EGPC Fire Prevention And Firefighting Guideline

EGPC FIRE PREVENTION AND FIRE FIGHTING GUIDELINE

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EGPC

EGPC HSE Assistant CEO WORD

Dear Colleagues,

Egypt efforts and directives of its wise leadership's continuous work constitute a catalyst for this renaissance and maintain the leading position that the state enjoys. Based on this vision and to achieve the goals and directives of the leadership I am honored to have the opportunity to draft the introduction to this manual, which represents the culmination of several months of hard work, by a specialized team of professionals in this industry.

The goal is to provide the Egyptian oil and gas sector with an approach to manage the significant risks involved in refining, production, drilling and distribution activities.
This manual contains all standards and guidelines developed over many years of experience

Here is the new version of the unified guide for firefighting and fire protection standards issued by the EGPC to keep pace with new technologies to reach the ultimate goal of placing Egypt at the forefront of the safest countries in the world

This is achieved by implementing all preventive measures and protecting lives and property - ensuring that all fire protection and fighting requirements are provided in accordance with the highest standards of quality and efficiency.

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ACKNOWLEDGMENT

The Egyptian General Petroleum Corporation extends its sincere thanks and appreciation to the esteemed members of the committee , consisting of specialized works in HSE from EGPC , NPC And CPC who have made commendable efforts in coordination meetings and reviewing the (Guideline for Fire Prevention and Fire Fighting)

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Introduction :

- The Fire prevention And fire fighting Guideline in the Petroleum and Mineral Resources Sector is the result of discussion between civil defense and fire safety specialists, practitioners and consultants.

Reference has been made to mature international standards e.g NFPA, BS, EN, VDS, ISO and others consider fire safety requirements that are considered possible and necessary to address fire risks in different types of locations.

- By presenting the Fire prevention And fire fighting Guideline in the Petroleum Sector, it emphasizes its goal of strengthening the professional relationship with fire professionals, and the community. In addition to ensuring the protection of lives, assets and the environment from fires and other emergencies, it is also expected to mark the beginning of a new chapter in professionalism in the field of Fire prevention And fire fighting Guideline
- The Egyptian General Petroleum Corporation (EGPC) developed a comprehensive guide to firefighting instructions, fire-fighting systems, and life preservation, in cooperation with the Ministry of Interior, for all petroleum activities,
- This guide aims to provide a framework for contractors and employees of the Egyptian General Petroleum Corporation to ensure unification of concepts and compatibility between all companies in the sector.
- The guide covers a wide range of topics, based on international best practices and well be updated regularly to reflect the latest changes in fire protection regulations, standards and methods.
- The General Petroleum Authority's guide to extinguishing, fire prevention, and life-preserving guidelines for petroleum activities, , is an essential resource for all Authority contractors and employees participating in them. By following the instructions contained in this guide, the General Petroleum Authority can help ensure the safety of its employees. Protect equipment and prevent accidents.
- The Egyptian General Petroleum Corporation is committed to continuous improvement of its performance in the field of firefighting, fire prevention, and life preservation, and it constantly reviews and updates its related instructions to ensure that they remain effective in various emergency situations to preserve lives and assets.
- The General Petroleum Authority encourages all to submit their comments on the Authority's Fire prevention And fire fighting Guideline, so that it can be continuously improved.

Chapter No.: 1

Civil Defense Requirements

Civil Defense Law (Civil Defense.)

After reviewing the Interim Constitution, Law No. 130 of 1955 issued in the Northern Region, and Law No. 179 of 1956 regarding Civil Defense issued in the Southern Region, and based on what the Council of State deemed necessary,

Article (1) Civil defense means protecting civilians, ensuring the safety of transportation and intelligence, ensuring the regular and steady progress of work in public facilities, maintaining national artistic and archaeological artifacts, and protecting buildings, facilities, institutions, and public and private projects from the dangers of air strikes and other acts of war.

Article (2) Civil defense measures include, in particular, the following:

1. Regulating air raid warning means.
2. Regulating fire extinguishing means.
3. Organizing the exchange of aid between cities, directorates, and Governorat, in the work of civil defense teams, and establishing rapid civil forces to rescue the stricken areas.
4. Establishing and preparing civil defense operations rooms.
5. Organizing detection and removal of unexploded bombs.
6. Restricting lighting and traffic, and turning off lights during air raids.
7. Storing supplies, tools, medicines, and disinfectants necessary for civil defense work.
8. Formation of raid observer teams to guide and assist the public.
9. Forming fire spotter teams to combat incendiary bombs and minor fires.
10. Configuration of atomic radiation detection rooms.
11. Preparing and implementing plans to evacuate some areas and neighborhoods of their residents and provide relief to the afflicted.
12. Preparing various hospitals and other places suitable for receiving those injured from air strikes, establishing ambulance and disinfection centers, and preparing ambulance and disinfection units to transport the injured to these centers and hospitals.
13. Establishing “general” trenches and bunkers and preparing special bunkers in buildings and facilities.
14. Preparing rescue teams and rubble removal teams, their tasks and means.
15. Teaching civilians methods of civil defense and training them in them through various means.

Article (3) The General Directorate of Civil Defense in the Northern Region and the Civil Defense Department in the Southern Region are responsible for the following: First, all civil defense work. To this end, it has the right to prepare projects and plans for these works, supervise their implementation, arrange the necessary tools and missions, and study the latest means and methods of dissemination. Teaching it to the public. Second: Confronting public disasters that are deemed such by a decision of the President of the Republic. To do so, it may directly request any ministry to provide the necessary people, equipment, and tools, and to use civil defense teams.

Article (4) A Supreme Council for Civil Defense shall be formed under the chairmanship of the Central Minister of Interior and the membership of:

1. The Central Minister of Public Health.
2. The Central Minister of Municipal and Rural Affairs.
3. Minister of Social Affairs and Central Labor.
4. Central Treasury Minister.
5. Chief of Staff of the Air Force.
6. State Advisor for the Fatwa and Legislation Department of the Ministry of Interior.
7. Civil Defense Directors in the Northern and Southern Regions. The Council may decide to summon whomever of the experts and others it deems necessary, without them having a counted vote in the decisions it issues.

The Council is responsible for setting the general policy for civil defense, approving the plans and projects of this defense presented to it, and following up on their implementation. The Council meets at the request of its Chairman whenever it deems it necessary. The Council meeting is valid if it is attended by at least three members, and decisions are issued by a majority. If the votes are equal, the opinion of the Chairman shall prevail.

Article (5) A civil defense committee shall be formed in each region, headed by the region's Minister of Interior and membership of:

1. Secretaries-General in the Northern Region or Undersecretaries in the Southern Region for each of the Ministries of Interior, Works, Transportation, Social Affairs, Labor, Municipal and Rural Affairs, Public Health, Supply, Economy, Treasury, and Education. .
2. Director of Military Operations.
3. Director of Air Operations.
4. The Director General of Post, Telegraph and Telephone in the Northern Region or the Director General of the General Authority for Telecommunications in the Southern Region.
5. Director General of Civil Defense.

This committee is responsible for examining civil defense plans and projects for the region and studying the means leading to their full implementation. The committee's decisions are presented to the Supreme Council of Civil Defense for approval. The committee shall convene at the request of its chairman whenever he deems it necessary. The committee meeting shall be valid if attended by at least seven members, and decisions shall be issued by a majority. If the votes are equal, the opinion of the chairman shall prevail.

Article (6) The Minister of the Interior shall issue, in each region, a decision regarding the measures that municipal councils must take, within the areas of their jurisdiction, and the district councils shall take these measures, with regard to the facilities and establishments affiliated with them, and they shall also take them in areas that do not have municipal councils. A decision will also be issued regarding the measures that must be taken by the owners of educational institutes, charitable institutions, public stores, amusement parks, commercial and industrial stores, homes that each contain more than one dwelling, and other real estate that needs special supervision in view of their nature, importance, or uses. These are specified in the aforementioned decision.

Article (7) During the period for which projects are determined, municipal councils and district councils shall establish the procedures necessary to take the measures referred to in the first paragraph of the previous article, and they shall be presented to the Minister of the Interior in each region for approval, and the Minister may introduce into this project whatever amendment he deems necessary in any way time.

Article (8) The state shall bear the expenses of the necessary measures for civil defense work, taking into account the provisions of Articles 10 and 11.

Article (9) In the event of an emergency, disaster, or declaration of mobilization, the Minister of Interior in each region, or his representative, may dispose of civil defense funds, whether allocated in the ministry's or emergency budget (including subsidies granted by the ministry to private bodies). He may entrust the ministries and departments concerned with purchasing machines, cars, devices, supplies, medicines, etc., and designate the public and private entities and bodies to which these things are delivered, without being bound by the financial rules and instructions stipulated in the laws and regulations, in order to benefit from them and keep them usable when needed, under their responsibility and under the control and supervision of the Ministry of Interior. .

Article (10) Municipal councils and district councils located within their jurisdiction shall allocate an annual appropriation to carry out the implementation of the civil defense measures imposed on them, such that this appropriation shall not exceed ten percent for municipal councils and 3% for district councils, from the net revenues of each. Among them, this appropriation is determined annually by a decision of the President of the Republic, based on the proposal of the Minister of the Interior, after agreement with the Minister of Municipal and Rural Affairs in each region. These appropriations may be increased by no more than double these two percentages by a decision of the President of the Republic, after five years have passed from the date of implementation of this law.

Article (11) Owners of the real estate referred to in Article Six must carry out, at their expense and on the dates specified for them, the works imposed on these real estate, provided that the costs do not exceed five percent of the value of the property, and this value is estimated at twenty times the annual rent that is taken as a basis. For the built real estate tax or the actual annual rent in areas where this tax is not imposed. This decision may be appealed within fifteen days from the date of notification by the concerned party, before a committee formed by a decision from the Minister of the Interior in each region, and its decision shall be final.

Article (12) It is permissible to stipulate in building permits that the licensee carry out civil defense work, and also to stipulate the preparation of special places that can be used as public hideouts when needed. The state bears the expenses of preparing these bunkers and compensates the property owner for any decrease in value caused by his property. The owners of the buildings referred to in the previous paragraph and their occupants must vacate the places intended to be public hideouts as soon as they are notified of this by the competent authority. Concerned parties may appeal the decisions issued before the committee stipulated in Article (11) within the period specified therein.

Article (13) The Minister of the Interior in each region shall issue a decision regarding the requirements and specifications for establishing bunkers and other civil defense works stipulated in the previous article. The decision issued by the authorities in charge of organizing work includes these requirements and specifications, with regard to real estate properties determined by the Minister of the Interior in each region.

Article (١٤) If the property owner does not carry out the works imposed on him, the administration may implement them at his expense.

Article(١٥) The Minister of the Interior in each region may issue a decision obliging owners of buildings and vacant lands not to interfere with the authorities responsible for civil defense work when they carry out these works on their properties. This decision shall be announced to the concerned parties by registered letter with acknowledgment of receipt and shall be published in the Official Gazette, and this publication shall result in its application to all. The owner shall be compensated for any damage to his property due to the actions referred to in the previous paragraph, and the dispute regarding this compensation shall be submitted to the court within whose jurisdiction the property is located.

Article (١٦) The Minister of the Interior in each region, or his representative, may issue decisions to seize real estate, whether built or UN-built, and the movables necessary for preparing public hideouts and sheltering immigrants and refugees, as well as hospitals and centers necessary for first aid and supply. The owner is compensated for the decrease in value that befalls the property, and he also compensates the owner of the seized movables, and the dispute regarding this compensation is submitted to the court within whose jurisdiction the seized property or movables is located.

Article(١٧) The Minister of the Interior may, in each region, establish teams of male and female volunteers who undertake training in civil defense work in their spare time with the intention of participating in civil defense work and confronting the public disasters stipulated in this law. The conditions for volunteers to carry out their work are regulated by a decision of the Minister of the Interior in each region.

Article(١٨) The Minister of the Interior in each region may decide at any time to conduct experiments and exercises on civil defense work to verify all its means. Anyone who refrains from implementing the measures related to the experiments or exercises referred to, or objects to their implementation, shall be punished with a fine not exceeding one Egyptian pound or ten Syrian pounds. In the event of recidivism within six months from the date of the final ruling, the penalty shall be imprisonment for a period not exceeding seven days and a fine not exceeding one Egyptian pound or ten Syrian pounds, or one of these two penalties.

Article (١٩) To the Minister of the Interior, in the event of mobilization and public disasters, To issue decisions to implement the civil defense plan, and to specify in its decisions the penalties to be imposed on anyone who violates it, provided that the penalty does not exceed two years' imprisonment and a fine not exceeding two hundred Egyptian pounds or two thousand Syrian pounds, or one of these two penalties..

Article (٢٠) Public employees, doctors, pharmacists, male and female nurses working in facilities or institutions of public benefit, those working in the industry or trade in foodstuffs, and transportation workers in the event of mobilization are prohibited from leaving the places where they perform their work without written permission to do so from the Civil Defense Department. In the Southern Region or the General Directorate of Civil Defense in the Northern Region. The Minister of the Interior, in each region, in agreement with the Minister of War, may prohibit immigration for any other group whose work is necessary for the stability of living.

Article (21) In military zones and areas administered by the Ministry of War, the Minister of War assumes the powers of the Minister of Interior, stipulated in this law.

Article(٢٢) The relationship between the civil defense authorities and the armed forces is coordinated by a decision issued by the Ministers of Interior and War, including the following:

a. The duty of the armed forces towards civil defense in normal circumstances.

b. How to provide assistance to the armed forces to the civil defense authorities,

In cases of extreme necessity and urgent, dangerous exceptional cases, specifying the tasks entrusted to the armed forces in these cases.

Article (23) The employees delegated by the Minister of the Interior in each region, including employees of the Ministry of the Interior and others, shall have the capacity of judicial officers in implementing the provisions of this law and the decisions implementing it, and they shall have the right to enter at any time the place of implementation of the measures stipulated in the law to verify Implementing these provisions and proving any violation thereof.

Article) (٢٤) It is not permissible to remove a machine, sign, or vehicle signal for use in civil defense purposes, or change its location, or make it unsuitable for what it was intended for. The violator shall be obligated to pay the expenses of returning the thing to its original state.

Article (25) Every violation of the provisions of this law and the decisions implementing it, except for what is stipulated in Articles 18 and 19, shall be punished by a fine of not less than an Egyptian pound or ten Syrian pounds - and not exceeding ten Egyptian pounds or one hundred Syrian pounds.

Article (26) The Minister of the Interior may, in each region, determine by his decision the cities and regions in which all or some of the measures stipulated in this law will be applied - and he may issue the necessary decisions to implement it.

Article (27) Law No. 130 of 1955 and Law No. 179 of 1956 referred to are hereby repealed, as well as every text that contravenes the provisions of this law.

Article (28) This law shall be published in the Official Gazette, and shall be effective from the date of its publication.

Signature: Gamal Abd-ElNasser

President of the United Arab Republic

Amendment by President EL-Sisi on 7/3/2014

President Abdel Fattah El-Sisi issued a presidential decree with Law No. 62 of 2014 amending some provisions of Law No. 148 of 1959 regarding civil defense, and it was published in the Official Gazette in its issue No. 26 bis (D) issued on July 2, 2014..

“In connection with this, it was clearly stipulated in Law No. 148 of 1959 regarding Civil Defense that the civil defense authorities must issue the necessary approval to begin the activity for the buildings and facilities that are designated by a decision from the Ministry of Interior, in coordination with the competent authorities that the law authorizes to do so. This ensures the preservation of real estate wealth from the dangers of fire and collapse».

And by reference To “the law’s decision stipulates that it replaces the text of Clause Four of Article 3 of the above-mentioned law regarding civil defense with the following text: “Civil defense work to protect factories, public facilities, facilities, and buildings specified by a decision of the Minister of the Interior against all dangers. To this end, it may set plans and requirements and organize the means used through its specialized agencies centrally or locally and grant the necessary approval for that in participation and cooperation with the competent authorities.

Civil Defense Requirements

Signed protocol Between the Ministry of Petroleum, represented by the Egyptian General Petroleum Corporation, and the Ministry of Interior - General Administration of Civil Defense on 10/20/2022 stipulates that all large and medium projects and establishments shall have their designs, references, training, and emergency plans approved by the General Administration, as for small establishments and car fuel stations. It is affiliated with the sub-departments of civil protection, provided that the sub-departments periodically visit all facilities, test firefighting and alarm systems, ensure that firefighting teams and trucks are prepared to work, and submit reports to the General Administration of Civil Defense and the companies.

