDITY OF FRA** i. The FRA is usually valid only under a limited set of conditions, depending on the inputs used. Any changes in factors such as building construction, geometry, outfitting and processes could result in the FRA no longer being valid. ii. Therefore, documentation should be provided on the set of conditions under which the FRA is considered to be valid and what types of changes in conditions would require a new FRA. iii. Where it is intended to ensure that a risk is acceptable, methods of monitoring for change, such as periodic inspection, should be documented in an operations and maintenance manual or equivalent document. **4. VIOLATION OF FRA** i. Implementation of the following controls should be considered to avoid changing the established risk unknowingly. ii. Educate the building owner and operator to identify when the FRA is affected and to understand change impacts. iii. Footnote the procedures and programs to reinforce the source of constraint or element of basis that allows for the applicable process steps to be changed. iv. Formalize the change process to account for pertinent departments being included in evaluation of the impact to the facility/program, including risk (i.e., getting the right people involved). v. Pilot programs used prior to change must be broader based in evaluating the total impacts to the modifications being made. vi. Audit the processes and programs to ensure continued support of elements such as the FRA. vii. Because the FRA cannot presume to address all the possible changes, it is incumbent on the analyst to incorporate the assumptions, limitations, and conclusions into the ongoing process procedures and programs to ensure adequate understanding of the key attributes affected. **5. INSPECTION** i. Inspection, testing, and maintenance requirements on which the assessment is based need to be documented.



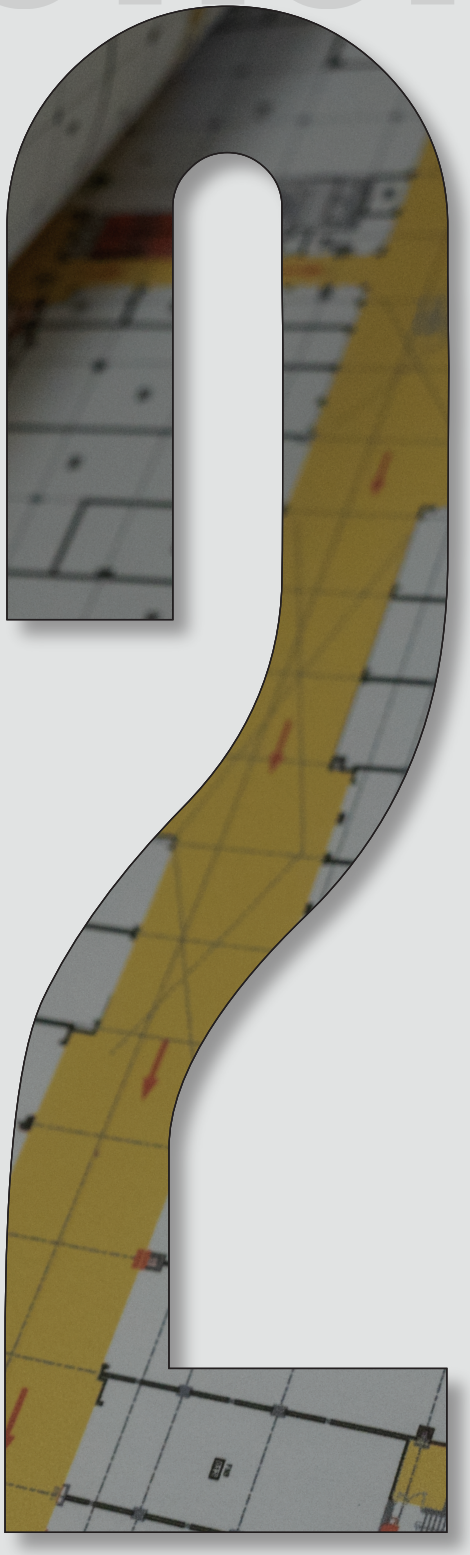
Chapter 2

Emergency Action Plan and Evacuation Procedures

Section H

Chapter 2

Emergency Action Plan and Evacuation Procedures



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1.0 Scope

1.1 This code provides general guidelines on Procedure to be followed during Emergency Evacuations.

1.2 To identify duties of personnel responsible during Emergency Evacuations.

1.3 To provide emergency drill procedures and its frequency.

1.4 Types of Evacuation strategies and Drill procedures

1.5 Content of Emergency Action Plan, Responsibilities of Emergency Response team.

2.0 Definitions

2.1. General

2.1.1. Shall
It is a mandatory requirement by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain.

2.1.2. Should
It is a suggested requirement recommended by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain but not mandatory.

2.1.3. Listed
Permitted and registered by General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain.

2.1.4. Owner
A person who is the proprietor and possesses the legal authority from government to own the particular land, property, assets, structure, businesses or material

2.1.5. Management under lease
A person or entity who is not the “Owner” of the building but is the user of the building through renting or leasing contract with the “Owner”.

2.1.6. Occupant
A person occupying the building permanently or temporarily as a occupier, sheltered, resident, tenant, employee, staff, user, visitor, lease holder, inhabitant and using the building for living or working or playing or occupation.

2.1.7. Emergency
An "emergency" is a circumstance when individuals need to be helped and taken to safety and is proclaimed by relevant authorities, such as the General Directorate of Civil Defense. An "Emergency" can be caused by man-made circumstances like arson, terrorism, or criminal activity, or it can be the result of natural disasters like earthquakes, floods, or hurricanes. It can also be the result of unintentional events like fire accidents or viral infection outbreaks.

2.1.8. Evacuation

Immediate transfer of people away from the emergency situation and location to a point of safety.

2.2. Emergency Evacuation Parameters

2.2.1. Partial Evacuation

Evacuation of people who are exposed to the immediately affected location or situation to a point of safety without evacuating people from the entire building or area.

2.2.2. Horizontal Phased Evacuation

Evacuation of people from one fire compartment to a point of safety to adjacent fire compartment, horizontally, such as in hospitals using horizontal exits. Horizontal phased evacuation is acceptable where floors are divided in an permitted manner into multiple fire resistive compartments and the occupants are moved from unsafe compartment to adjacent compartment horizontally to a point of safety.

2.2.3. Total Evacuation

Evacuation of all the people from the entire building or area to a point of safety.

2.2.4. Assembly Area (Assembly Point)

A designated area, usually outside and away from a building, which is considered to be a safe point when that building is affected during emergencies, where occupants of that building are led to report after evacuating the building.

2.2.5. Evacuation Drill (Fire Drill)

An exercise involving a simulation of an emergency situation in the building (Fire, in this document's context) or area to evaluate the emergency preparedness of the occupants in following the evacuation procedures and assessment of responding emergency personnel effectiveness in delivering their duties such as identifying victims, locating fires and emergency situations, and taking protective actions.

2.2.6. Emergency Action Plan (Emergency Evacuation Procedure)

A pre written and agreed plan, procedure and strategy, particular to certain building or occupancy, where actions required by designated personnel and procedures to be followed are addressed and documented. Such an emergency action plan is usually jointly prepared by the building owner, facility management, occupants (Residents or Employees) with or permits from concerned authorities.

2.2.7 Incident Fire Marshall

A designated and trained personnel from owner representative or facility management or management on lease, responsible for developing and executing emergency action plans, strategies, incident supervision and ordering.

2.2.8. Fire Safety Supervisor

A facility management staff or designated personnel trained to deliver specific duties such as assisting people during evacuation, usage of fire extinguishers during initial fire stages, coordination with emergency responders/ General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain, providing first aid, performing headcount, reporting to fire commander etc., during emergencies, as per emergency action plan.

Trained personnel, working under and in close association with Safety Supervisor who upon Safety Supervisor 's instructions, responds to the initial stages of fire accidents with first aid.

2.2.9. Response Team Member—FIRE RESPONDER

Trained personnel, working under and in close association with Safety Supervisor who upon Safety Supervisor 's instructions, responds to the initial stages of fire accidents with fire extinguishers, fire blankets.

2.2.10. Response Team Member—FIRST AIDERS

Trained personnel, working under and in close association with Safety Supervisor who upon Safety Supervisor 's instructions, responds to the initial stages of fire accidents with first aid.

3.0 Emergency Action Plan, Evacuation and Fire Drill

3.1. Introduction

3.1.1. The provisions of this chapter are to provide minimum guidelines on preparation of emergency action plans and procedures to ensure the safe and efficient evacuation of all occupants in the event of an emergency.

3.1.2. This guide is in no way all-inclusive nor could any manual be all inclusive of the types of emergency situations that may occur. However, this guide does offer the tenants the ability to respond in an effective manner.

3.1.3. These emergency action plan procedures can be effective only through the coordinated participation of Facility Management, Occupants, Tenants, Employees, and The building staff.

3.1.4. A complete understanding of the procedures by everyone in the building is essential for any Emergency Plan's success, when the situation demands.

3.1.5. Practicing an evacuation and emergency procedures during a non-emergency drill provides training that will be valuable in an emergency situation.

3.1.6. Successful emergency evacuation of the buildings and site, during emergencies, depends on prompt and correct decisions of the occupants and their immediate actions during the first minutes of the incident.

3.1.7. The emergency action plan predetermines the action to be taken by building staff in the event of a fire or emergency. This plan shall be put into effect immediately at the first indication of a fire or an emergency.

3.1.8. This chapter is based on the guidelines of **NFPA 101, 2024 Edition, NFPA 101 Guideline on High-rise buildings.**

3.1.9. **Section G, Chapter 01.Responsibilities of Stake holders** shall be referred to for the responsibilities of building owners, facility management personnel, Residents, Employees and Tenants.

3.2 Requirements for Emergency Action Plans

3.2.1 The general requirements for emergency action plan shall be as per **Table:- H.02-T1.**

Table:- H.02-T1: Emergency Action Plan Requirements

ITEMS	REQUIREMENTS
1. PREPARATION	i. The responsibility of preparation of specific Emergency Plans for the building lies with property owner, management firm and the facility management. ii. The responsibility for the implementation of the Emergency Plan and Procedures lies with property owner, management firm, the Facilities Manager, designated Emergency Evacuation Teams and any other appropriate personnel appointed and responsible for specific actions outlined in the plan. iii. The appointed fire safety supervisor is responsible for the implementation of the documented emergency guidelines and procedures, as a guide in the event of an emergency. iv. It is facility management 's responsibility to provide each tenant (Resident/ Employee/Occupant) with the "Fire Safety at Home/Office/Hotel etc.)" awareness brochure. v. It is facility management 's responsibility to keep record and provide the emergency action plan to General Directorate of Civil Defence (GDCD) for drills.
2. CONTENT	**1. GENERAL** i. It is of great importance that evacuation procedures and action plans are kept simple. ii. Evacuation procedures must be easy to understand and easy for anyone to execute. iii. Emergency plans and procedures shall be primarily in Arabic and English. In addition, the procedures shall be translated into the language the building occupant understands. iv. Emergency action plan shall clearly designate and appoint personnel with their names, contact details and specific responsibilities. v. Emergency action plan shall have a clear building evacuation plan, prepared in accordance with **Section C, Chapter 5, Table:- C.05-T1.8.** vi. Emergency action plan shall also include the latest, General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain and Municipality permitted floor plans with locations of main electrical switch board, firefighting equipment, building services control system etc. vii. Emergency action plans shall address the fire scenarios and evacuation strategies as per **Table:- H.02-T1.3.** viii. In addition to the fire accident emergencies in accordance with this chapter, the concerned parties shall also consider other emergencies such as earthquakes, floods, power outages, natural disasters, terrorism etc., that can affect and threaten the life safety of people in liaison with relevant authorities. **2. UPON DISCOVERING FIRE** i. It is everyone's responsibility to be vigilant for fire, smoke and smell. Upon discovering fire accidents, nearest manual fire call point (Manual Pull Station, Manual Push Button) shall be activated to confirm the fire and raise the fire alarm to notify the occupants. ii. Emergency action plan shall clearly mention the method of initiating these alarms and location of such alarm initiating devices.

Table:- H.02-T1: Emergency Action Plan Requirements

ITEMS	REQUIREMENTS
2- CONTENT	**3. UPON HEARING FIRE ALARM** i. If anyone is in immediate vicinity of fire and smoke and heat is enveloping the area, they shall leave the area without delay, using the safe fire exits. ii. Occupants shall not wait for Lifts, elevators and escalators and shall not be used during fire emergencies, unless guided and operated by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain or Fire Wardens as per predetermined strategy. iii. Occupants shall not re-enter the building, until instructed and guided by the fire response team. iv. Upon hearing the fire alarm, designated personnel shall undertake their responsibilities in accordance with the prewritten strategy and action plans in accordance with **Table:- H.02-T1.5.** v. Occupants shall follow the strategy as per the instructions of Safety Supervisor , Incident Fire commander or emergency response team member. **4. CALLING GENERAL DIRECTORATE OF CIVIL DEFENCE (GDCD) - KINGDOM OF BAHRAIN** i. However small the fire accident is, General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain shall be notified immediately by the occupants, facility management, security or Safety Supervisor s upon discovering the fire. ii. **Call on 999 MOI operation who will refer General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain.** iii. **When 999 is called follow these simple communication format, clearly.** **a. "There is fire accident at XXXXX (Location-Area)"** **b. Mention exact Location with Building number, (such as house, road and block numbers or any building numbers, street numbers, landmarks etc.)** **c. Nature of the building (Such as Number of Floors, "Very tall building", "School", "Hospital" etc.)** **d. Your Name and CPR (National ID) Number.** **e. If there are injured or seriously affected or trapped persons in the building.** **5. INITIATION OF EMERGENCY ACTION PLANS** i. Sound of fire alarm shall be the initiation of the building emergency action plan and shall be put into action. ii. The action plan strategies shall be specific to each building in accordance with **Table:- H.02-T1.3.** iii. The emergency response and management team shall be in accordance with **Table:- H.02-T1. 4.** iv. The responsibilities of the emergency response team shall be in accordance with **Table:- H.02-T1. 5.** v. Occupants, Staff, Employees, Visitors shall respond to emergency action plans and perform their responsibilities in accordance with **Table:- H.02 T1.6.** vi. The Assembly point shall confirm to **Table:- H.02-T1.7.**

Table:- H.02-T1: Emergency Action Plan Requirements

ITEMS	REQUIREMENTS
3. STRATEGIES	**1. GENERAL** i. The fundamental goal of any emergency response strategy shall be to move people to a point of safety from the emergency situation. ii. Accurate communication and methods of communication between emergency management team and occupants is of high importance to achieve orderly evacuation. iii. Withholding information from the occupants may not resolve panicking in every situation. iv. Effective coordination between facility emergency management team and various responding agencies such as General Directorate of Civil Defence (GDCD) -Kingdom of Bahrain, Police, Medical Services etc. v. Irrespective of the strategy, the emergency management team shall ensure that exit routes, elevators and corridors are free of fire and smoke and are safe to use. **2. NO EVACUATION (REMAIN IN PLACE) STRATEGY** i. Any "No Evacuation (Remain in place)" strategies shall be evaluated and certified by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain. ii. Remain in place strategy shall be adapted for facilities where in depth analysis of nature of building, hazard and occupants proves that such an action would best provide for the safety of building occupants. For example a. A small fire incident in the residential and hotel apartment unit or hotel guest room, or service rooms such as transformer rooms, generator rooms, electrical rooms etc., where total or partial evacuation may not be necessary. Except for the occupants of such unit, rest of the occupants can remain in place till the emergency management team notifies. b. Remain in place strategy may not be a suitable strategy for a factory or warehouse or commercial unit fire, however small, as the fire load in such units may be significantly higher and fire spread can be quick and unpredictable. **3. PARTIAL EVACUATION STRATEGY** i. Partial evacuation would a suitable strategy for high-rise, Super high-rise buildings and hospitals, where total evacuation, upon contained fire incidents maybe impractical and unnecessary. For example, a. It is impractical for immediate evacuation of the entire high-rise and super high-rise office building because of a fire incident in one of the offices or basements. Partial evacuation strategy till the incident is assessed by first responders would be a suitable strategy to restrict the evacuation to fire floor, floor above and floor below. b. Hospitals, where total evacuation of bedridden patients, people with disability and sick would be unnecessary, where fire accident maybe contained in small rooms, store rooms, basements etc. Partial evacuation of immediately affected people and areas through horizontal exits, to a point of safety would be a preferred strategy till the situation is assessed further.

Table:- H.02-T1: Emergency Action Plan Requirements

ITEMS	REQUIREMENTS
	4. TOTAL EVACUATION STRATEGY i. Total evacuation would be necessary where emergency management team assesses the situation as out of control or where full evacuation is the best option to achieve occupant's safety. For example, a. Building has exterior façade fires where fire can envelope the building swiftly. b. Where emergency management team assesses the situation as out of control and decides to evacuate the entire building. **5. MOVE OCCUPANTS TO REFUGE AREA IN THE SAME BUILDING** i. Any "Move occupants to Refuge Area" strategies shall be evaluated and certified by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain. ii. Where emergency management team analyses the situation as fully in control, or where fires are small and are contained to compartment, or area is filled with smoke and toxic gases, occupants' transfer to a safe refuge area to a point of safety in the same building, instead of evacuating them from the building would be an acceptable strategy.
4. THE EMERGENCY MANAGEMENT TEAM	**1. OWNER** i. Emergency action plan shall be initiated and prepared by the owner and owner's representative. ii. It is owner's responsibility to appoint the emergency management team through facility management. ii. It is owner's responsibility to handover the emergency action plans to the hired facility management or the management of the occupancy under owner's lease to follow. **2. FACILITY MANAGEMENT OR MANAGEMENT UNDER LEASE** i. It is facility management team OR under lease management's responsibility to appoint trained and able personnel to follow the emergency action plan. The appointed personnel shall be as follows. a. Incident Fire Commander b. Assistant Incident Fire Commander c. Safety Supervisor d. Assistant Safety Supervisor e. Response Team of minimum 4 personnel. (Fire Responder, First Aider, Assembly Point Coordinator, Drill observer) ii. The appointed emergency response team shall deliver their duties in accordance with **Table:- H.02-T1.5. Responsibilities of Emergency Response Team Personnel**. iii. Volunteers from the building that the facility management or management under lease is managing (Such as Residents, Students, Employees, Staff etc.) shall be permitted and encouraged to be involved as Emergency Response Team Members), and having their personal contact malformation, contacts and credential provided to GDCD.

Table:- H.02-T1: Emergency Action Plan Requirements

ITEMS	REQUIREMENTS
5. RESPONSIBILITIES OF EMERGENCY RESPONSE TEAM PERSONNEL	**1. INCIDENT FIRE COMMANDER** i. Incident Fire Commander and assistant incident fire commander of the team shall be a person who is on duty in the building on regular basis. ii. Assistant incident commander shall perform incident fire commander's responsibilities when incident fire commander is not on duty. iii. It is Incident Fire Commander 's responsibility to perform initial assessment of the situation and take actions as per written emergency action plans. iv. Incident Fire Commander shall communicate the incident nature and assessment to occupants. v. It is Incident Fire Commander 's responsibility to deliver specific instructions to particular emergency incidents to occupants and emergency response team. vi. The Incident Fire Commander shall have the authority to supervise, instruct, monitor, use resources and order the team and occupants during the emergency. vii. It is Incident Fire Commander 's responsibility to assign specific duties to the team members in accordance with emergency action plan and strategies. viii. It is Incident Fire Commander 's responsibility to coordinate with and brief the incident to the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain and Police when they arrive on site. ix. Incident Fire Commander shall work with General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain and Police by establishing working stations as Command centers or using the resources and controls at the Emergency Command Center. x. During non-emergency period, it is Incident Fire Commander's responsibility to ensure that the team members are familiar with and trained on building equipment and safety features such as fire pump, FACP, elevators and smoke control system controls that is in coordination with GDCD and in accordance with regulations followed in the kingdom of Bahrain. **2. ASSISTANT INCIDENT FIRE COMMANDER** i. Assistant Incident Fire Commander shall assist the Incident Fire Commander in all the duties of Incident Fire Commander as outlined but not limited to **Table:- H.02-T1.5.1.** ii. Assistant Incident Fire Commander shall ensure that all the building exit routes, exit corridors and routes are free of obstructions at all times. iii. Assistant Incident Fire Commander shall ensure that building fire and life safety equipment are maintained periodically in accordance with latest edition of **Bahrain Fire and Life Safety Code of Practice.** iv. Assistant Incident Fire Commander shall monitor the building for changes in structure, plans or equipment and report the same to Incident Fire Commander to be considered for updating the emergency action plan.

Table:- H.02-T1: Emergency Action Plan Requirements	
ITEMS	**REQUIREMENTS**
RESPONSIBILITIES OF EMERGENCY RESPONSE TEAM PERSONNEL	**3. SAFETY SUPERVISOR** i. Safety Supervisor shall be a full time employee or staff member on duty in the building. ii. Safety Supervisor shall be responsible to execute the instructions from Incident Fire Commander, during emergencies and non-emergency situations. iii. Safety Supervisor shall be the first responder to the initial stages of fire. And he shall be trained regularly in usage of appropriate type of fire extinguishers, fire blankets, first aid and building fire hose system. iv. Safety Supervisor shall call the security room and activate the fire alarm whenever a situation could pose immediate danger to people, property, or processes in the building. v. Safety Supervisor shall be responsible for relaying messages from Incident Fire Commander to the other team members and occupants. vi. Safety Supervisor shall be responsible for creating awareness among building occupants of the emergency action plans and actions to be taken by the occupants. vii. Safety Supervisor shall ensure that occupants, including new occupants/ tenants/ employees / contractors are familiar with the evacuation procedures. viii. Safety Supervisor shall ensure that occupants have vacated the floor/area/zone in the event of an evacuation and shall check assigned areas prior to leaving the building. ix. Safety Supervisor shall ensure that floor plans and route evacuation maps are posted in all relevant places. x. Safety Supervisor shall participate in the development, communication, implementation and maintenance of the overall Emergency Plan for their area of responsibility/zone/ building /office. xi. Safety Supervisor shall be aware of occupants with special needs who may need assistance during an evacuation, e.g. hearing- or sight-impaired, on crutches, in a wheelchair or People with Disabilities. xii. As an integral part of the emergency communication network, Safety Supervisor are to ensure that occupants in their area are aware of an emergency and the need to evacuate. xiii. Safety Supervisor shall assist in the evacuation process as indicated in the Emergency Evacuation Procedure. xiv. Safety Supervisor shall remain at the exit door from the inside of the building and continue to guide people to open sky and do not allow people to re-enter. xv. Safety Supervisor shall carry out systematic monthly Fire Safety checks of their assigned area to ensure that all fire equipment, exit signs etc. are in place and in good working order. xvi. Safety Supervisor shall ensure that a trained Assistant Warden is available during absence.

Table:- H.02-T1: Emergency Action Plan Requirements

ITEMS	REQUIREMENTS
RESPONSIBILITIES OF EMERGENCY RESPONSE TEAM PERSONNEL	**4. RESPONSE TEAM MEMBER—SAFETY SUPERVISOR** i. Fire Responder shall take instructions from Safety Supervisor. ii. Fire Responders shall be trained and shall know locations and usage method of all fire protection equipment. iii. Fire Responders shall move to the location of the fire emergency with sufficient fire extinguishing equipment. iv. Fire Responders shall evaluate the safety of the responder team before attempting to fight the fire. iii. Only under safe conditions safety supervisor shall fight the fire with a minimum of one (1) back up fire responder to assist in fighting the fire. vi. When the fire has been successfully extinguished, safety supervisor shall evaluate the burnt material for heat and remove the material from the area to a safe place for disposal, upon confirmation that the material is fully extinguished. vii. Safety supervisor shall follow these rules if they decide to fight fires: a. If in doubt or unconfident – do not fight the fires. b. Make sure that there are no other fires in the area. c. Never tackle a fire alone or if flames are above waist height. d. Convey to Safety Supervisor in-charge about the location and activity responders involved in. e. When using a fire extinguisher, keep low and make sure that the fire is attacked with the correct type of extinguisher. f. Once the fire is extinguished, report the facts to the Safety Supervisor at the Assembly Point. viii. Fire Responders shall follow these rules if they decide NOT to fight fires: a. Leave the area and check out if people are not in toilets, store rooms, etc., but only if it is safe to do so. b. Confine the fire by closing doors and windows on the way out, if it is safe to do so and does not cause undue delay in evacuation. ix. When General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain or Police arrive on site, leave the task to professionals and do not interfere unless asked. **5. RESPONSE TEAM MEMBER—FIRST AIDER** i. First Aider shall take instructions from trained and permitted. ii. First Aider shall be trained and shall know locations and usage of medical kit, CPR (cardiopulmonary resuscitation), Emergency treatments etc. iii. First Aiders shall be assigned at an assembly point of the premises. iv. First Aiders shall evacuate immediately when the alarm sounds. v. First Aiders shall carry first aid kit with them before evacuating the building. vi. First Aiders shall also arrange drinking water at the assembly point and supply everyone with water to prevent dehydration, exhaustion and fatigue. vii. First Aiders shall attend to injured and immediately seek professional medical assistance, depending on the seriousness of the victims.

Table:- H.02-T1: Emergency Action Plan Requirements

ITEMS	REQUIREMENTS
RESPONSIBILITIES OF EMERGENCY RESPONSE TEAM PERSONNEL	**6. RESPONSE TEAM MEMBER—ASSEMBLY POINT COORDINATOR** i. Assembly Point Coordinator shall take instructions from Safety Supervisor . ii. Assembly Point Coordinator shall be trained and shall know locations of all the assembly points of the building. iii. During a Fire Evacuation, Assembly Point Coordinator shall be in charge of assembly point to receive Personnel and assess situation. iv. Assembly Point Coordinator shall make sure that the evacuated people stand in line at the designated assembly point. v. Assembly Point Coordinator shall conduct a headcount when everyone has assembled in an orderly manner. vi. Assembly Point Coordinator shall ensure that the names of assembled people are called out loud and make note of their presence and health condition. vii. If people are missing at that assembly point, contact all other remaining assembly points, if any, on the premises to enquire about their presence. viii. If a missing person is assumed to be in the building, Assembly Point Coordinator shall inform the Safety Supervisor and the security room. ix. Assembly Point Coordinator shall make sure that every person on the list remains at the assembly point until receiving further instruction from Fire Warden. x. Assembly Point Coordinator shall ensure that Senior General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain Officer-in-charge, gives the "All clear" instruction before allowing people to reenter the building. **7. RESPONSE TEAM MEMBER—DRILL OBSERVER** i. Drill monitor or drill observer shall be appointed by the incident fire commander to monitor and review the emergency drill procedures and compliance with the emergency action plans. ii. Drill observer shall not be commissioned to perform the monitoring duty during real emergencies. iii. During real emergencies drill monitor shall assist the emergency response teams. iv. Drill monitors and observer duties shall be a. Observe the communication flow from emergency response team to occupants. b. The usage of exit routes by occupants c. Blockages of exit routes, if any. d. Difficulties experienced by people to achieve smooth evacuation. e. Difficulties experienced by people with disabilities, if any. f. The role specific responsibilities executed by emergency response team. g. Audibility of Voice evacuation messages. h. Gathering of evacuees at the assembly point . i. Roll call at the assembly point. j. Communication flow between occupants and the emergency response team. k. Overall evacuation efficiency of the building. l. Availability of appropriate extinguishers and hose reels. v. Observer shall make note of each observation and its impact on the existing emergency action plan. iv. Observer shall use the checklist mentioned in **Table:- H.02-T4.,** and assess the emergency action plan to review it with entire emergency response team. vii. Feedback and suggestions from occupants shall also be incorporated to improve the building emergency action plans.

Table:- H.02-T1: Emergency Action Plan Requirements

ITEMS	REQUIREMENTS
6. OCCUPANTS	i. It is the responsibility of all occupants to be aware of Emergency Action Plan of the building and their responsibilities as required by **Section G, Chapter 01., Responsibilities of Stakeholders** ii. All occupants shall know the locations of primary and alternate exits and be familiar with the various evacuation routes available in the building they live, work and play. iii. All occupants shall be familiar with Designated Evacuation Assembly Point Areas. iv. Occupants shall not re-enter a building after the fire incident, until "all clear" instruction is declared by General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain official. v. Occupants shall know how to report an emergency to the security. vi. Occupants are responsible for their own safety. Stay calm, avoid panic and confusion. vii. Occupants shall coordinate and cooperate with Incident Fire Commander, Safety Supervisor and Emergency Response Team members. viii. Occupants shall know the locations and operation of fire extinguishers. ix. Small and Insipid fires can be extinguished using fire extinguishers, only if trained and it is safe to do so. However, an immediate evacuation is essential for any and all fires occurring in the building or response as per building emergency strategy. x. Occupants shall never enter a room that is smoke filled. xi. Occupants shall never enter a room if the door is warm or hot when touched. xii. Once evacuation order is initiated, occupants shall not re-enter the room or area, to collect belongings. xiii. Once **FIRE ALARM** or **EVACUATE ORDER** is received, occupants shall select the nearest, safest route to exit the area or the building and proceed in an orderly manner to the Designated Assembly Point and await further instructions from the assembly point coordinator. xiv. A headcount will be taken to ensure that everyone has safely evacuated. Occupants shall not leave the Assembly Point unless told to do so.
7. REVIEW	i. Emergency action plans shall be reviewed and revised as per changes in the building, changes in the floor plans, number of occupants, changes in usage, changes in management, changes in staff, changes in emergency services contact details etc., every year and update GDCD. ii. The feedback from occupants shall be considered when revising any emergency action plans. iii. The lesson learnt from fire drills conducted in accordance with **Sub Section 3.4** of this chapter shall be evaluated and incorporated into the emergency action plans. iv. See Table **Table:- H.02-T4.** for Emergency Drill Observer's checklist.

3.3 Requirements for Emergency Evacuation Procedures

3.3.1 The general requirements for emergency action plan shall be as per **Table:- H.02-T2.**

Table:- H.02-T2: Emergency Evacuation Procedures

ITEMS	REQUIREMENTS
1. ASSEMBLY POINT OR ASSEMBLY AREA	**1. GENERAL** i. Each building shall have an "assembly point" in accordance with **Table:- H.02-T2.1.** ii. Assembly Point shall be predetermined, identified and designated with sign. iii. Large and distributed occupancies such as malls, theme parks, hospitals, schools shall have multiple assembly points. iv. Consideration shall be given to sheltered assembly points. **2. LOCATION** i. The assembly point shall be permitted by GDCD, unless/otherwise stated by GDCD. ii. Alternatively, an assembly point shall be at a distance, not less than the height of the building. iii. The assembly point shall be easily accessible. iv. The assembly point shall be in a location safe from the building structure, such that occupants are safe from fire heat radiation and falling debris. v. Assembly point shall be away from the fire access road and fire truck parking areas, such that the occupant assembly shall not hamper the fire fighters staging and operation activities. vi. The landscaping areas, parking lots, pedestrian ways, playgrounds etc., away from the building shall be permitted as an assembly points. **3. SIZE** i. The assembly point shall be large enough to accommodate the building occupants. ii. Where space is constraint, multiple assembly points in various areas shall be permitted. iii. A public large open space within 100 m of the building shall be permitted to be a "common assembly point" for a group of buildings owned by different owners. **4. SIGN BOARD** i. The assembly point shall be identified by the sign, in both Arabic and English, green colour and format, in accordance with **Figure:- H.02-F1.**



Figure:- H.02-F1.: Assembly Point Sign

Table:- H.02-T2: Emergency Evacuation Procedures	
ITEMS	**REQUIREMENTS**
2. VESTS FOR EMERGENCY RESPONSE TEAM	i. Each member of the emergency response team shall wear a fluorescent jacket/ vest. ii. Such vests or jackets shall have the "Designation" inscribed on them in capital letters, as INCIDENT COMMANDER, SAFETY SUPERVISOR , FIRE RESPONDER, FIRST AIDER, ASSEMBLY POINT COORDINATOR, OBSERVER etc. iii. Such vests shall be kept within reach and put on as soon as an emergency situation arises and when emergency drills are practiced.
	

Figure:- H.02-F2.: Emergency Response Team Vests

3.4. Requirements of Fire Drills

3.4.1. The emergency evacuation fire drills shall comply with **Table:- H.02-T3.**

Table:- H.02-T3: Emergency Evacuation Drills

ITEMS	REQUIREMENTS
1. OBJECTIVE	i. Emergency Evacuation Drills shall be conducted in every facility that is occupied by the people so that the occupants get familiar with the building emergency action plan, their role in such an emergency action plan and to be prepared mentally and habitually to train themselves to respond confidently to an emergency situation. ii. Emergency evacuation drills shall be conducted to evaluate the effectiveness of the building emergency action plans, crowd movement, time taken for partial evacuation, time taken for full evacuation, the familiarity of occupants with the building evacuation plans and procedures.
2. PROCEDURE	**1. GENERAL** i. Emergency Evacuation Drills shall be based on the specific requirements of the pre determined emergency action plans, specific to the building, prepared in accordance with **Section H, Chapter 02, Section 3.1.** with occupancy based considerations as required by **Section G, Chapter 01., Responsibilities of Stake holders** and specific nature of the occupancy, people behavior, topography, risks involved at the occupancy etc. ii. Every occupant shall be familiar with the building emergency action plan prior to conducting any emergency evacuation drills or fire drills. iii. Evacuation drills shall be scheduled and notified to building occupants by the Evacuation Coordinator(s) and Safety Supervisors, at least one week prior to the drill. iv. Drill shall be conducted to simulate fire conditions and fire scenario conditions such as one escape route obstructed, injured on the exit corridor, power failures, wrong exit sign directions etc. v. Drill shall be for different fires in each exercise, such as electrical fires, LPG fires, garbage fires, furniture fires, kitchen fires, fires at neighboring building, parking fires etc. **2. TRAINING** i. Training shall be arranged for the occupants (Residents, Staff, Employees, Visitors etc.), to familiarize the occupants with building emergency action plans, location of manual call points, location of stairs and exit routes, exit signage, location of assembly points, location of refuge areas, location of extinguishers, location of fire hose reels etc. ii. Training shall touch on but not limited to a. How to raise fire alarm b. How to call General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain c. How to use appropriate type of extinguisher d. When not to try to fight fires e. How to be familiar with building exits and evacuation plan layouts f. How to coordinate with building facility management g. How to coordinate with building emergency response team h. How to assist others during emergencies and evacuation iii. Occupants shall be familiar with and recognize the emergency response team members, incident fire commander and Safety Supervisor s of the building. iv. Building emergency evacuation procedures and building evacuation plan copies shall be handed out to occupants and participants after the training.

Table:- H.02-T3: Emergency Evacuation Drills

ITEMS	REQUIREMENTS
2. PROCEDURE	**3. PARTICIPATION** i. All building occupants shall participate in an emergency evacuation drill. ii. During the execution of drills, emphasis shall be placed upon orderly evacuation under proper discipline rather than upon speed. **4. NOTIFICATIONS** i. Owner, Facility Management and Management under lease shall be responsible for notifying the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain, if a drill is planned. ii. Such a notification shall be 48 hours prior to the drill schedule as well as an hour before the drill. iii. Drill notifications shall also be delivered to the neighboring building facility management or management under lease.
3. DRILLS AND THEIR FREQUENCY FOR VARIOUS OCCUPANCIES AND MANAGEMENTS	**1. FACILITY MANAGEMENT** i. Facility management shall have emergency action plan in accordance with **Section H, Chapter 02,** and **Section G, Chapter 01. Table:- G.01-T11.4.** ii. Facility Management team of every building shall conduct and practice fire drills as per building emergency action plans every 6 months, in compliance with **Section H, Chapter 02, Sub Section 3.4.,** and **Section G, Chapter 01.Table:- G.01- T11.11.** iii. Such a fire drill shall be only for facility management team and shall not be for the occupants. iv. Such a fire drill for facility management team shall be to ensure the emergency preparedness of the building facility management team. v. Report of such a monthly drill shall be sent to the building owner or management under lease. vi. See **Section G, Chapter 01,Table:- G.01-T11** for facility management responsibilities. **2. ASSEMBLY OCCUPANCY** i. Assembly occupancy management shall have emergency action plan in accordance with **Section H, Chapter 02**. and **Section G, Chapter 01 Table:- G.01-T12.5.** ii. Assembly occupancy Management team shall conduct and practice fire drill twice every 6 months, in compliance with **Section H, Chapter 02, Sub Section 3.4**., and **Section G, Chapter 01, Table:- G.01-T12.6.** iii. Drills shall not be required to involve general public of the assembly occupancy. iv. See **Section G, Chapter 01, Table:- G.01-T12** for assembly occupancy management responsibilities. **3. EDUCATIONAL OCCUPANCY** i. Educational occupancy management shall have emergency action plan in accordance with **Section H, Chapter 02**. and **Section G, Chapter 01., Table:- G.01-T13.4.** ii. Educational occupancy Management team shall conduct and practice fire drill once every 6 months, in compliance with **Section H, Chapter 02, Sub Section 3.4**., and **Section G, Chapter 01., Table:- G.01-T13.5.** iii. Drills shall involve entire school occupants, with total evacuation alarm. iv. See **Section G, Chapter 01., Table:- G.01-T13.** for Educational occupancy management responsibilities.

Table:- H.02-T3: Emergency Evacuation Drills

ITEMS	REQUIREMENTS
DRILLS AND THEIR FREQUENCY FOR VARIOUS OCCUPANCIES AND MANAGEMENTS	**4. BUSINESS-HIGHRISE AND SUPER HIGHRISE BUILDING MANAGEMENT** i. High-rise Business occupancy management shall have emergency action plan in accordance with **Section H, Chapter 02**. . and **Section G, Chapter 01., Table:- G.01-T14.4.** ii. Highrise Business occupancy Management team shall conduct and practice fire drill once every 6 months, in compliance with **Section H, Chapter 02, Sub Section 3.4**., and **Section G, Chapter 01.,Table:- G.01-T14.5.1.** iii. Drills shall involve entire occupants, with total evacuation alarm. iv. See **Section G, Chapter 01., Table:- G.01-T14.** for High-rise building management responsibilities. **5. HOTEL-HIGHRISE AND SUPER HIGHRISE BUILDING MANAGEMENT** i. High-rise Hotel occupancy management shall have emergency action plan in accordance with **Section H, Chapter 02**. and **Section G, Chapter 01., Table:- G.01-T15.4.** ii. High-rise Hotel occupancy Management team shall conduct and practice fire drill every 6 months in accordance with **Chapter 19, Section 4**., and **Section G, Chapter 01., Table:- G.01-T15.5.** iii. Drills shall not be required to involve Hotel guests and visitors. iv. See **Section G, Chapter 01., Table:- G.01-T14.5.2.** and **Table:- G.01-T15.5.** **6. RESIDENTIAL-HIGHRISE AND SUPER HIGHRISE BUILDING MANAGEMENT** i. High-rise Residential occupancy management shall have emergency action plan in accordance with **Section H, Chapter 02**. . and **Section G, Chapter 01., Table:- G.01-T14.4.** ii. Highrise Residential occupancy Management team shall conduct and practice fire drill once every 6 months in accordance with **Section H, Chapter 02 , Sub Section 3.4,** and **Section G, Chapter 01., Table:- G.01-T14.5.3.** iii. Drills shall involve entire occupants, with total evacuation alarm. iv. Drills shall be scheduled on a non-working day so that most of the residents can take part in the drill. v. **See Section G, Chapter 01., Table:- G.01-T11.** for facility management responsibilities. **7. HEALTHCARE MANAGEMENT** i. Healthcare occupancy emergency action plan shall be in accordance with **Section H, Chapter 02**. and **Section G, Chapter 01., Table:- G.01-T16.4.** ii. Healthcare occupancy Management team shall conduct and practice fire drill once every 6 months in accordance with **Section H, Chapter 02**. , **Section 4**. and **Section G, Chapter 01.,, Table:- G.01-T16.6.** iii. Drills shall not be required to involve occupants, patients or visitors. iv. Drills shall be scheduled at non-visiting hours. v. See **Section G, Chapter 01., Table:- G.01-T16.** for healthcare occupancy management responsibilities.

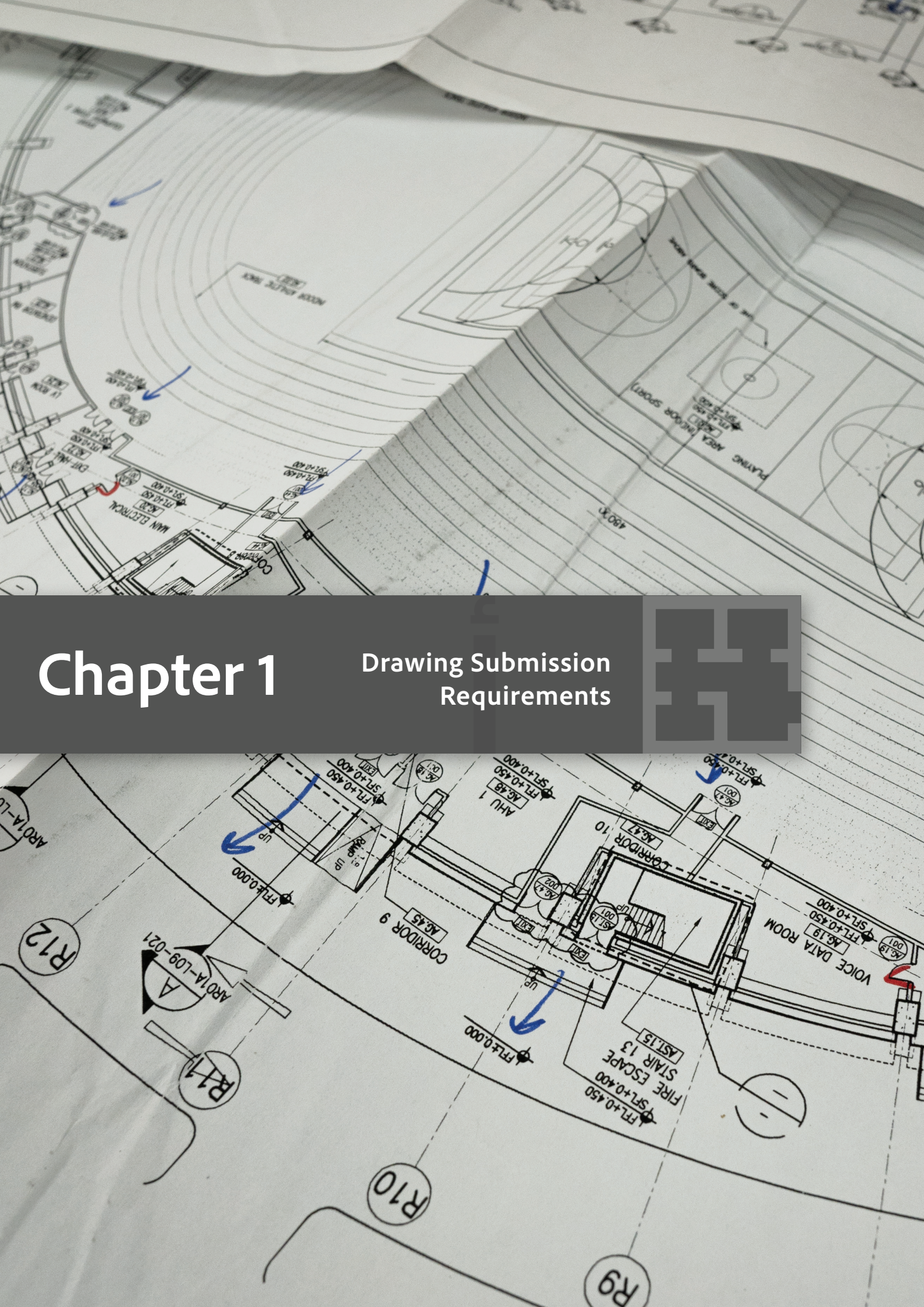
Table:- H.02-T3: Emergency Evacuation Drills	
ITEMS	**REQUIREMENTS**
DRILLS AND THEIR FREQUENCY FOR VARIOUS OCCUPANCIES AND MANAGEMENTS	**8. DETENTION AND CORRECTIONAL MANAGEMENT** i. Detention and Correctional occupancy emergency action plan shall be in accordance with **Section H, Chapter 02** and **Section G, Chapter 01, Table:- G.01-T17.4.** ii. Detention and Correctional occupancy Management team shall conduct and practice fire drill once every 6 months in accordance with **Section H, Chapter 02**, **Section 4**. and **Section G, Chapter 01., Table:- G.01-T17.6.** iii. Drills shall not be required to involve occupants, patients or visitors. iv. Drills shall be scheduled at non-visiting hours. v. See **Section G, Chapter 01., Table:- G.01-T17.** for detention and correctional occupancy management responsibilities. **9. MALL MANAGEMENT** i. Mall emergency action plan shall be in accordance with **Section H, Chapter 02** and **Section G, Chapter 01. Table:- G.01-T18.5.** ii. Mall Management team shall conduct and practice fire drill once every 6 months in accordance with **Section H, Chapter 02**, **Section 3.4**. and **Section G, Chapter 01, Table:- G.01-T18.6.** iii. Drills shall not be required to involve public. iv. Drills shall be scheduled at non-visiting hours with volunteers as public. v. See **Section G, Chapter 01. Table:- G.01-T18.** for Mall management responsibilities.

4.0 CHECK LIST FOR DRILL OBSERVER

4.1. The emergency evacuation drill observer checklist in its minimum format and content shall comply with **Table:- H.02-T4.**

Table:- H.02-T4.: Checklist for Emergency Evacuation Drill Observer

ITEMS	CHECKLIST
1. FACILITY INFORMATION	i. Name and details of the facility/ Building_____ ii. Type of Occupancy_____ iii. Number of People in the building_____ iv. Address_____ v. Contact Person/Incident Fire Commander_____ vi. Phone Number_____ vii. Date of the Drill_____ viii. Name and Signature of the drill observer_____
2. BEFORE DRILL	i. General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain has been informed 48 hours before and an hour before? **Yes/ No** ii. The occupants are familiar with building emergency action plan? **Yes / No** iii. The emergency response team is designated and trained? **Yes / No** iv. The emergency response team has drill vests for identification? **Yes / No** v. The drill observer has checklist? **Yes / No** vi. Safety Supervisor s have required flash lights? **Yes / No** vii. First aiders have required first aid kit? **Yes / No** v. People with Disabilities have been identified and assistance is arranged? **Yes / No** vi. Assembly points are identified and available? **Yes / No**
3. DURING THE DRILL	i. Fire was recognized and Manual call points was activated? **Yes / No** ii. Alarm sound was heard in all areas of the building? **Yes / No** iii. Occupants evacuated in accordance with emergency action plan? **Yes / No** iv. Occupant followed "Partial", "full" or "remained at place" as per plan? **Yes/ No** v. Was evacuation smooth, quick and orderly? **Yes / No** vi. Incident Fire Commander performed his duties as per plan? **Yes / No** vii. Safety Supervisor performed his duties as per plan? **Yes / No** viii. Fire Responder performed his duties as per plan? **Yes / No** ix. First aider performed his duties as per plan? **Yes / No** x. Emergency Response Team performed their duties as per plan? **Yes / No** xi. Assembly Point Coordinator performed his duties as per plan? **Yes / No** xii. Anyone did not participate in the drill? **Yes / No** xiii. Anyone re-entered building without "all clear" instruction? **Yes / No** xiv. Occupants gathered at Assembly Points in line? **Yes / No** xv. Assembly point coordinators had list of occupant names? **Yes / No** xvi. Rest rooms, prayer rooms, store rooms, plant rooms were searched? **Yes / No** xvii. Self Closing fire doors operated? **Yes / No** xviii. Communication between incident commander and Safety Supervisor was as per Emergency action plan? **Yes / No** xix. Communication between incident commander and occupants was as per Emergency action plan? **Yes / No** xx. Time taken by occupants to fully evacuate the building_____
4. AFTER THE DRILL	i. Were all occupants (Participants) accounted for? **Yes / No** ii. Was General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain involved in the drill? **Yes / No** iii. Building fire alarm system, sounders, voice evacuation, emergency lighting, extinguishers, hose reels, etc., functioned as intended? **Yes / No** iv. Was there discomfort for occupants in evacuating the building? **Yes / No** v. Was emergency action plan complete in its details and procedures? **Yes / No** vi. Update required for Emergency action plans? **Yes / No** vii. Update required for building fire and life safety systems? **Yes / No** viii. Training required for emergency response team? **Yes / No** ix. Training required for occupants? **Yes / No** x. Other recommendations_____



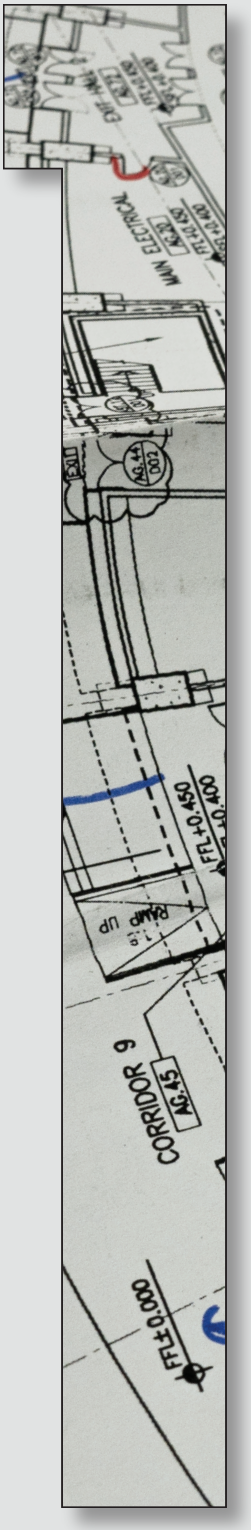
Chapter 1

Drawing Submission Requirements

Annex

Chapter

Drawing Submission Requirements



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1.0 SCOPE

1.1 This Chapter provides general information on drawing submission requirements, Legends, Code Compliance.

1.2 To standardize the drawings submitted to General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain for permit.

1.3 To standardize the drawing format, colour coding and the information that should be conveyed to General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain engineers for their review and permit.

1.4 To achieve code complaint project submission and permitted process in timely manner.

2.0 Drawing Submission Requirements

2.1 General requirements

2.1.1 The general requirements for drawing submission to General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain shall be in accordance with **Table:- H.03-T1, H.03-T2, H.03-T3** General Requirements.

2.1.2 The general requirements and format of **Table:- H.03-T1, H.03-T2, H.03-T3** shall apply to Consultants, Contractors, Décor companies, LPG contractors, House of expertise and event management companies, applying online for General Directorate of Civil Defence (GDCD) permit.

2.2 Format for Submission

2.3.1. The General format requirements shall be as per **Table:- H.03-T1.**

Table:-H.03-T1: Drawing Submission Format

ITEM	REQUIREMENTS
1. FILE FORMAT AND SIZE	i. Soft copy file format shall be as required by the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain. Generally pdf., dwf. formats are accepted for online permit process. ii. Each file can be a maximum of 50Mb and the total maximum size of entire attachments for a project shall not exceed 200 Mb. However all these file format and size specifications shall be in accordance with portal administration guidelines and procedures of individual departments. iii. Where an individual file size exceed 50 Mb, file can be split into parts as Part 1, Part 2, Part 3 etc. iv. Zip files, files with errors and password protected files shall not be submitted.
2. NUMBER OF FILES	i. Each project shall have total of 4 to 6 separate files, as required by the nature of project, as below. a. Architecture and Life Safety. b. Fire Detection and Alarm System. c. Fire Protection and suppression systems. d. Emergency Lighting and Signage systems. e. Smoke Control and management systems. f. LPG System (if applicable) ii. In addition to above mentioned files, additional letters such as material letters, scope of work, electrical appliance usage etc. maybe required if applicable, as required by **Table:- H.03-T1.**
3. FILE NAMES	i. Files required by **Table:- H.03-T1.2.i.** shall be named as below. a. XXXXX (Application number)_LIFE SAFETY. b. XXXXX (Application number)_FIRE ALARM SYSTEM. c. XXXXX (Application number)_FIRE PROTECTION SYSTEM. d. XXXX (Application number)_EMERGENCY LIGHTING SYSTEM. e. XXXXX (Application number)_SMOKE CONTROL SYSTEM f. XXXXX (Application number)_LPG SYSTEM. ii. Files required by **Table:- H.03-T1.2.** shall be named as below. a. MATERIAL AND ACTIVITY LETTER. b. SCOPE OF WORK c. LPG NOT REQUIRED d. UNDERTAKING (For any client undertakings) iii. File names such as below shall not be acceptable and drawings will not be reviewed. a. Fire b. Civil Defence / General Directorate of Civil Defence c. Residential d. Project e. Untitled f. FF g. Permit h. 2December i. Title page j. Ground floor

2.2. Format for Submission

Table:-H.03-T1: Drawing Submission Format

ITEM	REQUIREMENTS
4. DO NOT SUBMIT THESE DRAWINGS	i. General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain does not review or evaluate any aspect of a project other than fire and life safety. The following drawings shall not be included in the submissions. a. HVAC b. Drainage. c. Lighting. d. Plumbing. e. Structural Details f. Floor tiling g. Ceiling tiles h. Electrical distribution i. Landscaping ii. Product details with brand names, product catalogues and product brand specifications, product catalogues shall not be attached as part of submissions. Such submissions will not be reviewed and stamped.

2.3. Reasons for Rejection of Application.

2.3.1 There are some reasons for Application rejection are listed in **Table:- H.03-T2.**

Table:-H.03-T2: Reason for Application rejection

ITEM	REQUIREMENTS
1. REASONS FOR REJECTION OF APPLICATIONS	i. Drawings submitted to General Directorate of Civil Defence (GDCD) will be rejected without review, comments or suggestions if any of the following is true. a. Without required number of files b. Without appropriate file names as per this chapter c. Without scale d. Without check marking (On e-engineering/online submissions) e. Without cover page f. Without room names, occupancy names g. Without colour coding and format in accordance with this chapter h. Without material/activity/storage method letter for Storage and industrial projects i. Without clarifying letter of LPG/Natural gas usage. j. Without highlighting exact scope of work in modification/ adjustment/refurbishment jobs with yellow cloud for as permitted and red cloud for as revised. k. Submissions with product catalogues, product brochures, company and product licenses. ii. **Architecture/Life safety drawings** submitted to General Directorate of Civil Defence (GDCD) will be rejected without review, comments or suggestions if any of the following is true. a. Without fire access road layouts. b. Without sections with dimensions. c. Without all floor plans d. Without 1/3 of building diagonal distance between stairs in sprinklered buildings. e. Without 1/2 of building diagonal distance between stairs in non-sprinklered buildings. f. Without separation at discharge level stair between typical floor discharge and lower level or basement discharges. g. Without direct discharge through protected corridor for half the number of building stairs. h. Without stair details, step details in dedicated page as per this chapter. i. Without fire lift in dedicated shaft for high-rise buildings. j. Without fire lift lobby for Super high-rise building. k. Without generator room in high-rise and Super high-rise buildings. l. Without pump room and water tank locations, sections and details. m. With underground pump room having hatch entry, cat ladder and spiral stair access. n. Without required fire rating of corridors, stairs, LV room, substations, generator rooms, plant rooms, hazardous storage rooms, pump rooms etc.

2.3. Reasons for Rejection of Application.

Table:-H.03-T2: Reason for Application rejection

ITEM	REQUIREMENTS
2. REASONS FOR REJECTION OF APPLICATIONS	iii. **Fire Detection and Alarm** drawings submitted to General Directorate of Civil Defence (GDCD) will be rejected without review, comments or suggestions if any of the following is true. a. Fire Detection and alarm drawings superimposed on life safety details. b. Without legend c. Without wiring distribution. d. Without all floor plans e. Without sounder based detectors at bedrooms. f. Without above false ceiling detectors with remote response indicators. g. Without sounders/speakers having flashers at parking, basements, plant rooms and outdoor areas. h. Without control panel (FACP/FARP) locations. i. Without riser diagrams. j. Without voice speakers for high-rise and Super high-rise buildings. iv. **Emergency Lighting** drawings submitted to General Directorate of Civil Defence (GDCD) will be rejected without review, comments or suggestions if any of the following is true. a. Emergency lighting drawings superimposed on life safety details. b. Without legend c. Without wiring distribution. d. Without all floor plans e. Without cross zoning for central battery systems. f. Without control panel locations. g. Without riser diagrams. v. **Fire protection and Suppression** drawings submitted to General Directorate of Civil Defence (GDCD) will be rejected without review, comments or suggestions if any of the following is true. a. Fire protection drawings superimposed on life safety details. b. Without legend and sprinkler types c. Without piping distribution. d. Without all floor plans e. Without pipe sizes. f. Without Fire pump and water tank capacities on riser diagrams. g. Without riser diagrams. h. Without vertical turbine type pumps for negative suction water tank arrangements.

2.3. Reasons for Rejection of Application.

Table:-H.03-T2: Reason for Application rejection

ITEM	REQUIREMENTS
3. REASONS FOR REJECTION OF APPLICATIONS	vi. **Smoke control/ Management** drawings submitted to General Directorate of Civil Defence (GDCD) will be rejected without review, comments or suggestions if any of the following is true. a. With HVAC drawings or details. b. Smoke control drawings superimposed on life safety details. c. Without legend d. Without ducting distribution. e. Without all floor plans f. Without arrow marks for supply and return indications. g. Without control panel locations. h. Without riser diagrams. i. Without typical details and specifications for fans, ducts and curtains, if any. vii. **LPG/ Natural gas** drawings submitted to General Directorate of Civil Defence (GDCD) will be rejected without review, comments or suggestions if any of the following is true. a. LPG drawings superimposed on life safety details. b. Without legend c. Without piping distribution. d. LPG piping crossing through stairs, lift lobbies, garbage rooms. e. Without tank locations, sizes, capacity and separation dimensions. f. Without fill line location. g. Without PRDP location. h. Without all floor plans i. Without typical tank installation details. j. Without gas detectors and control panel locations. k. Without riser diagrams.

2.3. Legend on the Drawings.

2.3.1. Drawings submitted to General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain shall essentially have the symbols and legend as required below.

a. LIFE SAFETY drawings shall have symbols and legend as per **Figure:- H.03-F1**
b. FIRE ALARM SYSTEM drawings shall have symbols and legend as per **Figure:- H.03-F.2.**
c. VOICE EVACUATION SYSTEM drawings shall have symbol and legend as per **Figure:- H.03-F.2a.**
d. FIRE PROTECTION drawings shall have symbols and legend as per **Figure H.03-F3.**
e. EMERGENCY LIGHTING drawings shall have symbols and legend as per **Figure H03-F4.**
f. SMOKE CONTROL drawings shall have symbols and legend as per **Figure H.03-F5.**
g. LPG SYSTEM drawings shall have symbol and legend as per **Figure H.03-F6**

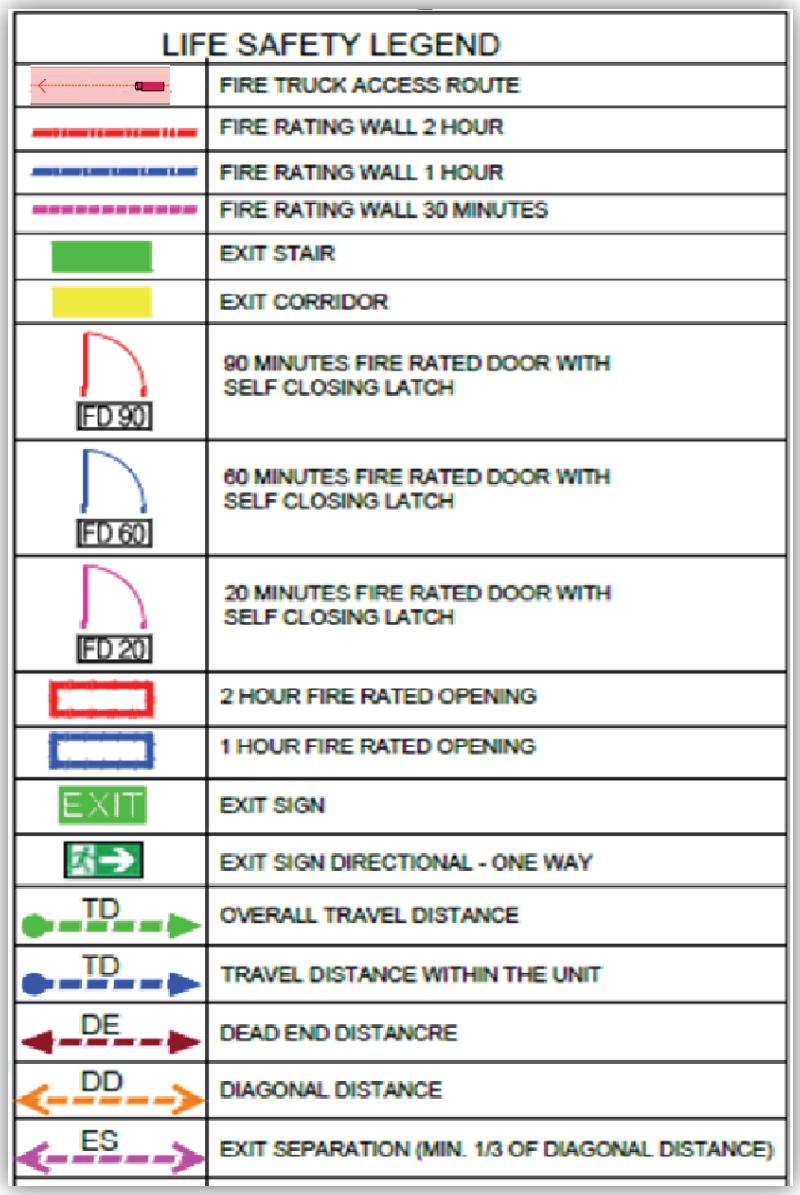


Figure:- H.03-F1.: Life Safety—Legends

2.3. Legend on the Drawings.

S	ADDRESSABLE SMOKE DETECTOR WITH BUILT IN ISOLATOR BASE
S	ADDRESSABLE SMOKE DETECTOR WITH BUILT IN ISOLATOR BASE WITH SOUNDER
OS	ADDRESSABLE OPTICAL SMOKE DETECTOR WITH BUILT IN ISOLATOR BASE
H	ADDRESSABLE HEAT DETECTOR WITH BUILT IN ISOLATOR BASE
H	ADDRESSABLE HEAT DETECTOR WITH BUILT IN ISOLATOR BASE WITH SOUNDER
MS	ADDRESSABLE COMBINE DETECTOR WITH BUILT IN ISOLATOR BASE WITH SOUNDER
	FIRE ALARM MANUAL CALL POINT
	FIRE ALARM SOUNDER OR HORN
	FIRE ALARM SOUNDER OR HORN (WEATHER PROOF)
	FIRE PHONE JACK
	ELECTRICAL LOOP SOUNDER (WEATHER PROOF)
	VOICE EVACUATION SPEAKER
E	EMERGENCY LIGHT
	DIRECTIONAL EMERGENCY SIGN
EXIT	EMERGENCY EXIT SIGN
MM	FIRE ALARM MONITORING MODULE
	CIVIL DEFENCE PANEL
AMP	INTELLIGENT AMPLIFIER (SIGA-AA-50) MOUNTS ON RACCR/DR BOX.
C.M	CONTROL MODULAR WITH POWER FOR ACCESSES CONTROL
FACP	ADDRESSABLE FIRE ALARM CONTROL PANEL
FRCP	ADDRESSABLE FIRE ALARM REPEATED PANEL

Figure:- H.03-F2.: Fire Alarm System—Legends

2.3. Legend on the Drawings.

LEGENDS	
SYMBOL	DESCRIPTION
	HORN SPEAKER
	WALL MOUNTED SPEAKER
	WALL MOUNTED SPEAKER WITH STROBE
	CEILING MOUNTED SPEAKER
	CEILING MOUNTED SPEAKER WITH STROBE
	PORTABLE TELEPHONE HAND SET
	FIRE PHONE JACK
	STROBE LIGHT
	STROBE LIGHT–W/P
	VOICE EVACUATION AMPLIFIER
	FIRE TELEPHONE PANEL
	VOICE EVACUATION CONTROL SYSTEM
	END OF LINE RESISTOR