For implement this protocol the following steps are required:-

1. The company prepares an engineering consulting report for alarm, fire, and lightning Defense systems through one of the offices or consultants registered in the Engineers Syndicate as firefighting consultants (not occupational health and safety or any other specialty). As for alarm and electrical systems, there are electrical consultants and civil consultants for the validity of buildings and warehouses. Clarify the following points:-

    a) Fire extinguishing systems with all their current components and their compatibility with the Egyptian fire code and civil Defense requirements (if there is a report)

    b) The basic codes in designing alarm and fire networks are the Egyptian fire code or NFPA or the English code, and the API is not considered in the design because it is not a code (code means a law imposed by the state)

    c) Future constructions that are completed but not yet finished, and what will be established in terms of the alarm and firefighting system and its components.

    d) All alarm and firefighting systems operate automatically and manually.

    e) A time plan is drawn up to implement these requirements, which does not exceed two years in the case of purchasing fire pumps. If less than that, it is a maximum of one and a half years, and this timetable is signed by the Chairman of the Board of Directors.

    f) The alarm network is designed to bring together all areas of the company in one panel, with sub-panels according to the large area of the facility.

    g) Extinguishing systems for crude oil or product storage tanks must be equipped with an automatic foam extinguishing system inside or above the tank (according to the type of ceiling) and As per NFPA 15, first ring shall be placed in ~1m from the roof. Second ring shall be placed at a distance of 3.7m from first ring (same as API 2030), 3.7m run down is allowed. Based on the height of the tank, no of ring will be calculated. Max of 3 rings are sufficient for spray cooling, since tank height will not exceed 20 m max. Top half of the tank is sprayed with water, bottom half of the tank will have a rundown (if water demand is calculated properly). Eg. Assume, Tank H is 14m. First ring will be placed in 1,3m h, 2nd ring will be placed in 9.3m ht. bottom portion will have run down.

h) Regarding the spill collection area around the tanks, flame sensors are placed linked to the automatic opening valves of the foam cannons directed towards either the body of the tank or the area of the valves. They operate automatically, not reciprocating, and are directed by the firefighting personnel upon arrival. These cannons must be outside the wall and at a height higher than the wall is at least two meters high to control the distribution of the foaming liquid from the collection basin.

i) Electrical systems must be clarified and all electrical panels outside or inside buildings whose voltage exceeds 220 volts must be equipped with a local automatic extinguishing system.

j) Explaining ground electricity drainage systems

k) In the case of a central air conditioning system, it explains the systems for closing the air passages in the event of a fire and the sensor systems that will be installed inside the air passages.

l) The estimated value is set for implementing the alarm and firefighting systems that will be installed only.

m) And lightning prevention system

n) Structural validity of buildings and tanks.

2. Submitting a letter to the General Administration of Civil Defense at the Ministry of Interior (Suez Road) that includes a request to review the engineering report (a fee will be paid to carry out the review) and review the emergency plans (in the event that the alarm and firefighting system is not completed, this plan will be written for the exit of workers from the site in a safe manner until the completion of the implementation of the requirements Civil Protection) and implementing firefighting training for workers at the site or the company at a rate of 25% of the company's employees and the insured. As for the contractor's employment, proof of the training of a relative must be submitted by receiving training on firefighting work in one of the departments affiliated with Civil Protection) with 2 copies of the report, one of them Non stamped paper and electronic, and upon completion of the review and approval by the Civil Protection, it will be stamped by the consultant and a stamp by the Engineers Syndicate to confirm that the consultant is still registered with the Syndicate.

3. A fee is paid to approve the engineering report in the amount of 1.5% of the value of the work of the alarm and firefighting systems for the site, which will be installed only and not the existing one. The value of approving emergency plans and training workers is paid in an account number either affiliated with the Ministry of Interior or affiliated with the Governorate (such as Alexandria - Cairo - and Giza).

4. For companies affiliated with Alexandria Governorate only (payment for all sizes of companies is made to the General Administration of Civil Defense in Alexandria every 3 years)

5. A report will be obtained from the General Administration of Civil Defense on the progress of implementing the plan to reconcile the situation, with periodic follow-up with the administration regarding the implementation of the stages and notification upon completion.

This does not prevent civil Defense officers from entering the sub-departments to test and inspect the alarm and firefighting systems, determine the readiness of the fire brigades and fire equipment to work, prepare the report and submit it to the general administration.

Regarding small establishments, administrative offices, and various types of car fuel stations (fuel - gas), they belong to the sub-departments of civil Defense in the Governorate.

Important note

- Before starting to implement any projects, the civil drawings, firefighting, alarm and air conditioning systems must be presented to the Civil Defense before sending them to any destination in order to avoid changing the drawings and re-obtaining approvals.
- For protection Water Mist Firefighting system are prefer used to electrical transformers, generators, and pressure pump rooms Low pressure water jet (8-10 bar)

And it was signed protocol Cooperation between the geographical regions (north and west of the Red Sea - Alexandria - Suez) and the civil Defense sub-departments stipulates the following:

1. In the event of a fire or serious accident, the facility's civil Defense shall be notified of the type of fire, the vehicles required, the place of their direction and entry into the facility, and the individual who will travel inside the facility. Coordination is made with him and the head of the emergency team in the facility to coordinate the control work to unify efforts.
2. In the event of an accident or fire on public roads involving vehicles transporting products, crude oil, or supply stations, direction is given, and whoever arrives first assumes leadership of the other teams.
3. In the event that Civil Defense requests assistance from geographical areas, coordination is made with the Chairman of the Safety Subcommittee for the geographical area, and he is responsible for moving vehicles in accordance with the operational requirements of the area, with Civil Defense being the head of direction.

Civil Defense requirements for firefighting and alarm systems for petroleum, petrochemical and gas facilities (General Administration Civil Defense Instructions)

- All firefighting and cooling systems operate automatically and manually (provided that the manual systems are modified to automatic systems according to the timetables submitted with the consultant's report)
- Submitting an engineering consulting report for firefighting, approved by the Engineers Syndicate, which includes all construction systems, including buildings, warehouses, operating units, and product storage, explaining the currently existing systems, their validity, what will be changed, the type of equipment that will be installed, and their technical specifications (it is preferable to develop some catalogs for the type of systems). A timetable not to exceed two years in the case of importing fire pumps, or one and a half years in the case of not importing fire pumps.
- Connecting the alarm systems in all the company's sites to each other on a panel that is in a place that is monitored 24 hours a day and equipped with means of communication with all parties.

Concerning the procedures and controls for fulfilling civil Defense requirements in facilities affiliated with the General Authority for the Suez Canal Economic Zone (General Administration civil Defense Instructions)

The procedures and controls that must be followed to obtain civil Defense approval are as follows:

First - For new establishments Which has not previously obtained civil Defense approval) The owner of the activity shall submit a request to the licensing authority (the General Authority for the Suez Canal Economic Zone, as it is the competent authority to obtain civil Defense approval for the activity, attaching to the request a technical report approved by a specialized engineering consultant explaining the detailed description of the site and the degree of danger. According to the type of activity as well as all firefighting equipment.

If all requirements are met, a report will be issued and the licensing authority will be notified to complete the procedures (within three days from the date of the inspection). In the event that there are observations or failure to meet some requirements, the licensing authority will be notified to address the owner of the activity to quickly fulfill those observations, and then the notification will be returned again after completion of implementation to notify the competent civil Defense department to re-inspection within three days.

In the event of any modifications or additions to the activity, it is necessary to submit a technical report explaining the firefighting equipment to be implemented in the project for study before implementation and to express the technical opinion in accordance with the steps previously explained in the special item.

Second - New establishments Requirements required to be met in facilities in accordance with the Egyptian Code for Design Foundations and Implementation Requirements to protect facilities from fire.:-

The requirements described in the following checklist must be met, which must be implemented in accordance with the provisions of the Egyptian Code for Design Foundations and Implementation Requirements to protect facilities from fire, taking into account compliance with the provisions of the laws, regulations and decisions regulating various activities, which are::-

1. Fire alarm systems, including detectors and alarm panels of approved types - Alarm monitoring for firefighting systems.
2. Escape routes - Doors installed on escape routes and resistant to fire - Illuminated guide signs.
3. Approach points for fire engines and response distances surrounding the building.
4. Manual extinguishing devices.
5. Firefighting systems with water, including water sources designated for extinguishing - fire pumps, extensions and fire hydrants - Siamese connections..
6. Automatic extinguishing systems with water sprinklers.
7. Damping gases - foam material - wet chemical liquid - firefighting systems (CO2-FM200) etc.
8. Ventilation systems according to the nature of the occupancy (especially in closed spaces).
9. Smoke extraction systems.
10. Procedures and equipment for securing warehouses, taking into account general requirements for storage.
11. Connecting central air conditioning systems to the automatic alarm system.
12. Electrical services (main electricity room– Transformers - low pressure rooms - and meters) and securing them.
13. The licensing authority shall notify the geographically competent Civil Defense Department to study the technical report submitted by the facility. In the event that the report fulfills the preventive requirements established in accordance with the Egyptian Code for Design Foundations and Implementation Requirements to protect facilities from fire, the Civil Defense Department shall issue initial approval for the facility to carry out the works mentioned in the report, mentioning any Recommendations that the administration deems necessary to implement within 15 days.
14. If the report is not met, the project consultant will be reviewed to complete the required amendments in the report in light of the provisions of the Egyptian Code for Design Foundations and implementation requirements to protect facilities from fire. After completing the required amendments, the project will be re-examined again and the necessary approval will be issued within 15 days.
15. Immediately after completing the implementation of all the requirements previously mentioned in the project consultant's report, the owner of the activity will notify the licensing authority to address the competent civil Defense department to conduct the necessary inspection of the activity. In the

event that the requirements are completed through inspection, a report will be issued by the competent civil Defense department and the licensing authority will be informed that the establishment has fulfilled the requirements (no later than 15 days)... However, if there are some observations, another report will be prepared with the observations that have not been implemented and the licensing authority will be addressed to announce the owner of the activity. No later than three days with the observations to be implemented and the administration notified for re-inspection. For important and major projects that require a technical study by the General Administration of Civil Protection, the relevant geographic Civil Defense Department shall provide the General Administration of Civil Defense with the technical report submitted by the project consultant for study. In the event of any observations, they shall be addressed by the project consultant and the Civil Defense Department shall be re-addressed. The technical report shall be submitted within 15 days from the date of submission of the project consultant's report (complete with all papers).

Second - Following up on existing establishments that have previously obtained civil Defense approval:

1) The licensing authority shall notify the competent civil Defense department of the request to conduct an inspection of the facility.

2) The necessary inspection of the facility shall be conducted, and the requirements for prevention against fire hazards shall be reviewed within three days from the date of receipt of the notification.

3) Steam boiler rooms - fuel stations and securing them in accordance with ministerial decisions and regulatory technical bulletins).

4) Training the facility's employees on firefighting and the use of firefighting equipment at a rate of not less than 25% of the total number of employees in the facility).

5) Evacuation plan.

6) Reports on the validity of preventive systems against fire hazards required for licensing for the first time or upon renewal). Taking into account that the requirements mentioned above differ according to the nature of each activity, according to what is contained in the Egyptian Code for the foundations of design and implementation requirements for protecting facilities from fire, and the specialized international codes regarding what is not provided for in the Egyptian Code.

7) It is necessary to review the General Administration of Civil Defense if there are any technical or administrative difficulties facing the competent Civil Defense Department in this regard.

8) It should be noted that the General Administration of Civil Defense spares no effort in providing technical advice for all major, national and investment projects in order to advance the wheel of investment and development and achieve prosperity and prosperity... in accordance with what is decided by the laws and codes regulating this regard and to preserve lives and public and private property.

Requirements for insuring Restaurants from fire risks (Restaurants / Cafeterias / Pastry shops) (General Administration Civil Defense Instructions)

In light of the issuance of the Egyptian Code for the foundations of design and implementation requirements to protect establishments from fire, “Requirements for securing restaurants from fire hazards,” pursuant to the Minister of Housing’s Resolution No. 235 of 2020. This is based on joint work and continuous coordination between the General Administration of Civil Defense and the National Center for Housing and Building Research.

Requirements for insuring restaurants from fire risks to be circulated to apply to all restaurants (restaurants / cafeterias / pastry shops), whether touristic or non-touristy, whether new or existing, before the issuance of the Egyptian Code for the principles of design and implementation requirements for protecting establishments from fire, in accordance with the field of application and the insurance requirements contained in the code referred to with Adhere to the checklist and inspection Check list attached to the technical bulletin, which explains whether or not the insurance requirements for restaurants are met from a fire security point of view, as of 7/1/2020.

The “Egyptian Code for Design Foundations and Implementation Requirements for Defense of Establishments from Fire and Requirements for Securing Restaurants from Fire Risks” was issued pursuant to the Minister of Housing’s Resolution No. 235 of 2020. This is in light of the joint work and continuous coordination between the General Administration of Civil Defense and the National Center for Housing and Building Research.

The referred to code was prepared so that the requirements contained therein could be circulated to apply to all restaurants (tourist or non-tourist restaurants / cafeterias / pastries, whether new or existing before the issuance of the Egyptian Code for the principles of design and implementation requirements for protecting facilities from fire, in accordance with the field of application and the insurance requirements contained therein. The checklist and inspection are adhered to Check list attached to the technical bulletin, which explains whether or not the insurance requirements for restaurants are met from a fire safety point of view.

Technical Bulletin No. (1) of 2020 regarding requirements for insuring restaurants from fire hazards will be effective as of 7/1/2020..... Technical Bulletin No. 28 issued in 2010 regarding insuring restaurants and tourist cafeterias will be canceled.

1- Field of application:

In the case of restaurants whose seating area does not exceed 100 m^2. It is sufficient to provide them with manual fire extinguishers that operate with dry chemical powder, with a capacity of 1 kg each and have a quality mark, with one device for each area of 50 $m^2$of the total area of the restaurant, along with providing it with a hose nozzle (Hose-reel) with a one-inch diameter installed on the public water network.

The following requirements apply to all restaurants (restaurants / cafeterias / pastry shops) whose seating area exceeds 100 m^2, in order to protect them from fire hazards, while adhering to the requirements contained in the laws, regulations and decisions in force at the time of issuance of the first operating license and no fundamental amendments have been made to them (amendments that result in: resulting in increased occupancy load or increased degree of risk). In the case of tourist restaurants, the requirements for securing kitchens, electrical panels, warehouses, and handling flammable materials apply.

2- Requirements for escape routes:

The provisions of the Egyptian Code for Design Foundations and Implementation Requirements to protect facilities from fire are applied to buildings or parts of buildings erected after the issuance of Building Law 119 of 2008. In the case of buildings erected before the issuance of the law, the requirements contained in the laws, regulations and decisions in force at the time of issuance of the first operating license must be adhered to.

3 - Control systems in restaurants:

3.1- General requirement:

- The restaurant is provided with manual fire extinguishers that operate with dry chemical powder, with a capacity of one kilogram and obtained a quality mark, at a rate of one device for every 50 m^2 of the restaurant's total area.

3-2 Water sources:

a. In the case of a seating area for patrons whose area does not exceed 200 m^2, the restaurant shall be provided with a hose nozzle (one inch in diameter) in a suitable location installed on the public water network.

b. In the case of the patrons' seating hall, whose surface area ranges from 200 $m^2$to 500 m^2, a water reserve of no less than 10 m^3 must be provided. It is necessary to provide a fixed pump or pump with a discharge rate of not less than 100 gallons per minute1 and a pressure of not less than 3 bar at the furthest point. The restaurant must be provided with a hose nozzle with a diameter of one inch to cover all occupations.

c. In the case of the patrons' seating area where the clear surface area exceeds 500 m^2 it is necessary providing a water reserve of no less than 25 m^2.

d. It is necessary Providing one fixed pump or pump, provided that it operates with 2 m^2, one permanent and the other reserve, or a fixed pump that operates with diesel or liquid fuel, and whose discharge rate is not less than 250 gal/min and achieves a pressure of not less than 3 bar at the farthest point .

e. It is necessary providing the restaurant with a hose nozzle (one inch) or more in diameter, so that it covers all Occupations.

3-3 Automatic water sprinkler systems:

a) In the case of the patrons' seating area, which has an area of more than 350 m^2 and is located below the exit drainage floor, it must be provided with automatic water sprinklers connected to the fire-fighting network implemented on site.

b) In the case of a seating hall for patrons whose area exceeds 500 m^2, it must be provided with automatic water sprinklers connected to the firefighting network implemented on site.

4 - Fire detection and alarm systems

4-1 In the case of a seating hall for patrons whose area does not exceed 350 M^2a manual alarm is permitted

4-2 In the case of a seating hall for patrons whose area exceeds 350 m2: an automatic fire alarm system must be used and all components of the system must be connected to the control panel

5 - Kitchen insurance requirements

5-1 securing the future of fumes (hood):

The smoke receiver (hood) for all heat sources in cooking areas must be equipped with independent fire-fighting systems using an automatic wet chemical liquid with the possibility of operating it manually).

5-2 Chimney insurance:

a. The outlet of the burning gases in the chimney must be higher than any point on the roof of the building in which the chimney is installed, at a height of not less than 1 meter and within a circumference of 4 meters from the chimney and from the structures.

b. The chimney must be inspected and tested and evidence must be provided to the neighborhood that it is in good condition before installing, connecting or operating the equipment.

c. The chimney must be secured with an open water sprinkler connected to the fire network installed on the site, if any, or with a rising water pipe, so that the sprinkler is at the top of the chimney and connected to a nozzle stop so that it can be opened easily away from heat sources and in a visible place.

d. No chimney connection is allowed to pass inside the building except through a vacuum or skylight.

5-3 Securing stove cylinders:

If there are butane cylinders on the site, it is necessary to use a gas regulator, and the distance between the butane cylinder and the flame source must not be less than 1 m, with the necessary ventilation provided in accordance with regulatory requirements. If the number of cylinders exceeds 2 cylinders, the cylinders are placed in a well-ventilated place at the bottom and above them are water sprinklers connected to a manual valve, with no electrical connections or extensions in this place.

6 - Requirements for securing electricity panels:

The main electrical panels must be secured with an automatic local fire extinguishing system or local illumination.

7- Warehouse insurance requirements:

7-1 In the case of warehouses whose area exceeds 50 m2, they must be provided with an automatic alarm system and automatic extinguishing system

7-2 In all cases, it is necessary to separate all warehouse spaces and garbage rooms with fire breaks that are resistant for an hour and prevent the penetration of smoke, and when there are openings their resistance is not less than 3/4 hour.

8 - Requirements for handling flammable materials:

- It is necessary to use flame-retardant materials to increase the efficiency of the combustion-resistant properties of interior finishing surfaces, in the case of flammable interior finishes, ceilings and walls. Commitment must be made to repeatedly use these materials in accordance with the recommendations of their manufacturers or every five years, whichever comes first.

قائمة الفحص و التفتيش لاشتراطات تأمين المطاعم من أخطار الحريق الصادر بها القرار الوزارى رقم (٢٣٥) سنة ٢٠٢٠ (CHECK LIST)

القائم بالفحص والتفتيش:	التاريخ:
"بيانات المطعم"	"وصف عام لمكونات المطعم"
اسم المطعم:	
عنوان المطعم:	
عدد الأدوار:	
تاريخ أول ترخيص للمطعم:	
الطاقة الاستيعابية:	
تاريخ آخر معاينة للحماية المدنية:	

البند	تطبيق الاشتراطات	نعم	لا	الملاحظات
١	**التطبيق**			
	المطاعم التى لا يزيد بها مسطح صالة جلوس الرواد على ١٠٠م٢			
	تزود المطاعم التى لا يزيد مسطح صالة جلوس الرواد بها على ١٠٠ م٢. يكتفى فى تأمينها بأجهزة إطفاء يدوية تعمل بالبودرة الكيميائية الجافة سعة الواحد ٦ كجم حاصلة على علامة الجودة بواقع جهاز لكل مساحة قدرها ٥٠ م٢ من مسطح المطعم الإجمالي، مع تزويدها بكر خرطوم (هوزريل) قطر واحد بوصة مركب على شبكة المياه العمومية.			
	المطاعم التى يزيد بها مسطح صالة جلوس الرواد على ١٠٠ م٢			
	تطبق الاشتراطات التالية على كافة المطاعم (مطاعم / كافيتريات / حلوانى) التى يزيد مسطح صالة جلوس الرواد بها على ١٠٠ م٢ لتأمينها من أخطار الحريق، مع الالتزام بالاشتراطات الواردة فى القوانين واللوائح والقرارات المعمول بها وقت صدور أول رخصة تشغيل ولم يتم إجراء تعديلات جوهرية عليها (تعديلات ينتج عنها زيادة حمل الإشغال او زيادة درجة الخطورة).			
	فى حالة المطاعم السياحية تطبق الاشتراطات الخاصة بتأمين المطابخ ولوحات الكهرباء و المخازن ومعالجة المواد القابلة للاشتعال.			
٢	**متطلبات مسالك الهروب**			
	تطبق أحكام الكود المصرى لأسس التصميم واشتراطات التنفيذ لحماية المنشآت من الحريق على المباني او جزء من المباني المقامة بعد صدور قانون البناء ١١٩ لسنة ٢٠٠٨. وفى حالة المباني المقامة قبل صدور القانون يجب الالتزام بالاشتراطات الواردة فى القوانين واللوائح والقرارات المعمول بها وقت صدور أول رخصة تشغيل.			

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٣	أنظمة المكافحة بالمطعم			
٣-١	عام			
	تزويد المطعم بأجهزة إطفاء يدوية تعمل بالبودرة الكيميائية الجافة سعة الواحد ٦ كجم حاصل على علامة الجودة بواقع جهاز لكل مساحة قدرها ٥٠ م٢ من مسطح المطعم الإجمالي.			
٣-٢	مصادر المياه			
أ.	في حالة صالة جلوس الرواد التي لا يزيد مسطحها على ٢٠٠م٢. • تزويد المطعم بكر خرطوم (هوزريل) قطر ١ بوصة بمكان مناسب مركب على شبكة المياه العمومية.			
ب.	في حالة صالة جلوس الرواد التي يتراوح مسطحها من ٢٠٠م٢ إلي ٥٠٠م٢. • توفير مخزون مياه لا يقل سعته عن ١٠م٣. • توفير مضخة او طلمبة ثابتة لا يقل معدل تصريفها عن ١٠٠جالون/دقيقة وتحقق ضغط لا يقل عن ٣ بار عند ابعد نقطة. • تزويد المطعم بكر خرطوم (هوزريل) قطر ١ بوصة بحيث يغطي جميع الاشغالات.			
ج.	في حالة صالة جلوس الرواد التي يزيد المسطح الصافي بها عن ٥٠٠م٢. • توفير مخزون مياه لا يقل سعته عن ٢٥م٣. • توفير طلمبة أو مضخة ثابتة واحدة بشرط أن تكون قابلة للعمل بمصدرين منفصلين بتيار دائم والآخر احتياطي أومضخة تعمل بالديزل أو الوقود السائل ولا يقل معدل تصريفها عن ٢٥٠ جالون/دقيقة وتحقق ضغط لا يقل عن ٣ بار عند أبعد نقطة. • تزويد المطعم بكر خرطوم (هوزريل) قطر ١ بوصة بحيث يغطي جميع الاشغالات.			
٣-٣	أنظمة رشاشات المياة التلقائية			
	تزود صالة جلوس الرواد بالكامل برشاشات المياه التلقائية التي تزيد مسطحها على ٣٥٠م٢ وتقع أسفل طابق صرف المخارج.			
	تزود صالة جلوس الرواد التي تزيد مسطحها على ٥٠٠ م٢ برشاشات المياه التلقائية.			
٤	أنظمة الكشف والإنذار بالحريق			
٤-١	توافر إنذار يدوي في حالة صالة جلوس الرواد التي لا تزيد مساحتها عن ٣٥٠م٢.			
٤-٢	توافر نظام إنذار آلى للحريق وأن تكون جميع مكونات النظام متصله بلوحة التحكم في حالة صالة جلوس الرواد التى تزيد مساحتها على ٣٥٠م٢.			

٥	متطلبات تأمين المطابخ			
٥-١	تأمين مستقبل الأدخنة (الهود)			
	تجهيز مستقبل الأدخنة (الهود) لجميع المصادر الحرارية بأماكن الطهي بأنظمة مكافحة للحريق مستقلة (بسائل كيمائي رطب تلقائي مع إمكانية تشغيله يدوياً).			
٥-٢	تأمين المداخن			
	أ. يكون مخرج الغازات المحترقة بالمدخنة أعلى من أي نقطة بسطح المبنى المركب به المدخنة بارتفاع لا يقل عن ١ متر وفى محيط ٤ م من المدخنة ومن الإنشاءات المجاورة.			
	ب. فحص واختبار المدخنة وتقديم ما يفيد أنها بحالة جيدة قبل تركيب أو توصيل المعدات أو التشغيل.			
	ج. تأمين المدخنة برشاش مياة مفتوح يرتبط على وصلة متصلة(ماسورة مياة صاعدة) بشبكة الحريق المركبة بالموقع ان وجدت بحيث يكون الرشاش أعلى المدخنة ويتصل بمحبس يدوي لإمكان فتحه بسهولة بعيد عن مصادر الحرارة بمكان ظاهر.			
	د. لا يسمح بمرور أى وصلة مدخنة داخل المبنى الا من خلال فراغ أو منور.			
٥-٣	تأمين اسطوانات البوتاجاز			
	• استخدام منظم للغاز • المسافة بين اسطوانة البوتاجاز ومصدر اللهب لا تقل عن ١م. • توفير التهوية اللازمة طبقاً للاشتراطات المنظمة. • في حالة زيادة عدد الاسطوانات عن ٦ اسطوانة يتم وضع الاسطوانات بمكان جيد التهوية من اسفل ويعلوها رشاشات مياه متصلة بمحبس يدوي مع عدم وجود اي توصيلات او تمديدات كهربائية في هذا المكان.			
٦	متطلبات تأمين لوحات الكهرباء			
	لوحات الكهرباء الرئيسية مؤمنة بنظام إطفاء تلقائى موضعى أو بالتسليط الموضعى.			
٧	متطلبات تأمين المخازن			
٧-١	فى حالة المخازن التى يزيد مسطحها على ٥٠ م٢ يلزم تزويدها بنظام إنذار آلي وإطفاء تلقائى.			

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٧-٢	يلزم فصل جميع فراغات المخازن وغرف القمامة بفواصل حريق مقاومة لمدة ساعة ومانعة لنفاذ الدخان، وعند وجود فتحات لا تقل مقاومتها عن ٤/٣ ساعة.			
٨	**متطلبات الأمان من الحريق**			
	معالجة المواد القابلة للاشتعال			
	استخدام المواد المؤخرة للاشتعال لرفع كفاءة خواص مقاومة الاحتراق لأسطح التشطيبات الداخلية، وذلك فى حالة وجود تشطيبات داخلية قابلة للاشتعال (أسقف – حوائط) مع الالتزام بتكرار استخدام تلك المواد طبقاً لتوصيات الشركات المصنعة لها أو كل خمسة سنوات أيهما أقرب زمنياً.			
	المستندات المطلوبة للمنشأة			
	تلتزم ادارة المنشأة بتقديم إقرار بالآتي: • وصف مسالك الهروب و المحافظة عليها وعدم غلقها او الغائها او وضع اي اشغالات تعوق استخدامها فى عملية الاخلاء. • متابعة صيانة وصلاحية التجهيزات الاطفائية والكهربائية بصفة مستمرة طوال فترة الموافقة الممنوحة. • تحمل المسئولية القانونية في حالة مخالفة ماسبق. • تقديم ما يفيد تدريب ٢٥ ٪ من العاملين بالمنشأة على أعمال الحماية المدنية.			
	في حالة الترخيص لأول مرة: • تقديم الرسم الهندسى المطابق للوضع القائم للنشاط معتمد من مهندس نقابي. • تقديم الرسم الهندسى المقدم لجهة الترخيص لمزاولة النشاط. • يتم تقديم تقرير من مهندس نقابى بوصف وصلاحية التجهيزات الإطفائية ومسالك الهروب طبقاً لاشتراطات تأمين المطاعم من أخطار الحريق.			
	النتيجة والرأى :			

التاريخ / /

القائم على الفحص والتفتيش

الاسم :

التوقيع:

4

Concerning preventive inspections of industrial facilities (Cooperation protocol between the General Administration of Civil Defense and the General Authority for Industrial Development)(General Administration Civil Defense Instructions)

In light of the cooperation protocol between the General Administration of Civil Defense and the General Authority for Industrial Development, which was approved by the Supreme Police Council on the occasion of the issuance of the Law Facilitating Industrial Licensing Procedures No. (15) of 2017,

The following items were included among the provisions of the protocol:

- The General Authority for Industrial Development is responsible for examining the licensing documents for industrial facilities necessary to practice the activity and the extent to which they meet the codes and requirements announced in the technical requirements manuals and their annexes, which relate to the fire-fighting and alarm codes and agreed upon with the civil Defense representatives who were represented in the licensing requirements committee, as well as examining the extent of continued compliance of the aforementioned facilities. With these requirements for the duration of the license, the Authority may seek the assistance of specialized officers from the General Administration of Civil Defense at the Ministry of Interior
- The General Administration of Civil Defense at the Ministry of Interior provides a number of (2) specialized officers to be present at the headquarters of the Public Authority for Industrial Development on the dates and timings that are agreed upon between the two parties. Their mission is to accomplish the assigned tasks, and in particular to review the technical specifications for civil Defense with engineering drawings and technical reports for protection. Civil and approval of the fire insurance plan submitted by the factory management, and the geographical administration is provided with it upon its request to conduct a pre-operation inspection in accordance with what is stated in it and what has been approved. The Public Authority for Industrial Development may seek the assistance of specialized officers from the General Administration of Civil Defense regarding:
- Monitoring and inspection of industrial facilities is carried out by the geographical civil Defense departments to conduct joint inspections to ensure that these facilities meet the technical requirements necessary to carry out the activity and approve evacuation and emergency plans.
- The General Authority for Industrial Development is responsible for notifying the General Administration of Civil Defense at the Ministry of Interior to participate in the work of the oversight, follow-up, and inspection committees on industrial facilities at the republic level. The General Administration of Civil Defense is committed to making its representatives available from those working in the civil Defense departments and sections in the security directorates in the Governorate, provided that the response to participate is a maximum. Four days from the date of notification of the administration.
- The checklist issued in accordance with the provisions of the Law to Facilitate Procedures for Granting Industrial Establishments Licensing, which was agreed upon by both sides during the discussion

of technical requirements, shall be the basis upon which inspection procedures for industrial establishments are carried out and by reviewing the drawings approved by both sides at the start of dealing. No amendment to this list may be made except With the approval of both parties .

- The General Authority for Industrial Development is responsible for verifying that the applicant for a license in high-risk industrial activities has obtained the training programs provided by the General Administration of Civil Defense at the Ministry of Interior before obtaining the operating license. As for low-risk industrial activities, the licensee is obligated to adjust his situation by obtaining the prescribed training according to the size and nature. Otherwise, the procedures stipulated in the law facilitating procedures for granting licenses to industrial establishments will be taken...and the training will be according to the following percentage:

  a) 25% of the total number of employees in the facility when licensed for the first time 15% upon annual renewal

  b) The numbers are determined based on the request submitted by the establishment's management

  c) The training shall be in accordance with what was stated in the circular issued by the Training Department No. (6) of 2005 regarding training programs and the amendment issued in 2017 regarding the value of training in the administration or at the factory site.

Definition of the law:

It was included in the Law on Conducting the Procedures for Granting Industrial Establishments Licensing No. 15 of 2017:

1. Issuing a license with a notification system for establishments that practice low-risk activities in accordance with the classification of the General Authority for Industrial Development.
2. Issuing a license in advance is for establishments that practice high-risk activities. Among the documents that the establishment is obligated to submit are a number of administrative and technical documents, which are:
   - ✓ The report on Defense against fire dangers includes all data related to fire prevention and resistance measures and is studied by specialized officers from the General Administration of Civil Protection.
   - ✓ In order to activate the unified technical requirements and determine a unified and effective method for their application in a way that ensures the greatest possible transparency and effectiveness, inspection lists have been prepared for industrial facilities for all stages of obtaining an operating license, including:
     - A checklist for completing the fire Defense report and used by competent officers

- From the General Administration of Civil Defense to review the technical report and ensure its completeness. The facility inspection list for Defense from fire hazards is used by officers of civil Defense departments at the republic level to inspect the facility and ensure that it meets the technical requirements for protecting the facility from fire.
- Licensing procedures for industrial facilities are implemented in accordance with the text of Law 15 of 2017 as follows:

First: New Establishments:

I. The investor submits an application to obtain an operating license, attaching a technical report approved by a fire consultant according to the form provided by the General Administration of Civil Protection.

II. The officers of the General Administration of Civil Defense present at the headquarters of the Public Authority for Industrial Development study the report submitted by the facility and express an opinion on its completion.

III. If the report is complete, the General Administration of Civil Defense will issue initial approval for the submitted report and approve the facility to carry out the work, mentioning the recommendations that the administration wishes to implement.

IV. The Authority informs the facility of the issuance of initial approval of the report and the necessity of carrying out the work as stated in the report. When the facility is notified of its complete fulfillment and implementation of the items and recommendations mentioned in the fire report, the Authority appoints a representative to carry out the inspection within a committee from the Geographic Civil Defense Department in the Directorate.

V. At least 72 hours before the inspection date, the Authority shall notify the General Administration of Civil Defense of the details of the scheduled inspection, including (establishment data - the name of the Authority representative in charge of the inspection, accompanied by the committee and his contact information - specifying the specific date for carrying out the inspection). Accordingly, the General Administration of Civil Defense shall notify the Defense departments The inspection report is sent to the General Administration of Civil Defense within 48 hours from the date of its completion. The inspection report indicates the presence of serious violations or the presence of non-serious violations, with the General Administration of Civil Defense being addressed therein (Department of Civil Defense in Industry) in In the event of serious violations, the Authority will suspend the establishment or reject the license application...

VI. In the event of non-serious violations, the facility will be granted a grace period of six months by the Authority, which may be renewed once in accordance with the articles of Law No. (15) of 2017.