Figure:- H.03-F2.a.: Fire Alarm System (Voice Evacuation System)—Legends

2.3. Legend on the Drawings.

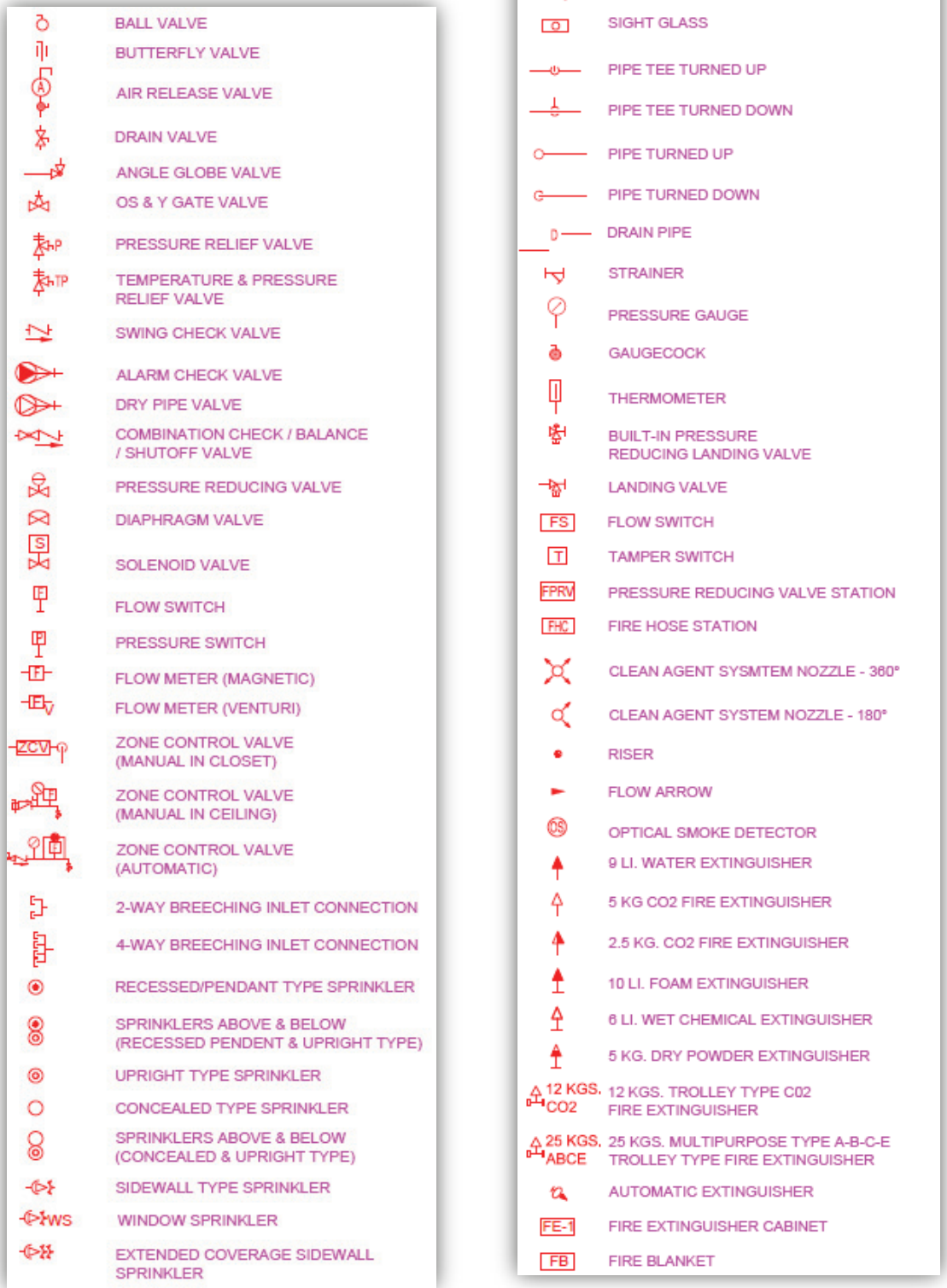


Figure:- H.03-F3.: Fire Protection System—Legends

2.3. Legend on the Drawings.

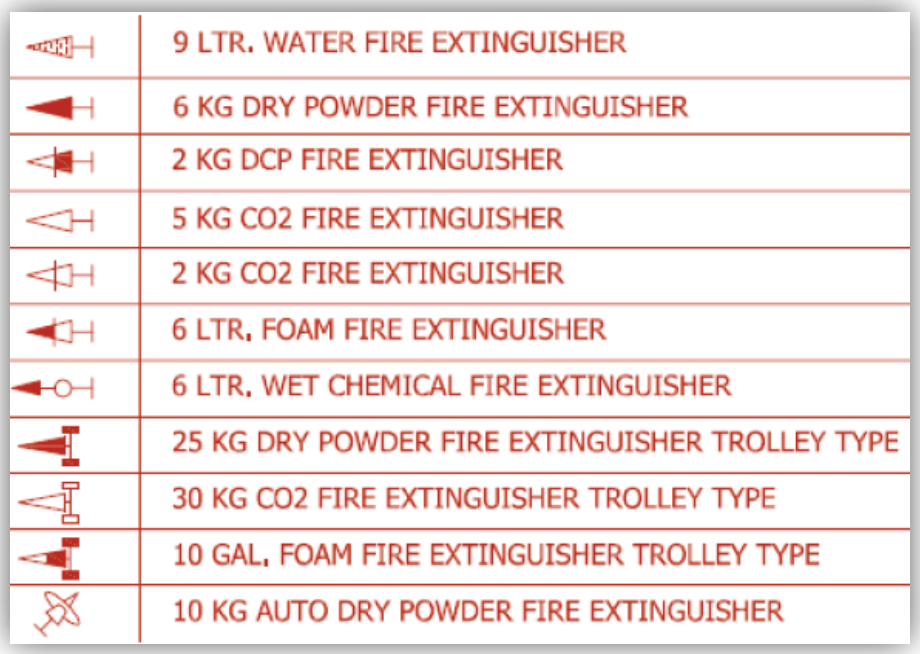


Figure:- H.03-F3.: Fire Protection System—Legends

2.3. Legend on the Drawings.

SYMBOL	DESCRIPTION
E	ADDRESSABLE 1x8W EMERGENCY LIGHT, NON MAINTAINED (SURFACE TYPE)
E	ADDRESSABLE 1x8W EMERGENCY LIGHT, NON MAINTAINED (RESECCED TYPE)
E	ADDRESSABLE 1x8W EMERGENCY LIGHT, NON MAINTAINED W/P
EXIT	ADDRESSABLE 1x8W EXIT LIGHT , MAINTAINED
EXIT	ADDRESSABLE 1x8W EXIT LIGHT HANGING TYPE SINGLE SIDE,MAINTAINED
EXIT	ADDRESSABLE 1x8W EXIT LIGHT DOUBLE SIDE HANGING ARROW,MAINTAINED
EXIT	ADDRESSABLE 1x8W EXIT LIGHT MAINTAINED W/P
CBU	CENTRAL BATTERY UNIT
CBP	ADDRESSABLE CENTRAL BATTERY MONITORING PANAL
DB	DISTRIBUTION BOX
	ADDRESSABLE EMERGENCY/EXIT LIGHT MONITORING CABLE

LEGENDS	
SYMBOL	DESCRIPTION
E	SELF CONTAINED 1x8W EMERGENCY LIGHT, NON MAINTAINED(SURFACE TYPE)
E	SELF CONTAINED 1x8W EMERGENCY LIGHT, NON MAINTAINED(RESECCED TYPE)
E	SELF CONTAINED 1x8W EMERGENCY LIGHT, NON MAINTAINED W/P
EXIT	SELF CONTAINED 1x8W EXIT LIGHT , MAINTAINED
EXIT	SELF CONTAINED 1x8W EXIT LIGHT HANGING TYPE SINGLE SIDE,MAINTAINED
EXIT	SELF CONTAINED 1x8W EXIT LIGHT DOUBLE SIDE HANGING ARROW,MAINTAINED
EXIT	SELF CONTAINED 1x8W EXIT LIGHT MAINTAINED W/P

Figure:- H.03-F4.: Emergency Lighting—Legends

2.3. Legend on the Drawings.

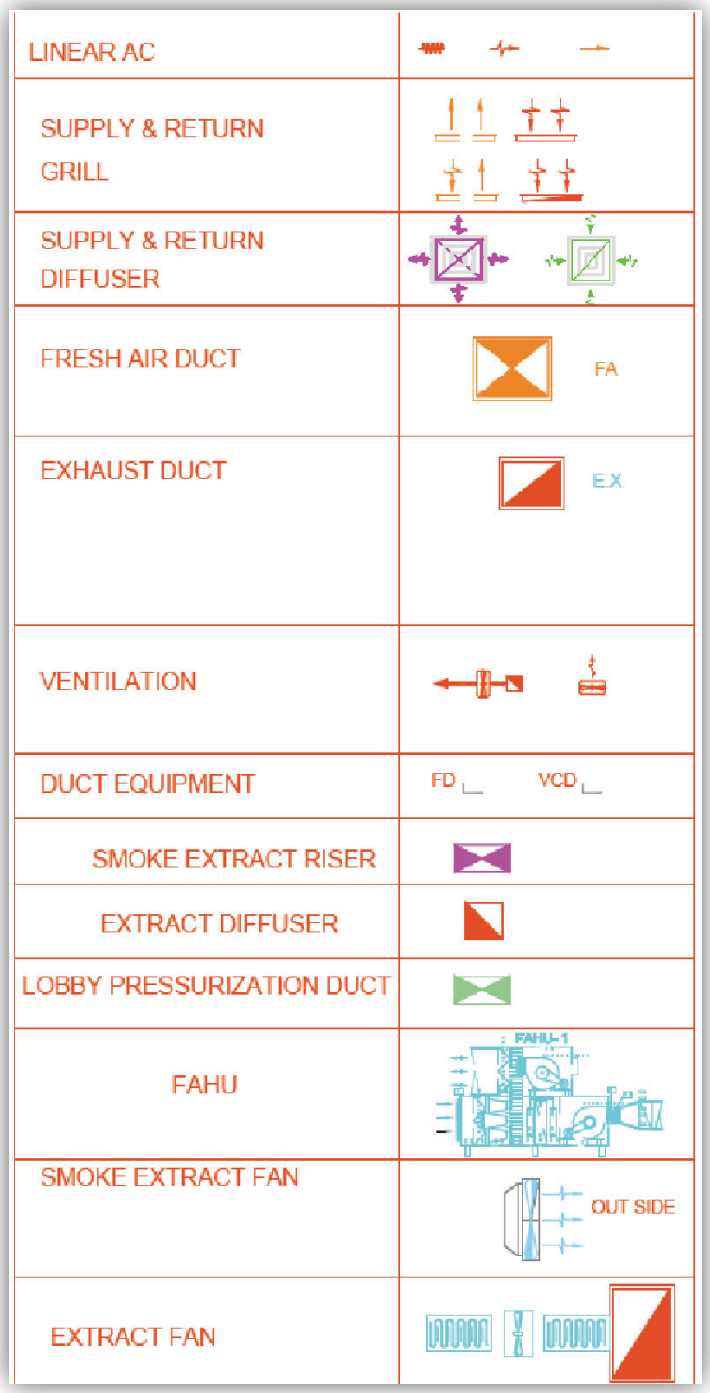


Figure:- H.03-F5.: Smoke Control System—Legends

2.3. Legend on the Drawings.

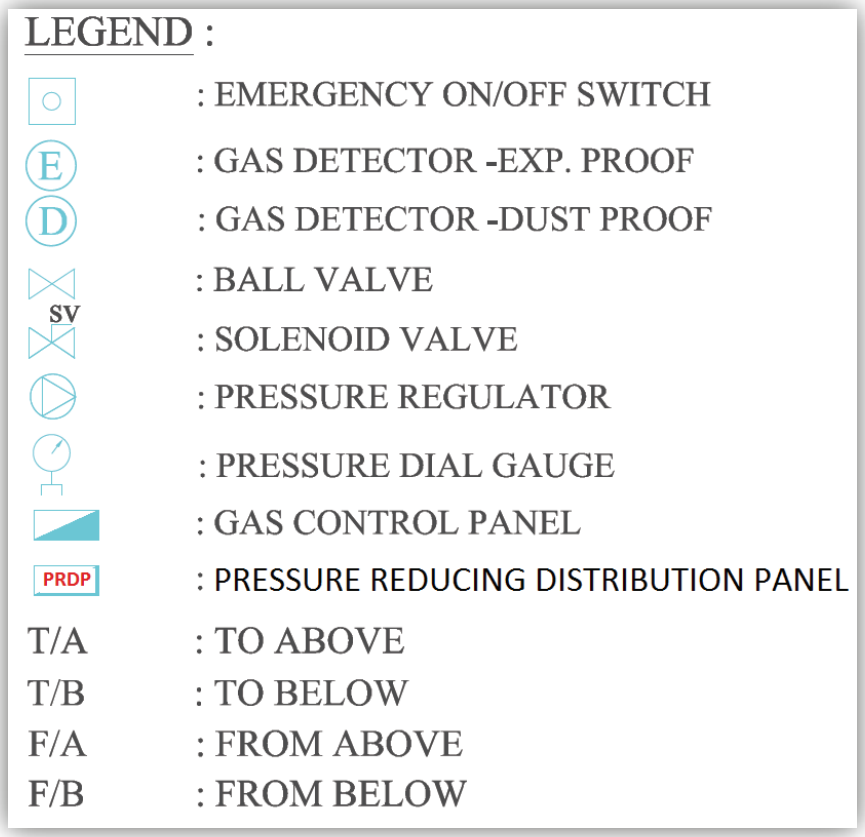


Figure:- H.03-F6.: LPG/ Natural Gas Systems—Legends

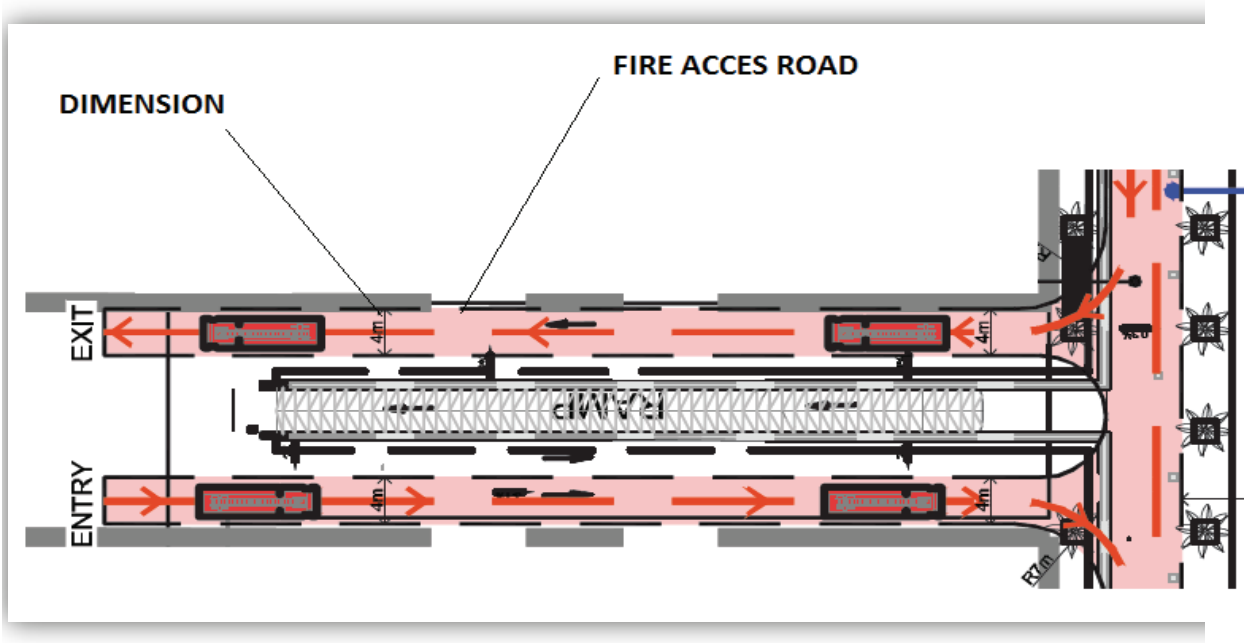
3.0. Consultant Submission

3.1. Life Safety Drawings.

3.1.1 Consultant's Life Safety drawings shall comply with the general requirements of **Section 2.0** and **Table:- H.03-T3.**

Table:- H.03-T3: Consultant's Drawing Submissions

ITEM	REQUIREMENTS
1. LIFE SAFETY DRAWINGS	i. Consultant's life safety drawing file shall consist of the following drawings. a. Cover page—1 page. b. Setting out plan—1 page c. Fire access road—1 page d. Floor plans—1 page for each floor e. Sections—2 pages f. Stair details—1 page g. Curtain wall, Cladding, Roofing—1 page h. Door schedule—1 page ii. All the above pages shall be combined as one file.
2. COLOUR SCHEME FOR LIFE SAFETY DRAWINGS	i. Colour scheme for life safety drawings shall be as per life safety legend of **Figure:- H.03-F1.** and below. a. Fire access road shall be PINK. b. Stairs shall be GREEN. c. Corridors, exit passageways, exit access way shall be LIGHT GREEN d. 2 hour rated walls shall be RED. e. 1 hour rated walls shall be BLUE f. 90 minutes fire door shall be RED, as per **Figure:- H.03-F1.** g. 60 minutes fire door shall be BLUE, as per **Figure:- H.03-F1.** ii. Travel distance shall be mentioned as per **Figure:- H.03-F1.** iii. Diagonal distance shall be mentioned as per **Figure:- H.03-F1.** iv. Separation distance between stairs shall be shown as per **Figure:- H.03-F1.** v. Dead end distances shall be mentioned as per **Figure:- H.03-F1.** vi. Room names/ occupancy usage shall be mentioned in each room. vii. Show occupant load factors and occupant load on each floor. viii. Show Stair details. See **Figure:- H.03-F7.c.** ix. Show pump room details. See **Figure:- H.03-F7.c.** x. See **Figure:- H.03-F7.a.** and **Figure:- H.03-F7.b.** for more details.



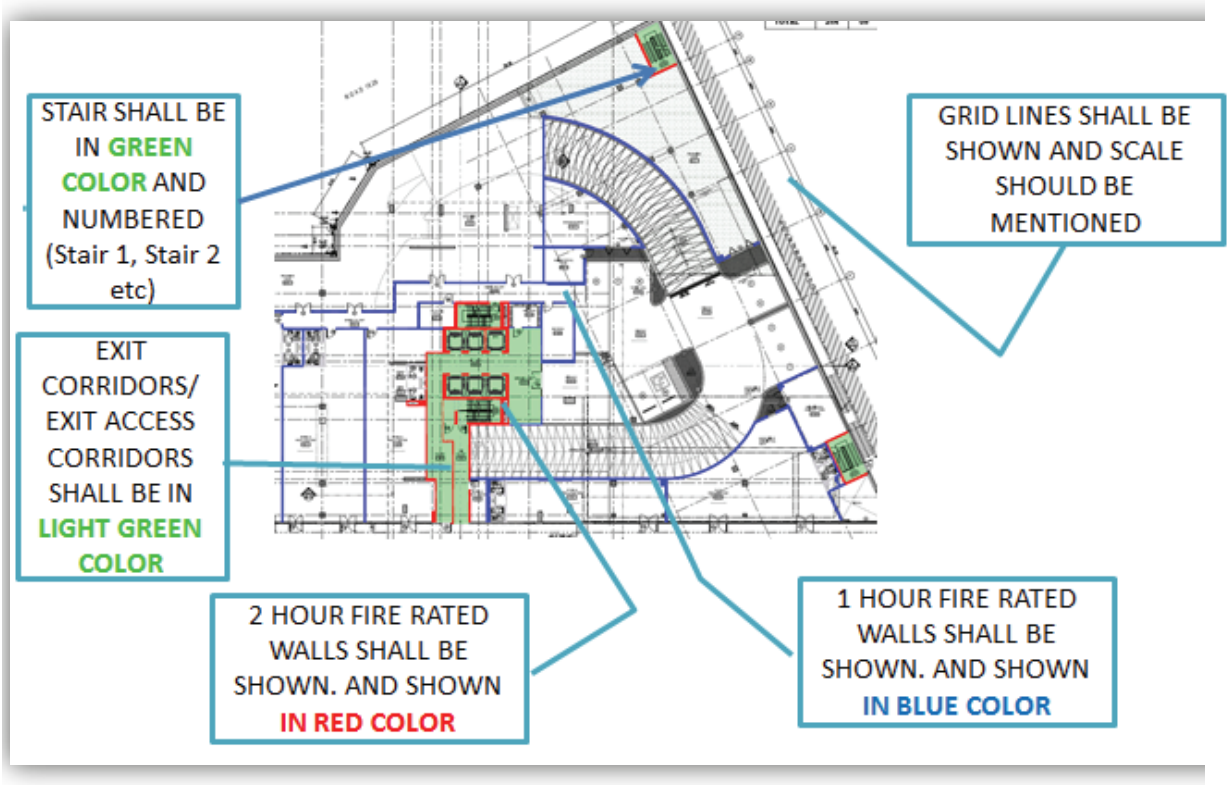


Figure:- H.03-F7.a.: Life Safety Drawing Colour Schemes

3.1. Life Safety Drawings.

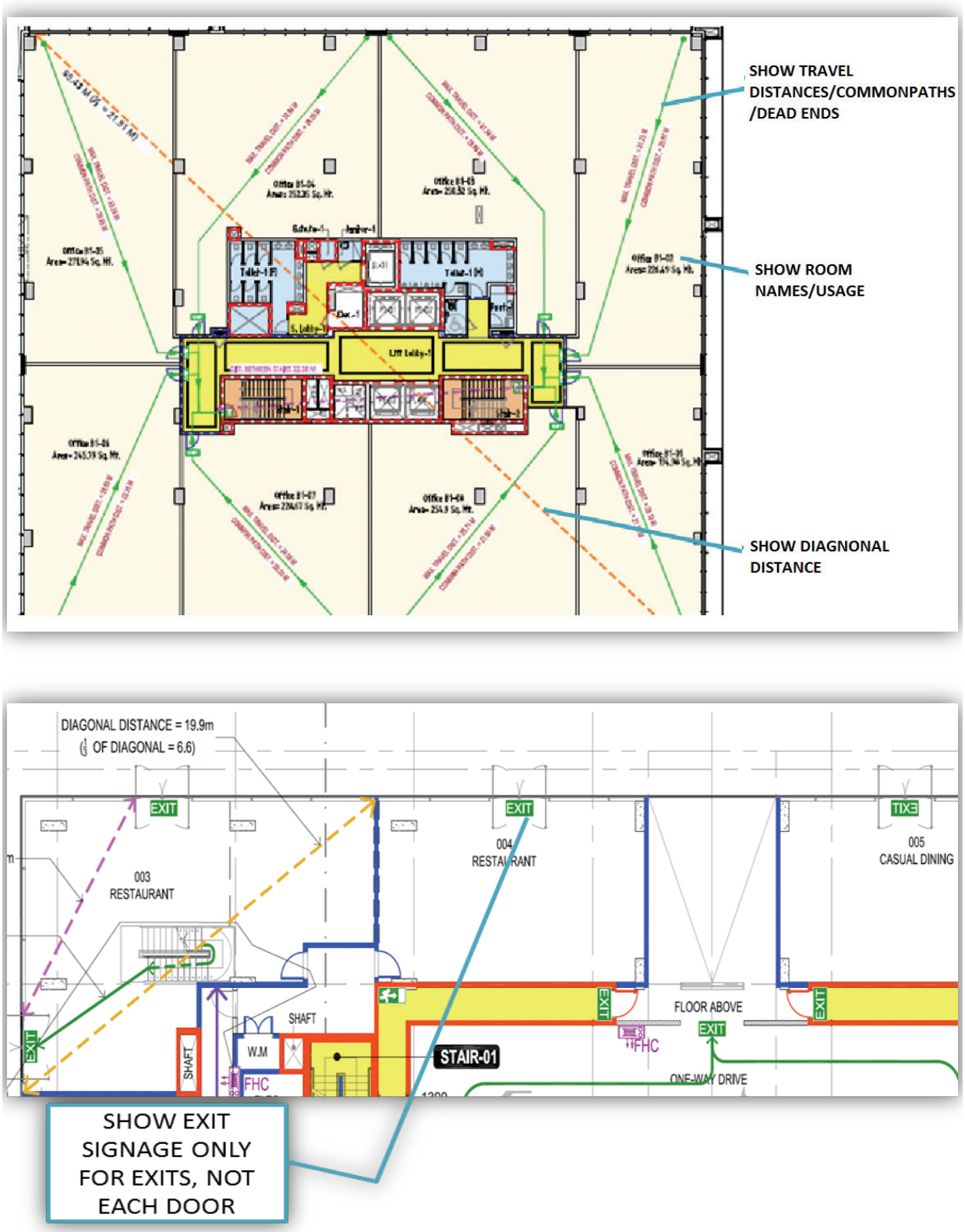


Figure:- H.03-F7.b.: Life Safety Drawing Colour Schemes

3.1. Life Safety Drawings.

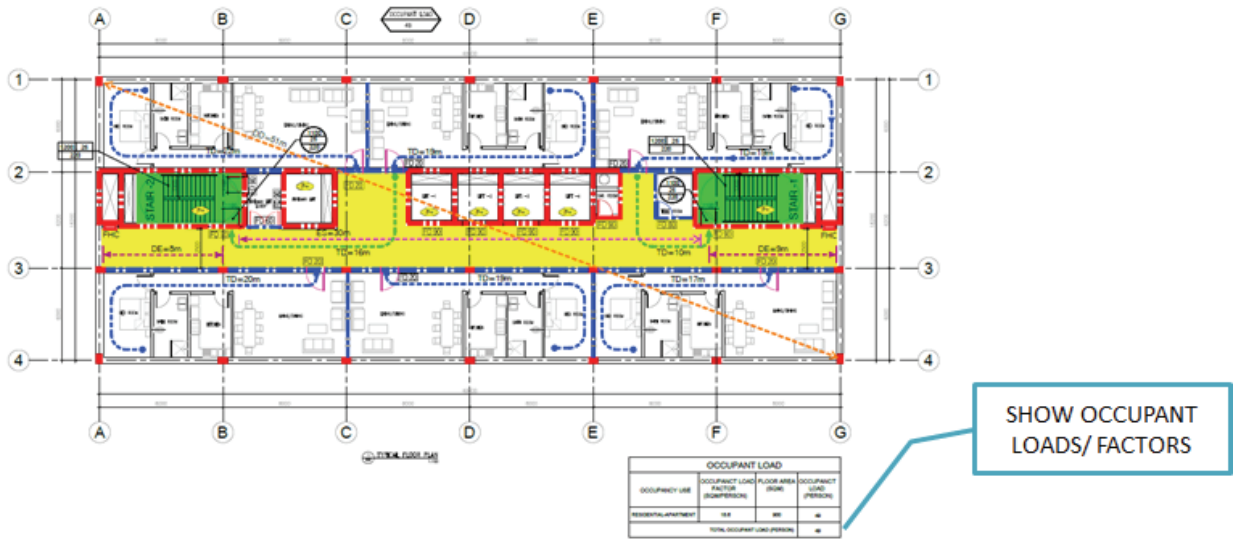
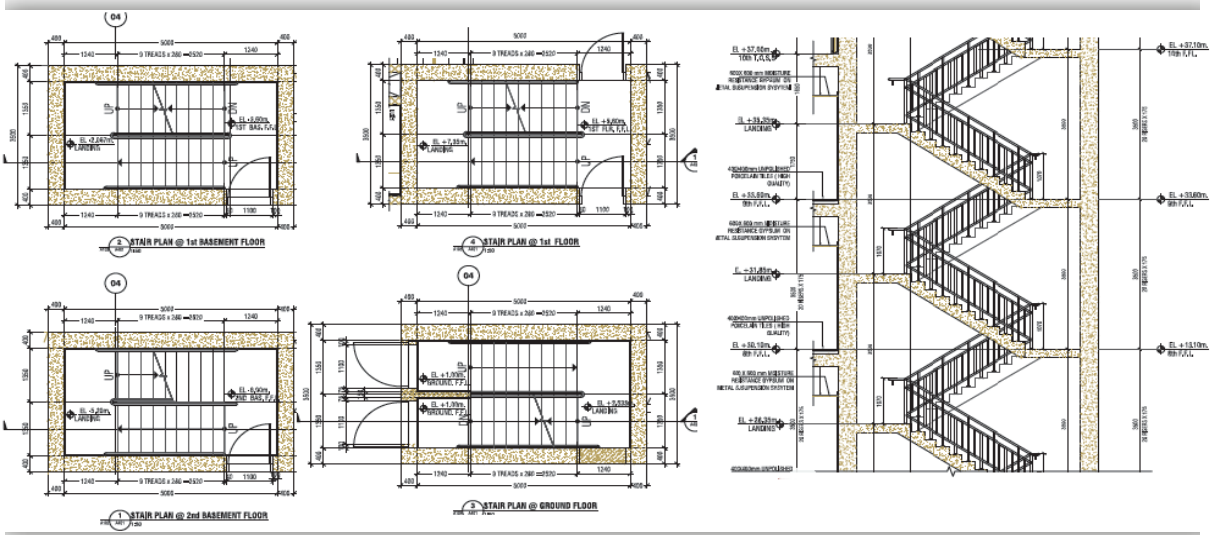


Figure:- H.03-F7.c.: Life Safety Drawing Colour Schemes



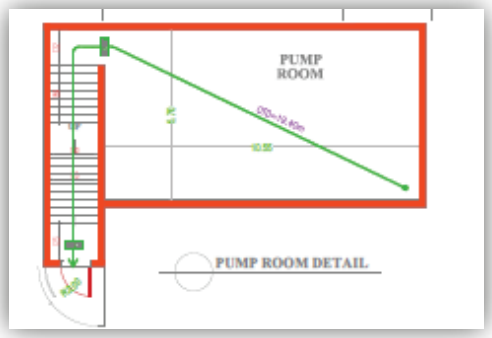


Figure:- H.03-F7.d.: Life Safety Typical Details

3.2. Fire Detection and Alarm, Voice Evacuation and Emergency Lighting Systems.

3.2.1 Consultant's Fire Alarm, Detection, Voice Evacuation and Emergency Lighting drawings shall comply with the general requirements of **Section 2.0** and **Table:- H.03-T4.**

Table:- H.03-T4. : Consultant's Drawing Submissions

ITEM	REQUIREMENTS
1. FIRE DETECTION AND ALARM SYSTEM AND VOICE EVACUATION SYSTEM	i. Consultant's fire alarm system drawing file shall consist of the following drawings. a. Floor plans showing fire detectors, manual call points, Voice speakers, Emergency lighting units, interfacing units, FACP locations—1 page for each floor. b. Riser diagram for Fire detection and alarm system—1 page c. Riser diagram for Emergency Lighting system—1 page d. Riser diagram for Voice Evacuation system—1 page e. Legend shall be shown on each page ii. All the above pages shall be combined as one file.
2. COLOUR SCHEME FOR FIRE DETECTION AND ALARM SYSTEM AND VOICE EVACUATION SYSTEM	i. Colour scheme for Fire detection and alarm system drawings shall be as per legend of **Figure:- H.03-F2 and 2.a.** Emergency lighting legend as per **Figure:- H.03-F4 .** and below. a. Fire detectors shall be RED. b. Fire detection and alarm wiring in RED. c. Voice speakers and wiring shall be in CRIMSON d. Emergency lighting units and wiring shall be in GREEN. ii. See **Figure:-H.03-F8.a .** and **H.03-F8.b.** for more details.

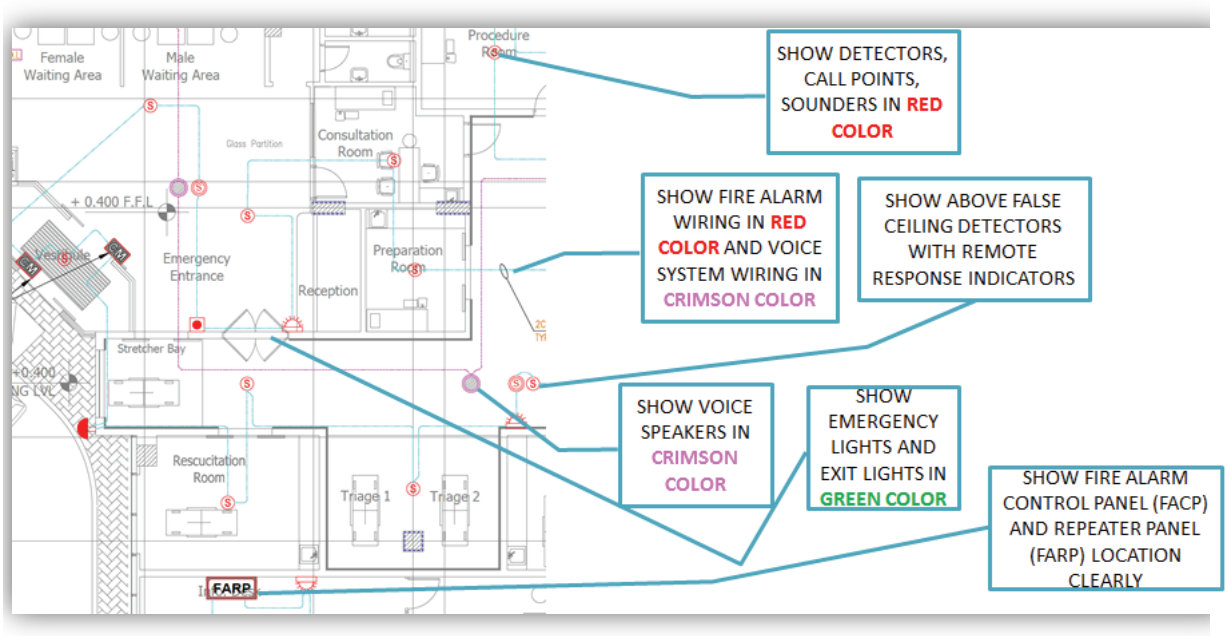


Figure:- H.03-F8.a.: Fire Detection, Voice Alarm And Emergency Lighting Colour Schemes

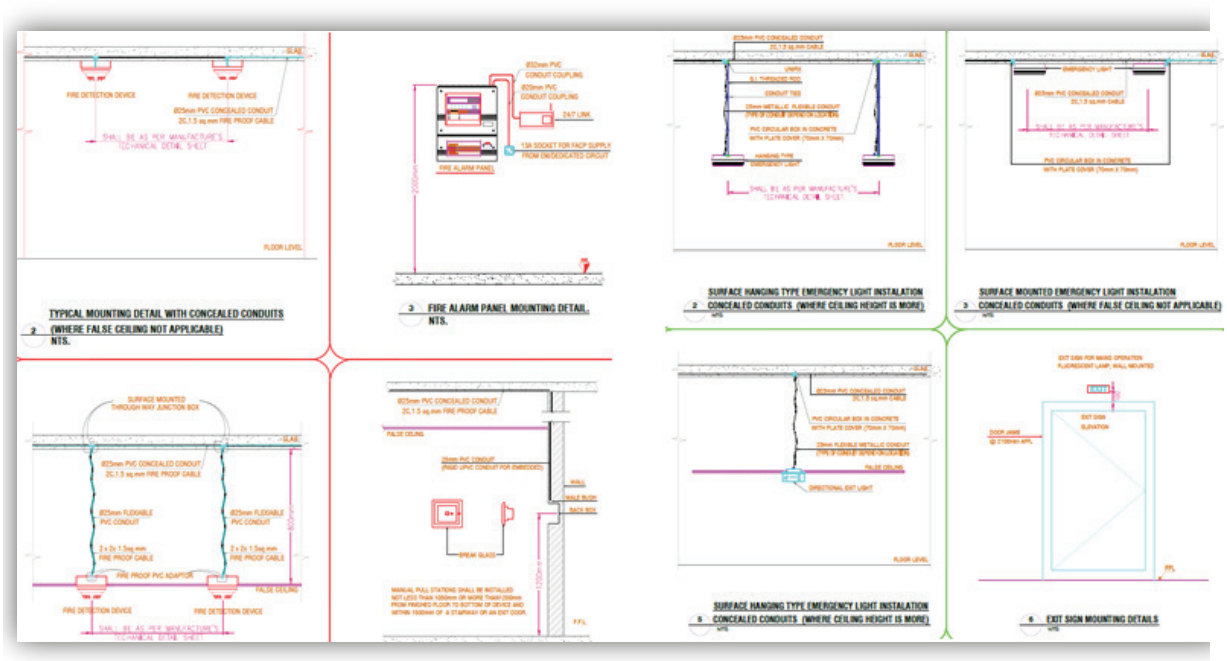


Figure:- H.03-F8.b.: Life Safety Drawing Colour Schemes

3.3. Fire Protection and Suppression System.

3.3.1 Consultant's Fire Protection and Suppression system drawings shall comply with the general requirements of **Section 2.0** and **Table:- H.03-T5.**

Table:- H.03-T5. : Consultant's Drawing Submissions

ITEM	REQUIREMENTS
1. FIRE PROTECTION AND SUPPRESSION SYSTEM	i. Consultant's fire protection and suppression system drawing file shall consist of the following drawings. a. Floor plans showing sprinkler heads, fire hose cabinets and connecting piping, major valves such as ACV, Zone control valve—1 page for each floor. b. Gas suppression system layout with Containers location, piping distribution and nozzles. c. Foam suppression system layout with storage tank location, piping distribution and nozzles. d. Design criteria tables for Sprinklers, Gas suppression systems and foam suppression systems. e. Pre-action system layout with piping and nozzle heads f. Pipe sizes on each piping distribution g. Pump room location and details—1 page or next to its floor plan h. Riser diagram for Sprinklers, hose cabinets with pump and water tank capacities—1 page i. Legend shall be shown on each page j. Breeching inlet connection locations. k. Typical installation details of every equipment in the proposal—1 page ii. All the above pages shall be combined as one file.
2. COLOUR SCHEME FOR FIRE PROTECTION AND SUPPRESSION SYSTEM	i. Colour scheme for Fire protection and Suppression system drawings shall be as per legend of **Figure:- H.03-F3** and below. a. Sprinklers, nozzles, FHC , Valves shall be RED. b. Hose Piping shall be BLUE. c. Sprinkler piping, gas suppression piping, foam system piping etc in GREEN. d. Fire extinguishers shall be RED. ii. See **Figure:- H.03-F9.a, Figure:- H.03-F9.b. Figure:- H.03-F9.c** and **Figure:- H.03-F9.d.** for more details.

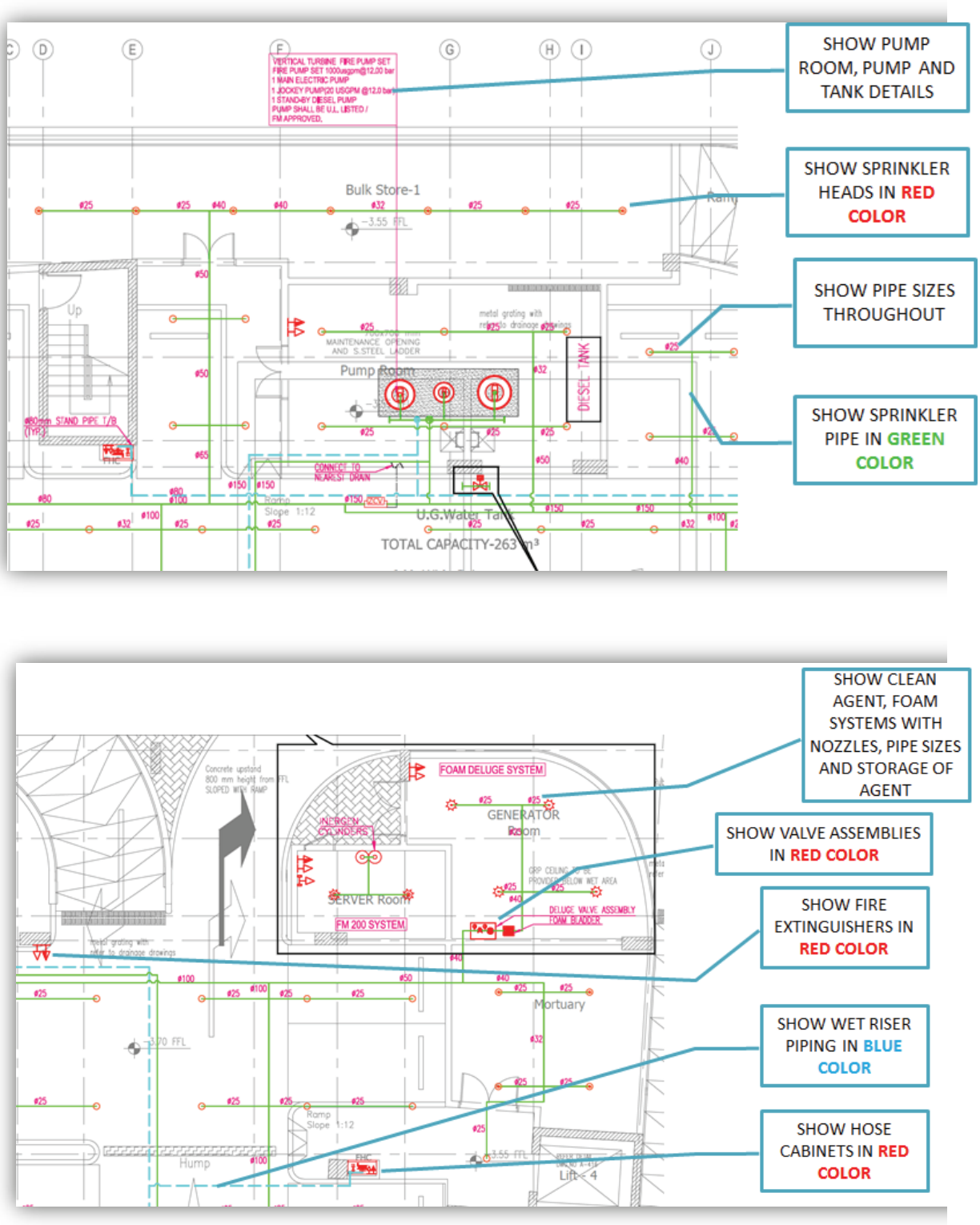


Figure:- H.03-F9.a: Fire Protection System Colour Schemes

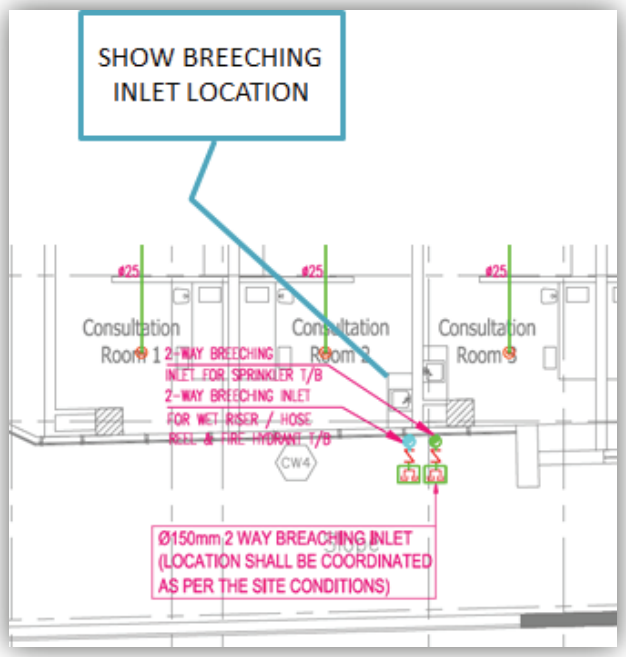


Figure:- H.03-F9.b : Fire Protection System Colour Schemes

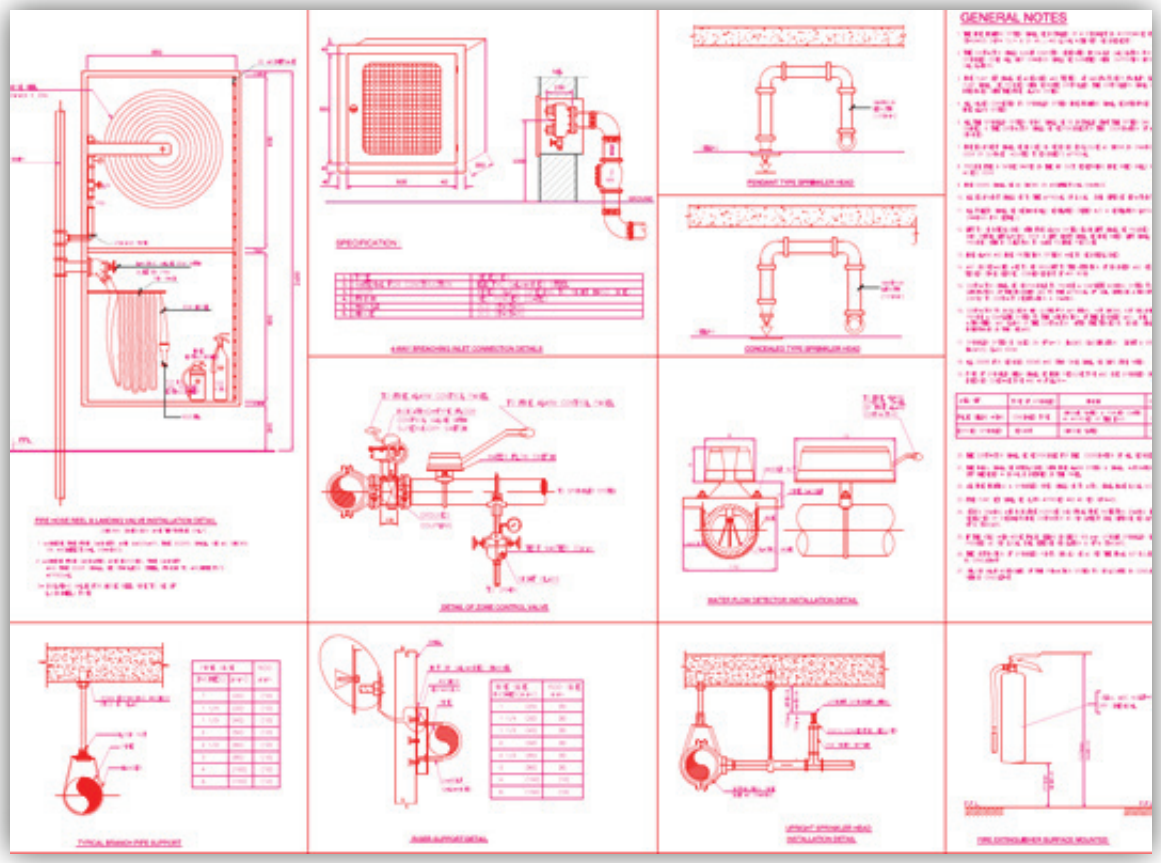


Figure:- H.03-F9.c : Typical Fire Protection System Installation

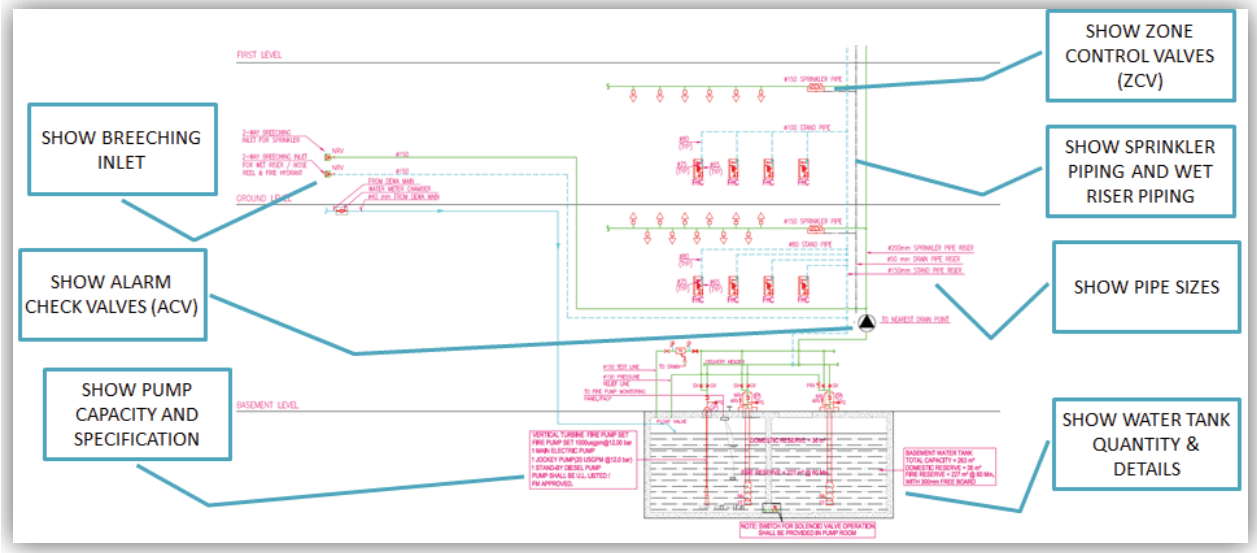


Figure:- H.03-F9.d : Fire Protection System Riser Diagram

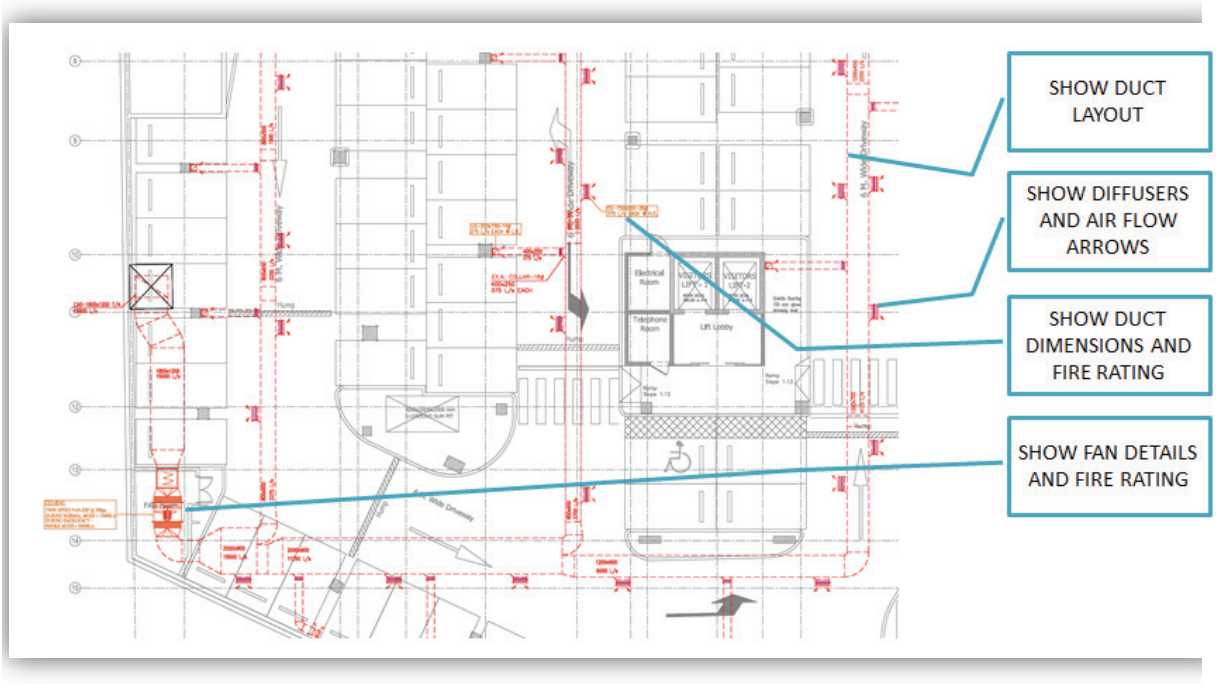
3.4. Smoke Control and Smoke Management System.

3.4.1 Consultant's Smoke Control and Smoke Management system drawings shall comply with the general requirements of **Section 2.0** and **Table:- H.03-T6.**

Table:- H.03-T6 : Consultant's Drawing Submissions

ITEM	REQUIREMENTS
1. SMOKE CONTROL AND SMOKE MANAGEMENT SYSTEM	i. Consultant's Smoke control and smoke management system drawing file shall consist of the following drawings. a. Floor plans showing extraction ducts, ducts for fresh air make-up, pressurization ducts, corridor smoke control ducts, extraction points, supply points—1 page for each floor. b. Where natural ventilation is applicable, clear sections shall show wall openings and the opening calculation table shall be shown. c. Duct fire rating, sizes shall be shown. d. Design criteria table shall be shown. e. Extraction fan specifications and location shall be shown. f. Riser diagram for system with ducting and principle for each floor—1 page g. Legend shall be shown on each page h. Typical installation details of every equipment in the proposal—1 page ii. All the above pages shall be combined as one file.
2. COLOUR SCHEME FOR SMOKE CONTROL AND SMOKE MANAGEMENT SYSTEM	i. Colour scheme for smoke control and smoke management system drawings shall be as per life safety legend of **Table:- H.03-F5.** and below. a. Supply ducting shall be RED. b. Extraction ducting shall be CRIMSON. ii. See **Figure:- H.03-F10.a** and **Figure:- H.03-F10.b** for more details.

3.4. Smoke Control and Smoke Management System.



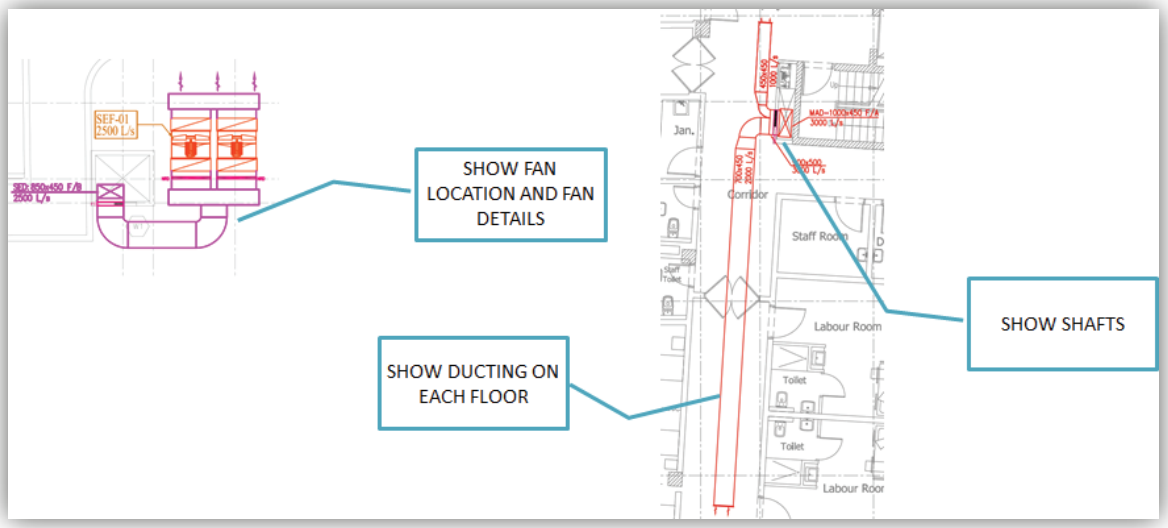
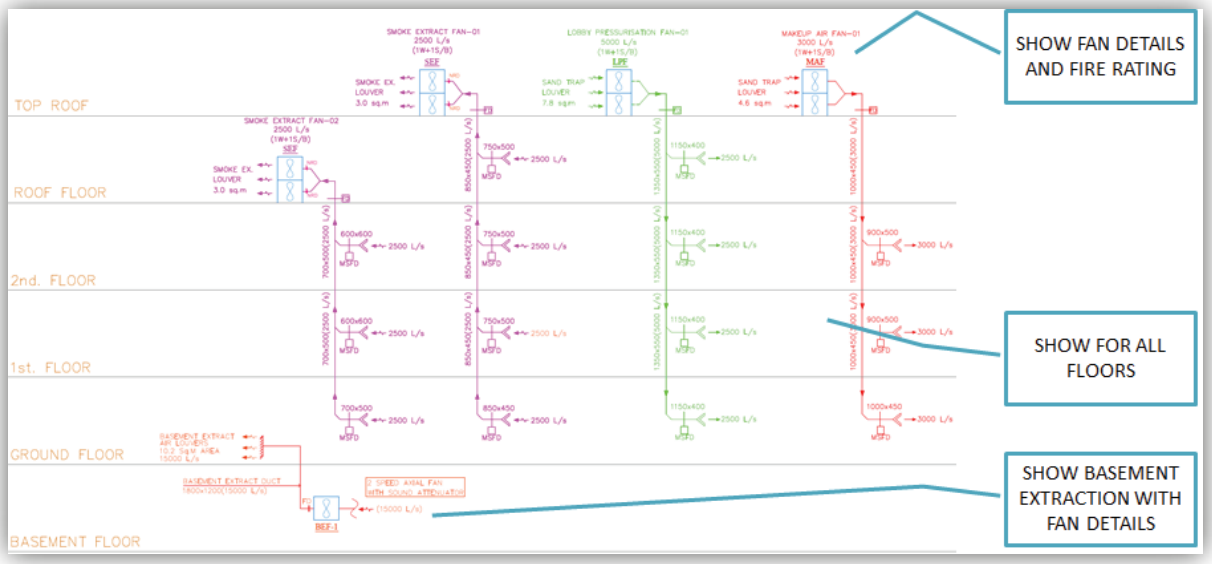


Figure:- H.03-F10.a : Smoke Control System Colour Schemes

3.4. Smoke Control and Smoke Management System.



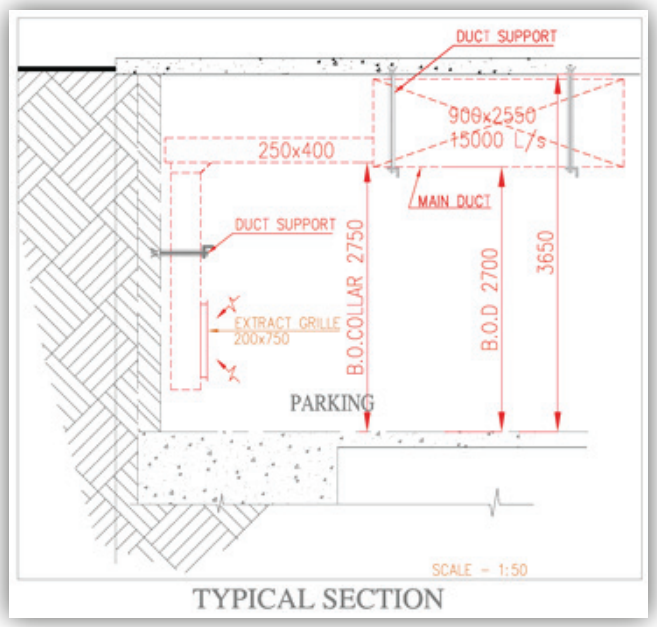


Figure:- H.03-F10.b : Smoke Control System Riser And Typical Details

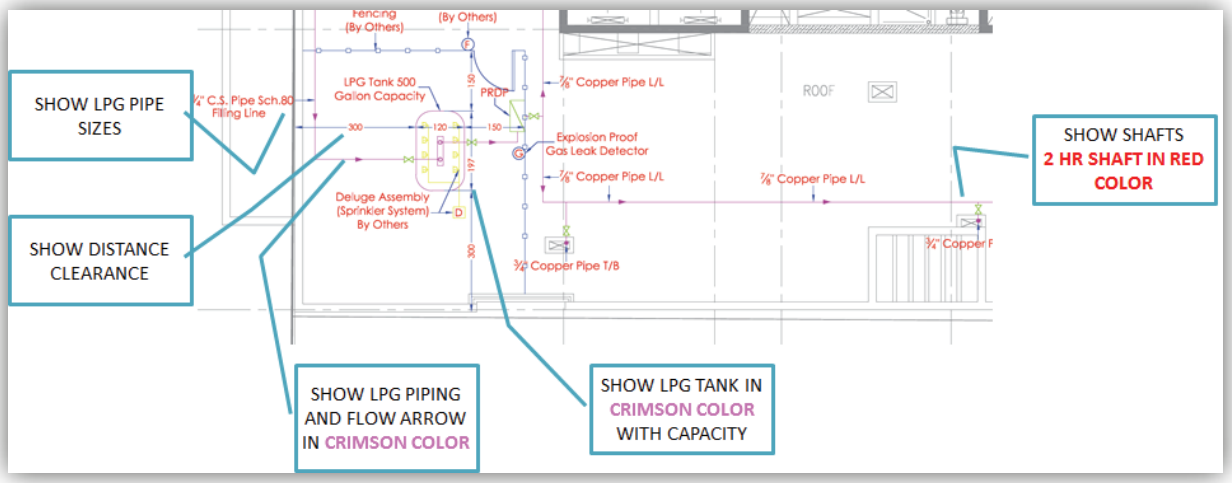
3.5. LPG/ Natural Gas System.

3.5.1. Consultant's LPG/ Natural Gas system drawings shall comply with the general requirements of **Section 2.0.**and **Table:- H.03-T7.**

Table:- H.03-T7 : Consultant's Drawing Submissions

ITEM	REQUIREMENTS
1. LPG/NATURAL GAS SYSTEM	i. Consultant's LPG/Natural gas system drawing file shall consist of the following drawings. a. Floor plans showing LPG/Natural gas piping distribution, control valves, supply points, gas detectors, emergency switches, control panel location, filling point location, PRDP location —1 page for each floor. b. Location and installation details of tanks with clear tank dimensions, separation distances from buildings, roof edges, structures and shafts.- 1 page c. Pipe type and sizes shall be shown. d. Shaft fire rating shall be shown. e. Riser diagram for system with piping distribution for each floor—1 page f. Legend shall be shown on each page g. Typical installation details of every equipment in the proposal, including piping through shafts, containment arrangement, detector installation, control panel installation, PRDP details with dimensions —1 page ii. All the above pages shall be combined as one file.
2. COLOUR SCHEME FOR LPG/NATURAL GAS SYSTEM	i. Colour scheme for LPG / Natural Gas system drawings shall be as per life safety legend of **Figure:- H.03-F6.** And below. a. Gas piping distribution shall be CRIMSON. b. Gas tanks shall be CRIMSON. c. Shafts and containment piping shall be RED. ii. See **Figure:- H.03-F11.a.** and **H.03-F11.b.** for more details.

3.5. LPG/ Natural Gas System.



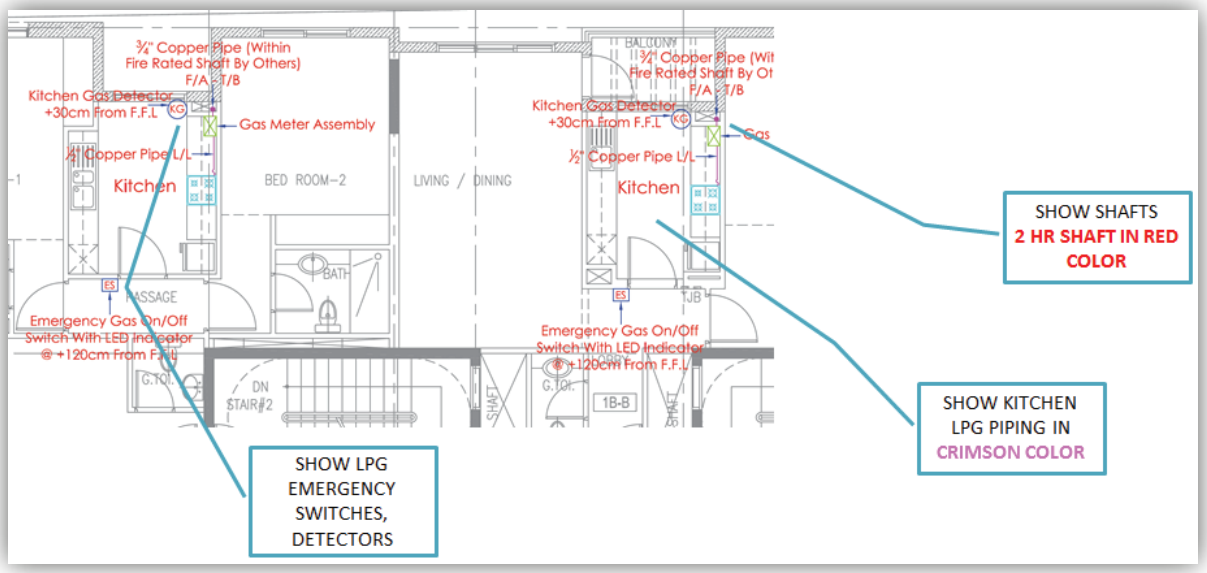
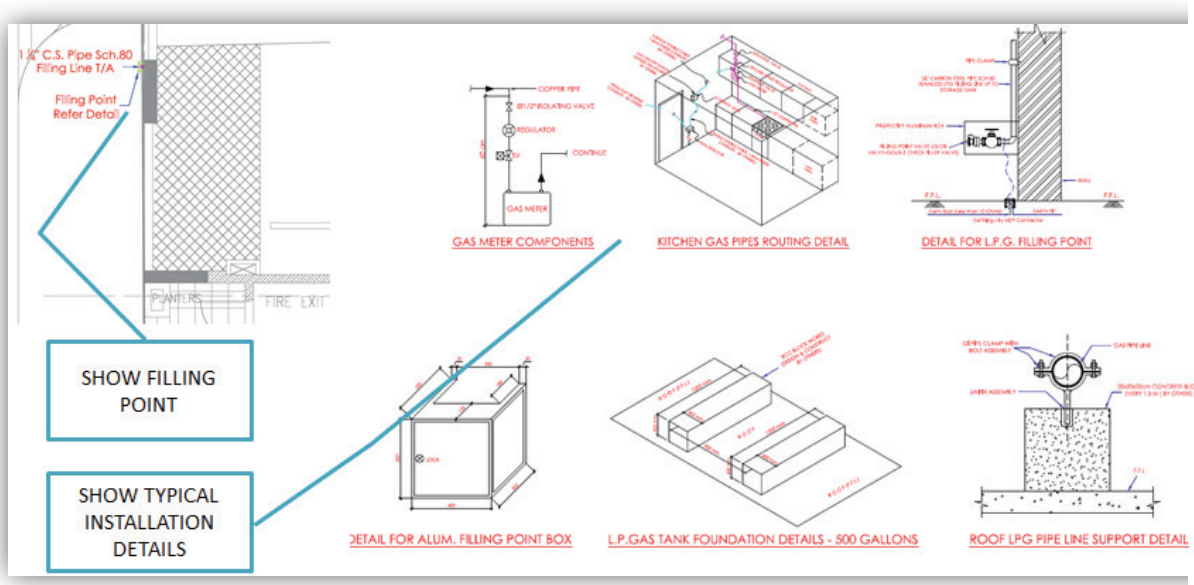
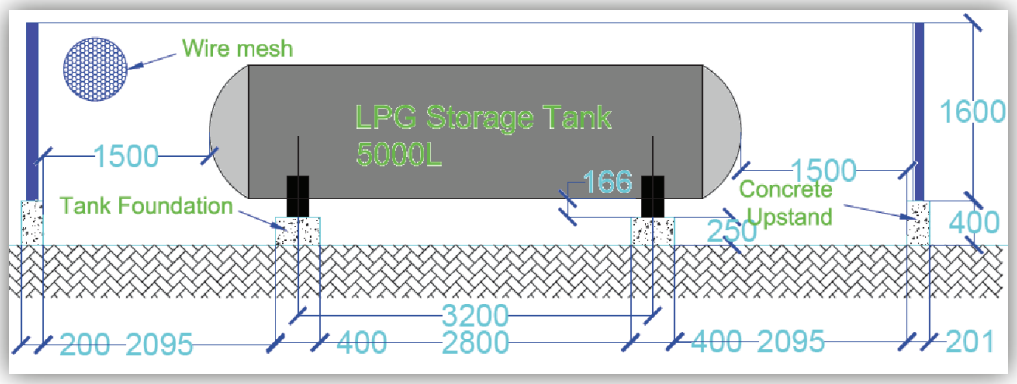


Figure:- H.03-F11.a : LPG / Natural Gas System Colour Schemes





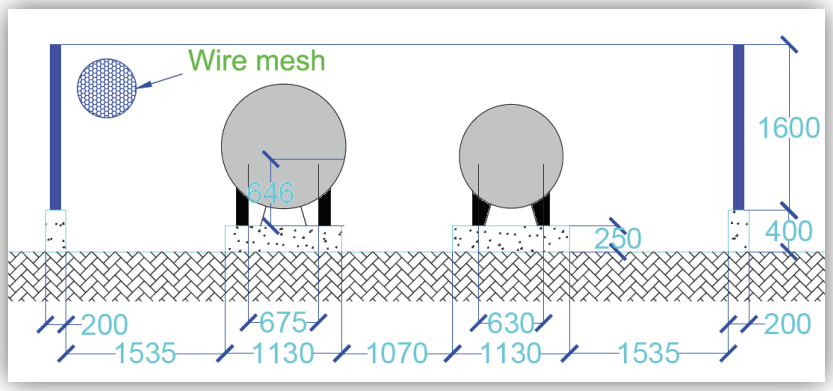


Figure:- H.03-F11.b : LPG/ Natural Gas System Typical Installation Details

4.0 Décor/ Fit out submissions

4.1. Life Safety Drawings.

4.1. Décor/Fitout drawings shall comply with the general requirements of **Section 2.0.** and **Table:- H.03-T8.**

Table:- H.03-T8 : Décor / Fitout Drawing Submissions

ITEM	REQUIREMENTS
1. LIFE SAFETY DRAWINGS	i. Decor life safety drawing file shall consist of the following drawings. a. Cover page—1 page. b. Setting out plan/ Floor plan with scope of work highlighted—1 page c. Floor plans with furniture layouts—1 page for each floor d. Sections, above false ceiling details—1 pages e. Stair details—1 page f. Door schedule—1 page ii. All the above pages shall be combined as one file.
2. COLOUR SCHEME FOR LIFE SAFETY DRAWINGS	i. Colour scheme for life safety drawings shall be as per life safety legend of **Figure:- H.03-F1.** and **Table:- H.03-T3.2.** ii. See **Figure:- H.03-F12.a.** and **Figure:- H.03-F12.a.** for more details.