Second: Follow up on existing establishments:

i. The General Authority for Industrial Development or its geographical branches sends a letter with an attached report of the latest inspection of the General Department of Civil Protection. Accordingly, the various civil Defense departments are notified to conduct the inspection with the knowledge of the committee within 48 hours of the receipt of the notification.

ii. In the case of a facility that has previously obtained approval from the General Administration of Civil Defense and wishes to make any amendments, the investor is required to submit a technical report to amend the approval only if the amendments requested by the facility have an increased effect on the facility's fire occupancy load.

iii. Accordingly, the implementation of all what is stated in the technical bulletin is being followed up under the supervision of the Director of the Civil Defense Department and under the direct supervision of the Chief of the Fire Department and with the knowledge of the Head of the Prevention Department, with the necessity of creating regularly registered books in this regard...without prejudice to the application of any of the items described above and coordination. In any comments with Captain /Deputy of the General Fire Department and the General Department of Civil Protection, they will spare no effort in providing any technical advice in this regard.

iv. The officers of the General Administration of Civil Defense present at the headquarters of the Public Authority for Industrial Development study the report submitted by the facility and express an opinion on its completion.

v. If the report is complete, the General Administration of Civil Defense will issue initial approval for the submitted report and approve the facility to carry out the work, mentioning the recommendations that the administration wishes to implement.

vi. The Authority informs the establishment of the initial approval of the report and the necessity of carrying out the work as stated in the report

vii. When the facility is notified of its complete fulfillment and implementation of the items and recommendations mentioned in the fire report, the Authority will appoint a representative to carry out the inspection within a committee from the Geographic Civil Defense Department in the Directorate.

viii. At least 72 hours before the inspection date, the Authority shall notify the General Administration of Civil Defense of the details of the scheduled inspection, including (establishment data - the name of the Authority representative in charge of the inspection, accompanied by the committee and his contact information - specifying the specific date for carrying out the inspection). Accordingly, the General Administration of Civil Defense shall notify the Defense departments The inspection report is sent to the General Administration of Civil Defense within 48 hours from the date of its completion. The inspection report indicates the presence of serious violations or the presence of non-serious violations, with the General Administration of Civil Defense being addressed therein (Department of Civil Defense in Industry) in In the event of serious violations, the Authority will suspend the facility or reject the license application... However, in the event of non-serious violations, the facility will be granted a grace period of six months by the Authority, which may be renewed once in accordance with the articles of Law No. (15) of 2017.

Third: Follow up on existing establishments:

The General Authority for Industrial Development or its geographical branches sends a letter with an attached report of the latest inspection of the General Department of Civil Protection. Accordingly, the various civil Defense departments are notified to conduct the inspection by the committee within 48 hours of the arrival Notification

Procedures for fulfilling civil Defense requirements in industrial facilities.(General Administration civil Defense Instructions)

The procedures required to be followed to obtain civil Defense approval are as follows:

1. **First: With regard to new establishments (that have not previously obtained civil Defense approval):**

- ✓ The owner of the activity shall submit a request to the licensing authority, as it is the competent authority, to obtain civil Defense approval for the activity, attaching to the request a technical report approved by a fire consultant detailing the detailed description of the site and the degree of danger according to the type of activity, as well as all firefighting equipment.
- ✓ The technical report submitted by the facility is studied, and if the report is complete, the Civil Defense Department issues initial approval for the submitted report and approves the facility to carry out the work, mentioning the recommendations that the administration wishes to implement. (Within a period of (15) days)
- ✓ If the report is not completed, the project consultant will be reviewed to complete the required amendments in the report in light of the provisions of the Egyptian Code for Design Foundations and Implementation Requirements.
- ✓ After completing the required amendments, the project will be re-examined again and the necessary approval will be issued. Within a period of (15) days.
- ✓ Immediately upon completion of the implementation of all requirements previously mentioned in the project consultant's report, the owner of the activity will notify the licensing authority to set a date for conducting an inspection of the activity. (In coordination with the licensee within two days).
- ✓ In the event that the requirements are completed through inspection, a report will be issued by the Civil Defense Department and the licensing authority will be addressed stating that the establishment fulfills all requirements (no later than 15 days)... However, if there are some observations, another report will be issued with the observations that have not been implemented and the licensing authority will be addressed to announce the owner of the activity.

- ✓ With observations to implement them and re-notify the administration for inspection.) Within a maximum period of three days for large projects that require study by a number of technical engineers at the General Administration of Civil Protection, the Geographic Civil Defense Administration shall address the administration with the technical report submitted by the project consultant, and the administration shall prepare a report with the knowledge of a committee of specialized engineers. If there are any comments on the report, they will be addressed by the project consultant and the Civil Defense Department will be contacted again for a technical opinion. (Within 15 days from the date of submission of the project consultant's report containing all documents)

2. <u>Second: Following up on existing establishments (that have previously obtained civil Defense approval):</u>

- ✓ The licensing authorities notify the Civil Defense Department of the request to inspect the industrial facility. An inspection of the facility is conducted, the requirements for Defense against fire hazards are reviewed, and a report is prepared thereon. (Within three days from the date of completion of the inspection committee members) If all requirements are met, a report will be prepared and the licensing authority will be notified to complete the procedures (within three days)
- ✓ In the event that there are observations or failure to meet some basic requirements, the licensing authority will be notified to address the owner of the activity to quickly fulfill those observations, and then re-notify it again after completion of implementation to notify the Civil Defense Department for re-inspection. (Within three days).
- ✓ In the event of any amendments or additions to the activity, the owner of the activity must submit a technical report explains the firefighting equipment to be implemented in the project for study before implementation and to express a technical opinion, as previously explained in the steps in the item on "new facilities."

<u>Third Requirements that must be met in industrial facilities according to the Egyptian Fire Code:</u>

- ✓ The requirements described in the following checklist must be met, which must be implemented in accordance with the provisions of the Egyptian Fire Code:

  1. Fire alarm systems include (detectors and alarm panel of the approved type - alarm monitoring for firefighting systems).
  2. Escape routes - doors installed on escape routes and resistant to fire Luminous.
  3. Approach points for fire trucks and response distances at the factory.
  4. Manual fire-fighting devices of all types.
  5. Tags Guidance

6. Firefighting systems with water include (water sources designated for extinguishing - fire pumps - extensions).
7. And faucets Fire extinguishing - Siamese connections)
8. Automatic extinguishing systems with water sprinklers.
9. Fire-fighting systems using suppressant gases.
10. Foam and wet chemical liquid control systems.
11. Ventilation systems according to the nature of occupancy (especially in closed spaces)
12. Smoke extraction systems
13. Warehouses and their security - Observance of general requirements for storage
14. Central air conditioning systems and the extent of their connection with automatic alarms.
15. Electrical services (main electricity room - transformers - low pressure rooms and meters) and secure it.
16. Steam boiler rooms - fuel stations and their security (in accordance with ministerial decisions and regulatory technical bulletins). 15 - Training workers on firefighting work and the use of manual equipment, reels and fire hydrants (at a rate of not less than 25% of the total workers).
17. Evacuation plan
18. Reports on the validity of preventive systems against fire alarm required for licensing for the first time or upon renewal, taking into account that these general requirements vary according to the nature of each activity, as well as taking into account that these requirements are implemented in accordance with what is stated in the Egyptian Code for the principles of design and implementation requirements, and in the event of their absence.

- ✓ There is an item in The Egyptian code is referred to the American code NFPA and other international codes. It should be noted that the General Administration of Civil Defense spares no effort in providing technical advice for any new or existing projects in order to advance the wheel of investment and development and achieve well-being and prosperity without disturbing the firefighting system and in accordance with the laws and codes regulating the preservation of lives and property.
- ✓ It is necessary to take into account the application of all provisions, laws and ministerial decisions regulating such activities.

وزارة الداخلية
الإدارة العامة للحماية المدنية
وكالة الاطفاء

Ministry of Interior
General Administration of Civil Protection
Civil Protection In Industry Dept

محضر اجتماع
بتاريخ ٢ /١٠/٢٠٢٢

بمناسبة ورود خطاب الاعلام والعلاقات والمتضمن طلب الهيئة العامة للبترول والمتضمن انه فى اطار اعمال (المراجعات الميدانية – المعاينات – اعتماد خطط الطوارئ – اعتماد الرسومات الهندسية – اعتماد التقارير استشاري الاطفاء للمشروعات الجديدة والتعديلات للمشروعات القائمة) لشركات الانتاج والتكرير ومستودعات شركات التوزيع والبتروكيماويات التي يتم تنفيذها من قبل اقسام الحماية المدنية بمديرية الامن وارسالها للأدارة العامة للحماية المدنية لمراجعة الرسومات والتقارير، وارسالها مرة اخري للأقسام ، مما يأخذ الكثير من الوقت والجهد ، تلتمس الموافقة علي التنسيق مع الأدارة العامة للحماية المدنية مباشرة بدلا من اقسام الحماية المدنية بمديريات الأمن ، وذلك بهدف اداء الاعمال المشار اليها وتنفيذ الاجراءات الوقائية ونظم الانذار والاطفاء بكفاءة في الوقت المطلوب ، وذلك أسوة بما يتم التعامل به مع المنشأت السياحية والفندقية ، وبتاريخ اليوم الساعة (١٠ص) تم عقد اجتماع تنسيقي بحضورنا السيد اللواء / سامح محمد بسيم

وحضر وكل من :-

- مقدم / محمد جلال :- مدير ادارة الصناعة بالانابة .
- السيد اللواء/ ناصر نبيل :- ممثل الهيئة العامة للبترول .
- الكيميائي / جمال فتحي محمد :- مستشار الرئيس التنفيذي للهيئة العامة للبترول والمشرف علي البيئة والامن الصناعي .

وتم الاتفاق علي الاتي:-

لا مانع من عمل المراجعات الميدانية – المعاينات – اعتماد خطط الطوارئ – دراسة الرسومات الهندسية - تقارير الاستشارية والتعديلات للمشروعات القائمة وذلك بالادارة العامة للحماية المدنية .

- بالنسبة لمحطات الوقود يتم عمل المعاينات بمعرفة ادارات الحماية المدنية الجغرافية

- قرر مسؤلي الهيئة العامة المصرية للبترول استعدادهم لدفع الرسوم المقررة لكل عملية طبقا للوائح المنظمة في هذا الشأن

التوقيعات

١- لواء

٢- مقدم

٣- ناصر

٤- جمال

لواء /

حازم فاروق عبد الكريم

مدير الادارة العامة للحماية المدنية

Field of business for fire prevention and alarm system consultants to study the implementation of conditions and requirements Egyptian fire code

SCOPE OF WORK

A. **introduction** :

--------------------- Company intends to develop and change the fire-fighting system and extinguishing systems in a more efficient and accurate manner, based on what was included in the civil Defense report and the Egyptian fire code for preventive requirements against dangers. The fire burned the entire company site, and since the site may not meet some of the requirements of the Egyptian fire code, in order to avoid violating any laws, rules, or decisions. In addition to updating the site's security systems, this is done by developing a plan to launch tenders to contract with one of the specialized consulting offices (copies of the Engineers Syndicate's accreditation certificates for firefighting consultants must be attached, or that the office is accredited by the Engineers Syndicate as a firefighting consultant office to do the following (including, but not limited to):

1) Study, review and design the engineering modifications required for the Egyptian Fire Code What is included in the civil Defense report on fire detection and alarm systems for all company sites and the approval of the design work from the Engineers Syndicate after it is approved by the Civil Defense Department.
2) Submitting a report to reconcile the situation, including preliminary drawings for the fire and alarm networks, calculating quantities, and the estimated financial value of the networks (to develop a time plan for implementation, to be signed by the Chairman of the Board of Directors and the foreign member in Arabic and English, and placed in the report) within a maximum of 3 months from the date of award.
3) Calculate the estimated financial value for carrying out all the work for each item separately, presented with the report
4) Permanent supervision, coordination, follow-up and inspection of works during the implementation stage until the initial receipt stage and providing technical consultations upon request.
5) Representing a company -------------- before the Civil Defense Department
6) Make any modifications to the engineering drawings And Paintings and engineering calculations (3D Modeling - Auto-cad) and review all the alarm and firefighting systems in the company and their compliance with the Egyptian fire code and their suitability to work.
7) Preparing a schedule of the expected cost of the project that includes all the details for each item of work separately

8) Contribute with the owner's representative in approving and submitting all required documents to the official authorities (Civil Defense Department) taking into account also that the scope of work for the consulting body's report includes the hydraulic calculations of the firefighting network and its accessories and the extent of their efficiency in the event of future expansions to ensure the implementation of all preventive requirements against fire dangers.

B. General information for bidders

The following is required from the specialized consulting body:

1. Study the entire company site, the existing equipment, their suitability for work, and the required modifications, if any
2. Study the report of the Civil Defense Committee
3. A field visit is conducted by the consulting body before submitting offers for studies on preliminary engineering works (preliminary engineering works)
4. Preparing a response to all the points contained therein and the possibility of avoiding some comments without the need to modify the designs
5. Providing the necessary technical and scientific studies and consultations, in addition to submitting an integrated technical bid (study - design - estimated value - time plan - implementation supervision) to implement all requirements of the Egyptian Fire Code to develop fire-fighting systems and firefighting systems of all kinds and deal with government agencies to take Necessary approvals and fulfillment's.
6. The conditions and specifications contained in the Egyptian codes governing the scope of work of the project and the American codes are considered or the English code or what is stipulated in the Egyptian Fire Code and the NFPA in all its parts, as well as the Egyptian Code for Fire Fighting and the Civil Defense Report as the basis of the design, unless explicitly stated otherwise and with the approval of the company.

C. Scope of work required

Performing advisory services related to modifications, provided that all technical specifications contained in the Egyptian Fire Code and the Civil Defense Report are adhered to, along with adherence to the following requirements.:-

1. Studying the civil Defense report and closing comments, etc., in order to achieve the maximum benefit for the company.
2. Making the necessary and necessary designs to avoid the observations mentioned in the civil Defense report and the Egyptian fire code for all the company's sites.

3. Performing all the professional work necessary for the amendments and supervising their implementation in accordance with the highest levels and in the manner and method recognized professionally. He is also committed to studying the amendments and the size of its various elements in accordance with the company's requirements, taking into account the fulfillment of these requirements within the limits of the contracted cost and the agreed upon time..

4. Preparing executive drawings and hydraulic calculations necessary to carry out the work for all company sites.

5. Modifying, developing, and supervising the implementation of all current fire-fighting networks, fire detection and alarm systems, and all works (structural and electro mechanical) In accordance with the requirements of the Egyptian Code for fire and alarm networks, the NFPA Code in all its parts, and all necessary works to achieve civil Defense requirements and complete the project to the fullest extent.

6. The system components must conform to the standard specifications, and all system components must be approved by the relevant bodies and authorities before installing them on the site.

7. Preparing and approving executive drawings from civil Defense before starting to implement the works subject to the contract.

8. He is committed to obtaining the approval and approval of the competent authorities (civil Defense and otherwise) on the designs and amendments and implementing all comments issued by those authorities necessary to complete obtaining approvals.

D. Detailed scope of works

The work shall be limited to preparing, developing and issuing the following outputs in compliance with the Egyptian Fire Code as follows:

1) Development And preparation Plan and engineering designs For all company sites and inside buildings, with a sufficient and appropriate number of hose-reel And automatic extinguishing system CO_2 (Spot direction) for all 380 volt main panels in addition to Business Insurance With an automatic fire alarm, as well as an alarm between the suspended ceiling and the main one More than 80 cm for the following facilities:-------

2) Preparing the plan and engineering designs for insurance works with fire hydrants (Engineering Building)

3) Preparation The drawing And engineering designs to Warehouse insurance the main Automatic shut-off

4) Preparation The drawing And engineering designs to Waste area

5) Study development and preparation Plan and engineering designs To modify the water and foam extinguishing system in the company's areas

6) Developing and preparing the plan and engineering designs to create an automatic fire extinguishing system Preparation Plan and engineering designs to Transformer rooms Electrical machines the outside Automatic firefighting (Water spray or Total immersion CO2 In the closed state)In addition With a foaming device of suitable capacity And setting up an automatic extinguishing system CO2(spotlighting) For all 380 volt main boards as well All cable rooms (below the power stations)System automatic extinguishing (Total immersion)

7) Preparation Plan and engineering designs To connect all occupancies to the automatic fire alarm with exposed heads, provided that all subsidiary alarm panels are connected to the main control room (Local control rooms)

8) Submitting an engineering technical report on the existing fire pumps (capacity - discharge rates - operating system - current efficiency) according to hydraulic calculations and discharge rates for the size of the work, as well as studying the quantities of water available from the external water source (Open Source) and its efficiency in emergency situations.

9) Check the mechanical properties of the line Firefighting water network and hydraulic calculations the network and its accessories and their efficiency in the event of future expansion.

10) Preparing a general plan and approving a description of all escape routes and directional signs.

11) Develop a time plan to reconcile the situation, in addition to studying the calculation of the estimated value for implementing all previous works, each item separately.

12) Representing the company before the Civil Defense Department to obtain the necessary approvals from it before starting the amendments and supervising the implementation.

13) Submitting a schedule of work for review and approval by the company (the concerned departments of the company are responsible for determining priorities for implementing the schedule proposed by the consulting body).

14) Provide a timeline for how to implement these works

15) Preparing tender documents and documents and what they include from General and special specifications and specifications Schedule Quantities, plates and detailed drawings to Including all business items In addition to providing the necessary technical consultations For the items agreed to be implemented

16) Preparing the technical specifications and conditions necessary to present tenders for new works to contractors to implement these works.