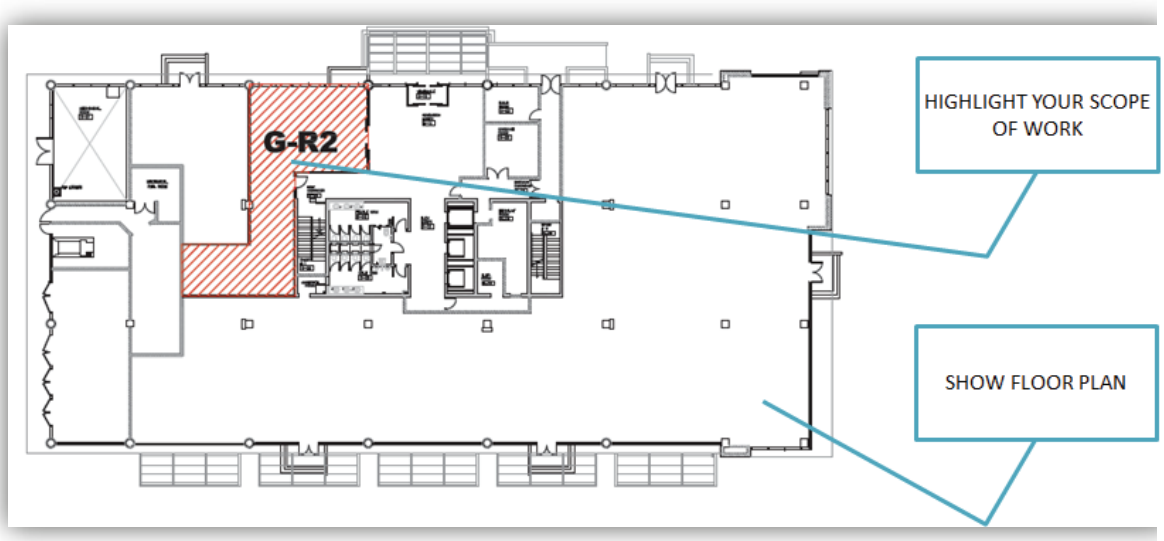
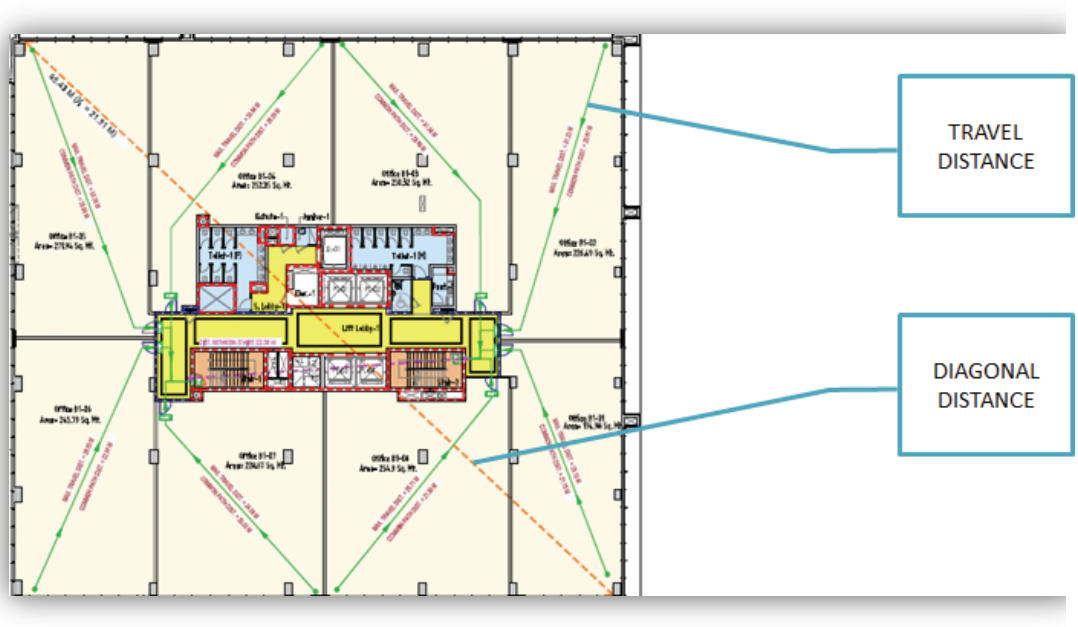


Figure:- H.03-F12.a.: Décor / Fit Out Drawing Requirements



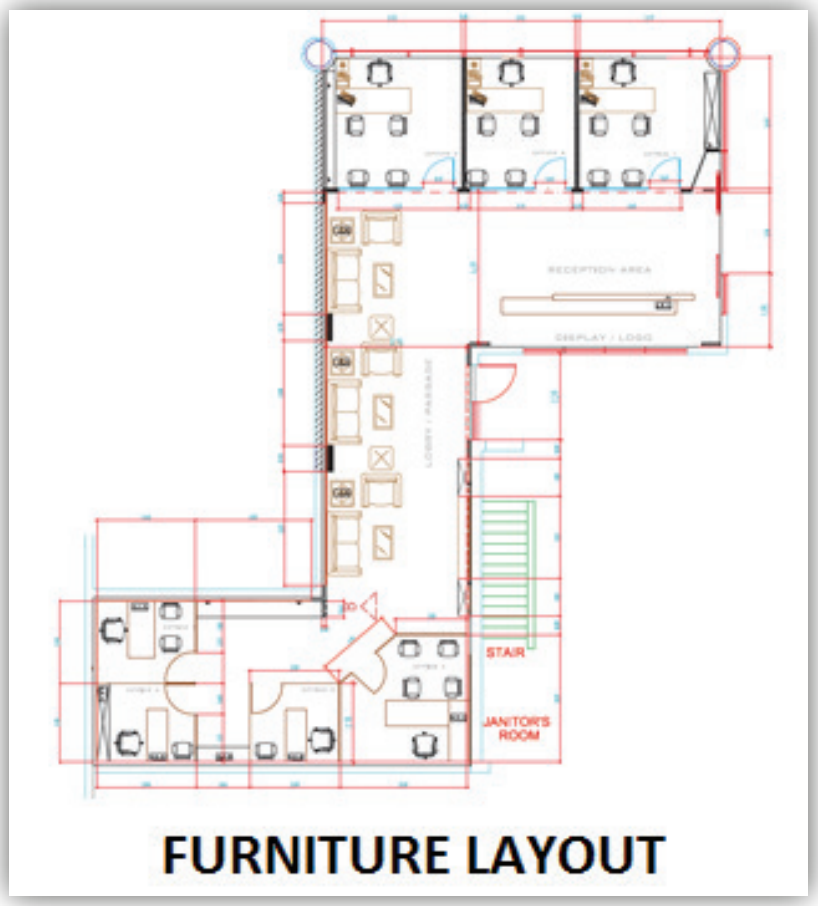


Figure:- H.03-F12.b.: Décor Travel Distances And Furniture Layouts

4.2. Fire alarm, Detection and Voice Evacuation System.

4.2.1. Décor/Fitout drawings shall comply with the general requirements of **Section 2.0.** and **Table:- H.03-T9.**

Table:- H.03-T9 : Décor / Fitout Drawing Submissions

ITEM	REQUIREMENTS
1. FIRE DETECTION AND ALARM SYSTEM AND VOICE EVACUATION SYSTEM	i.Decor fire alarm system drawing file shall consist of the following drawings. a. Floor plans showing fire detectors, manual call points, Voice speakers, Emergency lighting units, interfacing units, FACP locations—1 page for each floor. b. Riser diagram for Fire detection and alarm system—1 page c. Riser diagram for Emergency Lighting system—1 page d. Riser diagram for Voice Evacuation system—1 page e. Legend shall be shown on each page ii. All the above pages shall be combined as one file.
2. COLOUR SCHEME FOR FIRE DETECTION AND ALARM SYSTEM AND VOICE EVACUATION SYSTEM	i. Colour scheme for Fire detection and alarm system drawings shall be as per life safety legend of **Figure:- H.03-F2, F2a.,** Emergency lighting legend as per **Figure:- H.03-F4.** and below. a. Fire detectors shall be RED. b. Fire detection and alarm wiring in RED. c. Voice speakers and wiring shall be in CRIMSON d. Emergency lighting units and wiring shall be in GREEN. ii. See **Figure:-H.03-F13.** for more details.

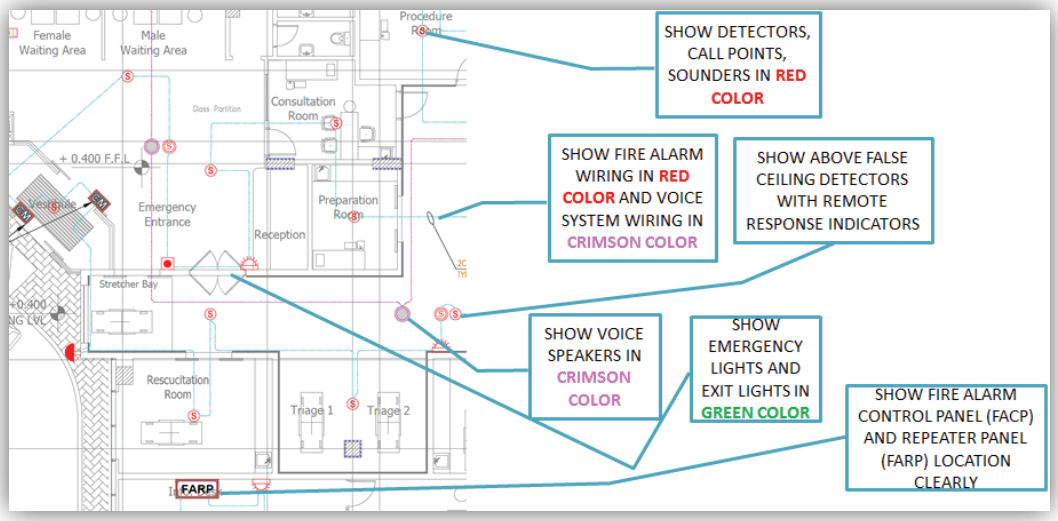


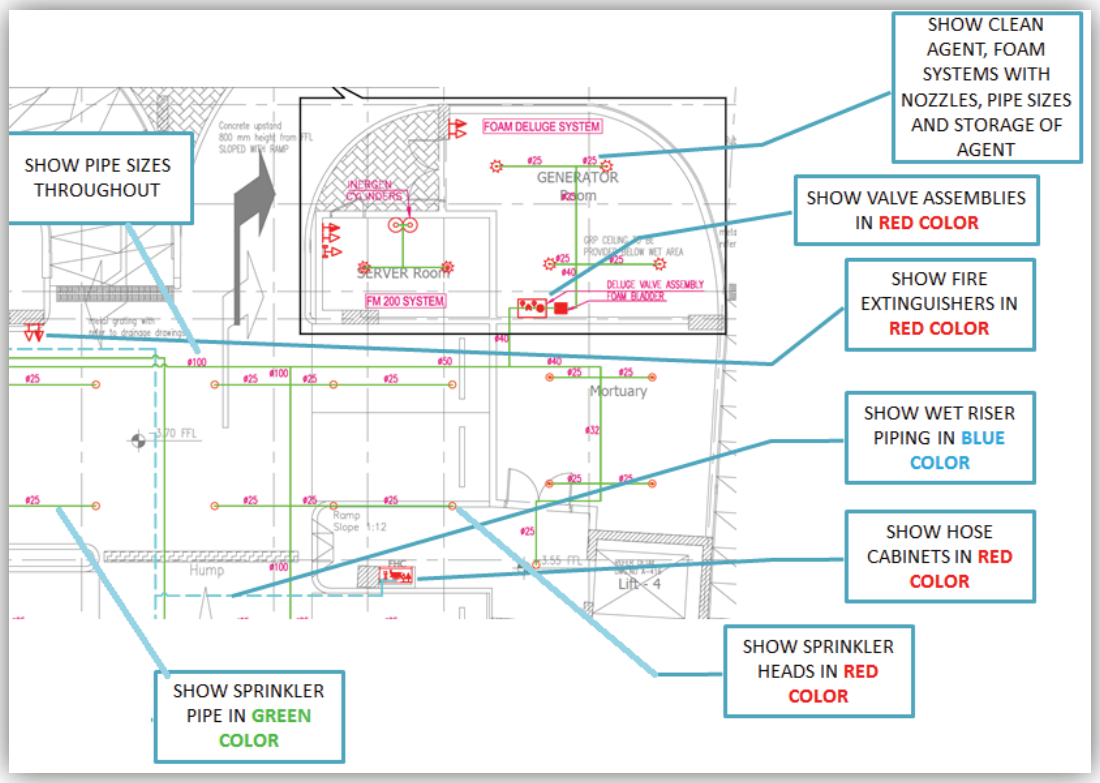
Figure:- H.03-F13.: Décor / Fit Out Drawing Requirements

4.3. Fire Protection and Suppression System.

4.3.1. Décor/Fitout drawings shall comply with the general requirements of **Section 2.0.** and **Table:- H.03-T10.**

Table:- H.03-T10 : Décor / Fit out Drawing Submissions

ITEM	REQUIREMENTS
1.FIRE PROTECTION AND SUPPRESSION SYSTEM	i. Decor fire protection and suppression system drawing file shall consist of the following drawings. a. Floor plans showing sprinkler heads, fire hose cabinets and connecting piping, major valves such as ACV, Zone control valve, fire extinguishers — 1 page for each floor. b. Gas suppression system layout with Containers location, piping distribution and nozzles. c. Foam suppression system layout with storage tank location, piping distribution and nozzles. d. Pipe sizes on each piping distribution e. Riser diagram for Sprinklers, hose cabinets with pump and water tank capacities—1 page f. Legend shall be shown on each page ii. All the above pages shall be combined as one file.
2. COLOUR SCHEME FOR FIRE PROTECTION AND SUPPRESSION SYSTEM	i. Colour scheme for Fire protection system drawings shall be as per life safety legend of **Figure:- H.03-F3.** and below. a. Sprinklers, nozzles, FHC , Valves shall be RED. b. Hose Piping shall be BLUE. c. Sprinkler piping, gas suppression piping, foam system piping etc in GREEN. d. Fire extinguishers shall be RED. ii. See **Figure A2.3.e** for more details.



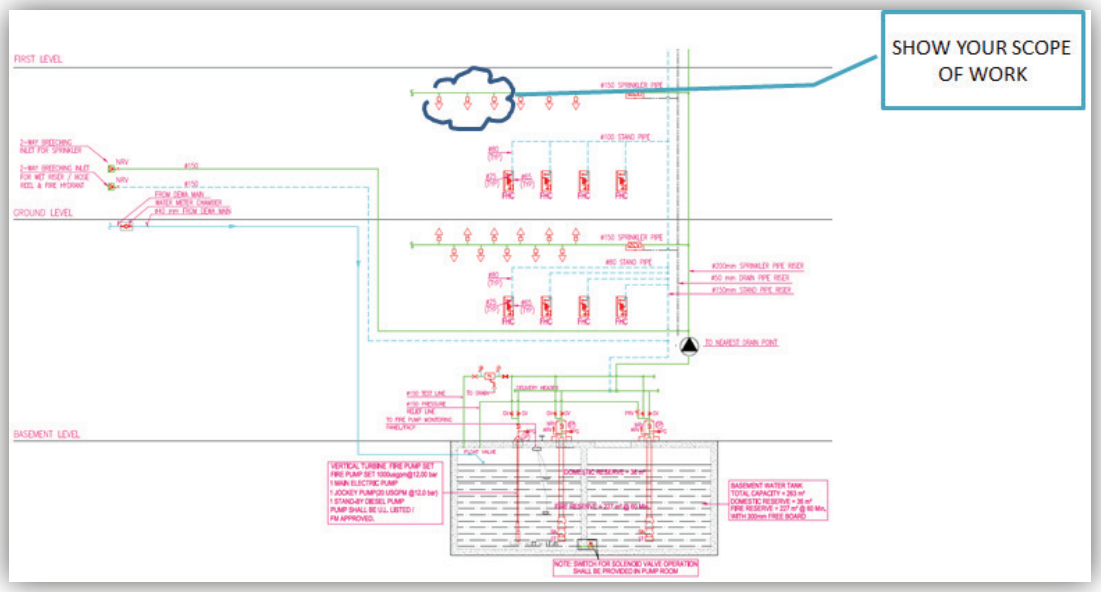


Figure:- H.03-F14 .: Décor / Fit Out Drawing Fire Fighting

4.4. Smoke Control and Smoke Management System.

4.4.1. Décor/Fitout drawings shall comply with the general requirements of **Section 2.0** and **Table:- H.03-T11.**

Table:- H.03-T11 : Décor / Fitout Drawing Submissions

ITEM	REQUIREMENTS
1. SMOKE CONTROL AND SMOKE MANAGEMENT SYSTEM	i. Decor Smoke control and smoke management system drawing file shall consist of the following drawings. a. Floor plans showing extraction ducts, ducts for fresh air make-up, pressurization ducts, corridor smoke control ducts, extraction points, supply points—1 page for each floor. b. Where natural ventilation is applicable, clear sections shall show wall openings and the opening calculation table shall be shown. c. Legend shall be shown on each page d. Typical installation details of every equipment in the proposal—1 page ii. All the above pages shall be combined as one file.
2. COLOUR SCHEME FOR SMOKE CONTROL AND SMOKE MANAGEMENT SYSTEM	i. Colour scheme for smoke control and smoke management system drawings shall be as per life safety legend of **Figure:- H.03-F5.** and below. a. Supply ducting shall be RED. b. Extraction ducting shall be CRIMSON.

4.5. LPG / Natural Gas System

4.5.1. LPG/ Natural gas drawings shall comply with the general requirements of **Section 2.0.** and **Table:- H.03-T12.**

Table:- H.03-T12: Décor / Fitout Drawing Submissions

ITEM	REQUIREMENTS
1. LPG/NATURAL GAS SYSTEM	i. Decor LPG/Natural gas system drawing file shall consist of the following drawings. a. Floor plans showing LPG/Natural gas piping distribution, control valves, supply points, gas detectors, emergency switches, control panel location, filling point location, PRDP location —1 page for each floor. b. Location and installation details of tanks with clear tank dimensions, separation distances from buildings, roof edges, structures and shafts.- 1 page c. Pipe type and sizes shall be shown. d. Shaft fire rating shall be shown. e. Riser diagram for system with piping distribution for each floor—1 page f. Legend shall be shown on each page g. Typical installation details of every equipment in the proposal, including piping through shafts, containment arrangement, detector installation, control panel installation, PRDP details with dimensions —1 page ii. All the above pages shall be combined as one file.
2. COLOUR SCHEME FOR LPG/ NATURAL GAS SYSTEM	i. Colour scheme for smoke control and smoke management system drawings shall be as per life safety legend of **Figure:- H.03-F6.** and below. a. Gas piping distribution shall be CRIMSON. b. Gas tanks shall be CRIMSON. c. Shafts and containment piping shall be RED. ii. See **Figure:- H.03-F11.a. and H.03-F11.b.** for more details.

5.0 Modifications, Revisions and refurbishment submissions

5.1. All modifications, refurbishments, revisions of already permitted drawings shall comply with the general requirements of **Section 2.0.** and **Table:- H.03-T13.**

Table:- H.03-T13: Modifications and Revision Drawing Submissions

ITEM	REQUIREMENTS
1. SCOPE OF WORK	i. Modifications and revisions drawing file shall comply with all the submission requirements of **Section A2.2.** and consist of the following format and attachments. a. As permitted drawings showing permitted floor plans, highlighted (Clouded) in YELLOW, the portions to be revised. b. As proposed drawings showing revised floor plans, highlighted (Clouded) in RED, the portions revised. c. Note shall be inserted next to such permitted YELLOW clouding and revised RED clouding, exact scope of work in the proposed revision. d. A LETTER on consultants letter head, both in Arabic and English, declaring the exact changes in scope with floor wise list. ii. See **Figure A2.4.a.** and **A2.4.b.** for more details.

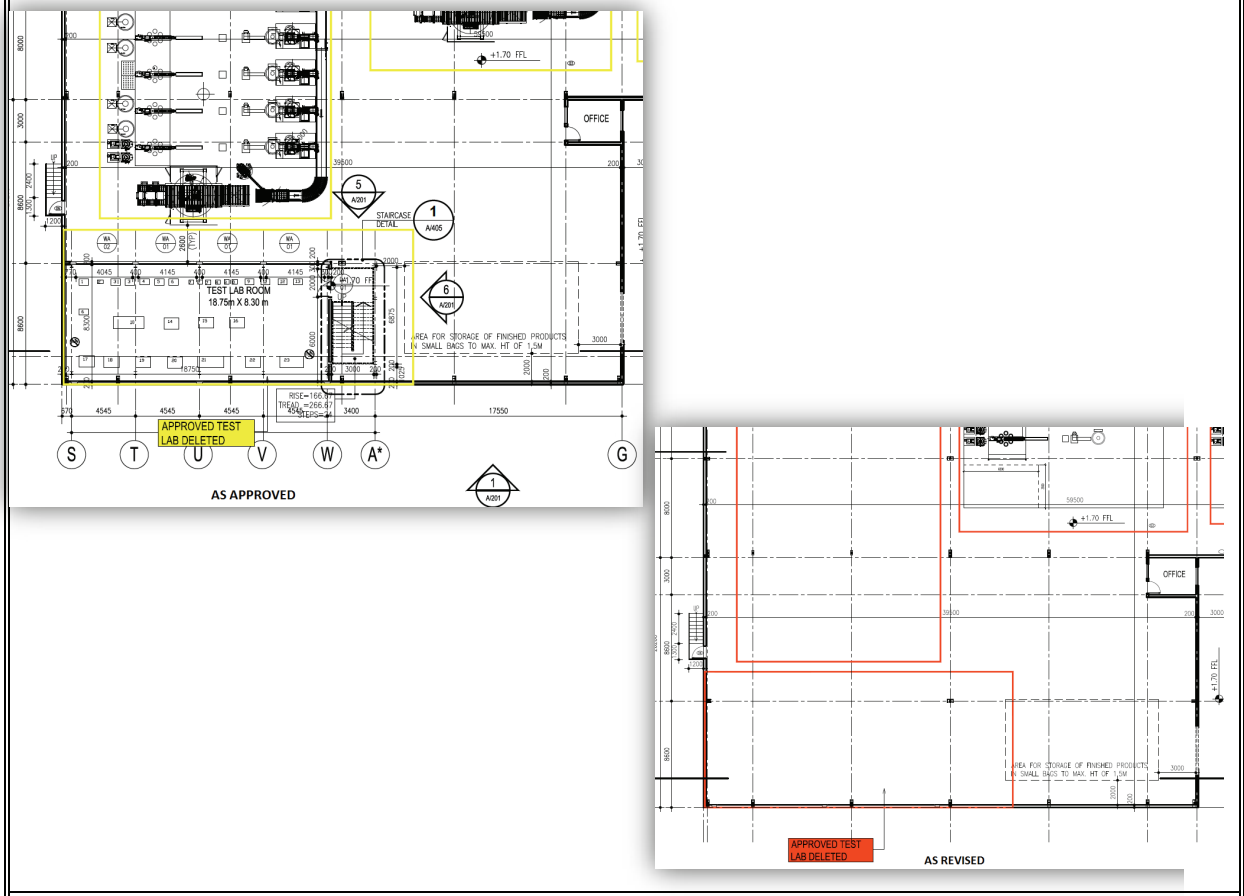
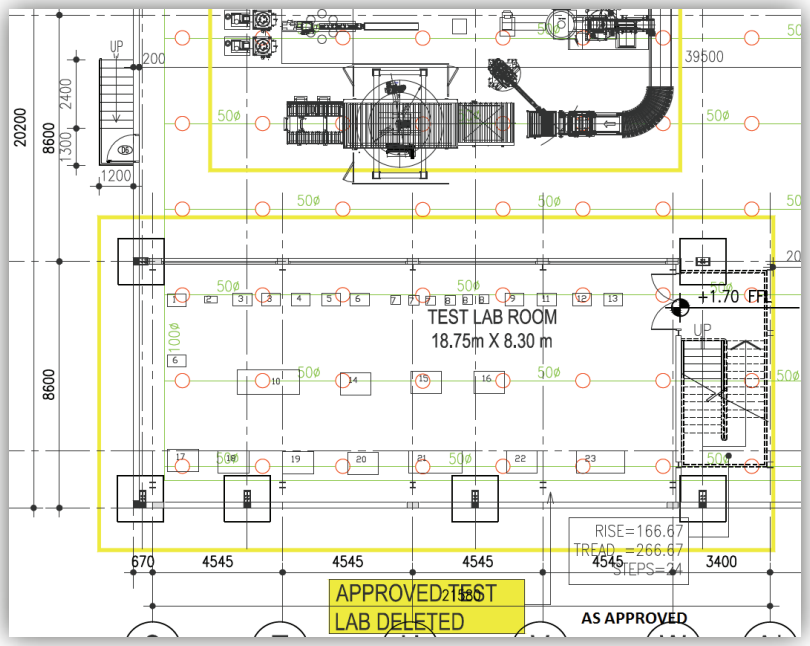


Figure:- H.03-F15. : Modification/ Revision Of Architecture Plans

5.0 Modifications, Revisions and refurbishment submissions

5.1. All modifications, refurbishments, revisions of already permitted drawings shall comply with the general requirements of **Section 2.0** and **Table:- H.03-T13.**



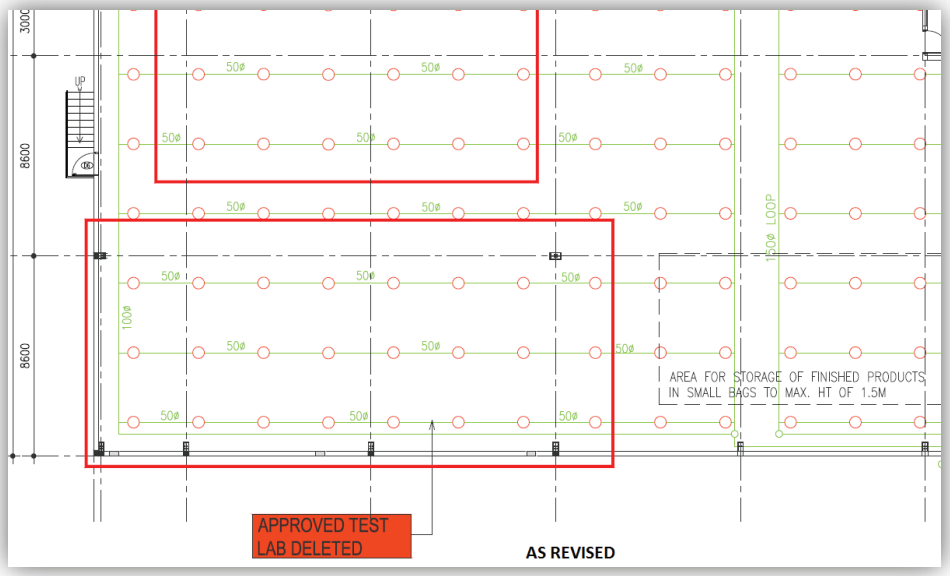


Figure:- H.03-F16.: Modification/ Revision Of Fire Fighting

6.0. Infrastructure Drawing Submission

6.1. Consultant's drawings shall comply with the general requirements of **Section 2.0** and **Table:- H.03-T14.**

Table:- H.03-T14.: Consultant's Drawing Submissions

ITEM	REQUIREMENTS
1. INFRASTRUCTURE DRAWINGS	i. Consultant's infrastructure drawing file shall consist of the following drawings. a. Cover page—1 page. b. Setting out plan with plot usage. The division of plots shall clearly convey the type of buildings, Nature of occupancies in colour coded format (For example, G+9 Buildings in one colour group, G+4 in another colour etc)—1 page c. Fire access road—1 page d. Details of fire access road dimensions, detailed layout of road network in scale conveying clearly the road network, roundabouts, bridges/ underpasses with sections. —1 page for each sector/ phase/ plot. e. Sections of roads showing trenches allotted to Hydrant, Fuel Gas, Fire detection and alarm systems etc—2 pages f. Master Hydrant network—1 page g. Details of Hydrant network, with pipe sizes—1 page for each sector/ phase/ plot h. Fire pump room location, pump and tank capacities—1 page i. Riser diagram showing hydrant looped network, pump and tank capacities—1 page j. LPG/ Fuel gas network—1 page k. LPG/ Fuel gas tank location with capacities and specifications—1 page. l. If, commercial villas are part of the proposal, Fire Detection and Alarm system in each villa and the interfacing network with FACP, Repeater panel locations—1 page for each sector/ phase/ plot. m. Riser diagram showing Fire Detection and Alarm system network, —1 page. ii. Plot usage, Road network shall be combined as one file. iii. Yard hydrant, fire fighting details shall be combined as one file.
2. COLOUR SCHEME FOR INFRASTRUCTURE DRAWINGS	i. Colour scheme for life safety drawings shall be as per life safety legend of **Figure:-H.03-F1.** and below. a. Fire access road shall be PINK. b. Stairs shall be GREEN. c. Corridors, exit passageways, exit access way shall be LIGHT GREEN d. 2 hour rated walls shall be RED. e. 1 hour rated walls shall be BLUE f. 90 minutes fire door shall be RED, as per **Figure:-H.03-F1** g. 60 minutes fire door shall be BLUE, as per **Figure:-H.03-F1** ii. Show pump room details. See **Figure:- H.03-F7.c** iii. See **Figure:- H.03-F17.** and **relevant sections of this chapter for Fire Detection and Alarm, Fire Fighting, and LPG Systems** for more details.

6.1. Infrastructure submissions

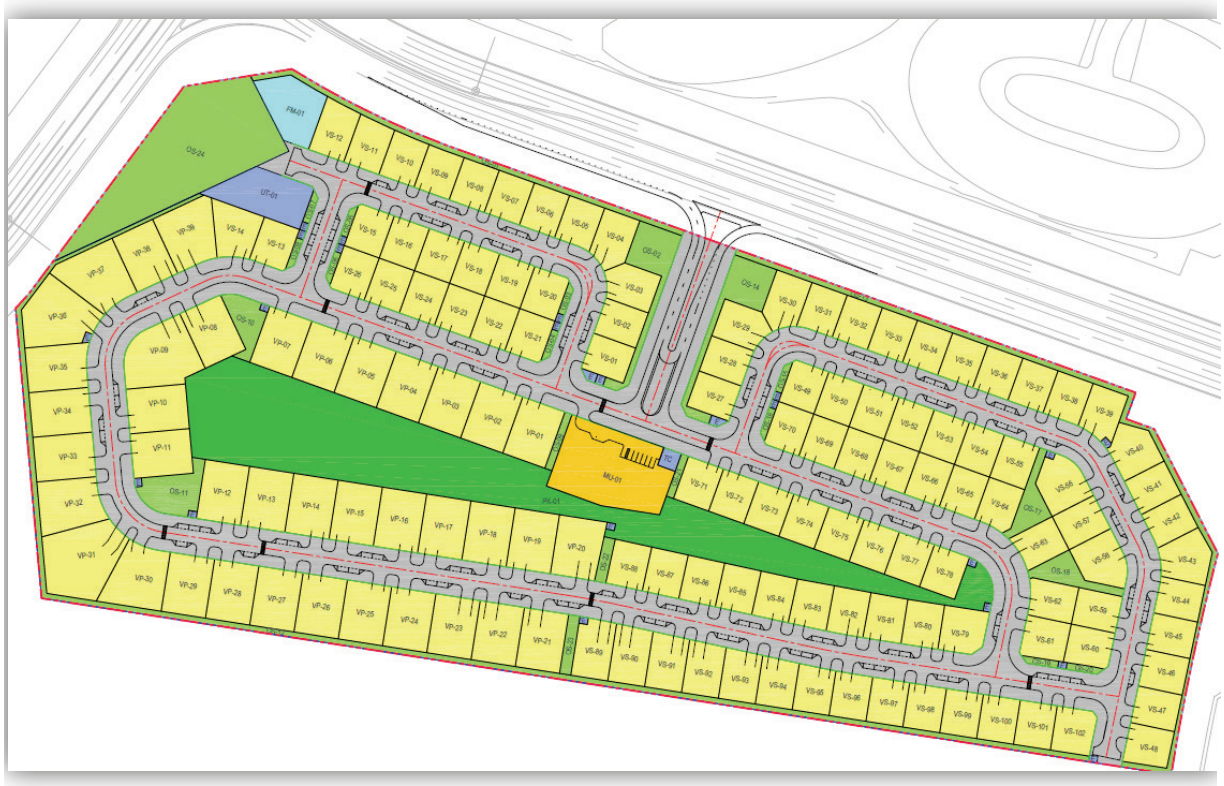
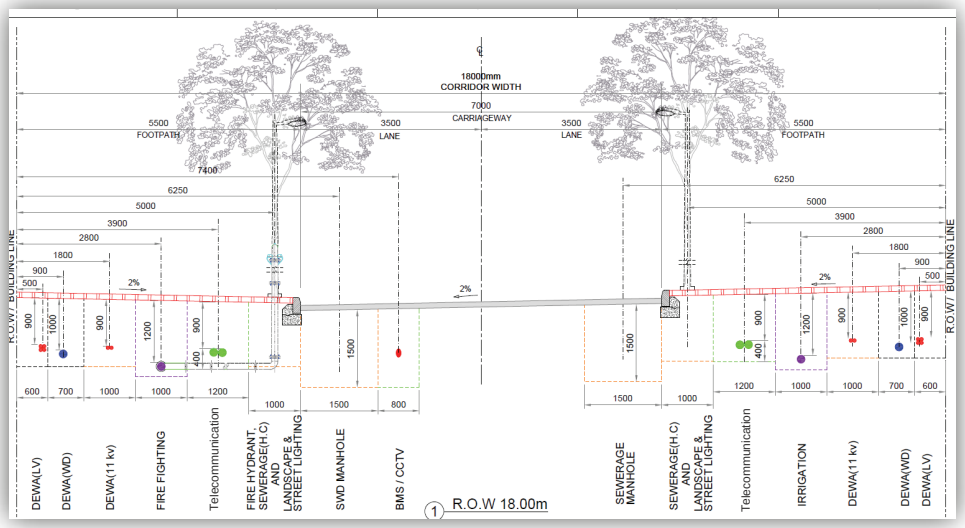


Figure:- H.03-F17.: Infrastructure Submissions

6.1. Infrastructure submissions



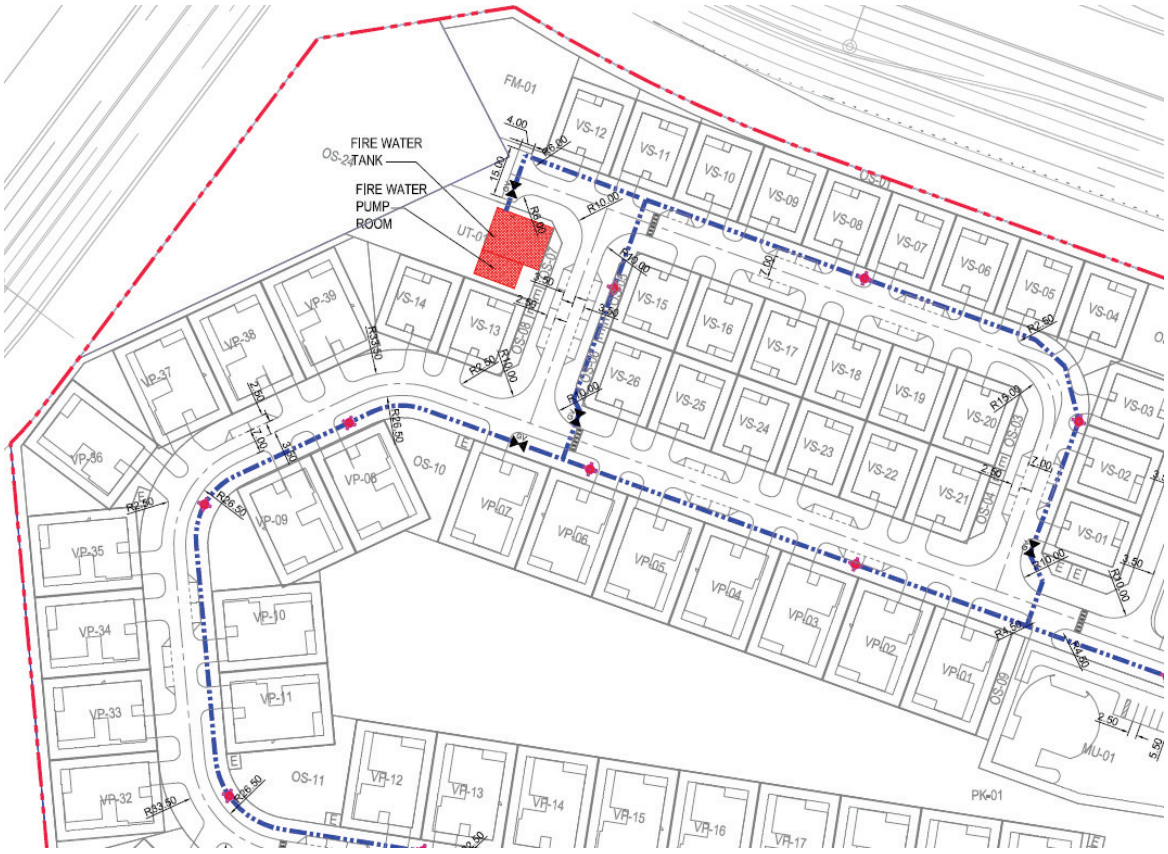
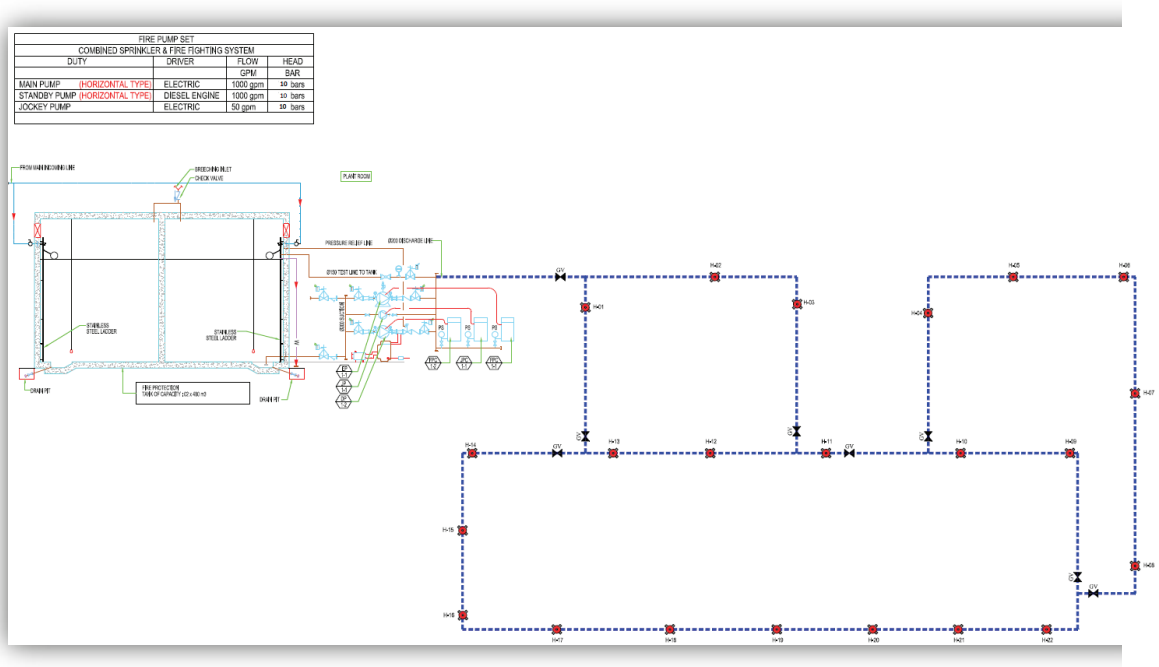


Figure:- H.03-F17.: Infrastructure Submissions

6.1. Infrastructure submissions



FIRE PUMP SET			
COMBINED SPRINKLER & FIRE FIGHTING SYSTEM			
DUTY	DRIVER	FLOW	HEAD
		GPM	BAR
MAIN PUMP (HORIZONTAL TYPE)	ELECTRIC	1000 gpm	10 bars
STANDBY PUMP (HORIZONTAL TYPE)	DIESEL ENGINE	1000 gpm	10 bars
JOCKEY PUMP	ELECTRIC	50 gpm	10 bars

Figure:- H.03-F17.: Infrastructure Submissions

7.0 Event Proposal Submission

7.1. Event organizers proposals and drawings shall comply with the **Table:- H.03-T15** for the event permit.

Table:- H.03-T15 .: Event Proposal Submissions

ITEM	REQUIREMENTS
1. EVENT PROPOSAL LETTER	i. Event organizers shall prepare a NOC request letter stating the following. a. Nature of the event and activities. b. Location of the event c. The date and duration of the event d. Number of people attending the event e. Involvement of cooking, cooking gas, flame shows, pyrotechnics, laser shows, flammable materials etc.
2. EVENT PROPOSAL DRAWINGS AND LAYOUTS	i. Event organizers shall prepare event proposal layouts and drawings on **A2 size, COLOURED** hardcopy as follows. See **Figure:-H.03-F18** a. A satellite image, highlighting the location of the event-1 page. b. Master plan showing the layout of the event, showing road approaches, fencing, gates, area etc. 1 page. c. A detailed event layout plan—2 pages MAXIMUM, showing the following c.1. Actual event area with dimensions. c.2. Seating arrangements if any, with chairs and tables. c.3. Grandstand arrangements if any, with isles and sections. c.4. Number of exits, exit gates, exit doors with dimensions and exit signs. c.5. Stage if any, with dimensions and elevations. c.6. Locations of fire extinguishers. c.7. Locations of food and beverages stands, kiosks and food trucks. c.8. Locations of cooking arrangements, location of cooking gas, BBQ etc. c.9. Locations of first aid kits. c.10.Locations of portable power generators. c.11.Locations of Police, Ambulance and General Directorate of Civil Defence vehicles. c.12. Locations of 'Assembly Points'. d. Where the venue has fire fighting and fire detection systems available, same shall be shown –1 page
3. ADDITIONAL DOCUMENTS	i. Event proposals shall be attached with additional documents as follows. a. For cooking gas usage, General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain permit for LPG installations. c. For flammable gas usage, General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain permit for LPG/Flammable gas installations. d. For tents and membrane structures event décor and installations, material test certificates for tent fabrics, membranes, etc. e. For flame shows and pyrotechnics, equipment test certificates and operator qualifications and certifications.

7.2. Event organizers shall comply with minimum requirements for the Fire and Life Safety as per **Table:- H.03-T16.** for the event arrangements.

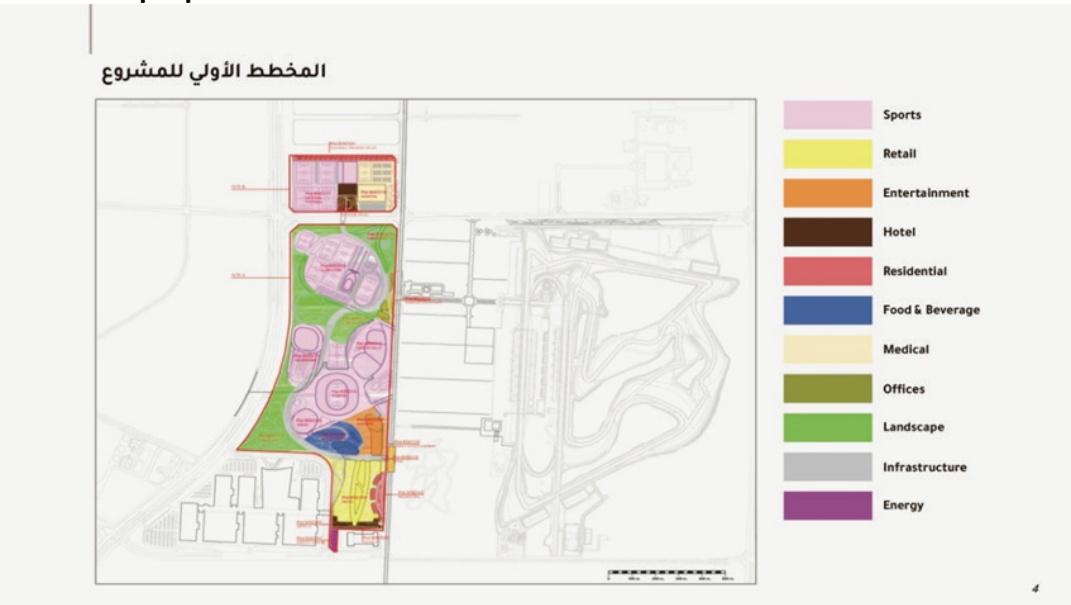
7.3. Event organizers shall comply with their responsibility in accordance with latest edition of **Bahrain Life Safety Code of Practice, Section G, Chapter 01, Sub Section 3.21.**

Table:- H.03-T16.: Minimum Fire and Life Safety requirements for Events

ITEM	REQUIREMENTS
1. NUMBER AND SIZE OF EXITS	i. Minimum width of each exit shall not be less than 1.5 m. ii. There shall be minimum of 2 exits, REMOTELY LOCATED, if the total number of people in the event do not exceed 500. iii. There shall be minimum of 3 exits, REMOTELY LOCATED, if the total number of people in the event is between 501 to 1000. iv. There shall be minimum of 4 exits, REMOTELY LOCATED, if the total number of people in the event is between 1001 to 2000. v. There shall be minimum of 6 exits, REMOTELY LOCATED ON OPPOSITE SIDES, if the total number of people in the event exceeds 2000.
2. HANDRAILS AND GUARDS	i. Guards shall be provided at the open sides of exit ways which exceeds 760 mm above the floor or grade below. ii. Height of the guard shall be not less than 1065 mm from the base surface to the top of guard. iii. Handrails shall be provided on both sides of Stairs, Spiral Stairs, Ramps, Bridges, steps etc. iv. Handrails should be within 865 mm - 965 mm from the surface of the tread.
3. ILLUMINATION	i. The entire event area shall be well illuminated during the entire duration. ii. Continuous illumination shall be provided for exits, exit ways, exit corridors, exit stairs, ramps, aisles, escalators, walkways leading to public ways. iii. Minimum illumination shall be of of 1 ft-candle (10.8 lux) for floor and walking surfaces. iv. Minimum illumination shall be of 10 ft-candle (108 lux) for stairs. v. Photo luminescent markings shall be provided to exits and exit ways.
4. EMERGENCY LIGHTING	i. Emergency Lighting System shall be provided throughout the event area. ii. Emergency Lighting shall be capable of functioning for not less than 3 hours in the event of failure of normal lighting. iii. Emergency Lighting shall serve in case of Interruption of normal lighting, public utility and outside electrical power supply. iv. Emergency Lighting shall provide initial illumination that is not less than an average of 10.8 lux and at any point not less than 1.1 lux, measured along the path of egress at floor level.

Table:- H.03-T16.: Minimum Fire and Life Safety requirements for Events	
ITEM	**REQUIREMENTS**
5. EXIT SIGNAGE	i. Permitted Exit Signs and directional signs with a directional indicator showing the direction of Exit travel shall be installed throughout the area. ii. Exit Signs shall be easily visible from any direction of exit access. iii. Sign placement shall be within rated viewing distance of 30 m. iv. No decorations, furnishings, or equipment that impairs the visibility of a sign shall be permitted.
6. PORTABLE FIRE EXTINGUISHERS	i. Portable fire extinguishers in compliance to latest edition of Bahrain Fire and Life Safety Code of Practice, shall be provided along normal walking paths of Exit ways and exits, near stages, cooking areas and at 30 m intervals. ii. All the Portable Fire Extinguishers shall be fully charged and ready for use in case of an emergency.
7. OTHER SAFETY REQUIREMENTS	i. LPG systems shall not be installed without General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permit. ii. Flame shows, pyrotechnics shall not be conducted at events without General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain permitted. iii. Events shall not be held without General Directorate of Civil Defence permit and inspection. iv. Events organizers shall request for inspection from General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain prior to the event commencement. v. Events organizers shall request for Standby fire trucks and Civil defence personnel where it is required by the General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain operations department. It is event organizers responsibility to verify with General Directorate of Civil Defence (GDCD) – Kingdom of Bahrain operations department. vi. Smoking and Shisha shall be permitted only at designated areas.
8. EVENT ORGANIZERS RESPNSIBILITY	i. Event organizers shall comply with their responsibility in accordance with latest edition of **Bahrain Fire and Life Safety Code of Practice, Section G, Chapter 01, Sub Section 3.21.c**

7.1. Event proposal submissions



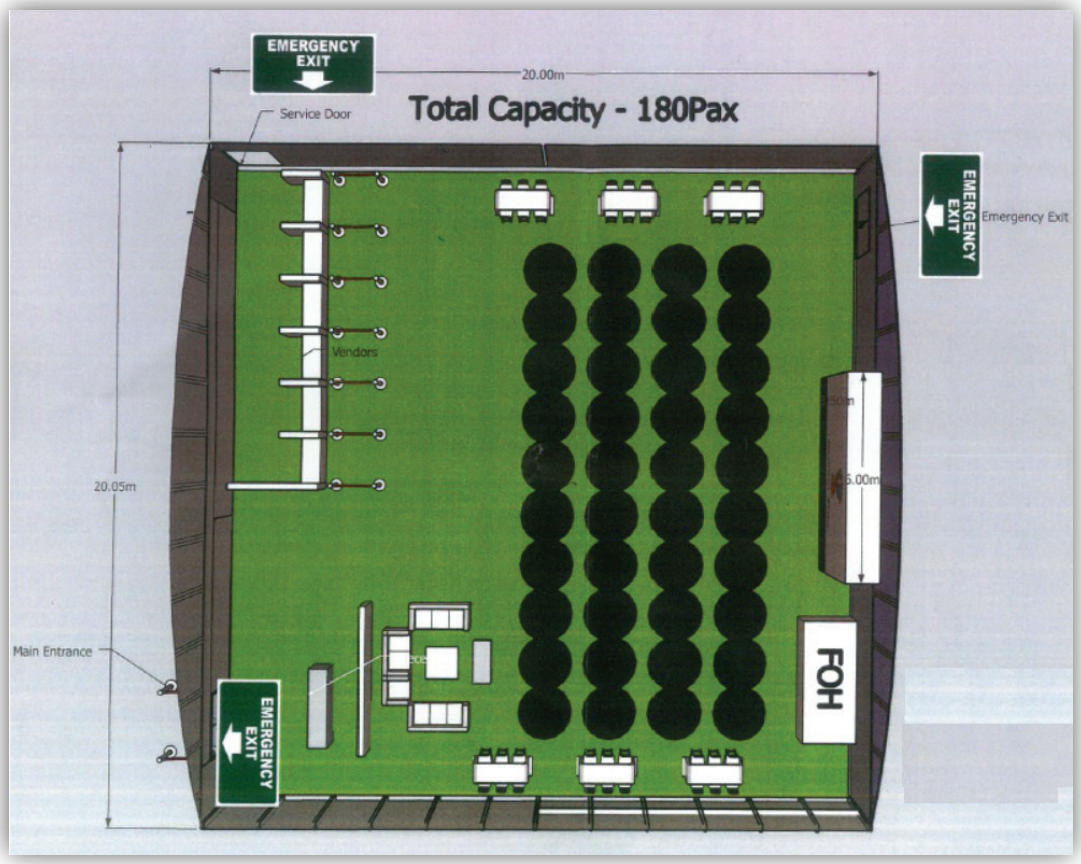
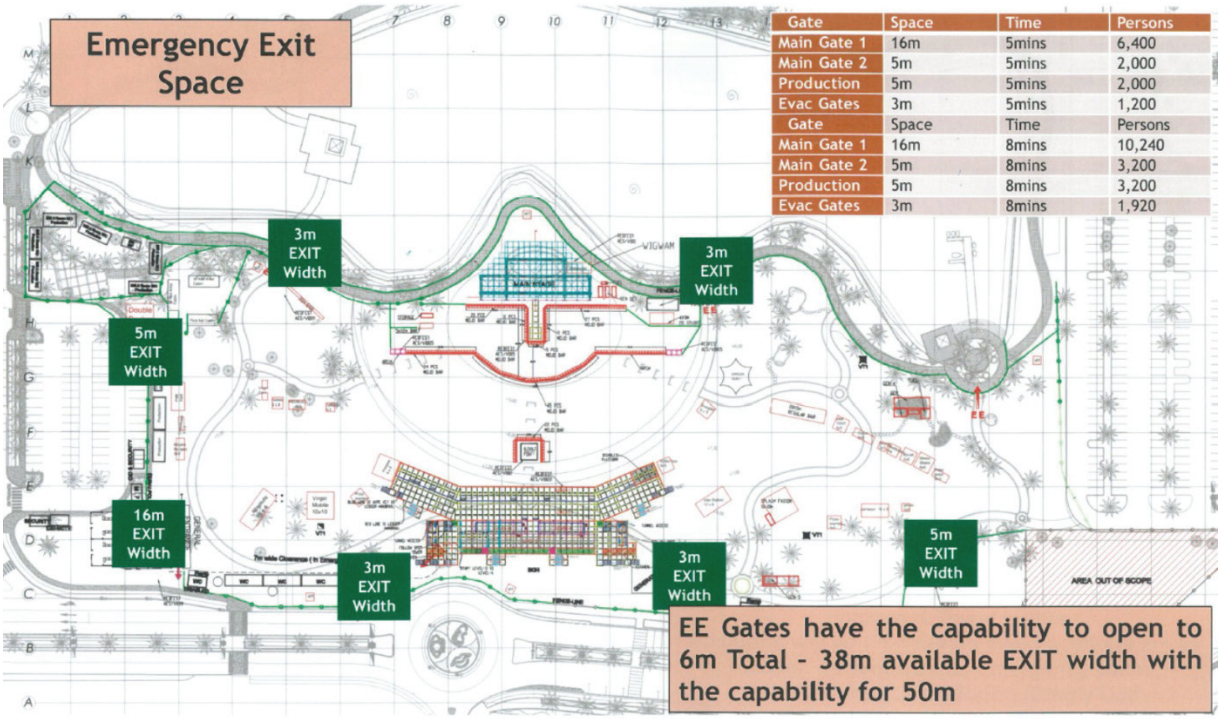


Figure:- H.03-F18.: Typical Event Proposal Submission

7.1. Event proposal submissions



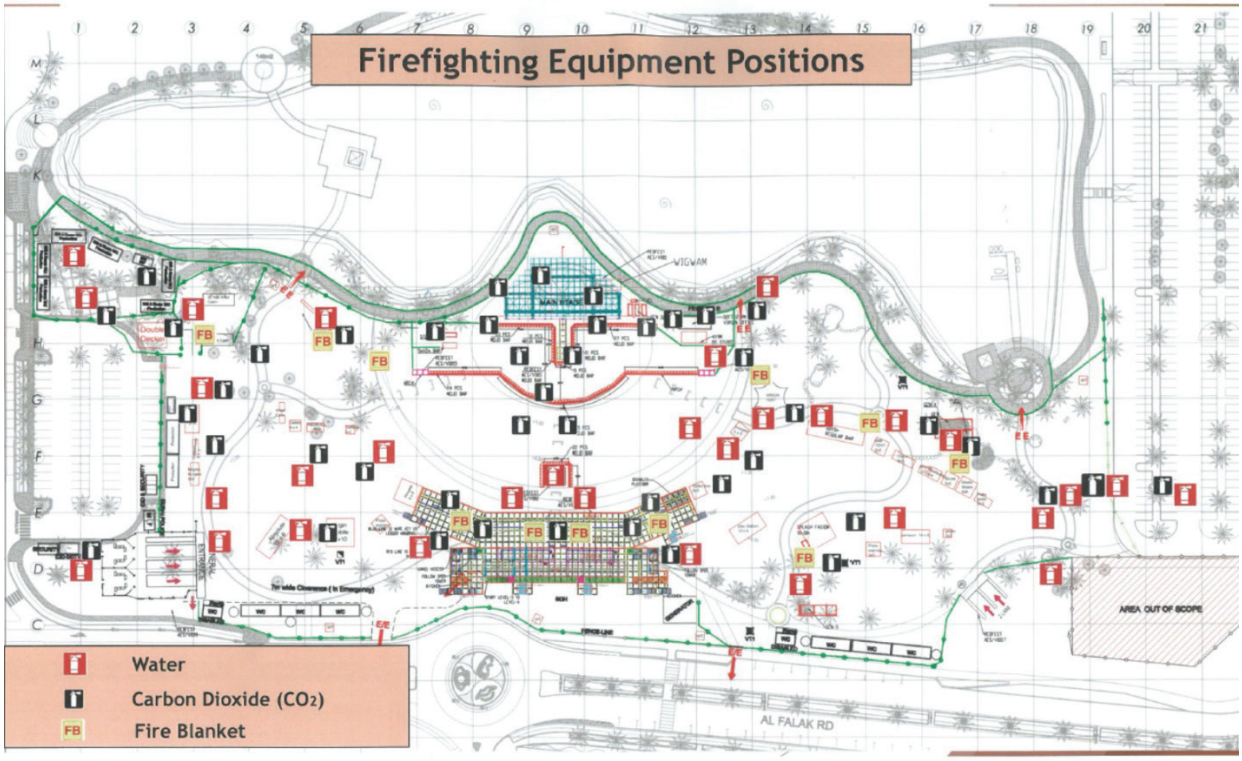
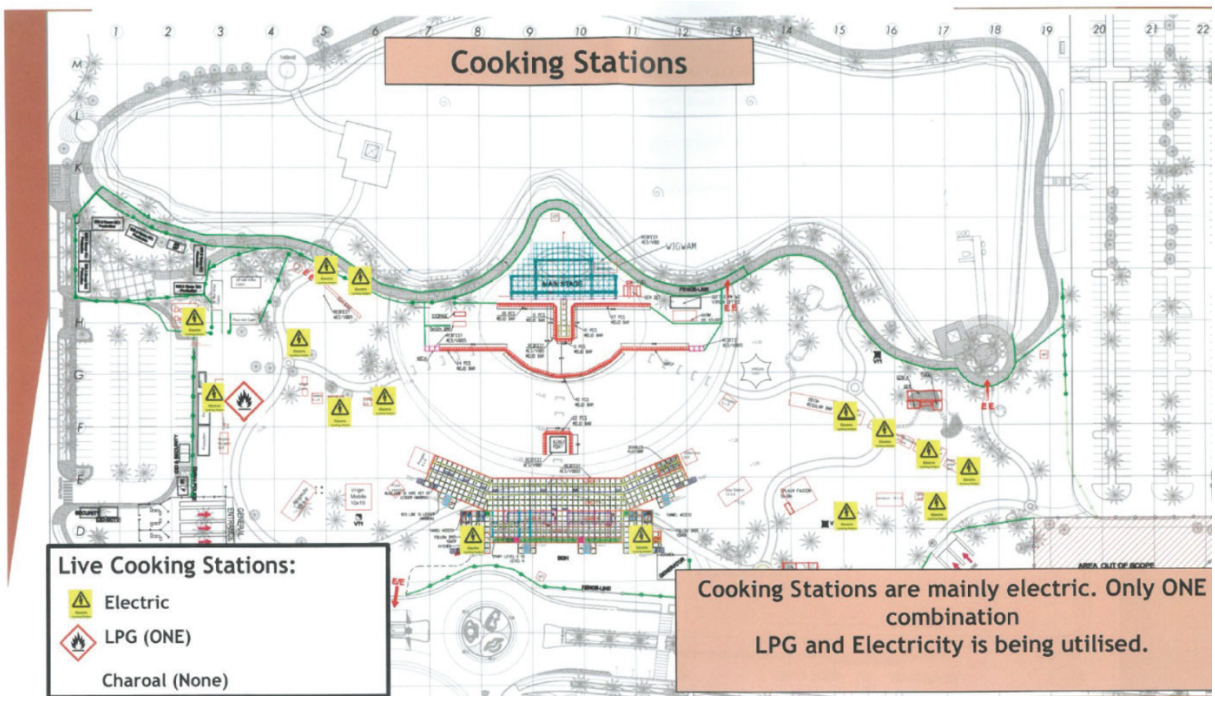


Figure:- H.03-F18.: Typical Event Proposal Submission

7.1. Event proposal submissions



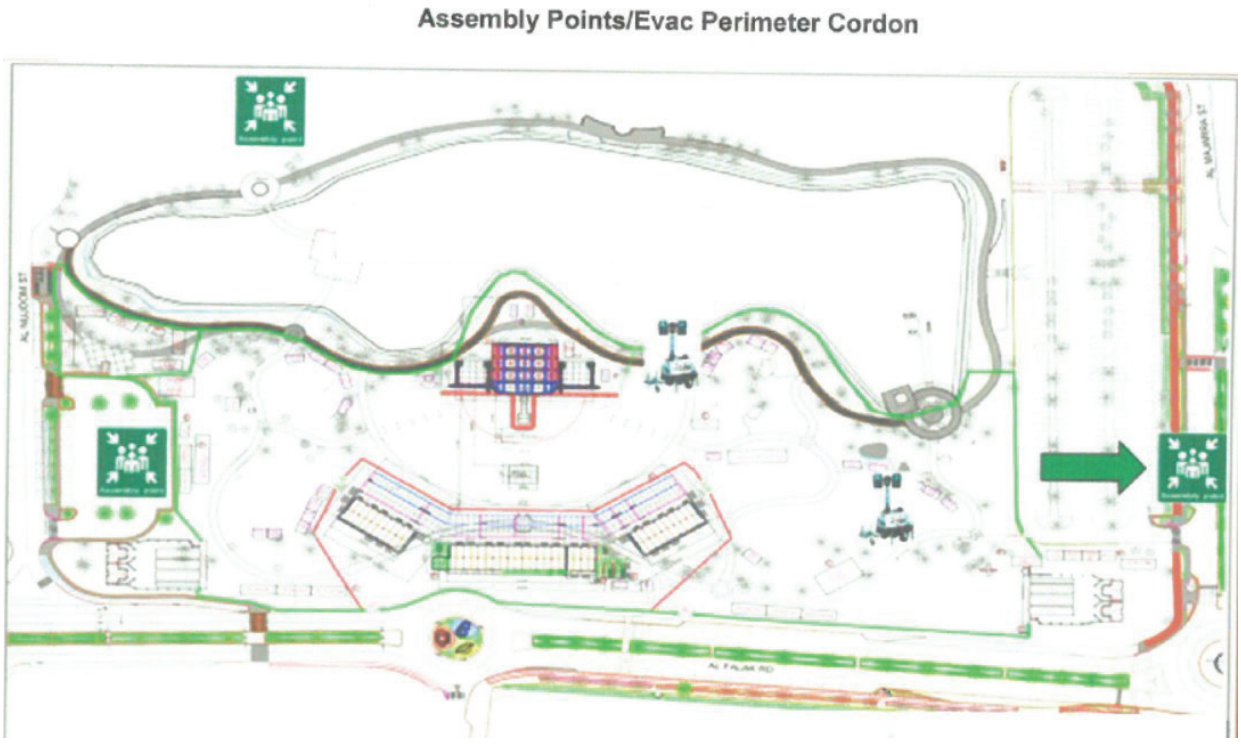


Figure:- H.03-F18.: Typical Event Proposal Submission

8.0 Façade, Cladding, Curtain wall and Roofing report submissions

8.1. Façade, Cladding, curtain wall and roofing proposals and drawings shall comply with the **Table:- H.03-T17.**

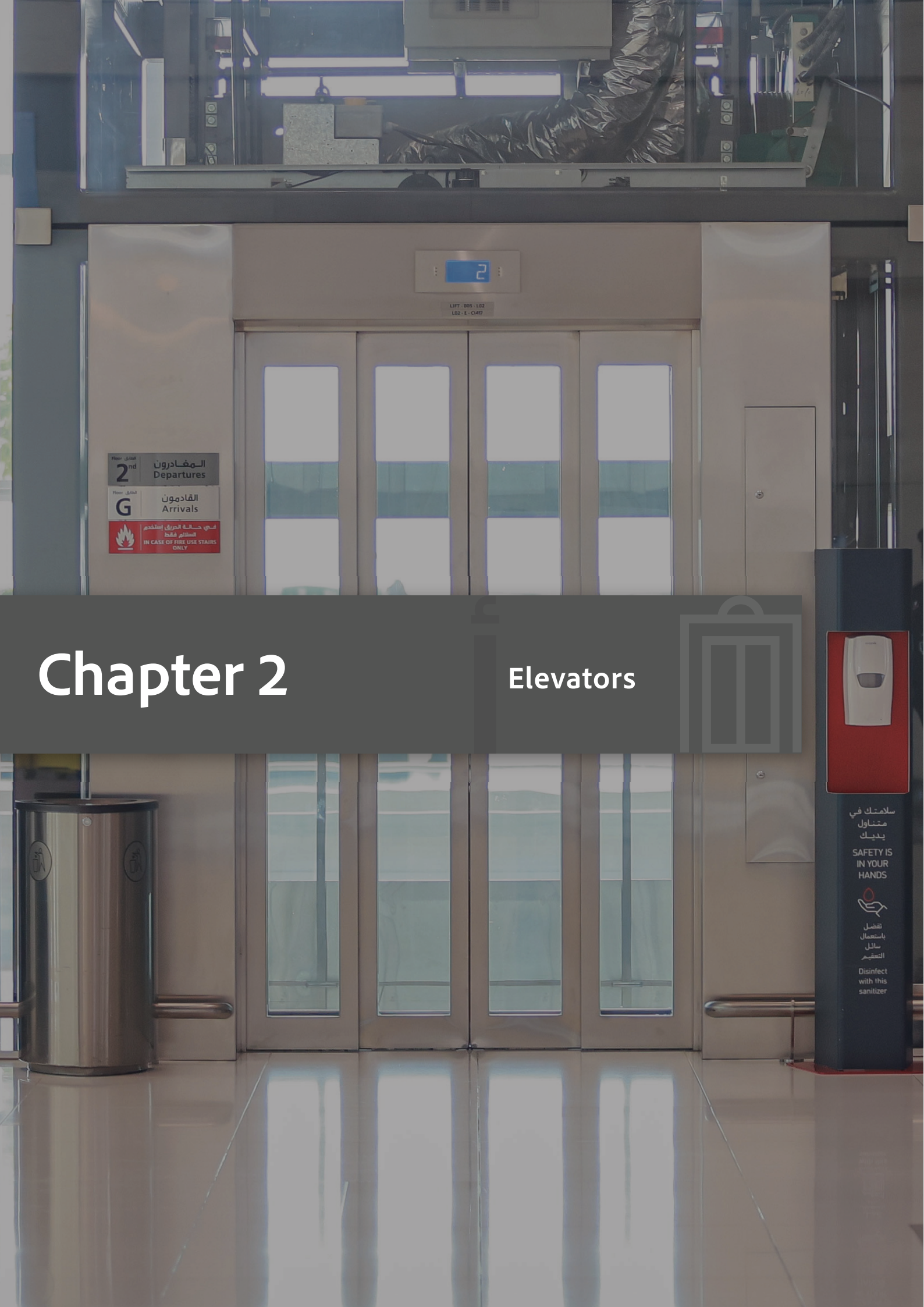
Table:- H.03-T17 :Cladding, Curtain wall and Roofing Proposal Submissions

ITEM	REQUIREMENTS
1. AUTHORIZED APPLICANT	i. Façade, Cladding, Curtain wall and Roofing submissions to General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain shall only be submitted through GDCD permitted House of Expertise (OR) the Main Consultant (OR) the Façade Consultant having qualified personnel as per **Section A, Chapter 01, Sub Section 5.4.7.5 and 5.4.8.** ii. It is House of Expertise (OR) Main Consultant (OR) Façade Consultant's responsibility to understand the requirements of Bahrain Fire and Life Safety Code of Practice, material test requirements, General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain registration of contractors and suppliers and the report submission format.
2. REPORT FORMAT	i. Report shall essentially follow the following format. a. All reports shall be in pdf format. b. It is applicants responsibility to recreate soft copies of the sample formats shown in this table and adhere to submission format. c. It is applicants responsibility to submit error free pdf files such that General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain stamp as "water mark" can be inserted into the pdf files without glitch. **d.** A cover page –1 page as per **Format A2.9.1.: Cover page format and sample.** e. Under taking declarations from each involved party—1 page as per **Table H.03-T17.4. Stamped undertaking declarations.,** followed by their General Directorate of Civil Defence (GDCD) - Kingdom of Bahrain valid certificate and followed by CoC from certification body—5 pages MAXIMUM as shown in **Sample A2.9.12.** f. An engineering evaluation and assessment—3 pages MAXIMUM as per format and Table shown in **Format A2.9.13.** Non-compliances shall be clearly conveyed in the assessment. g. Sectional schematics –3 pages as shown in **Format A2.9.14.** Schematics shall depict exact design and site conditions, clearly labeling the components, dimensions and materials. h. An inspection report—3 pages MAXIMUM as per format and Table shown in **Format A2.9.15.**
3. UN ACCEPTABLE REPORTS	i. Reports not complying to **Table:- H.03-T17.** shall not be reviewed and shall not be acceptable. ii. Reports submitted by parties other than General Directorate of Civil Defence (GDCD) permitted house of expertise shall not be acceptable. iii. **DO NOT** submit product catalogues and brochures. iv. **DO NOT** provide generalized technical description of how and why fire spreads. v. **DO NOT** provide Test standard methods and details. vi. **DO NOT** submit without stamps and signatures, where applicable as per format samples. vii. **DO NOT** provide irrelevant and unnecessary attachments.