17) Submit a proposal for the names of contractors who will be invited to submit technical and financial offers to carry out the works

18) Participation with ------------------------------- Company in evaluating the technical and financial offers when issuing a tender to carry out the works.

19) It is necessary to be present to match the firefighting and alarm equipment from the contractor supplier, which will be purchased and approved before purchase, and to inspect it after connection and before installation, and to ensure the safety of the installation in accordance with the technical principles and requirements of the Egyptian fire code.

20) Receiving and testing the fire and alarm project from the installation contractor and approving it with a certificate.

21) The fire and alarm project is received from the consultant and the required certificates are provided

E. Technical presentations of works

The items and alternatives to be presented must be specified in each item, accompanied by technical catalogs and all technical specifications that enable the company to study the technical offer in the following manner: -

- ✓ Type of materials used
- ✓ Technical Specifications

F. Business guarantee

Adequate warranty H Amendments to the company's current system ---------- for these works unless otherwise stated in the attached specifications

G. The language used

1. Technical offers, correspondence, inquiries and documents are written in Arabic And English
2. It is permissible to write the technical and financial offer together in both Arabic and English, and in the event of a difference in interpretation, Arabic shall be the ruling language.

H. Technical evaluation

The company will, before conducting any detailed evaluation of the bids or offers submitted, determine whether the specified basic standards and specifications have been adhered to, and it may request completion and clarification of some technical matters in the event of insufficient data.

The technical offer must include: -

a) All technical details associated with each item

b) The best suggestions from the consulting body.

I. Attachments

Maps and engineering drawings Overall plan for on-site construction

J. Codes and references

i. Egyptian fire code

ii. Civil Defense Authority report

iii. Safety; NFPA,

iv. Wind & earthquake ASCE-7, UBC 1997

v. Electricity IEC/CENELEC, APS, NFPA, NACE

Chapter No.: 2

Means and Egress

In this Chapter:

- Specification for Exits, Stairs, Exit Access, Exit Corridors, Exit Discharge.
- Doors, Handrails, Locks and Latches, Access Control.
- Travel Distances, Dead Ends, Common paths, Occupant Loads.

Intent of the Chapter:

- 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.
- To enable designers to consider floor plans and exit widths that can accommodate people movement and evacuation fluently as per required Occupant Loads.

1. Definitions:

1.1. Means of Egress

1.1.1. Shall

It is a mandatory requirement from Civil Defence

1.1.2. Should

It is a suggested requirement recommended by Civil Defence but not mandatory.

1.1.3. Listed

Approved and registered by Civil Defence

1.1.4. 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.

1.1.5. 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.

1.1.6. Exit Access

That portion of a means of egress that leads to an exit.

1.1.7. Exit

That portion of a means of egress that is separated from all other spaces of the building or structure by construction, location or equipment as required to provide a protected way of travel from Exit access to the exit discharge.

1.1.8. Exit Discharge

That portion of a means of egress between the termination of an exit and a public way.

1.1.9. Level of Exit Discharge.

The story or level where required number of the building exits discharge to outside to finished ground level.

1.1.10. 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.

1.1.11. Accessible Means of Egress

A continuous and unobstructed means of egress that provides an accessible route to a public way.

1.1.12. 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.

1.1.13. 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.

1.1.14. 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.

1.1.15. 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 unenclosed exit access ramp.

1.1.16. Aisle Access way

The initial portion of an exit access that leads to an aisle.

1.1.17. Aisle Ramp

A ramp within a seating area of an assembly occupancy that directly serves rows of seating to the side of the ramp.

1.1.18. Egress Court

A court or yard which provided access to a public way for one or more Exits.

1.1.19. 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.

1.1.20. Ramp

A walking surface that has a running slope steeper than 5% slope.

1.1.21. Smoke-proof Enclosure

An enclosure designed to limit the entry and movement of products of combustion produced by a fire.

1.1.22. Lobby

An entrance or foyer in a building.

1.1.23. 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).

1.1.24. Vestibule

A small room next to an exit stair door and connecting it with the interior of the building.

1.1.25. Story

The portion of a building located between the upper surface of a floor and the upper surface of the floor or roof next above.

1.1.26. Story in Height.

The story count starting with the level of exit discharge and ending with the highest occupiable story height containing the occupancy considered.

1.2. Stair

1.2.1. Stair

Change in elevation, consisting of one or more risers.

1.2.2. 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.

1.2.3. 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.

1.2.4. 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.

1.2.5. Stairway, Interior

A stairway that does not meet the requirements of exterior stairway and serves the interior of the building.

1.2.6. 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.

1.2.7. Scissor Stair

Two interlocking stairways providing two separate paths of egress located within one stairwell enclosure.

1.2.8. 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.

1.2.9. Stair Tread

A stepping space in a stair flight to set the foot.

1.2.10. Stair Riser

The near-vertical element in a set of stairs, forming the space between a step and the next.

1.2.11. Stair Landing

The floor area at the top of a flight of stairs or between two flights of stairs.

1.2.12. Handrail

A horizontal or sloping rail intended for handhold and grasping by the hand for guidance or support.

1.2.13. 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.

1.3. Door

1.3.1. 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.

1.3.2. 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.

1.3.3. 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.

1.3.4. Elevator Lobby Door

A door between an elevator lobby and another building space other than the elevator shaft.

1.3.5. 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.

1.3.6. 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.

1.3.7. Fire Exit Hardware

A type of panic hardware that additionally provides fire protection where used as part of a fire door assembly.

1.3.8. Actuating Member or Bar

The activating mechanism of a panic hardware or fire exit hardware device located on the egress side of a door.

1.3.9. Automatic Closing Door

A door that normally is open but that closes when the automatic-closing device is activated.

1.4. Special Definitions

1.4.1. 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.

1.4.2. 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.

1.4.3. 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.

1.4.4. 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.

1.4.5. 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 overall 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 predetermined 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.

1.4.6. 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.

1.4.7. 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.

1.4.8. Refuge Area

An area that is either a.

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.

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.

1.4.9. 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.

2. Means of Egress

2.1. Intention

2.1.1. Means of Egress requirements in this chapter are to accomplish the following.

2.1.1.1. 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.

2.1.1.2. Protect and improve survivability of occupants not intimate with initial fire development.

2.1.1.3. Provide building features such that safe crowd movement is ensured during emergencies.

2.2. General Requirements

2.2.1. 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.

2.2.2. The two means of egress shall be arranged to minimize the possibility that both might be rendered impassable by the same emergency condition.

2.2.3. 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.

2.2.4. 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.

2.2.5. The requirements of this chapter are minimum guidelines. Refer to the international standards Life Safety Code of Practice,

2.2.6. International codes and standards referred for this chapter are the latest editions of, NFPA 101, NFPA 5000, SFPE Handbook, IBC and their referenced standards.

2.2.7. No new construction shall be executed unless the building has been designed and approved as per Civil Defence requirements.

2.2.8. No new construction shall be occupied in whole or in part unless the building has been designed, approved, inspected and completion certificate is obtained as per Civil Defence requirements.

2.2.9. No modifications, alterations, extensions and change of usage to a building or structure shall be carried out unless such proposals have been designed, approved, inspected and completion certificate is obtained as per Civil Defence requirements.

2.2.10. No under construction buildings or structures shall be occupied in whole or in part unless such proposals have been designed, approved, inspected and completion certificate is obtained as per Civil Defence requirements.

3. Components of Means of Egress

3.1. General

3.1.1. 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.

3.1.2. Such means of egress is categorized into distinct following sections.

a. **The** Exit Access

b. **The** Exit

c. **The** Exit Discharge

3.1.3. The egress is essentially achieved by combination of the following components of means of egress.

a. Doors

b. **Stairs**

c. Corridors

d. **Passageways**

e. **Horizontal** Exits

f. Bridges between buildings

g. **Ramps**

h. **Elevators** and Escalators

i. Area of Refuge

j. Escape Slides and Ladders

3.1.4. General requirements for any components of Means of Egress shall comply with Table 3.1.

Table 3.1: 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 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 approved 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, measure vertically to the top of the guard from the finished walking surface.

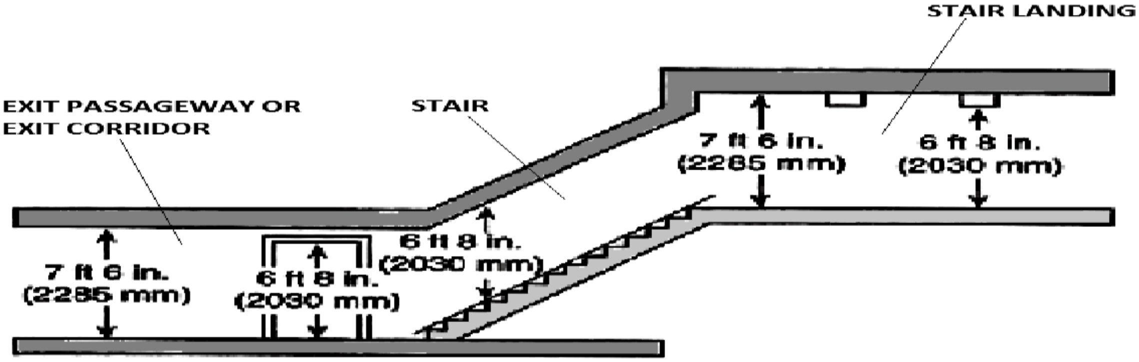


Figure 3.1.: Head room in means of egress

3.2. Doors (Door Assembly):

3.2.1. 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.

3.2.2. Door assembly shall comply with **Table 3.1** and **Table 3.2.** However, type of Door allowed and modified if provided by individual occupancies as per **Section 5.**, shall override the requirements of **Table 3.2.**

Table 3.2: 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 hing 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.

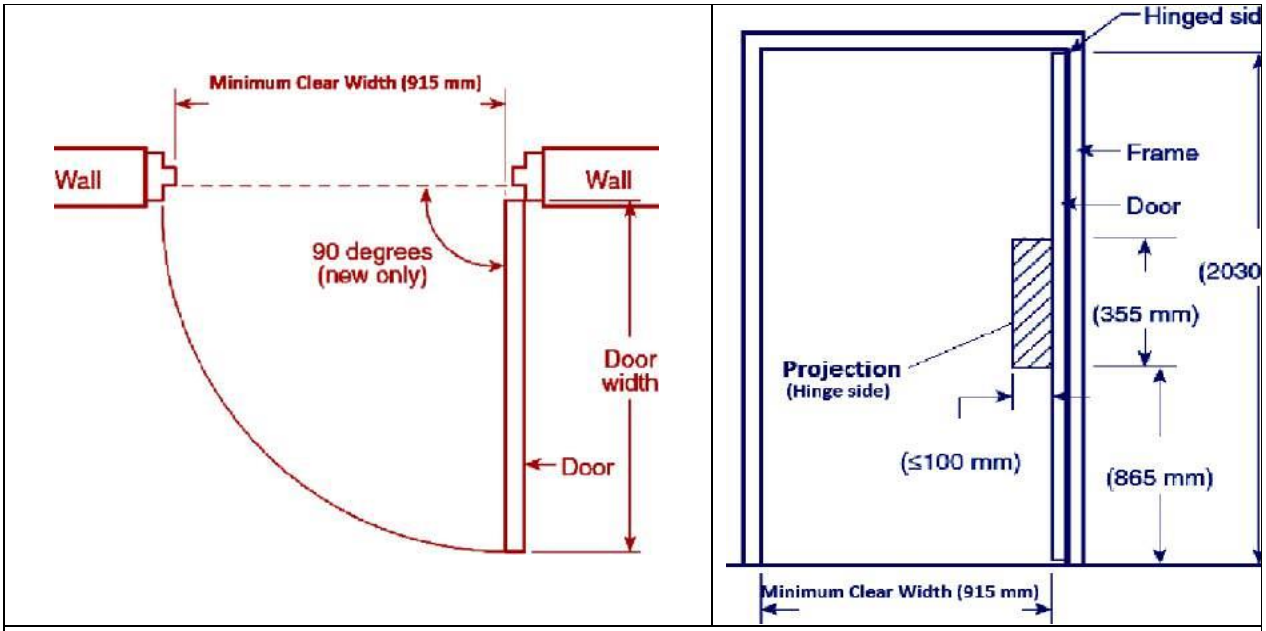
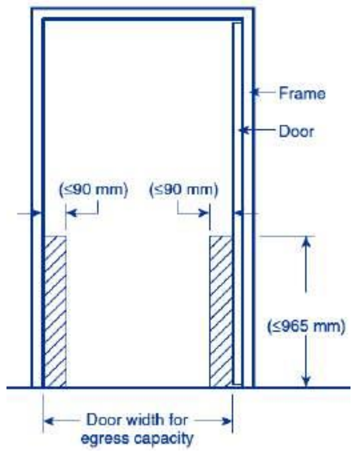


Figure 3.2.: Measuring Door Assembly width

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 mm 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 the requirements of **Table 3.2.** vi. Minimum door width of an exit stair having a width equal to or more than 1420 mm, shall be not less than two thirds of the required width of stairway.
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.
 **Figure 3.3.: Measuring Door Assembly for Egress Capacity**	
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 67 N (15 lbf) to release the latch, 133 N (30 lbf) to set any door leaf in motion, 67 N (15 lbf) to open any door leaf to the minimum required width.
6. DOOR LEAF ENCROACHMENT	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 approved 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 3.2.1.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. 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 sec-

	onds. 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.
9. DELAYED EGRESS LOCKING SYSTEMS	i. Delayed Egress locking Systems shall be allowed only in fully sprinklered 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. 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 approved and listed, the building is fully sprinklered, 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 3.2.8**. And Delayed Egress locks as per **Table 3.2.9.** 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 open-able from the car side without a key, tool, special knowledge or effort.
12. PANIC HARDWARE AND FIRE EXIT HARDWARE	i. Only approved and listed fire exit hardware shall be used on fire protection-rated door assemblies. See **Section 7** 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 3.4.: Panic Hardware height from the finished floor

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 3.3.**

Table 3.3: Revolving Door Maximum Speed		
INSIDE DIAMETER	POWER DRIVEN SPEED CONTROL (RPM)	ANUAL SPEED CONTROL (RPM)
1. 1980 mm	11	12
2. 2135mm	10	11
3. 2285mm	9	11
4. 2440mm	9	10
5. 2590mm	8	9
6. 2745mm	8	9
7. 2895mm	7	8
8. 3050mm	7	8

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 sprinklered area and given egress capacity of 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

<table>
<tr><td></td><td colspan="2">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.</td></tr>
<tr><td colspan="2">
TURNSTILE FOR ILLUSTRATION</td><td>
SECURITY TURNSTILE FOR ILLUSTRATION</td></tr>
<tr><td>17. HORIZONTAL SLIDING DOORS AND POWEROPERATED SLIDING DOORS</td><td colspan="2">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 approved
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. 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".</td></tr>
</table>

	viii. 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"
18. FIRE RESISTANCE RATING OF DOORS	i. Fire resistance rating of Doors, which open into exit corridors, exit access corridors and into exit stairs shall comply with Table 3.3.a. and Table 3.3.b. unless specified in individual occupancies. ii. Door fire rating is not required where located in non-fire rated walls.

Table 3.3.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 Re-quired	Not Required	Latches Only
5. Service corridor of 1 hour fire rating	60 Minutes	Not Re-quired	Self-Closing	Table 3.2.
6. Service corridor of no fire rating	None	Yes	Not Required	Table 3.2.
7. Elevator Lobby	60 Minutes	Yes	Self-Closing	Table 3.2.10
8. Garbage room	60 Minutes	Yes	Self-Closing	Latches Only

Table 3.3.b.: Fire Resistance Rating of Unit Doors

MAIN DOORS OF UNITS IN ENCLOSED EXIT CORRIDOR	DOOR FIRE RAT-ING	SMOKE PROOF	SELF CLOSING	LATCHES AND LOCKS
1. Apartment unit main door	60 Minutes	Not Required	Not Required	Table 3.2.7
2. Residential unit main door	60 Minutes	Not Required	Not Required	Table 3.2.7
3. Labor accommodation unit door	60 Minutes	Not Required	Not Required	Table 3.2.7
4. Staff accommodation unit door	60 Minutes	Not Required	Not Required	Table 3.2.7
5. Hotel unit main door	60 Minutes	Not Required	Yes	Table 3.2.7
6. Office unit main door	-None if sprin-klered -60 Minutes, if not	Not Required	Yes	Table 3.2

	sprin-klered			
7. Kitchen door in residential/ Apartment	60 Minutes	Not Required	Not Required	Table 3.2.7
8. Unit doors in open external corridor	60 Minutes	Not Required	Not Required	Table 3.2.7
9. Education class room doors	-None if sprin-klered -60 Minutes, if not sprin-klered	Not Required	Yes	Table 3.2

3.3. Stair

3.3.1. 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.

3.3.1. 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, providing a protected way of travel to the Exit Discharge.

3.3.2. Stair shall comply with **Table 3.1** and **Table 3.5.** However, type of Stair allowed and modifications, if provided by individual occupancies as per **Section 5**, shall override the requirements of **Table 3.4.**

Table 3.4: Stair

ITEM	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 3.6.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. 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, flights and arrangements in accordance with **Figure 3.13.a.,** the maximum difference of dimension allowed in a flight is 10 mm.
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).
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.