8.0 Façade, Cladding, Curtain wall and Roofing report submissions

Table:- H.03-T17 :Cladding, Curtain wall and Roofing Proposal Submissions

ITEM	REQUIREMENTS
3. UNACCEPTABLE REPORTS	viii. **DO NOT** submit reports for projects where suppliers are not registered with General Directorate of Civil Defence (GDCD) . It is main consultants and contractors responsibility to get suppliers approach for their registration. ix. Reports clearly and efficiently not highlighting non-compliances shall not be acceptable. x. **DO NOT SUBMIT REPORTS JUSTIFYING NON-COMPLIANT CLADDING AND ROOFING MATERIALS.**
4. STAMPED UNDERTAKING DECLARATIONS	i. Every party involved in the project shall furnish undertaking declarations as follows. **a.** House of Expertise (OR) Main consultant (OR) Façade Consultant—1 page As per **Format Sample A2.9.2.: House of Expertise/ Main Consultant/Façade Consultant undertaking letter format and sample.** **b.** Main consultant—1 page as per **Format Sample A2.9.3.: Main consultant undertaking letter format and sample.** **c.** Main contractor—1 page as per **Format Sample A2.9.4.: Main contractor undertaking letter format and sample.** **d.** Panel supplier—1 page as per **Format Sample A2.9.5.: ACP/MCM/SOLID METAL/PEWFS/ GRC panel Supplier undertaking letter format and sample.** **e.** EIFS/ETICS supplier—1 page as per **Format Sample A2.9.6.: EIFS/ ETICS Supplier undertaking letter format and sample.** **f.** Natural stone supplier—1 page as per **Format Sample A2.9.7.: Natural stone Supplier undertaking letter format and sample.** **g.** Firestopping system supplier—1 page as per **Format Sample A2.9.8.: Fire-stopping system Supplier undertaking letter format and sample.** **h.** Insulation material supplier—1 page as per **Format Sample A2.9.9.: Insulation material Supplier undertaking letter format and sample.** **i.** Roofing panel supplier—1 page as per **Format Sample A2.9.10.: Roofing panel Supplier undertaking letter format and sample.** **j.** Glazing supplier—1 page as per **Format Sample A2.9.11.: Roofing panel Supplier undertaking letter format and sample.**



Chapter 2

Elevators

Chapter 2

Elevators



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1.0 SCOPE

1.1 This Chapter provides general information on elevator requirements, types and its components.

1.2 To standardize the elevators installing in - Kingdom of Bahrain.

1.3 To achieve code complaint and permitted process in timely manner.

2.0 Elevator Classification.

2.1 Elevator can be classified into two types based on the technology used in their operation:

2.1.1 Hydraulic Elevators: These elevators rely on the force of hydraulic pressure, from either oil or air, to operate the elevator car.

2.1.2 Electric Elevator: Also known as, traction elevators, these elevators depend on the power of strong electric motor to pull the elevator car upward while simultaneously lowering the counterweight.

3.0 Definitions:

3.1. Lift Well

The space or space in which the elevator or the counterweight, if any, moves. This space is bounded by the bottom (pit), ceiling, and walls.

3.2. Pit

The part that borders the elevator shaft from the bottom, and the lowest point where the car is parked at the bottom

3.3. Landing

The surface of the ground where loading and unloading takes place.

3.4. Car Guide Rail

Rods controlling the track of the cart or counterweight

3.5. Car buffer

A device that reduces the level of impact, containing hydraulic or other damping fluids, and is installed at the end of the elevator stop at the bottom of the well.

3.6. Lift Car

It is the moving part designated for transporting people, goods, or both.

3.7. Machine room

The place designated for installing the lift machine and its accessories.

3.8. Counterweight

It is the weight that works to balance the car against the rated load

3.9. Rated load

It is the maximum load capacity that the lift equipment is designed and installed to handle for normal operation.

3.10. Rated speed

It is the maximum speed that the lift equipment is designed and installed to operate for normal use.

3.11. Car area

The space in the elevator car in which passengers can stand.

3.12. The elevator's electronic control panel

The electronic panel is what converts pressing the buttons inside the car into a command to stop or move the lift.

3.13. Drive Motor

The drive motor in a lift converts electrical energy into mechanical energy to move the lift car up and down the well/shaft, controlling speed and direction. It ensures smooth acceleration and deceleration, holds the lift in position when stopped, and often includes regenerative braking system for energy efficiency. This motor is vital for the lift's safe and efficient operation.

3.14. Suspension Rope

The ropes are fixed between the car and the counterweight, which moves the car from top to bottom and vice versa.

3.15. Door Operator

A device for opening the door of the lift car when it is stopped at the desired landing floor.

3.16. Car Doors

These are the doors that open into the lift well. It act as barriers between the lift car and the well. The car door allows you to enter and exit the lift car from the floors of the building.

3.17. Apron stroller cover

A two-part device that prevents toes or people from falling into the elevator shaft/lift well.

3.18. Level Indicator

A digital screen that determines the lift's location.

3.19. Elevator Push Button

It is the button installed at the landing lift door which when pressed, calls the lift to the location from which the request signal is issued.

3.20. Limit Switches

It is a device that prevents the elevator from traveling beyond the floors assigned to them. It cuts off power to the elevator motor if the elevator car exceeds its normal travel range.

3.21. Brake

The emergency brake operates using a mechanical safety mechanism located under the elevator car that locks itself to the rail when over speed is detected. If the elevator car begins to accelerate or descend into the well/shaft too quickly, the brakes will be applied and the car will stop safely.

3.22. Traction Sheave

It is the wheel connected to the traction motor that raises, and lowers the elevator and the counterweight.

3.23. Landing Doors

A lift landing door is installed at the entrance of each floor of the lift shaft. The landing door gives you access to the lift car.

3.24. Overspeed Governor

A device that operates the safety devices responsible for stopping the car when the speed limit is exceeded.

3.25. Car Guide Rail

The rails that determine the path of the lift or the counterweight.

3.26. Safety Gear

It is a mechanical device that works when the lift exceeds the regulated speed limit or falls to the bottom, by detecting signs of movement.

3.27. Traveling Cables

It is a cable used to transmit power to the lift car, and communicate between the control unit and the lift car.

3.28. Governor Tension Sheave

The part that controls the tension position of the traction ropes in the lift.

3.29. Car Guide Rail and Counterweight shoes

This equipment directs the elevator car and the counterweight inside the rail and prevents it from deflecting or tilting. It ensures the movement of the car and reduces friction.

3.30. Car sling (Hydraulic Lift)

Car sling is a fundamental tool predominantly used in hydraulic elevators and rarely in traction elevators.

3.31. Crosshead (Hydraulic Lift)

The cross-head supports a door header, door hanger assembly, door operator assembly, and a cross-beam.

3.32. Hydraulic Valve Block (Hydraulic Lift)

The Hydraulic valve block is a regulatory element in the hydraulic system. It controls the pressure, flow, and direction of fluid flow.

3.33. Piston (Hydraulic Lift)

For short intervals when an elevator is traveling away from the fire floor, piston effect reduces the pressure difference from the elevator lobby to the rest of the building. In extreme cases this could result in smoke infiltration into the elevator lobby.

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3.34. Crosshead

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4.0 Lift Requirements:

4.1 Lift Car

4.1.1. The floor area of the car must be specified according to the tables shown in the standard (Table Nos. 1/2/3/4), defining the relationship between the number of passengers or the rated load in kilograms and the available car area in square meters, to prevent overloading. Lifts intended for individual transfers must be installed and designed so that their dimensions and other constructional specifications do not hinder the entry or use of people with disabilities. Appropriate control mechanisms must also be allocated to support this use, in accordance with EN 81-70.

4.1.2. The car must be equipped with an audible or visual alarm that activates when the load exceeds the specified limit, and the lift will not operate until the load is reduced to the specified level.

4.1.3. The car may have one or multiple doors.

4.1.4. The car must be equipped with electric lighting with an intensity of at least 100 lux at a height of 1 meter above the car floor and control panel, and at least 100 mm away from the walls, with no fewer than two parallel-connected lamps.

4.1.5. The materials used in the lift car must not produce harmful gases in the event of fire.

4.1.6. Emergency exits in the car's roof and side doors must meet the requirements of standard (EN 81-20).

4.1.7. The car's internal height must be at least 2 meters, and the clear height of the entrance for normal use must be at least 2 meters.

4.1.8. The car's control buttons, switches, stop button, and alarm button must be at least 40 cm above the car floor.

4.1.9. It is required that the car door feature a perforated panel.

4.1.10. The car must have an emergency lighting source that automatically charges, capable of lighting at least one lamp with an intensity of 5 lux for one hour in case of a power outage, automatically lighting up once power is lost.

4.1.11. An emergency warning device must be installed in the car and placed in a visible and reachable location so that passengers can get outside assistance.

4.1.12. Lifts must have means to prevent unintended movement of the car away from the floor by more than the allowable limits when the car and landing doors are open.

4.2 Lift Well

4.2.1 Solid walls, ceiling, and floor must be used in the construction of the lift well. The construction materials must non-combustible and, in the event of a fire, must not release any harmful gases or smoke.

4.2.2 All threshold openings must be covered with doors at least 2 meters high, and the clear width of the landing doors must not exceed 0.05 meters more than the car entrance from both sides, ensuring the top barrier of the landing door does not obstruct entry to the car.

4.2.3 The lift well must withstand all loads, including those from the machine and guide rails during the operation of safety gear, uneven load distribution in the car, or car/counterweight collisions with buffers.

4.2.4 The lift well must have adequate ventilation, solely for elevator use.

4.2.5 Using the lift well for non-elevator purposes is prohibited, and the well must not contain devices or cables not related to the elevator, except for placing elevator-specific heating devices (not hot water or steam), with control devices located outside the lift well.

4.2.6 The lift well must have continuous lighting with an intensity of at least 50 lux in work areas and 20 lux in non-work areas, used during maintenance and repair operations. This lighting includes one light at the bottom and top of the well. The light shall be switched on/off through a key installed in the lift well. The lift well must be protected from vertical heat or smoke transfer to other floors.

4.2.7 The lift well must be protected against the vertical transfer of smoke or heat to adjacent floors.

4.2.8 The lift well must not be part of the building's ventilation system, and adequate smoke ventilation must be provided in case of fire in the lift well.

4.2.9 No more than four lifts are allowed in one lift well. If more than four, a new well must be provided, with one lift designated for firefighters, separated from others by fire-resistant materials.

4.2.10 If the lift well contains multiple lifts, a barrier must be placed between moving parts (car, counterweight) with sufficient rigidity to withstand 300 Newtons over a 5 cm^2 area, extending 2.5 meters from the lower floor threshold. A barrier is required if the distance between the barrier and moving parts of different elevators is less than 50 cm, with a width 15 cm more than the moving parts on both sides along the lift well's height, preventing collisions of the moving parts of the car and the counterweight during maintenance operations of the adjacent lifts.

4.2.11 In case of using water sprinklers for firefighting inside the lift well or machine room, the sprinklers must be inactive unless the elevator is at the floor, and power supply to the elevator and lighting is automatically off via the fire alarm system.

4.3 Suspension and Support Means

4.3.1. Suspension and support means, including cable ends and ropes, must ensure sufficient overall safety, minimizing the risk of car falling, considering usage conditions, materials, and manufacturing conditions.

4.3.2. Lift Car and counterweights shall be suspended with ropes or steel chains, provided that the number of ropes or chains shall not be less than two. Such ropes and chains shall not contain connections except in necessary cases to fix or form their circuits.

4.3.3. The safety factor for suspension ropes must not be less than:

- (12) for lifts working by the method of traction with three ropes or more.
- (16) for lifts working by the method of traction with two ropes.
- (12) for lifts with drum drive.
- (10) for chain using elevators.

4.3.4. Threaded wells and pulleys used for displacement, suspension, and balancing must be protected and provided with special devices to:

- Prevent physical damages.
- Prevent ropes/chains from leaving pulley/sprocket grooves in case of laxity.
- Prevent the entry of odd objects among ropes/chains and grooves of pulleys/ gears.

4.4. Load Monitoring (including overspeed).

4.4.1. Lifts must be designed and constructed to prevent normal operation if the load exceeds the rated load.

4.4.2. The lift must be equipped with an overspeed governor. This requirement does not apply to lifts whose design does not allow high speeds.

4.4.3. High-speed lifts must be equipped with an overspeed governor.

4.4.4. Lifts operated by friction pulleys must be designed in such a way to ensure the stability and firmness of the traction ropes on the pulley.

4.4.5. The ratio between the diameter of the overspeed governor wheel and the diameter of the rope must not be less than 30, with the rope diameter not less than 6 mm.

4.4.6. In case the rope of the overspeed governor is cut or loosens, it must stop the car movement with the help of an electric safety gear.

4.4.7. The overspeed governor must be installed in the lift well in an accessible location under all circumstances. If installed in the well, it must be reachable from outside the well.

4.5. Machines

4.5.1. Every lift designed to transport people must be operated with at least one machine. This condition does not apply to lifts where the counterweight is replaced by a second car.

4.5.2. The lift installation company must ensure that the lift machines and associated devices are only accessible for maintenance or in emergency situations.

4.5.3. Belts can be used to connect the motors to the parts of the electromechanical brake, with a minimum of two belts.

4.5.4. Each lift machine must have a braking system that operates automatically in either of the following cases:

i. If the main electrical current is cut off from the lift
ii. If the current is cut off from the control circuits board

4.5.5. The braking system must be electromechanical (friction type), with the possibility of adding other types of braking systems, such as electrical brakes.

4.5.6. Electromechanical brakes must be capable of stopping the lift machine independently when the car is moving at the designated speed in the downward direction and is loaded with the specified load plus 25%.

4.5.7. Each elevator machine must contain a manual emergency operating device that works by any means to release the brake in emergency situations, and ensures that it is reactivated immediately as soon as the manual pressure is removed.

4.5.8. The lift must be equipped with an automatic braking system that operates without delay in case of a primary power outage.

4.5.9. Necessary precautions must be taken to protect the machines from rotating devices that can pose special risks to:

i. Any keys or bolts in the machine pivot
ii. Belts, and chains
iii. Gears and threaded wheels
iv. Machine salient axes
v. Fly ball type speed regulator

This shall not include traction sheaves hand winding wheels, brake drums, and similar smooth round parts. Such parts shall be, partially at least, coated in yellow.

4.6. Machine Room Inside Lift Well

4.6.1. If an elevator machine is installed inside a well, the machine supports and working platforms must be designed to bear the load.

4.6.2. The working spaces on the lift machine platform in the lift well must be sufficient to allow safe work (especially on the equipment), and a net height of at least 2.1 m must be provided in the work areas.

4.7. Control Devices

4.7.1. The function of control devices must be clearly indicated.

4.7.2. Control devices for lifts designed for use by unaccompanied disabled persons (EN 81-70) must be designed and prepared according to their conditions.

4.7.3. Call circuits for a group of lifts can be common or interconnected.

4.8. Car Doors and Landing Doors

4.8.1. The door design must not pose any physical danger to passengers, nor should it risk catching or trapping their clothing or other objects.

4.8.2. The distance between the door panels or between the door and its vertical legs or thresholds should not be less than 6 mm, and 10 mm in special cases, when the door is in the closed position.

4.8.3. The doors should open automatically upon collision with any object with a force not exceeding 150 Newtons, through a protective device covering at least 25 mm to 1600 mm from the threshold.

4.8.4. The necessary precautions must be taken to prevent the lift from moving or continuing to move unless both the car door and the floor doors (threshold) are fully closed, except for the following cases:

i. The non-secure closure area during slow speed alignment with the landing threshold and
ii. the area extending to a height not exceeding 1.65 m above landing threshold.
This is done to load and unload lifts by trained and authorized personnel.

4.8.5. When there are no active requests to move the lift, the doors should automatically close after a predetermined time period (which is set based on the expected usage intensity of the lift).

4.8.6. The door frames and doors must be made of solid materials resistant to twisting, deformation, or loss of rigidity over time.

4.8.7. Landing doors and their attached locks must have mechanical strength such that if a mechanical force of 300 Newtons is applied to the closed door, perpendicular to any point on its surface from inside or outside, distributed over an area of 5 cm^2, and a force of 1000 Newtons on an area of 100 cm^2 at any point on the door or its frame, the door and lock together must:

i. Resist permanent deformation exceeding 1 mm.
ii. Resist elastic deformation exceeding 15 mm.
iii. Operate the door well after this test.

4.8.8. Each landing door must have a metal threshold capable of withstanding all forces and loads applied during the passage of loads and people from and to the vehicle.

Note: It is recommended that the floor before the door threshold has a little tilt outward the well to avoid the leak of washing and spraying water into the well. In case of using glass doors, the same shall conform to the standard (EN 81-20).

4.9. Emergency Door Opening

4.9.1. It must be possible to open the landing door from the outside using a special key matching the lock opening triangle.

4.9.2. This key should be provided only to authorized persons accompanied by written instructions detailing the necessary precautions to avoid accidents following the lock opening.

4.9.3. After emergency lock opening, the locking device should not remain in the open position with the landing door closed.

4.9.4. If the landing door is pushed open by the car door, a device (weight or springs) must ensure automatic closure of the landing door if it is opened for any reason when the car is outside the opening area.

4.9.5. Landing doors must automatically close securely after being opened in emergencies.

4.9.6. In emergencies, to allow passengers to leave the car if the lift stops near the landing, it should be possible to:

i. Open the car door fully or partially by hand from the landing.

ii. Open the car door fully or partially with the associated landing door by hand from inside the car if they are coupled.

4.10. Suspension Ropes

4.10.1. The safety factor for suspension ropes is calculated as per the standard (EN 81-20) and must not be less than:

- 12 for traction lifts with 3 or more ropes
- 16 for traction lifts with 2 ropes
- 12 for drum drive lifts
- 10 for lifts using chains

The safety factor is calculated as the ratio between the minimum breaking strength of the rope (or chains) in Newtons and the maximum tensile force in the rope when the vehicle is stationary at the first-floor level and loaded with the rated load.

4.10.2. Ropes Requirements

i. The nominal diameter of the rope must not be less than 8 mm.

ii. The tensile strength of the ropes and other properties (structure, elongation, shape, flexibility, tests, etc.) must comply with the relevant European standards (EN 12385).

iii. The ratio between the rope diameter and the traction sheave diameter must not be less than 40, regardless of the number of rope strands.

4.10.3. The safety factor for suspension chains must not be less than 10 and fewer than two chains.

4.10.4. The rope end shall be fixed in the car, the counterweight or the suspending points of the dead parts of twisted ropes by metal ties (ends) or,

i. resin filled sockets,
ii. self- tightening wedge type sockets,
iii. heart shaped thimbles with no less than three proper twists
iv. hand spliced eyes,
v. ferrule secured eyes or in any other way equal in safety level.

4.10.5. Chain ends must be secured in the car, counterweight, or attachment points for dead parts of twisted chains using proper ends, with connections between chains and ends capable of withstanding at least 80% of the chain's minimum breaking strength.

4.10.6. It shall be possible to lift the empty car when the counterweight is anchored on the buffer and the lift machine is moving upward.

4.11. Cables

4.11.1. Lift cables must meet the requirements of the relevant standards (BS EN 81).

4.11.2. To provide mechanical strength, the cross-sectional area of the safety device connectors must be at least 0.75 mm².

4.11.3. If the ducting or the cable itself contains connectors with different voltage electrical circuits, all connectors or cables shall be isolated as per the isolation identified for the maximum voltage.

4.12. High Voltage Test

- All electrical equipment, except engines, electronic devices, and components, must withstand the testing voltage when a high voltage is applied between the electrified parts and the metal frame of the equipment for one minute without any flashing or isolation collapse.

4.13. Insulation Resistance

- The insulation resistance between each live conductor and the ground must be measured, with minimum values taken as per the standard (EN 81-20).

4.14. Car and Counterweight Safety Gear

4.14.1 The car shall be equipped with a safety gear able to work downward and to stop the car with its full rated load on tripping speed of the speed regulator, even if the suspending devices are stopped through arresting the guide rods and stopping the car in that place.

4.14.2 If there are available places under the car, or the counterweight, the base of the lift pit of the default load shall be designed to bear at least 5000 N/m2. The counterweight shall be equipped with a safety gear.
Note: It is preferred to avoid locating lift wells above areas accessible to people.

4.14.3 For elevators whose rated speed exceeds 3.5 m/s, an anti-backward device must be provided, and it must stop the lift.

4.14.4 Safety gears of each car and counterweight shall be operated individually by the speed controller for each of them. When the rated speed does not exceed 1 m/s, the

safety gear of the counterweight may be operated by disabling the suspending device of the counterweight or using the safety rope.

4.14.5 The release (work commencement) of the safety gear of each car and the counterweight shall be possible only on lifting the car or the counterweight.

4.14.6 After releasing (opening) the safety gear, a technically qualified person shall intervene.

4.15. Counterweight

If the counterweight contains packed weights, measures must be taken to prevent them from shifting from their place. For this reason, one of the following methods must be used:

i. A metal frame inside which these weights are fixed.
ii. Tie rods used to secure these weights, provided the weights are made of metal and the rated speed of the lift does not exceed 1 m/s.

4.16. Ordinary Stopping Switches at the End of Track and Final Stopping Switches

4.16.1 Final stopping switches shall be adjusted at the nearest possible place to the track ends (lower and upper levels). It shall work before the car or the counterweight touches the buffers. The final stopping switches shall remain in opening positions when the car or the counterweight are stable on the buffers fully pressured.

4.16.2 Final stopping switches shall work as follows:

a) For positive driven lifts, such switches shall be opened directly through the positive mechanical insulation of the circuits that feed the engine and the brakes.
b) For single or double speed traction driven lifts, such switches shall work either: -
   i. By opening the electrical circuit and cutting off the electrical current as per Paragraph (a) above, or
   ii. The electrical safety gear shall open the electrical circuit that directly feeds connectors coils.
c) For variant voltage lifts or continuously varied speed lifts, such switches shall work accordingly, provided that the machine shall stop quickly, i.e. in the shortest time in line with the system.

4.16.3 After the work of the final stopping switches, the lift shall not be re-operated automatically. The lift shall be re-operated only by a qualified person.

4.17. Guiderail

4.17.1. Guide rails, connections and accessories thereof shall be with resistance to bear the weight and the forces, in order to ensure the safe operation of the lift.
Safe operation aspects of the guide rails are:

a. The car and counterweight directors shall be ensured.
b. Deviations shall be limited to the cases that:

i. Not lead to unintended opening of the door interlock.
ii. Not affect the operation of the safety gears.
iii. Not lead to the collision of the moving parts to the other parts.

4.17.2. The car and the counterweight shall have guide rails made of steel, not less than two guides for each.

4.17.3. The method of installing the guide rails into the brackets and in the building shall allow the compensation of the building stability effects or the shrinkage of the concrete, either automatically or by simple adjustment, provided that the attachment design shall be in such a way in which its turning do not result in releasing the guide.

4.18. Preventing Accidents During Maintenance

4.18.1. If there are two lifts inside the well, a barrier not less than 2.5 m high and not exceeding 30 cm height above the basement floor, shall be placed there between.

4.18.2. Limit switch shall be installed in the pit in order to stop the lift and hold it in case of emergency, and the same shall be accessible form inside/outside the lift. Whenever the pit's width exceeds 1.6 m, two limit switches shall be installed. The lowest part of the well shall consist of a hole and smooth flat surface, except the ones allocated for buffers, guides bases and water drainage equipment. The pit shall be free of any material that may lead to slide, and designed to resist water leakage.

4.18.3. The lighting for lifts, pit, machinery room or pulley shall be separated from the feeding of the lift machine, whether through another circuit or from the same circuit, but shall be connected before the main circuit breaker(s).

4.18.4. The feeding required for the plugs- located at the roof of the car and in machinery and pulley room, as well as the well as the pit, shall be separated from the feeding of the lift machine; either through other circuits or from the same circuit, but shall be connected before the main breaker. Such plugs shall be of a triangular type 2P+PE, 250V.

Using the above-mentioned plugs shall not mean the use of an electric cable with a cross-section size of the connector equivalent to the current passing through it.

The cross-sectional area of the conductor may be smaller, provided that the same shall be protected from excess currents.

4.18.5. The pit shall be equipped with: -

i. An electric switch accessible when opening the level door to stop the lift;
ii. Electric plug;
iii. Electric switch for lightening the well accessible when opening the door leading to the pit.

4.18.6. When the car is stable on the fully compressed buffers, the following conditions shall be met at the same time:

a) The vertical distance between the floor of the pit and the lowest part of the car shall not be less that 0.5 m. This distance may be reduced to less than 0.10 m within a horizontal distance of 0.15 m between:

i.A protective barrier or part of the vertically sliding doors of the car.
ii.The lowest part of the car and guide rails.

b) The free vertical distance between the highest fixed part of the pit, for example the tensile device of the compensation ropes located at the top part thereof and lowest part of the car, except the ones detailed in a (1) and (2) above which shall be 0.3 m at least.

4.19. Electrical Safety Requirements

4.19.1. Defects hereunder, which can occur to the electrical equipment of the lift, shall not cause hazards to the operation of the lift:

i. Loss of voltage.
ii. Low voltage.
iii. Loss of conductor continuity.
iv. Insulation defect in metal tools or grounding.
v. Short circuit or separation of circuit. Change in value or operation of an electrical component such as the resistor, capacitor, transistor, lamp, etc.).
vi. Lack or weak attraction of the armature of the contactor or relay.
vii. Non-separation of the armature of the contactor or relay.
viii. Failure to open the contact.
ix. Failure to close the contact.
x. Phase reflection.

4.19.2. All openings in electrical wiring shall be protected to prevent hazards and electric shocks.

4.20. Emergency Operation

4.20.1. If the manual force required to move the car upward with its full rated load exceeds 400 Newtons, the lift machine must be equipped with a manual emergency operation device allowing the car to be moved to the landing level using a smooth wheel.

4.20.2. If these devices are removable, they must be stored in an easily accessible location in the machine room, clearly marked to prevent confusion with devices for other machines.

4.20.3. It must be easy to check whether the car has reached the door unlocking zone by marking the suspension ropes or speed governor rope.

4.20.4. In the event of an emergency, the power switch shall provide a means to control the movement of the lift car. This control shall be achieved through the use of protected buttons that require continuous pressure from the operator. The direction of movement (up or down) shall be clearly indicated.

4.21. Alarm System

4.21.1. Each lift must have an emergency alarm that can be activated from inside the car, audible from outside the shaft, or an emergency communication system to contact rescue services.

4.21.2. The alarm device must have a clear label (Lift Alarm) indicating its purpose. For multiple lift, the car from which the call originated must be identifiable.

4.21.3. The system must provide continuous two-way voice communication with rescue services, with no additional actions required from the trapped person after initiating the call.

4.21.4. Lifts with a travel distance exceeding 30 meters must have an intercom system or a similar system between the car and the machine room, powered by an emergency power source.

4.22. Over Speed Governor

4.22.1. The speed governor for the car's safety device must activate at a speed of at least 115% of the lift's rated speed and less than:

a. 0.8 m/s for the over speed governors of immediate type, excluding those of the captive roller type.
b. 1 m/s for the over speed governors of immediate type, including those of the captive roller type.
c. 1.5 m/s for the over speed governors of immediate type with impact buffers and rated safety devices for the rated speeds of not more than 1.0 m/s.
d. 0.25 m/s + 1.25 m/s for the over speed governors with rated speeds of more than 1.0 m/s.

4.22.2. For lifts with rated speeds exceeding 1 m/s, the speed necessary to activate the governor should be as close as possible to the values mentioned from 22-1.

4.22.3. For lifts with heavy rated loads and low rated speeds, the governor must be specifically designed for this purpose, with activation speed as close as possible to the minimum values mentioned from 22-1.

4.22.4. The activation speed for the counterweight safety device's governor must be greater than that for the car's safety device as mentioned in 22-1, not exceeding it by more than 10%.

4.22.5. The governor must indicate the direction of rotation corresponding to the safety device's operation.

4.22.6. The governor must be operated by a steel rope designed for this purpose, with a minimum breaking load related to a safety factor of at least 8 times the tensile force generated in the governor rope during activation. The maximum friction factor (μmax) should be 0.2 for traction-type governors, with a nominal rope diameter of at least 6 mm.

4.22.7. The governor or any other device must activate to stop the lift machine by an electrical safety device before the car reaches the activation speed, whether ascending or descending.

4.22.8. If the governor does not automatically return to its position after activating the safety device, the electrical safety device must prevent the lift from moving until the governor is reset.

4.22.9. Access to the governor must be possible for inspection and maintenance purposes. If the governor is installed in the lift well, it must be accessible from outside the shaft.

5.0 Occupancy Requirements

5.1 Hotel/Residential Occupancy

5.1.1. The General requirement shall be as per **Table:- H.A02.T1**

Table:-H.A02-T1: Hotel/Residential Occupancy

Type of Car	Car Capacity (kg)	Length (m)	width (m)	Lift Area (m^2)	Area of Person (m^2)	Number of people
1	450	1	1.3	1.3	0.3	4
2	630	1.1	1.4	1.54	0.3	5
3	1000	1.1	2.1	2.31	0.3	8
4	1000	1.6	1.4	2.24	0.3	7
5	1275	2	1.4	2.8	0.3	9

Note: The default standard for the passenger's weight is 75 kg.

5.2. Business Occupancy

5.2.1. The General requirement shall be as per **Table:- H.A02.T2**

Table:-H.A02-T2: Business Occupancy

Type of Car	Car Capacity (kg)	Length (m)	width (m)	Lift Area (m^2)	Area of Person (m^2)	Number of people
1	450	1	1.3	1.3	0.21	6.2
2	630	1.1	1.4	1.54	0.21	7
3	1000	1.1	2.1	2.31	0.21	11
4	1000	1.6	1.4	2.24	0.21	11
5	1275	2	1.4	2.8	0.21	13

5.3. Healthcare Occupancy

5.3.1. The General requirement shall be as per **Table:- H.A02.T3**

Table:-H.A02-T3: Healthcare Occupancy

Rated Load (kg)	Car floor width by depth (mm)	Clear door opening width (mm)	Application
630	1100 × 1400	900	General passenger lifts in small healthcare buildings, firefighters' lifts, escape lifts
800	1350 × 1400	900	General passenger lifts in small healthcare buildings, firefighters' lifts, escape lifts
1000	1600 × 1400	1100	General passenger lifts, firefighters' lifts, escape lifts
1275	2000 × 1400	1100	General passenger lifts, firefighters' lifts, escape lifts
1600	1400 × 2400	1400	Trolley/stretcher lifts, housekeeping lifts
2500	1800 × 2700	1400	Bed lifts, escape lifts
2500	1800 × 2700	1800	General goods lifts
5000	2500 × 3500	2500	Large goods lifts

5.4. Lift Car Dimensions

5.4.1. The General requirement shall be as per **Table:- H.A02.T4**

Table:-H.A02-T4: Lift Car Dimensions

Type of car	Minimum car dimensions[a]	Accessibility level	Building types, usage	Remarks
1	Car width: 1000 mm Car depth: 1300 mm (450 kg)	This car accommodates one wheelchair user without an accompanying person.	Shall only be used in existing buildings where building constraints do not permit the installation of a type 2 car.	Type 1 provides only limited accessibility for persons using a manual wheelchair as described in EN 12183:2014 or an electrically powered wheelchair of Class A as described in EN 12184:2014. This type also provides accessibility for persons using walking aids (e.g. a walking stick) and for persons with sensory and intellectual disabilities.
2	Car width: 1100 mm Car depth: 1400 mm (630 kg)	This car accommodates one wheelchair user and an accompanying person.	Shall be the minimum size for new buildings.	Type 2 provides accessibility for persons using a manual wheelchair as described in EN 12183:2014 or an electrically powered wheelchair of Class A or B as described in EN 12184:2014. This type also provides accessibility for persons using walking aids (e.g. a walking stick) and for persons with sensory and intellectual disabilities. Passenger with wheelchairs or walking aids are unlikely to be able to turn around in this type of car and have to leave the car backwards.
3	Car width: 1100 mm Car depth: 2100 mm (1000 kg)	This car accommodates one user with a wheelchair of Class C and some other passengers. It also allows transport of stretchers.	Recommended size for cars in public areas (e.g. outdoor facilities, stations etc.) and for cars where transport of wheelchairs of Class C shall be provided.	Type 3 provides accessibility for persons using a manual wheelchair as described in EN 12183:2014 or an electrically powered wheelchair of Class A, B or C as described in EN 12184:2014. It also provides accessibility for persons using manual wheelchair with tractor unit (propulsion attachment). When cars of this type are configured with two opposite entrances this can provide straight through circulation from the main entrance to different floor levels.