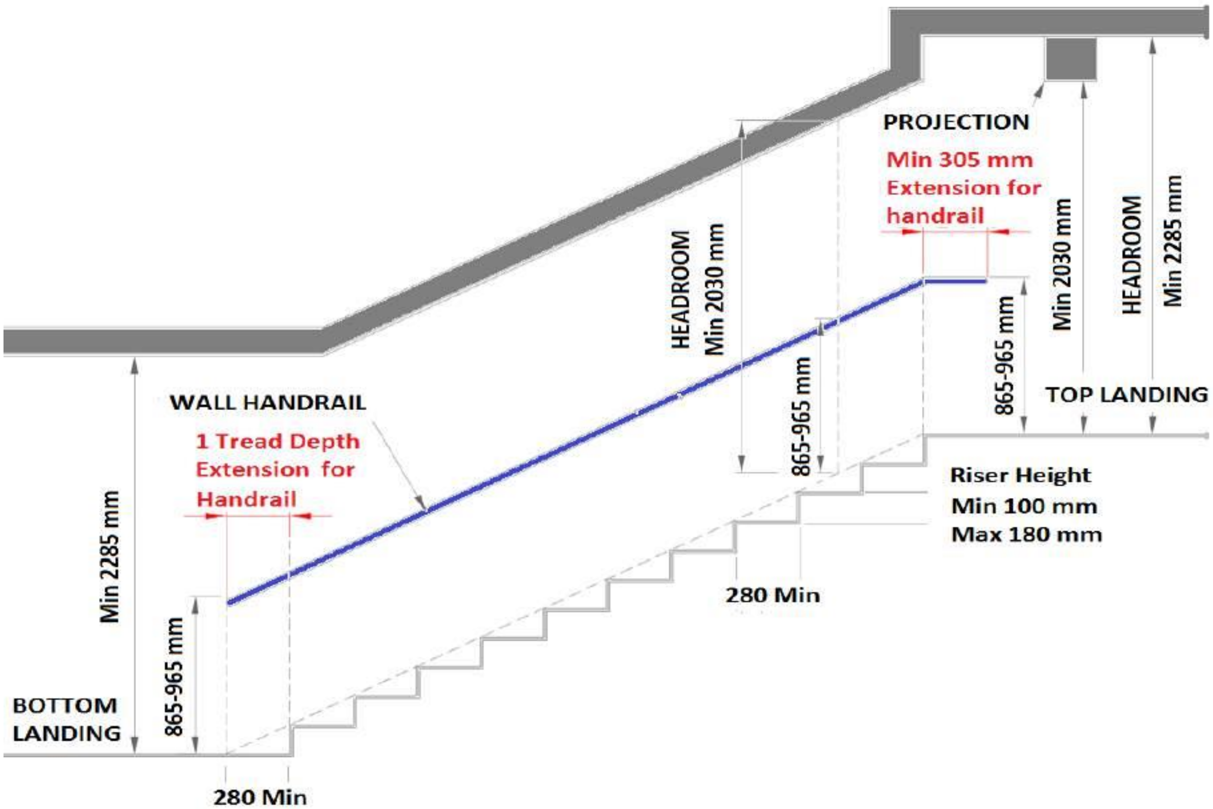


Figure 3.5.: Stair Specifications

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.

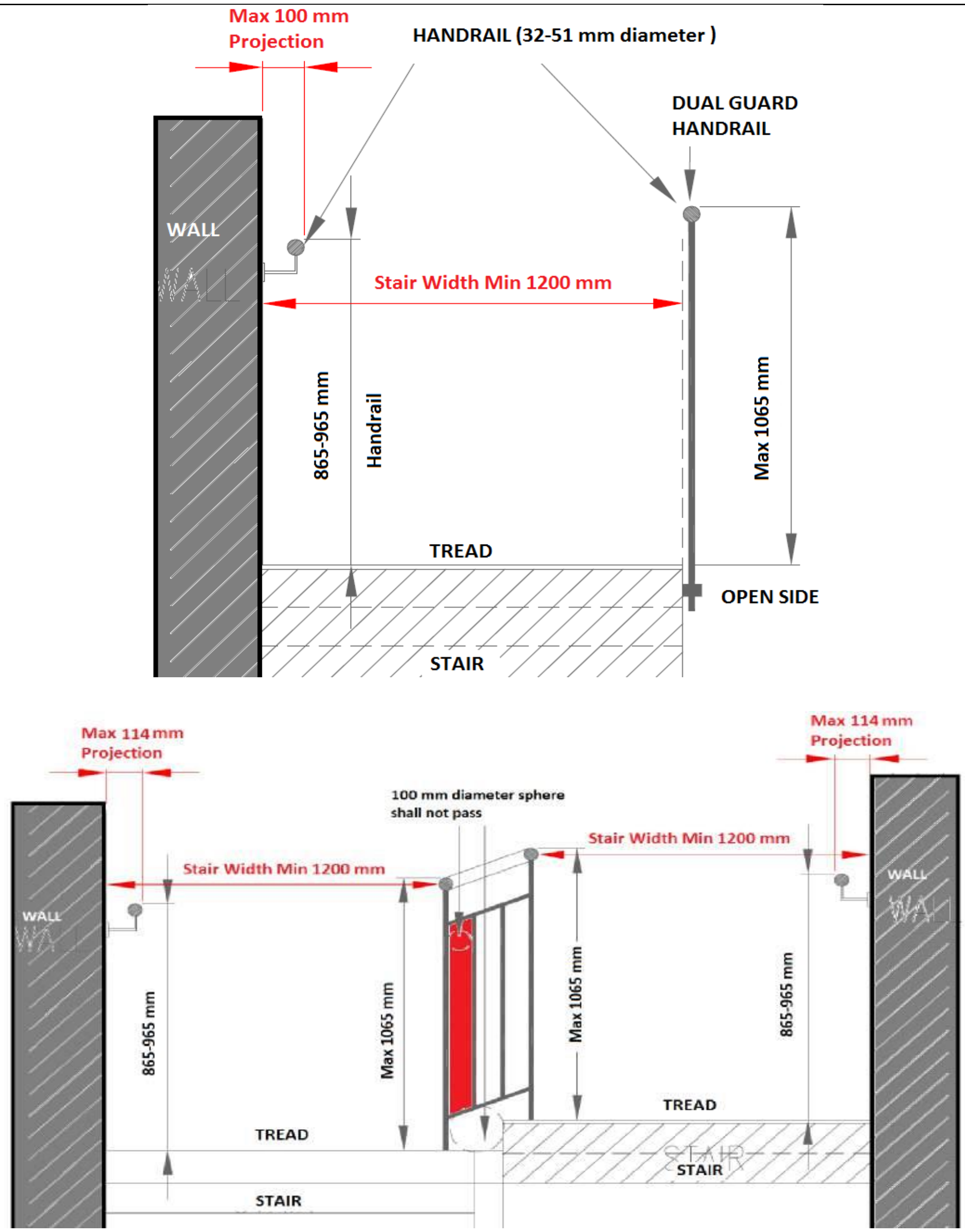
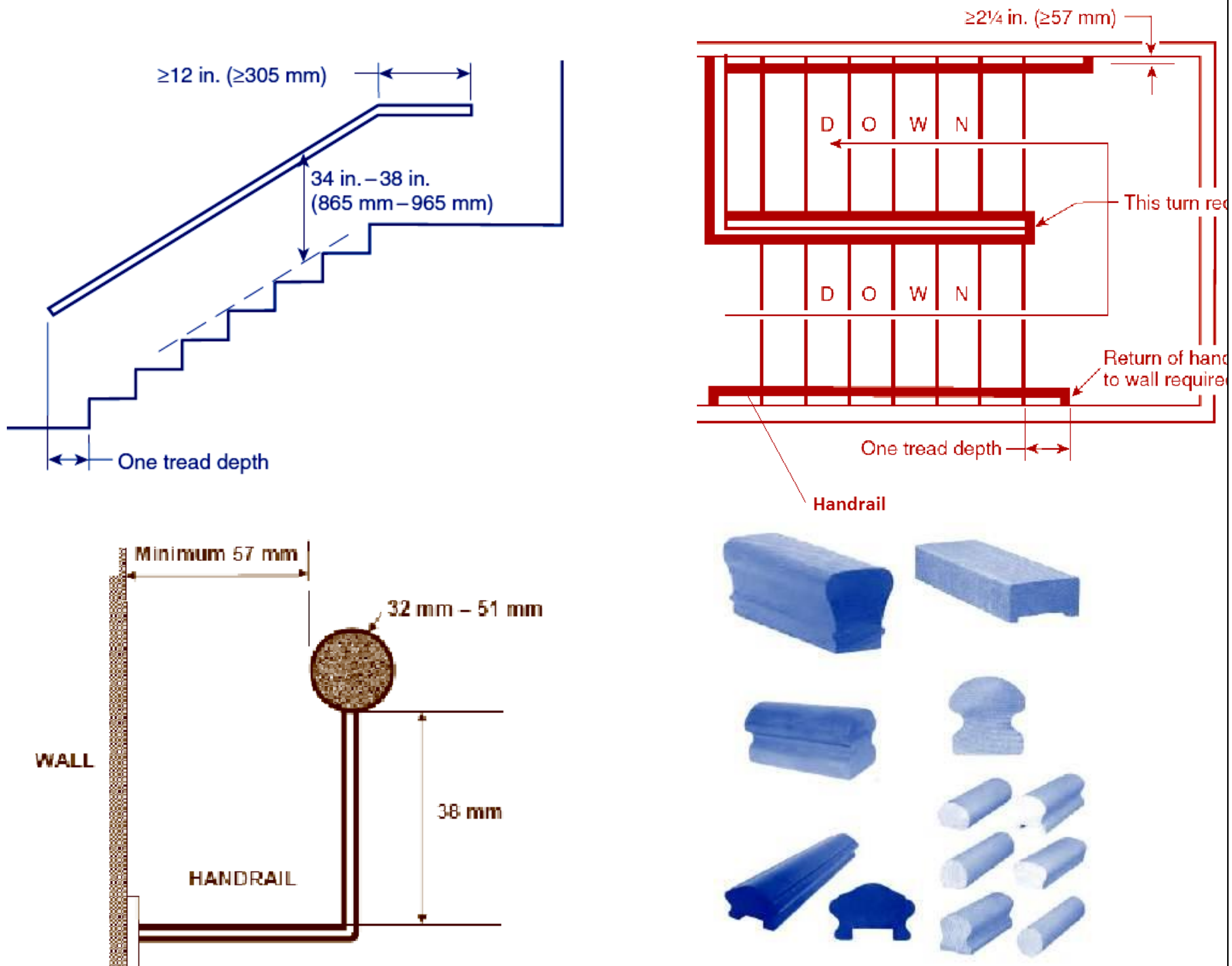


Figure 3.6.a.: Handrail projection, Stair Width Measurements

Table 3.4: Stair	
ITEM	REQUIREMENTS
7. STAIR SEPARATION FROM REST OF THE BUILDING AREAS	i. Every stair serving as an exit 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 of at least block-work and ensure 2 hour fire resistance rating. ii. Every stair serving as an exit in High depth, Midrise, (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 roof-line. 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 enclosure.
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.

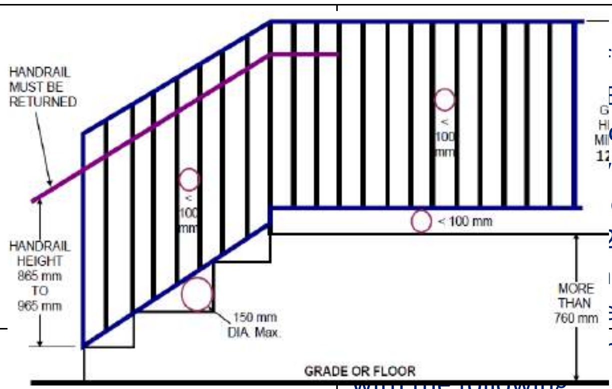
10. HANDRAILS	i. Stairs shall have handrails on both sides. ii. Handrails on stairs shall be not less than 865 mm and not more than 965 mm, above the surface of the tread, measured vertically to the top of the rail from the leading edge of the tread. iii. The height of required handrails that form part 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 vii. Handrails shall continue for the full length of each flight of stair. viii. Inside handrails shall be continuous, graspable between flights at landings. ix. Inside handrails shall be continuous between flights at landings. x. Handrails shall have circular cross section with an outside diameter of not less than 32 mm and not more than 51 mm. xi. 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. xii. 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 mm. xiii. Handrail brackets shall have edges with radius not less than 0.25 mm.



SOME HANDRAIL SHAPES FOR ILLUSTRATION (See Table 3.4.10.x.)

Figure 3.7.: Handrail Specifications

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 approved 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.



	be provi… any, and… English ar… ovided in… visible fo… e floor la… 2135 mm… minimur… e provided… marking is… with the following:
13. TREAD MARKING	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.
14. 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.
15. EQUIPMENT ACCESS	i. Industrial Equipment Access shall comply to 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.

3.4. Horizontal Exit

3.4.1. 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.

3.4.2. Horizontal Exit shall comply with **Table 3.1** and **Table 3.6.** However, allowance of horizontal exits and modifications if provided by individual occupancies sections, shall override the requirements of Table **3.6.**

Table 3.6: 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. 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 protective, 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 protective 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 m^2 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 sprinklered buildings.
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 shall be permitted. iv. All doors in horizontal exits shall be self-closing or automatic closing.

	v. All doors serving horizontal exit shall have approved 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 roof line, 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.

3.5. Smoke-proof Enclosures

3.5.1. 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.

3.5.2. Smoke-proof enclosures shall comply with **Table 3.1** and **Table 3.7.** However, allowance of smoke-proof enclosures and modifications if provided by individual occupancies sections, shall override the requirements of Table **3.7.**

Table 3.7: Smoke proof Enclosures

ITEM	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 remainder 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 sprinklered, 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 m^2 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.
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.

3.6. Exit passageways

3.6.1. 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.

3.6.2. 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.

3.6.3. 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.

3.6.4. Exit passageways shall comply with **Table 3.1** and **Table 3.8.** However, allowance of Exit passageways and modifications if provided by individual occupancies as per **Section 5**, shall override the requirements of **Table 3.8.**

Table 3.8: Exit passageways

ITEM	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 increased 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. Approved and listed Fire rated windows shall be permitted to be installed on exit passageway walls only if the building is sprinklered.
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 3.16.c.** for not acceptable Exit passageways.

3.7. Ramps

3.7.1. Ramps used as means of egress shall comply with **Table 3.1** and **Table 3.9.** However, allowance and modifications of ramps, if provided by individual occupancies as per Section **5**, shall override the requirements of **Table 3.9.**

Table 3.9: 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 m 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. 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.

3.8. Area of Refuge

3.8.1. Area of Refuge is not mandated by Civil Defence. 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.

3.8.2. 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.

3.8.3. Area of Refuge used as means of egress shall comply with **Table 3.1** and **Table 3.10.**

Table 3.10: Area of Refuge

ITEMS	REQUIREMENTS
1. SEPARATION	i. Area of refuge shall be separated from remainder of the storey 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. 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 3.6., 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"

3.9. Exit Discharge

3.9.1. 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.

3.9.2. Exits shall terminate directly, at a public way or at an exterior exit discharge, unless otherwise provided in **Table 3.12.**

3.9.3. Exit Discharge in means of egress shall comply with **Table 3.1** and **Table 3.12.**

Table 3.12.: 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-sprinklered 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. 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.
3. DISTANCE BETWEEN POINTS OF EXIT DISCHARGE	i. In sprinklered 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. ii. In non-sprinklered 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. iii. 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 3.12.4.i and ii.
4. 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.

5. DISCHARGE TO ROOF	i. Discharge to roof is allowed only if the building is sprinklered 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.
6. 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.
7. 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.

4. Capacity of Means of Egress

4.1. The Occupant Load

4.1.1. The Occupant Load is the total number of people or occupants that might occupy a building or portion thereof at any one time.

4.1.2. 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.

4.1.3. 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.

4.2. Egress Capacity

4.2.1. 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.

4.2.2. 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.

4.2.3. Where means of egress from a storey above and a storey below converge at an inter- mediate 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.

4.2.4. 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.

4.2.5. 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.

4.2.6. Where more than one exit access leads to an exit, each exit shall have a width adequate for the number of persons it accommodates.

4.2.7. 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.

4.2.8. 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.

4.2.9. The width of means of egress shall be measured in the clear at the narrowest point of the egress component under consideration.

4.2.10. 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.

4.2.11. 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.

4.3. Number of Means of Egress

4.3.1. Minimum number of means of egress from any storey or portion thereof shall be as per **Table 3.14.**

Table 3.14.: 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 of Egress
iv. OCCUPANT LOAD MORE THAN 1000	Not less than 4 of Egress
v. BALCONY, MEZZANINE,	Minimum 2 Means of Egress
vi. OCCUPANT LOAD MORE THAN 6000 AT OUTDOORS	Not less than 3 of Egress
vi. OCCUPANT LOAD MORE THAN 9000 AT OUTDOORS	Not less than 4 of Egress

4.4. Remoteness of Means of Egress

4.4.1. Exits shall be located, and exit access shall be arranged, so that exits are readily accessible at all times.

4.4.2. Where exits are not immediately accessible from an open floor area, continuous passageways, 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.

4.4.3. Exit access corridors shall provide access to not less than two approved exits, unless single exits are permitted as per individual occupancies.

4.4.4. 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. Occupancy Specific Requirements

5.1. Assembly, Group A, B, C.

5.1.1. The assembly occupancies shall comply with Table 3.17. 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 3.17.: Assembly, Group A, B, C.	
ITEM	**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. 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. v. 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.
3. 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 Civil Defence for approval. ii. All means of egress serving a smoke-protected assembly seating area shall be provided with smoke control system to achieve the level of smoke at not less than 1830 mm above the floor of the means of egress. iii. 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. iv. 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.

	v. In smoke-protected assembly seating, Travel distance from any seat to nearest entrance to concourse shall not exceed 122m. vi. The travel distance from the entrance to the vomitory portal or from the egress concourse to an approved egress stair, ramp, or walk at the building exterior shall not exceed 61 m.

5.2. Business, Group A, B, C.

5.2.1. The Business occupancies shall comply with **Table 3.19** 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 3.19.: Business , Group A, B, C.

ITEM	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 open Stair shall be permitted for a 2 storey, Single tenant, fully sprinklered building, provided that full travel distance to outside including the travel distance within stair does not exceed 30 m.

5.15. Industrial, Group A, B, C. (Process, Manufacturing, Workshops)

5.15.1. The Industrial, Group A, B, C. (Process, Manufacturing, Workshops) occupancies shall comply with Table 3.36. Along with all other sections of this chapter. Where conflicts arise between this section and other sections of this Chapter, the requirements of this section shall prevail.

Table 3.36.: Industrial, Group A, B, C. (Process, Manufacturing, Workshops)

ITEM	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 4.4 of** this chapter. iii. Not less than 1 exit shall be provided such that exit can be reached without traversing to another storey. 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 **section 4.4** 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. ii. Exit access corridors where provided, in non sprinklered industrial occupancies, shall be separated from other parts of the building by 1 hour fire resistance rated construction.

6. Design, Installation, Inspection and Maintenance of Means of Egress

6.1. General

6.1.1. 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.

6.1.2. 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.

6.2. The Doors

6.2.1. Testing and Acceptance

6.2.1.1. Doors and opening protective shall be tested as “Door Assembly” by Civil Defence approved. Acceptable test standards shall be.

6.2.1.2. Individual hardware such as locks, hinges, vision panels etc. or door core materials, panels, the Door Assembly as intended shall be registered by Civil Defence.

6.2.1.3. All door and opening protective manufacturers shall be registered. No door assembly shall be sold or distributed without certification and license.

6.2.2. Design/ Specification/ Submittals

6.2.2.1. 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.

6.2.3. Installation

6.2.3.1. The installation of door assemblies shall be carried out approved installer as per door manufacturer's installation instructions and shall comply with local regulations and the construction documents.

6.2.4. Installer Qualification

6.2.4.1. The 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.

6.2.5. Inspector Qualification

6.2.5.1. Inspection shall be consultant’s responsibility to perform inspections or undertaking inspections shall be trained by door manufacturers.

6.2.5.2. Inspection shall be carried out in accordance with standard international inspection criteria .

6.2.6. Inspection

6.2.6.1. 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.

6.2.6.2. A written record of the inspections and testing shall be signed and kept for inspection 6.2.6.3. Door assemblies shall be visually inspected from both sides of the opening to assess the overall condition of the door assembly.

6.2.6.4. 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 **Section 3.2.** of this chapter.

d. Latching and locking devices comply with requirements of **Section 3.2.**

e. Releasing hardware devices are installed in accordance with **Section 3.2.**

f. Door leaves of paired openings are installed in accordance with **Section 3.2.**

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 **Section 3.2.**

i. Powered door openings operate in accordance with **Section 3.2.**

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

7.1. Acceptable Test Standards and criteria

7.1.1. 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, Approved .

7.1.2. There is no year of edition mentioned against any test standards. It is the intent of 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. 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 Protective

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, open-able window assemblies and elements of building hardware. Fire resistance tests for doors, shutters and open-able windows.

v. EN 1634-2: Fire resistance and smoke control tests for door, shutter and open-able 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, open-able windows and elements of building hardware - Part 3: Smoke control test for door and shutter assemblies

vii. EN 14600: Door-sets and open-able 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 open-able 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 open-able windows

x. EN 15269-3: EXAP – Part 3: Fire resistance of hinged and pivoted timber door-sets and open-able timber framed windows

xi. pr EN 15269-4: EXAP – Part 4: Fire resistance of hinged and pivoted glazed door-sets and shutter assemblies.

xii. pr EN 15269-5: EXAP – Part 5: Fire resistance of hinged and pivoted metal framed glazed door-sets and open-able windows

xiii. pr EN 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. pr EN 15269-8: EXAP – Part 8: Fire resistance of timber horizontally folding doors.

Chapter No.: 3

Fire Extinguishers

In this Chapter:

- Definition of various types of fire extinguishers

- Classes of Fires and applicable categories of fire extinguishers
- Inspection and maintenance of fire extinguishers

Intent of the Chapter:

- To familiarize end users of various types of Fire Extinguishers.
- To enable designers and owners to Choose extinguishers appropriately according to the hazard.
- To regulate the inspection and maintenance of Fire Extinguishers.

1. Definitions:

1.1. General:

1.1.1. Gallon. U.S. Standard and Kilogram

1 U.S. gal = 3.785 UL. 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.)

1.1.2. Kilogram

1 Kg = 2.20.lb (Pounds)

1.2. Fire Extinguishers

1.2.1. Class A Fire

Fires in ordinary combustible materials, such as wood, cloth, paper, rubber, and many plastics.

1.2.2. Class B Fire

Fires in flammable liquids, combustible liquids, petroleum greases, tars, oils, oil-based paints, solvents, lacquers, alcohols, and flammable gases.

1.2.3. Class C Fire

Fires that involve energized electrical equipment.

1.2.4. Class D Fire

Fires in combustible metals, such as magnesium, titanium, zirconium, sodium, lithium, and potassium.

1.2.5. Class K Fire

Fires in cooking appliances that involve combustible cooking media (vegetable or animal oils and fats).

1.2.6. 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.

1.2.7. 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, Fire Fighting Systems, and Definitions.

1.2.8. 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.

1.2.9. Carbon Dioxide

A colorless, odorless, electrically non-conductive inert gas that is a suitable medium for extinguishing Class B and Class C fires.

1.2.10. 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.

1.2.11. Wet Chemical

Wet chemicals include, but are not limited to, solutions of water and potassium acetate, potassium carbonate, potassium citrate, or any combinations thereof

1.2.12. Dry Powder

Solid materials in powder or granular form designed to extinguish Class D combustible metal fires by crusting, smothering, or heat-transferring means.

1.2.13. Film Forming Foam

The film-forming foam agents referenced in this standard are AFFF (aqueous film-forming foam) and FFFP (film-forming fluoroprotein foam).

1.2.14. 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 k Pa) at 70°F (21°C).

1.2.15. Low Pressure Cylinder

For the purposes of this standard, low-pressure cylinders are those containing fire extinguishing agent (medium), nitrogen, compressed air, or other compressed gases at a service pressure of 500 psi (3447 k Pa) or lower at 70°F (21°C).

1.2.16. 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, standpipe and hose, or other fixed protection equipment.

1.2.17. Extinguisher Service Pressure

The normal operating pressure as indicated on the nameplate or cylinder of a fire extinguisher.

1.2.18. Factory Test Pressure

The pressure at which a shell was tested at time of manufacture. This pressure is shown on the nameplate.

1.2.19. Recharging

The replacement of the extinguishing agent (also includes the expellant for certain types of fire extinguishers).

1.2.20. Servicing

Includes one or more of the following: (a) maintenance, (b) recharging, (c) hydro-static testing

1.2.21. Cartridge Operated Fire Extinguisher

A fire extinguisher in which the expellant gas is in a separate container from the agent storage container.

1.2.22. Non-rechargeable Extinguisher

A non-rechargeable (non-refillable) fire extinguisher is not capable of (nor intended to be capable of) undergoing complete maintenance, hydro-static testing, and being restored to its full operating capability by the standard practices used by fire equipment dealers and distributors.

1.2.23. Portable Fire Extinguisher

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.

1.2.24. Rechargeable Extinguisher

A rechargeable (refillable) fire extinguisher is capable of undergoing complete maintenance, including internal inspection of the pressure vessel, replacement of all substandard parts and seals, and hydro-static testing.

1.2.25. 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.

1.2.26. Self-expellant Fire Extinguisher

A fire extinguisher in which the agents have sufficient vapor pressure at normal operating temperatures to expel themselves

1.2.28. Wheeled Type Extinguisher

A portable fire extinguisher equipped with a carriage and wheels intended to be transported to the fire by one person.

2.1. Intention

2.1.1. 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 natures of fires.

2.1.2. However, usage of fire extinguishers shall be limited to informed and trained personnel. Any fire can grow into catastrophe within minutes. It is not the intention of Civil Defence nor recommendation for people to stay within fire vicinity to fight fires with portable extinguishers, unless the fire is manageable scale and person using the extinguisher is trained.

2.2. Basic Awareness

2.2.1. 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

2.2.2. When a fire extinguisher is being selected, the following physical conditions should be considered.

2.2.2.1. Gross Weight: In the selection of a fire extinguisher, the physical ability of the user should be contemplated. When the hazard exceeds the capability of a hand portable fire extinguisher, wheeled fire extinguishers or fixed systems should be considered.

2.2.2.2. 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.

2.2.2.3. Agent Reaction: 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.

2.2.2.4. 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 ready passage of the fire extinguisher.

2.2.2.5. Wind and Draft: If the hazard is subject to winds or draft, the use of fire extinguishers and agents having sufficient range to overcome these conditions should be considered.

2.2.2.6. 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.

2.2.3. Extinguishers should be kept near a door that can be used as an escape route.

2.2.4. Stay low. Avoid breathing the heated smoke, vapors, or fumes as much as possible, as well as the extinguishing agents.

2.2.5. 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 door(s) behind you, and do not re-enter until the facility management handles the incident and Civil Defence personnel evaluate the situation.

2.2.6. A fire creates conditions of stress and intense excitement. Under these conditions, the choice of a 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) Marking clearly the intended use.
d) Training employees in the use of proper fire extinguishers.

2.2.7. 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.

2.2.8. Obsolete Extinguishers

2.2.8.1. The following types of extinguishers are considered obsolete and should be removed from service and replaced

a. Soda acid types
b. Vaporizing liquid
c. Cartridge-operated water
d. Cartridge-operated loaded stream
E. Copper or brass shell fire extinguishers (excluding pump tanks) joined by soft solder or rivets
f. Extinguishers rated prior to 1955 and marked B-1, C-1 on the nameplate

g. Fire extinguishers not listed or labeled

h. Halon 1211 and Halon 1301 Agents

2.2.9. Training

2.2.9.1. At least 25 % of the Security personnel, Occupants, Employees and Supervisory personnel of each occupancy shall be trained on basic fire awareness, types, use and operation of fire extinguishers in emergency situation.

2.2.9.2. The training shall be conducted by an authorized agency by the Civil Defence

2.3. General Requirements

2.3.1. The General requirements of Fire Extinguisher shall be as per Table 4.1

Table 4.1: General Requirements of Fire Extinguishers	
ITEMS	REQUIREMENTS
1. EXTINGUISHER RATING	AS PER THE TEST LABORATORIES FOLLOWING ARE THE RATING CRITERIA i. Class A Rating. Tested on Wood 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. iii. Class A: The Fires involving ordinary combustible solid materials such as wood, cloth, paper, rubber, and many other plastics. iv. Class B: The Fires involving flammable liquids, combustible liquids, all petroleum based products, solvents, paints, chemicals and flammable gases. v. Class C: The Fires involving energized electrical equipment due to ignition of electrical nature. vi. Class D: The Fires involving combustible metals, such as magnesium, titanium, zirconium, sodium, lithium, and potassium. vii. Class K: The Fires involving cooking appliances due to combustible cooking media such as vegetable oils and animal fats etc. 1. LABELING i. An extinguisher labeling for example (UL Listed), "2-A: 10-B: C" conveys the following information. a. Extinguisher is capable of extinguishing Class A fire with equivalency of 2.5 gallons of water (Number 1=1.25 Gal of water, number 2=2.5 Gal of water, number 3=3.25 Gal of water etc.) b. Extinguisher is capable of extinguishing class B fire with a capacity of 10 ft. of coverage. (Number against B implies square foot coverage of extinguisher for class B fires) c. c. Extinguisher is also applicable to Class C fires and is non-conductive (Usually there are no numbers against C)
3. PLANNING	THE FOLLOWING ITEMS SHOULD BE EVALUATED BEFORE SELECTING, INSTALLATION AND DISTRIBUTING PORTABLE FIRE EXTINGUISHERS : 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. 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$_0$C to 49$_0$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 4.1.: Symbols for Fire Extinguisher Classes

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.

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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 must be taking.
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 un-ventilated 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 un-ventilated 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.
</td></tr>
<tr><td>6. OPERATION AND USE</td><td>
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 approval 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 application techniques, and more fire extinguishers could have to be used, or the fire could possibly not be extinguished.
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, color 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
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6. OPERATION AND USE	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, and physical ability of the user. Pre-planning 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 ways and the nature of the flooring and outside grounds over which the fire extinguisher needs to be moved should be taken into account. 4. ACTUATION 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.

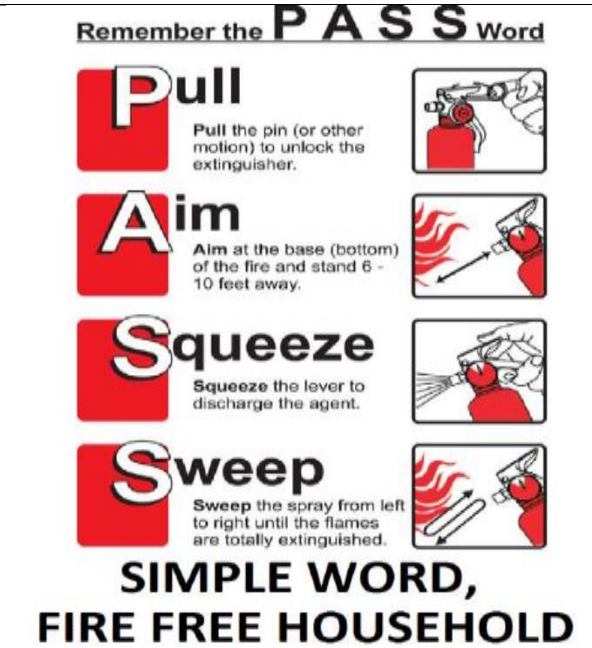

Figure 4.2.: Fire Extinguisher Signage for various locations

2.4. Types of Fire Extinguishers

2.4.1. The Selection of Fire Extinguishers shall be based on Table 4.2.

Table 4.2: Types and Selection of Fire Extinguishers

ITEMS	REQUIREMENTS
1. WATER TYPE	1. DESCRIPTION i. The most popular type is the 2½ gal (9.46 L) 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. This includes water, antifreeze, wetting agent, and loaded stream fire extinguishers. These fire extinguishers are intended primarily for use on Class A fires. The stream initially should be directed at the base of the flames. After extinguish of flames, it should be directed generally at smoldering or glowing surfaces. Application should begin as close as possible to the fire. Deep-seated fires should be thoroughly soaked and might need to be "broken apart" to effect complete extinguish. 2. APPLICATION i. Class A fires, Wood, Paper, Textile, Garbage, Furniture, Residential Plastic, Interior decor. 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

	1. DESCRIPTION i. AFFF (aqueous film-forming foam) a type fire extinguishers are rated for use on both Class A and Class B fires. ii. 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 re-ignition.

<table>
<tr><td>2. FOAM TYPE</td><td>
iii. Fire extinguishers of these types are usually available in hand portable models of 1.6 gal (6 L) and 2½ gal (9.46 L) and in wheeled models having a liquid capacity of 33 gal (125 L). These fire extinguishers have ratings of 2 A: 10-B, 3-A: 20-B, and 20-A: 160-B, respectively.
iv. The extinguishing agent is a solution of film-forming surfactant in water that forms mechanical foam when discharged through an aspirating nozzle.
v. On Class A fires, the agent acts as both a coolant and penetrate to reduce temperatures to below the ignition level.
vi. On Class B fires, the agent acts as a barrier to exclude air or oxygen from the fuel surface.
vii. 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.
viii. 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.
ix. 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, Wood, Paper, Textile, Garbage, Furniture, Residential Plastic, Interior decor.
ii. Class B fires, Flammable Liquids
3. NOT SUITABLE FOR
i. Class C fire, Electrical equipment, Office equipment, Computers. Below $4^{o}C$ ambient temperatures
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FOAM TYPE EXTINGUISHER FOR ILLUSTRATION
</td></tr>
<tr><td>3. CO2 TYPE</td><td>
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.
</td></tr>
</table>

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, it has a relatively short range of 3 ft. to 8 ft. (1 m to 2.4 m).