4	Car width: 1600 mm Car depth: 1400 mm Or Car width: 1400 mm Car depth: 1600 mm (1000kg)	This car accommodates one wheelchair user and a few other passengers. It also allows a wheelchair to be rotated within the car.	Shall be the minimum size for cars with doors on adjacent walls[b].	Type 4 provides accessibility for persons using a manual wheelchair as described in EN 12183:2014 or an electrically powered wheelchair of Class A or B as described in EN 12184:2014. Type 4 provides sufficient space for most wheelchair users and for passengers with walking aids.
5	Car width: 2000 mm Car depth: 1400 mm or Car width: 1400 mm Car depth: 2000 mm (1275 kg)	This car accommodates one wheelchair user and several other passengers. It also allows a wheelchair to be rotated within the car.		Type 5 provides accessibility for persons using a manual wheelchair as described in EN 12183:2014 or an electrically powered wheelchair of Class A, B or C as described in EN 12184:2014. Type 5 provides sufficient turning space for persons using wheelchairs of Class A or B and for persons using walking aids (e.g. walking frames, rollators etc.)

a. The car width is defined as the horizontal distance between the inner surface of the structural walls of the car measured parallel to the front entrance. The car depth is defined as the horizontal distance between the inner surfaces of the structural walls of the car measured perpendicular to the width.
b. The distances between the doors and adjacent car walls as shown in Figure 1 [of BS EN 81-70:2018] should be as large as possible.

6.0 Maintenance & Inspection

6.1 Maintenance (Electric Lift)

6.1.1. The Maintenance requirement of Electric Lift shall be as per **Table:- H.A02.T5**

Table:-H.A02-T5: Maintenance (Electric Lift)

Area	Equipment's	Check
General	Housekeeping	All equipment and devices must be free of dust, corrosion or rust
	Electric wiring	All electrical connections must be insulated
Pit	Pit area	For excess oil/grease at bottom of guides; area is clean, dry and free from debris
	Anti-rebound device and switch	Free movement and tension of ropes, location of the switch And Operating
	buffer	Oil level; lubrication; switch (where fitted); fixings; operation.
	Electric safety devices	Operating
Machine room	Drive motor/generator	condition of the bearings, commutator and lubrication
	Gear box	Condition of gears and lubrication
	Traction sheave	Condition of traction sheave
	Brake	condition of braking system, gear condition, and stopping accuracy
	Controller	cabinet is clean ,dry and free from dust
	Over speed Governor and tension pulley	Ensuring free movement of moving parts and their condition. Also, its operation and switch
	Main rope diverter pulley(s)	condition of the pulley and bearings (vibration, noise), commutator and lubrication
	Suspension ropes/chains	condition the wear, elongation and tension; lubrication only where intended
	Rope/chains terminations	Condition of the deterioration and wear; fixings
	Safety gear	Moving parts for free movement and wear; lubrication; fixings; operation; switch
	Motor run time limiter	Operating
	Electric safety devices	Operating electric safety chain; correct fuses are fitted
Well	Car/counterweight guides	All guides rail are oiled, fixing
	Car/counterweight guide shoes	condition of Guide shoes/rollers for wear; fixings; lubrication where necessary
	Suspension ropes/chains	Wear of rollers or packing plates, fastening, lubrication
	Rope/chains terminations	For deterioration and wear; fixings
	Final limit switches	Operating
	Well lighting	Operating

	Electric safety devices	Operating electric safety chain
Externall	Lift Car	Emergency lighting, car buttons, key switches; fixings of panels and ceiling
	Landing entrances	Operation of landing locks; doors for free running; door guiding; door gaps; wire rope, chain or belt when used, for integrity; emergency unlocking device; lubrication
	Car door	Door closed contact or lock; doors for free running; door guiding; door gaps; wire rope or chain when used for integrity; passenger door protective device; lubrication
	Floor level	Stopping accuracy at landing
	Emergency alarm device	Operation
	Landing controls and indicators	Operation

6.2 Maintenance (Hydraulic Lift)

6.2.1 The Maintenance requirement of Hydraulic Lift shall be as per **Table:- H.A02.T6**

Table:-H.A02-T6: Maintenance (Hydraulic Lift)

Area	Equipment's	Check
General	Housekeeping	All equipment and devices must be free of dust, corrosion or rust
	Electric wiring	All electrical connections must be insulated
Pit	Pit area	For excess oil/grease at bottom of guides; area is clean, dry and free from debris
	buffer	Oil level; lubrication; switch (where fitted); fixings; operation.
	Electric safety devices	Operating
Machine room	Tunk unit	check Fuel level, tank outlets for any leakage
	Controller	cabinet is clean ,dry and free from dust
	Pressure relief valve	Operating
	manual relief valve	Operating
	Hand pump	Operating
	Motor run time limiter	Operating
	Electric safety devices	Operating electric safety chain; correct fuses are fitted
	Hoses/pipework	For damage and leakage
Well	jack	Oil leakage
	Telescopic Jack	Synchronization
	Over speed Governor and tension pulley	Ensuring free movement of moving parts and their condition. Also, its operation and switch
	Main rope pulley(s)	condition of the pulley and bearings (vibration, noise), commutator and lubrication
	Car/balancing weight/ jack guides	All guides rail are oiled, fixing
	Car/balancing weight/ jack shoes	condition of Guide shoes/rollers for wear; fixings; lubrication where necessary
	Safety gear	Moving parts for free movement and wear;; fixings; operation; switch
	Suspension ropes/chains	Wear of rollers or packing plates, fastening, lubrication
	Rope/chains terminations	For deterioration and wear; fixings
	Final limit switches	Operating
	Well lighting	Operating
	Electric safety devices	Operating electric safety chain
	Anti-creep device	Operation
	Rupture valve/one way restrictor	Operation

	Hoses/pipework	For damage and leakage
Externall	Lift Car	Emergency lighting, car buttons, key switches; fixings of panels and ceiling
	Landing entrances	Operation of landing locks; doors for free running; door guiding; door gaps; wire rope, chain or belt when used, for integrity; emergency unlocking device; lubrication
	Car door	Door closed contact or lock; doors for free running; door guiding; door gaps; wire rope or chain when used for integrity; passenger door protective device; lubrication
	Floor level	Stopping accuracy at landing
	Emergency alarm device	Operation
	Landing controls and indicators	Operation

6.3 Inspection Checklist

6.4 Lift Alarm System Requirements

6.4.1. Smoke detectors, whether integrated or other types of automatic fire detectors located in lift lobbies, shafts, and machine rooms—including spaces allocated for machines, control rooms, and control areas used to initiate firefighter service calls—must be linked to the building's or establishment's alarm systems.

6.4.2. Each smoke detector in the lift lobby, shaft, and machine room, or other automatic fire detection systems must be capable of initiating a lift recall when all other devices on the same starting device circuit are in alarm state, either manually or automatically.

6.4.3. The smoke detector in the lobby should be placed on the ceiling within 6.4 meters of the centerline of each lift door within the group of lifts under the detector's control.

6.4.4. Smoke detectors should not be installed in lift shafts without sprinklers unless they are installed to activate smoke exhaust equipment for the shaft.

6.4.5. If environmental conditions prevent the installation of an automatic smoke detection system, another type of automatic fire detection system should be allowed.

6.6.6. When any detector initiates firefighter service procedures, it should also be announced at the building's or establishment's alarm control unit and remote notification systems.

7.0 Firefighter and evacuation lift

7.1. Introduction

There are two types of lifts that can operate in the event of a fire in the building, which are most likely created for this purpose. They are as follows:

7.1.1. Firefighter lifts: Firefighters use this type of lift to move between floors, especially the upper floors, and to transport their equipment. The requirements for the lift are specified in BS EN 81-72.

7.1.2. Evacuation lifts: firefighters or the evacuation team to evacuate people with limited mobility who cannot easily use the stairs uses this type.

7.2. Requirements:

7.2.1. At least one lift must be available for the use of firefighters in buildings whose height is more than six floors, or in buildings where the height exceeds 24 meters from ground floor level, whichever is lower, or in buildings where the depth in the basement from ground level to the lowest floor served by the lift exceeds 10 meters, or in buildings where the General Fire Department deems it necessary to have an lift for the use of firefighters.

7.2.2. If there are several lifts, at least one lift is chosen for the use of firefighters, and it must be the largest lift.

7.2.3. The speed of the firefighter lift must not be less than 1 m/s.

7.2.4. The lift load must not be less than 630 kg or 1000 kg, depending on the case.

7.2.5. If the lift is used for evacuation or to use a stretcher for the injured, or if there are opposite doors to the lift, the load of the firefighter lift must not be less than 1,000 kg, and the car size must not be less than (2.1 m x 1.1 m). This type of lifts is required in all buildings exceeding 10 floors, as well as some buildings with special nature.

7.2.6. The clear door width must not be less than 0.8 m

7.2.7. The firefighter lift must reach the ground floor to the highest floor in the building in less than a minute, and the time is calculated after the closure of doors.

7.2.8. The travel distance between the firefighter lift and any point on the same floor designated to accommodate people in the building must not exceed 60 meters.

7.2.9. If the floor area of the building is 900 square meters or less, the presence of one lift well is sufficient to use for the firefighters' lift in the building.

7.2.10. If the floor area in the building is 900 square meters or more, there must be at least two lift wells to accommodate two or more lifts for firefighters to use in order to cover all parts of the building and achieve the required travel distance in the building.

7.2.11. When designing the well, ease of access to all parts of the building must be taken into account.

7.2.12. In the event that there is no firefighter lift near the main entrance to the building, it must be taken into account that the distance from the entrance designated for firefighters to the firefighter lift does not exceed 15 m. It must be ensured that access route is through a protected, fire-resistant corridor in order to facilitate the evacuation and escape process.

7.2.13. The firefighter lift must connect directly and allow access to all floors above the ground floor in the building.

7.2.14. The firefighter lift can be used by people at normal times and is prohibited from being used to transport goods and waste at all times.

7.2.15. The lift must withstand a temperature of 70 C in lift lobbies and machine rooms.

7.2.16. Electrical and electronic control panels must operate under the effect of smoke in the machine room and well for a period of not less than two hours.

7.2.17. Call switches, signals, and electrical appliances must withstand a temperature of 70 C for a period of not less than two hours.

7.2.18. Automatic doors must be used for all lift doors (car and floor landings) and they must be fire-resistant for a period of not less than an hour and a half.

7.2.19. A light signal must be installed indicating that the lift is in an emergency state.

7.2.20. The lift must be provided with a telephone or intercom that connects the lift user to the machine room and the main entrance for firefighters.

7.2.21. A sign must be installed indicating that it is a firefighter's lift.

7.2.22. In the event that there is a firefighter lift with a group of shared lifts, the well must achieve for all lifts the same level of fire resistance as that required for the firefighter lift well. This requirement also applies to the lift lobby and the machine room. In the event that there is no wall separating the firefighter lift from the other lifts, all lifts and their electrical equipment must achieve the same level of fire resistance as that required for the firefighter lift, in order to ensure the correct operation of the firefighter lift and its safe performance.

7.2.23. The operation of the firefighter lift must continue and not be affected in the event of an electrical malfunction through the lift call switch or any other switch outside the well.

7.2.24. The firefighter lift must continue to operate and not be affected in the event of an electrical malfunction in the event that a group of lifts is located in a common well.

7.3 Firefighter lift lobby requirements

7.3.1. The firefighter lift must be in a special hall protected from fire on all floors, and the hall area must be sufficient to allow the insured's stretcher to enter through the door.

7.3.2. The firefighter lift key must be in the lift's private lobby, along a horizontal distance of 2 m near the lift, and at a height of between 1.8 m and 21 m from ground level.

7.3.3. The net area of the firefighter lift lobby must not be less than 2.5 m^2, excluding the area allocated for escape corridors in the lift lobby.

7.3.4. The area of the lift lobby designated for firefighters at the main entrance designated for firefighters must be sufficient to accommodate firefighters and their equipment.

7.3.5. It is preferable to have the lift lobby and the building staircase in one area in order to use it as a protected area that can be used by people who find it difficult to use stairs. Additionally, the necessity of having stairs is to provide an alternative in case of a sudden malfunction or issue with the lift, which would allow firefighters and other emergency personnel to access the building.

7.3.6. An instruction board must be placed in the lift lobby showing the load and the number of passengers allowed, and it must contain a diagram of the escape routes on the ground floor or the evacuation floor.

7.4. Special requirements for electrical supply sources

7.4.1. The backup supply source for the firefighter lift must be protected from fire and in a safe area.

7.4.2. Two sources (main and backup) must be provided for electrical supply to the lift and lighting.

7.4.3. The supply cables for the main and backup sources must be of the fire-resistant type and must be isolated from other supply sources.

7.4.4. The reserve source must be sufficient to operate the firefighter lift with the required load and meet the needs of the firefighter lift reaching the highest floor in a time not exceeding one minute.

7.5. Protect equipment from the influence of water

7.5.1. The electrical and lighting source must be at a distance of no less than 0.5 m from the permissible level of water in the pit.

7.5.2. The equipment located in the vicinity of the machine outside the well or hole must be provided with adequate protection and not be affected by malfunctions due to water.

7.5.3. The water must not rise above the level of the shock absorber (BUFFER) while it is fully compressed.

7.5.4. It must be ensured that the water level does not reach parts that may cause the lift to malfunction.

7.6. Escape hatches in the lift ceiling

7.6.1. An escape hatch must be provided in the ceiling of the lift with dimensions of not less than 50 cm x 70 cm. For an lift with a capacity of 630 kg, the dimensions of the escape hatch must not be less than 0.504 square meters.

7.6.2. Entry and exit from the escape hatch must be without difficulty and free of obstacles, whether there is lighting installed inside the car. In the event of a false ceiling, it must be possible to open and remove it without using any auxiliary tools.

7.7. Call other lifts for firefighter use.

7.7.1. A manual operating switch must be provided on the ground floor next to the other lifts. It must be activated in the event of a fire, including all lifts. The key must be in a glass box with a sign explaining its purpose.

7.7.2. If the manual switch is activated or a signal is received from the main alarm panel indicating the presence of a fire in the building, the situation will be reacted to as follows:

A- All lift control switches on the ground floor or inside the lift, including the door reopening switch, are turned off.

B All orders in all floors are cancelled.

7.7.3. If there are door sensors that are affected by heat or smoke, they must be stopped working so that the doors can be closed.

7.7.4. In the event of a power outage to one of the lifts in the group, the other lifts must not be affected and must return to the ground floor or the evacuation floor.

7.7.5. If the lifts reach the ground floor or the evacuation floor, the doors of the lift car and the landing doors must be opened and stopped from service.

7.7.6. The lift must be reactivated to normal mode through an electrical signal from the main alarm panel or by reactivating the firefighter's switch on the ground floor.

7.8 Activate the firefighter lift

Activating the firefighter lift takes place in two basic stages:

7.8.1 The first phase

i. In case the switch, button, or detector is activated, either manually or automatically by the alarm system (if present in the building), all lift calls will be cancelled, and the lifts will return to the ground floor or the evacuation floor.
ii. Lift requests from floors other than the ground floor or evacuation floor will not be accepted, and all current operations will be terminated until the lifts reach the ground floor.
iii. All lifts in all floors must be directed towards the ground floor.
iv. All landing doors and car doors must be closed if they are on different floors, and opened when they reach the ground floor.
v. The doors must be opened when they reach the ground floor and remain open.
vi. The audio device must stop working after arriving and opening the doors.

7.8.2 The second phase

After activating the operating mode in the first phase:

i. All lift requests will be cancelled, and the smoke and heat sensors in the doors will be stop working due to the possibility of closing the doors.
ii. The door will be closed by pressing the car door close button and holding it until the door is fully closed. If the pressure on the button is released before the door is fully closed, the door will automatically open.
iii. When the button for the desired floor is pressed, the lift will travel to that floor. If multiple floor buttons are pressed, the lift will travel to the nearest requested floor. Upon reaching that floor, all other floor requests will be cancelled, and the user will need to press the button for the desired floor again.
iv. Upon reaching the desired floor, the user must press and hold the door open button until the door is fully open. If the finger is removed from the button before the door is fully open, the door will close again.
v. The restart of the firefighter lift and its return to actual service is done through an electrical signal from the main alarm panel when it is reactivated, or by restarting the firefighter lift switch on the ground floor.

8.0 Lift Maintenance and Periodic Inspection Requirements

- The lift must be inspected and approved by a specialized technical inspection and examination entity accredited by the Civil Defense.

- Each lift should undergo regular service covering periodic maintenance by an experienced entity in lift maintenance and accredited by relevant authorities such as the Civil Defense.

- A record of periodic maintenance and fault repairs, along with their dates, should be kept in the lift's machine room.

- The entity responsible for periodic maintenance is also responsible for addressing lift faults, ensuring their service is available 24/7.

- The entity responsible for periodic maintenance and inspection must notify the official authority immediately in the following cases:

1. When a maintenance contract is signed or canceled.

2. When an inspector notices any defect affecting the safety of lift users.

3. When the building owner refuses to carry out the required maintenance work.

4. The Civil Defense is the reference for resolving disputes between concerned parties or violations of these requirements.

- The building owner must take measures to maintain the lift's safety.

- A responsible person, such as a building guard or lift operator, should be trained to operate the lift under normal conditions and to handle incidents and faults, notify the maintenance entity, and contact the Civil Defense if maintenance requests are refused.

9.0 References

i BS EN 81-1: Safety rules for the construction and installation of lifts. Electric Lifts
ii BS EN 81-2: Safety rules for the construction and installation of lifts. Hydraulic Lifts
iii BS EN 81 -72: Safety rules for the construction and installation of lifts. Particular applications for passenger and goods passenger lifts. Firefighter's lifts.
iv BS 9999: Fire safety in the design, management and use of buildings. Code of practice



Chapter 3

CCTV

Annex

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CCTV



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1.0 Scope

The camera security surveillance system aims to provide effective solutions for monitoring facilities around the clock, with a focus on installing cameras in vital locations. The installation and operation of the cameras must be continuously adhered to, and a control room should be designated, with the possibility of connecting to the Ministry of Interior's devices when needed. The General Directorate of Civil Defense specifies the technical specifications for surveillance devices, including their installation locations and quantities. Facility owners must regularly maintain and update the system to ensure its efficiency, retain the recordings without any modifications, and submit them to the General Directorate of Civil Defense upon request. It is prohibited to transfer or store recordings without obtaining official approval, and the installation of cameras in places such as bedrooms, bathrooms, physiotherapy rooms, changing rooms, and areas designated for women is also prohibited. These measures come within the framework of enhancing the public interest, as surveillance systems contribute to providing a safe and stable environment, while achieving a balance between security and individual rights.

2.0 Definitions

2.1 General

2.1.1 Shall

It is mandatory requirement for General Directorate of Civil Defense (GDCD) -Kingdom of Bahrain

2.1.2 Should

It is a suggested requirement recommended by General Directorate of Civil Defense (GDCD) - Kingdom of Bahrain but not Mandatory

2.1.3 Listed

Permitted and registered by General Directorate of Civil Defense (GDCD)
- Kingdom of Bahrain.

2.1.4 Security Surveillance System

The security surveillance system is a set of tools and techniques designed to monitor and protect locations and individuals from potential threats, and this system aims to enhance security. The security camera system is considered an essential part of surveillance systems, as it is used to monitor and record activities in various environments. The cameras are installed in strategic locations to monitor sensitive or important areas.

3.0 Security Surveillance System

3.1 General

3.1.1 Security cameras and monitoring devices must be installed and operated around the clock, and they should have a control room. Their cameras and monitoring devices should be linked to the Ministry of Interior's systems if such linkage is required.

3.1.2 Owners and managers of facilities and organizations must maintain and periodically update surveillance cameras and devices to ensure their proper performance, continuous compliance with technical specifications, and effectiveness in achieving their intended purpose, at their own expense and within the specified timelines.

3.1.3 The specifications for security surveillance systems are determined by the General Directorate of Civil Defense - Kingdom of Bahrain.

3.2 Applicability

3.2.1 The responsibility for adhering to these requirements lies with the building owner and the project consultant, in coordination with the General Directorate of Civil Defense - Kingdom of Bahrain.

3.2.3 The requirements outlined in this chapter are general guidelines for security monitoring systems. The use of advanced systems that exceed the requirements of this chapter is permitted.

3.2.4 The building owner and project consultant are responsible for providing the infrastructure, system characteristics, and requirements necessary for integration according to the specifications of the security monitoring system as required by the General Directorate of Civil Defense - Kingdom of Bahrain.

3.2.5 All recording devices must be installed in secure locations under continuous surveillance, with access limited to authorized personnel only, and tampering must be prevented.

3.2.6 The General Administration of Civil Defense, according to its discretion and regulatory authority, has the authority to determine and add additional locations for the installation and operation of security surveillance systems (cameras) as required by public interest and security requirements, after conducting the necessary technical studies.

3.3. Specifications

3.3.1. The minimum specifications of the security monitoring system shall be in accordance with **Table:-C.02-T1**

Table:- C.02-T1 : Smart Monitoring System Specifications

ITEMS	REQUIREMENTS
1. Cameras	1. Must be coloured. 2. The camera resolution must not be less than Full HD 1080p. 3. It must be compatible with ONVIF standards. 4. It should support H264/H265, MJPEG compression formats. 5. They must be visible and not hidden; if this is not possible, special approval must be obtained from the General Directorate of Civil Defense –Kingdom of Bahrain. 6. The live feed must not be less than 30 frames per second for each camera. 7. For outdoor cameras. Its rating should not be less than IP66, or it should be placed in a dedicated surveillance camera enclosure with a rating of at least IP66, suitable for working in external environmental conditions characterized by high temperatures, humidity, and dust levels. 8. The audio recording feature may not be used without the approval of the General Directorate of Civil Defense – Kingdom of Bahrain. 9. The installation of cameras and security monitoring devices in bedrooms, bathrooms, physiotherapy rooms, changing rooms, and areas designated for women is prohibited.
2.Recording Devices	1. The recording resolution should not be less than Full HD 1080P and support up to 5MP. 2. The live display resolution should not be less than Full HD 1080P in the case of single-camera display. 3. It must be capable of performing the three basic functions simultaneously, which are: i. Live broadcast ii. Recording. iii. Viewing the recordings. 4. The device must be capable of displaying the camera name, real time, and date clearly without affecting the scene, and the camera name should be descriptive and indicative of the location being monitored, not just symbols. 5. The device must have the automatic self-recording feature in case of a restart for any reason (misuse, error during shutdown, maintenance, or the device experiencing an operational halt). 6. It is prohibited to transfer, store, send, or publish any of the mentioned recordings without the approval of the General Directorate of Civil Defense – Kingdom of Bahrain.
3.Projectors	1. All screens must have high operational specifications suitable for continuous operation. 2. The display resolution should not be less than Full HD 1080P. 3. The aspect ratio of the displayed images and scenes must be balanced to match standard ratios such as (4:3), (16:9), and other standard ratios. 4. The display screen should be dedicated to monitoring and not for television viewing. 5. Screens must be provided for all cameras. 6. Important cameras must be displayed in the center of the screen and include the facility entrance, reception offices and similar areas, passenger drop-off zones, elevator and stair lobbies on the main floors, the main lobby, and any other locations specified by the General Directorate of Civil Defense.

3.4. Classification of occupancies and camera locations.

3.4.1. The minimum locations of the security monitoring system shall be in accordance with **Table:-C.02-T2**

Table:- C.02-T1 : Smart Monitoring System Locations

Occupancy	Locations
1.Commercial Establishments **- Category A** **- Category B** **- Category C**	1. Entrances and exits of the facility. 2. Main emergency exits on the ground floor and parking areas leading outside the facility. 3. Emergency exits between floors. 4. Main reception areas. 5. All corridors of the facility. 6. Prayer room corridors. 7. Restroom corridors. 8. All locations of ATMs. 9. The exterior area of the facility (covering surrounding streets and parking, with a camera view angle of no less than 110 degrees horizontally). 10. Areas for visitors getting in and out of vehicles. 11. All loading and unloading areas. 12. Vehicle entrances and exits to the facility and parking lots (including multi-story parking and basements, indicating vehicle plates, types, and colors). 13. Parking lot pathways. 14. Around the perimeter of the building. 15. External walkways. 16. Gardens and green areas within the facility boundaries. 17. Gathering points in case of emergencies. 18. Lobby or main reception area. 19. Elevator door halls. 20. Inside elevators. 21. Areas for ascending and descending stairs and escalators. 22. Inside storage rooms. 23. Waiting areas. 24. Entrances and exits of halls. 25. Gas cylinder storage area and water tank rooms. 26. Air handling unit entrances for air conditioning systems. 27. Entrances to communication, data, and electrical network rooms. 28. Fuel tanks for backup generators.
2.Residential Buildings, Hotels, and similar facilities	1. Entrances and exits of the facility. 2. Main emergency exits on the ground floor and parking areas leading outside the facility. 3. Emergency exits between floors. 4. Main reception areas. 5. All corridors of the facility. 6. Prayer room corridors. 7. Restroom corridors. 8. All locations of ATMs. 9. The exterior area of the facility (covering surrounding streets and parking, with a

	camera view angle of no less than 110 degrees horizontally). 10. Areas for visitors getting in and out of vehicles. 11. All loading and unloading areas. 12. Vehicle entrances and exits to the facility and parking lots (including multi-story parking and basements, indicating vehicle plates, types, and colors). 13. Parking lot pathways. 14. Around the perimeter of the building. 15. External walkways. 16. Gardens and green areas within the facility boundaries. 17. Gathering points in case of emergencies. 18. Lobby or main reception area. 19. Elevator door halls. 20. Inside elevators. 21. Areas for ascending and descending stairs and escalators. 22. Inside storage rooms. 23. Waiting areas. 24. Entrances and exits of halls. 25. Gas cylinder storage area and water tank rooms. 26. Air handling unit entrances for air conditioning systems. 27. Entrances to communication, data, and electrical network rooms. 28. Fuel tanks for backup generators. 29. Restaurants, cafes, and external shops within the facility boundaries. 30. Sports fields and outdoor pools. 31. Safekeeping rooms for valuables and bags. 32. Entrances and exits of halls. 33. Corridors of shops and restaurants inside the facility.
3.Commercial Establish-ments and shopping centers	1. Entrances and exits of the facility. 2. Main emergency exits on the ground floor and parking areas leading outside the facility. 3. Emergency exits between floors. 4. Main reception areas. 5. All corridors of the facility. 6. Prayer room corridors. 7. Restroom corridors. 8. All locations of ATMs. 9. The exterior area of the facility (covering surrounding streets and parking, with a camera view angle of no less than 110 degrees horizontally). 10. Areas for visitors getting in and out of vehicles. 11. All loading and unloading areas. 12. Vehicle entrances and exits to the facility and parking lots (including multi-story parking and basements, indicating vehicle plates, types, and colors). 13. Parking lot pathways. 14. Around the perimeter of the building. 15. External walkways. 16. Gardens and green areas within the facility boundaries. 17. Gathering points in case of emergencies. 18. Lobby or main reception area. 19. Elevator door halls.

	20. Inside elevators. 21. Areas for ascending and descending stairs and escalators. 22. Inside storage rooms. 23. Waiting areas. 24. Entrances and exits of halls. 25. Gas cylinder storage area and water tank rooms. 26. Air handling unit entrances for air conditioning systems. 27. Entrances to communication, data, and electrical network rooms. 28. Fuel tanks for backup generators.
4.Healthcare Facilities	1. Entrances and exits of the facility. 2. Entrances to emergency medical service centers. 3. Entrances to operating rooms, intensive care units, radiology rooms, morgues, and neonatal intensive care units. 4. Entrances to laboratories, pharmacies, drug storage areas, blood banks, supply rooms, the central kitchen, cafeterias, hospitality shops, and services. 5. Inside laboratories, pharmacies, drug storage areas, blood banks, supply rooms, the central kitchen, cafeterias, hospitality shops, and services. 6. Medical and administrative archives. 7. Main emergency exits on the ground floor and parking areas leading outside the facility. 8. Emergency exits between floors. 9. Main reception areas. 10. All corridors of the facility. 11. Prayer room corridors. 12. Restroom corridors. 13. All locations of ATMs. 14. The exterior area of the facility (covering surrounding streets and parking, with a camera view angle of no less than 110 degrees horizontally). 15. Areas for visitors getting in and out of vehicles. 16. Ambulance access points. 17. All loading and unloading areas. 18. Vehicle entrances and exits to the facility and parking lots (including multi-story parking and basements, indicating vehicle plates, types, and colors). 19. Parking lot pathways. 20. Around the perimeter of the building. 21. External walkways. 22. Gardens and green areas within the facility boundaries. 23. Gathering points in case of emergencies. 24. Lobby or main reception area. 25. Elevator door halls. 26. Inside elevators. 27. Areas for ascending and descending stairs and escalators. 28. Inside storage rooms. 29. Waiting areas. 30. Entrances and exits of halls. 31. Gas cylinder storage area and water tank rooms. 32. Air handling unit entrances for air conditioning systems. 33. Entrances to communication, data, and electrical network rooms.

	34. Fuel tanks for backup generators. 35. Restaurants, cafes, and external shops within the facility boundaries. 36. Sports fields and outdoor pools. 37. Safekeeping rooms for valuables and bags. 38. Entrances and exits of halls. 39. Corridors of shops and restaurants inside the facility.
5.Fuel Dispensing Stations and Gasoline Retail	1. Vehicle entrances and exits to the station and parking lots. 2. Locations of fuel supply lines for vehicles. 3. Locations for fueling the station. 4. Vehicle parking areas. 5. Vehicle service locations. 6. At the entrances to external restrooms. 7. At the entrances to stores. 8. At cash registers and payment terminals. 9. At all locations of ATMs. 10. The exterior area of the facility (covering surrounding streets and parking, with a camera view angle of no less than 110 degrees horizontally). 11. All loading and unloading areas. 12. Around the perimeter of the facility. 13. Inside storage rooms. 14. Outdoor areas. 15. Gathering points in case of emergencies. 16. Entrances to communication, data, internal network, and electrical rooms. 17. Gas cylinder storage area, liquefied gas storage area, and filling locations, along with water tank rooms. 18. Backup fuel tanks. 19. Air handling unit entrances for air conditioning systems.
6.Educational Facilities	1. Entrances and exits of the facility. 2. Main emergency exits on the ground floor and parking areas leading outside the facility. 3. Emergency exits between floors. 4. Main reception areas. 5. Entrances to restaurants, cafeterias, and service centers. 6. All corridors of the facility. 7. Prayer room corridors. 8. Restroom corridors. 9. Indoor and outdoor public plazas. 10. The exterior area of the facility (covering surrounding streets and parking, with a camera view angle of no less than 110 degrees horizontally). 11. Areas for passenger drop-off and pick-up. 12. All loading and unloading areas. 13. Vehicle entrances and exits to the facility and parking lots (including multi-story parking, indicating vehicle plates, types, and colors). 14. Parking lot pathways. 15. Around the perimeter of the building.

	16. External walkways. 17. Sports fields. 18. Entrances to sports fields. 19. Gathering points in case of emergencies. 20. Lobby or main reception area. 21. Elevator door halls. 22. Inside elevators. 23. Areas for ascending and descending stairs and escalators. 24. The last floor of the stairs. 25. Inside storage rooms. 26. Waiting areas. 27. Entrances and exits of halls. 28. Gas cylinder storage area and water tank rooms. 29. Air handling unit entrances for air conditioning systems. 30. Entrances to communication, data, internal network, and electrical rooms. 31. Fuel tanks for backup generators.
7.Assembly Occupancies	1. Entrances and exits of the facility. 2. Main emergency exits on the ground floor and parking areas leading outside the facility. 3. Emergency exits between floors. 4. Main reception areas. 5. All corridors of the facility. 6. Seating areas. 7. Cooking area. 8. Storage and warehouse area. 9. Food preparation area. 10. Dining area. 11. Restroom corridors. 12. Indoor and outdoor public plazas. 13. The exterior area of the facility (covering surrounding streets and parking, with a camera view angle of no less than 110 degrees horizontally). 14. Areas for visitors getting in and out of vehicles. 15. All loading and unloading areas. 16. Vehicle entrances and exits to the facility and parking lots (including multi-story parking, indicating vehicle plates, types, and colors). 17. Parking lot pathways. 18. Around the perimeter of the building. 19. External walkways. 20. Gathering points in case of emergencies. 21. Lobby or main reception area. 22. Elevator lobby. 23. Inside elevators. 24. Areas for ascending and descending stairs and escalators. 25. The last floor of the stairs. 26. Inside storage rooms. 27. Waiting areas. 28. Entrances and exits of halls. 29. Gas cylinder storage area and water tank rooms.

	30. Air handling unit entrances for air conditioning systems. 31. Entrances to communication, data, internal network, and electrical rooms. 32. Fuel tanks for backup generators.
8.Assembly Occupancy: **Places of Worship**	1. Entrances and exits of the facility. 2. Main emergency exits on the ground floor and parking areas leading outside the facility. 3. Areas for ascending and descending stairs. 4. Corridors. 5. The exterior area. 6. Surrounding plazas and courtyard. 7. Entrances. 8. Restroom corridors.