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 re-flash.

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-sides weeping 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 re-ignition. These agents are not suitable for use on pressurized fuel fires or cooking-grease fires.

2. APPLICATION

i. Class C fires, Electric equipment, office equipment, computers, printing machines, copy machines.

ii. Class B fires, Flammable Liquids.

3. NOT SUITABLE FOR

i. Water soluble flammable liquids such as alcohol, acetone, esters, and ketones.

CO2 TYPE EXTINGUISHER FOR ILLUSTRATION

1. DRY POWDER (MULTI PURPOSE)

i. Fire extinguishers of this type contain an ammonium phosphate base agent. Hand fire extinguishers are available with fire extinguish ratings of 1-A to 20-A and 10-B: C to 120-B: C and wheeled models with fire extinguish ratings of 20-A to 40-A and 60-B: C to 320-B: C.

4. DRY POWDER TYPE 4. DRY POWDER TYPE	ii. Multipurpose agents are used in exactly the same manner as ordinary dry chemical agents on Class B fires. For use on Class A fires, the multi-purpose agent has the additional characteristic of softening and sticking when in contact with hot surfaces. In this way, it can adhere to burning materials and form a coating that will smother and isolate the fuel from air. iii. When applying the agent, it is important to try to coat all burning areas in order to eliminate or minimize the number of small embers that could be a potential source of re-ignition. The agent itself has little cooling effect and, because of its surface coating characteristic, it cannot penetrate below the burning surface. For this reason, extinguish of deep-seated fires could possibly not be accomplished unless the agent is discharged below the surface or the material is broken apart and spread out. iv. Fire extinguishers with a Class B rating can extinguish a fire involving combustible cooking media (vegetable or animal oils and fats). v. Only fire extinguishers having a Class K rating are recommended for use on cooking-grease fires. 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. Though it is multipurpose, Class rating should be strictly followed.

DRY POWDER EXTINGUISHER FOR ILLUSTRATION

5. DRY CHEMICAL TYPE	1. DRY CHEMICAL 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. Stored-pressure fire extinguishers are available in capacities from 1 lb. to 30 lb. (0.5 kg to 14 kg) for hand fire extinguishers and 125 kg to 250 lb. (57 kg to 113.5 kg) for wheeled fire extinguishers. Cartridge/cylinder-operated fire extinguishers are available in capacities from 4 lb. to 30 lb. (1.8 kg to 14 kg) for hand fire extinguishers and 45 lb. to 35 lb. (20 kg to 159 kg) for wheeled fire extinguishers 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.
6. WET CHEMICAL TYPE	1. WET CHEMICAL i. Fire extinguishers of this type are available in hand portable models of 1.5 gal (6 L) and 2½ gal (9.46 L). 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.

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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 re-ignition. 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 extinguish, a thick foam blanket is formed to prevent re-ignition while cooling both the appliance and the hot cooking oil. Wet chemical extinguishers also offer improved visibility during firefighting as well as minimizing clean-up afterwards.
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.
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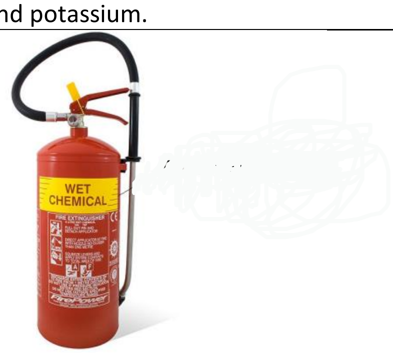

WET CHEMICAL EXTINGUISHER FOR ILLUSTRATION
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<tr><td>7. HALOCARBON (CLEAN AGENT) TYPE</td><td>
1. HALOCARBON (CLEAN AGENT)
i. Halocarbon agents are similar to halon agents in that they are nonconductive, noncorrosive, and evaporate after use, leaving 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.
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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 un-ventilated 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.
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.
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HALOCARBON / CLEAN AGENT FIRE EXTINGUISHER FOR ILLUSTRATION
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<td>8. WHEELED TYPE</td>
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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.
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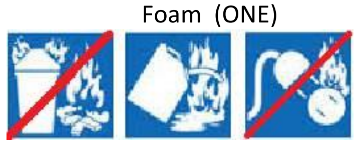
WHEELED TYPE EXTINGUISHERS FOR ILLUSTRATION

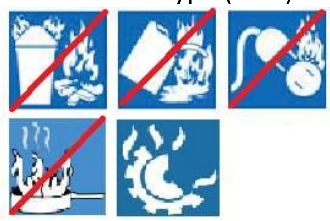
2.5. Application of Fire Extinguishers

2.5.1. The application of Fire Extinguishers for various hazards shall be as per Table 4.3.

Table 4.3: application of Fire Extinguishers

HAZARD	AREA	TYPE OF EXTINGUISHER	DISTRIBUTION
1. 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. MEETING ROOM & TRAINING 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. FUEL DISPENSING I. Mini Marts ii. Restaurant iii. seating areas	i. Multi-purpose Dry Powder (ONE)  AND **i.** CO2 Type (ONE) 	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. Cabinets shall clearly have signage that indicates presence of extinguishers inside the Fire Hose Cabinet (FHC)

HAZARD	AREA	TYPE OF EXTINGUISHER	DISTRIBUTION
2. CLASS B FIRES 	1. MEETING ROOM & TRANING i. Laboratories ii. Cleaning solvent stores 2. MERCANTILE i. Chemical Stores ii. Flammable liquid Stores 3. STORAGE (WAREHOUSE) AND FACTORIES i. Chemical Storage and activity ii. Flammable liquid Storage and activity iii. Flammable material Storage and activity 4. DIESEL GENERATOR ROOM, DIESEL GENERATOR SET/SHED 5. PARKING AREAS	i. Foam Type (ONE)  AND i. Multi-purpose Dry Powder (ONE)  ii. i. Wheeled Type Foam (ONE) 	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 15m. 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)
3. CLASS C FIRES	1. ELECTRICAL/LV ROOM 2. TELEPHONE ROOM 3. LIFT MACHINE ROOM 4. AHU ROOM 5. MECHANICAL PLANT ROOM 6. CABLE SPREADING ROOMS 7. RMU ROOMS 8. SWITCHGEAR ROOM 9. HV ROOM 10. TRANSFORMER ROOM 11. ELECTRICAL HEAVY EQUIPMENT AND MACHINARY	i. CO2 Type (ONE)  OR i. CLEAN Agent Type (ONE)  i. Wheeled CO2 Type (ONE) 12 Kg 	I. Maximum travel distance to such an extinguisher shall not be more than 9 m. II. That is from any point of the area, there shall be one extinguisher within a distance of 9 m. III. Extinguisher shall be placed inside the room next to exit.

HAZARD	AREA	TYPE OF EXTINGUISHER	DISTRIBUTION
4.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) 	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.
5. CLASS K FIRES 	1. KITCHEN, HOMES	i. Wet Chemical Type (ONE) And CO2 Type (ONE) 	i. Extinguishers shall be placed inside kitchen next to Kitchen exit door.

3- Design, Installation, Inspection and Maintenance of Fire Extinguishers :

3.1. Design/Specification and Submittals

3.1.1. Design, Specifications and Submittals to Civil Defence for approval shall be main consultant's responsibility. Consultant shall have competent and knowledgeable personnel to understand the Civil Defence requirements and codes and standards.

3.1.2. 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.

3.2. Installation

3.2.1. Installation of Fire Extinguishers shall be carried out only by Civil Defence approved 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.

3.2.2. Fire extinguisher Installation contractor qualification and approval from Civil Defence is based on their training from respective system manufacturers, experience, understanding of codes and standards and workmanship.

3.2.3. Fire extinguisher Installation contractors shall apply to Civil Defence and secure passing marks in Civil Defence examination to gain license and be qualified as "approved Fire extinguisher contractors".

3.2.4. Installation contractor shall not commence work on site without receiving Civil Defence stamped and approved drawings from the Consultant.

3.2.5. It is contractors responsibility to adhere to consultant's Civil Defence approved drawings and Manufacturer's installation guidelines and specifications.

3.3. Inspection and Acceptance

3.3.1. Inspection and acceptance shall be main consultant's responsibility.

3.3.2. Main consultant shall inspect contractor work during installations and ensure that fire extinguishers are charged, installed, inspected, commissioned and performing as per the Civil Defence approved drawings, manufacturer's design and installation guidelines, acceptance criteria and their intended purpose.

3.3.3. Consultant shall handover total number, types, location of fire extinguishers, and inspection report and maintenance manuals to the owner.

3.4. Inspection and Maintenance

3.4.1. 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.

3.4.2. The fire extinguishers shall be serviced and maintained once every year. The Table 4.4 requirements are minimum guidelines. NFPA 10 shall be referred for further details and maintenance requirements.

3.4.3. The inspection and maintenance of Fire Extinguishers shall be as per Table 4.4.

Table 4.4: 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 Civil Defence approved 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, and 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 non-conductive 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.
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. Hydro-static 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.

4- Fire Extinguisher Material Test Standards and Approval.

4.1. Acceptable Test Standards and criteria

4.1.1. 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, Approved and Registered by the Civil Defence Material Approval Department.

4.1.2. 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."

4.1.3. Portable Extinguisher (General):

i. ANSI/UL 711, Standard for Rating and Fire Testing of Fire Extinguishers

ii. ANSI/NFPA 10, Portable Fire Extinguishers

iii. CAN/ULC-S508-M90, Standard for Rating and Fire Testing of Fire Extinguishers and Class D Extinguishing Media

iv. EN 3-7 +A1, EN 3-8, EN 3-9, Portable fire extinguishers. Characteristics, performance requirements and test methods.

4.1.4. Mobile (Wheeled/Trolley) Type Extinguisher

i. EN 1866-1, 2, 3. Mobile fire extinguishers Characteristics performance and test methods.

4.1.5. CO2 Extinguisher

i. ANSI/UL 154, Standard for Carbon Dioxide Fire Extinguishers;

ii. CAN/ULC-S503-M90, Standard for Carbon Dioxide Hand and Wheeled Fire Extinguishers.

iii. EN 1866-1, Standard for Carbon Dioxide Wheeled Fire Extinguishers.

iv. EN ISO 5923, Equipment for fire protection and firefighting. Fire extinguishing media. Carbon

6.1.6. Dry Chemical/Dry Powder Extinguisher

i. UL 299, Standard for Dry Chemical Fire Extinguishers;

ii. CAN/ULC-S504-M86, Standard for Dry Chemical and Dry Powder Hand and Wheeled Fire Extinguishers.

iii. EN 615, Fire protection, fire extinguishing media specifications for powder (other than class D powders)

4.1.7. Water Type Extinguisher

i. ANSI/UL 626, Standard for Water based Fire Extinguishers;

ii. CAN/ULC-S507-92, Standard for 9 Liter Stored Pressure Water Type Fire Extinguishers.

4.1.8. Foam Type Extinguisher

i. ANSI/UL 8, Standard for Foam Fire Extinguishers.

4.1.9. Halocarbon Type Extinguisher

i. ANSI/UL 2129, Standard for Halocarbon Agent Fire Extinguishers

4.1.10. 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 No.: ٤

Fire Detection And Alarm System

In this Chapter:

- Definitions of Fire Detection and Alarm equipment and systems.
- Specifications and design consideration for various Fire
- Detection and Alarm Systems,
- Installation, Commissioning and Maintenance of Fire Detection and Alarm Systems.

Intent of the Chapter:

- To provide means of detecting smoke, heat, flame, fire and provide means of alarming the occupants at the earliest.
- To provide minimum design, installation, commissioning and maintenance requirements for the Fire Detection and Alarm Systems.
- To establish and maintain equipment and material quality.

1. Definitions:

1.1. General:

1.1.1 Shall

It is a mandatory requirement from Civil Defence.

1.1.2 Should

It is a suggested requirement recommended by Civil Defence but not mandatory.

1.1.3 Listed

Approved and registered by individual EGPC, Civil Defence material department.

1.2. Types of Smoke and Fire Detectors

1.2.1 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.

1.2.2 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 presence of smoke particles.

1.2.3 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.

1.2.4 Alarm Warning

A signal activated by the alarm system to warn of emergency conditions that require action by particular people who may (or may not be) occupants of the affected area.

1.2.5 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

1.2.6 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 cultural resources.

1.2.7 Analogue Addressable System

Addressable system that reports quantitative status signals rather than two state signals.

1.2.8 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.

1.2.9 Area of voice coverage
Area in which speech signal from voice alarm are sufficiently intelligible and warning signals from the system are sufficiently audible.

1.2.10 Automatic Alarm
Automatic alarm systems that activate auxiliary systems, such as firefighting system, elevators and fire safety system.

1.2.11 Bell
An electro Mechanical device used to produce audible signals.

1.2.12 Buzzer
A device used to produce low audible warning without causing panic.

1.2.13 Analogue Addressable System
Addressable system that reports quantitative status signals rather than two state signals.

1.2.14 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.

1.2.15 Area of voice coverage
Area in which speech signal from voice alarm are sufficiently intelligible and warning signals from the system are sufficiently audible.

1.2.16 Automatic Alarm
Automatic alarm systems that activate auxiliary systems, such as firefighting system, elevators and fire safety system.

1.2.17 Bell
An electro-Mechanical device used to produce audible signals.

1.2.18 Buzzer
A device used to produce low audible warning without causing panic.

1.2.19 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.

1.2.20 Combined System
An alarm system consists of conventional, addressable and analogue systems.

1.2.21 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.

1.2.22 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.

1.2.23 Emergency Voice Communications (EVC)

A system that is interlinked with the fire alarm to give evacuation or emergency messages throughout the premises for all occupants.

1.2.24 Evacuation system

A system intended to evacuate the building occupants to a safe refuge by broadcasting alert and evacuation messages.

1.2.24 Flame Detector

A device used for detecting infrared and ultraviolet rays emitting from flames.

1.2.25 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.

1.2.26 Fixed Temperature Detector

A device that responds only when its sensitive element heated up reaches a predetermined temperature.

1.2.26 Heat Detector

A fire detector that detects either abnormally high temperature or rate of rise, or both.

1.2.27 Horn

A funnel-like device used for emitting audible signals different from bell sounds.

1.2.28 Line-Type Heat Detector

A device used for detecting heat in which sensing element is continuous line along a certain path.

1.2.29 Manual Call Point

Manual operation device used to activate the fire alarm.

1.2.30 Manual System

A system that does not contain automatic detectors and whereby the fire alarm may be activated only manually.

1.2.31 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.

1.2.32 Multi-State Detector

A device that produces output signals (more than two), to include "Normal”, "Fire Alarm" and other abnormal conditions.

1.2.33 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.

1.2.34 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.

1.2.35 Rate-of-Rise Detector

A device that responds when the temperature rate of rises is more than a predetermined level.

1.2.36 Smoke Detector

A device used for detecting visible and invisible particles of smoke resulting from combustion. Several operating principles are used for detection; examples include; photo electrical and Ionization spot-type detectors, Air-sampling type and optical beam- type smoke detectors.

1.2.37 Spot-Type Smoke Detector

A device in which sensitive element is fixed in a certain location.

1.2.38 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.

1.2.39 Standby Supply

An electrical automatic power supply connected to the fire alarm system and operated in case of main supply failure.

1.2.40 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.

1.2.41 Zone

A part of the protected building which contains one or more fire detectors, the zone is defined by a unique alphanumeric which is indicated at the control panel.

2. System Design

a) General

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. In conventional systems each detection zone shall be supplied by a separate circuit. Whereas in addressable systems, several zones may be supplied by a single loop.

b) Detection Zones

i. The area and the number of zones in a given building shall comply with the following:

1. The area of any single open detection zone to which the building has been divided shall not exceed 2000 m^2; except for a single, open plan area, which should not exceed 10 000 m^2.
2. If any floor area is greater than 2000m^2, it shall be divided into separate detection zones of 2000m^2 or less, this subdivision may or may not be achieved by a physical barrier.
3. Search distance shall not exceed 60 m for conventional system; Search distance for addressable system is 100 m if building is protected by sprinklers.
4. If the floor area of a given building is less than 300 $m^2$and height less than 15 m, a zone may cover more than a single story, therefore the entire building may be considered a single zone even if it is a multiple storey building.
5. Whereas in case that the total building floor area exceeds 300 m^2, each detection zone shall be restricted to a single storey.
6. Automatic fire detectors within any enclosed stairwell lift shaft or other enclosed flu-like structure should be considered as a separate detection zone.
7. Indication of detection zone status on the control panel is by LED and/or graphical text indicator.
8. For voids above or below the floor area of a room, these may be included within same detection zone of the room, provided that the voids and the room constitute a single fire compartment and the floor area is less than 1000m^2.
9. Any remote indicator should be clearly labeled to indicate detectors located in voids. They should be sited and/or labeled in such a way as to assist in determining the location of the detectors that they serve.

c) 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.

d) Manufacturer Specifications

i. Along with recommendations of this chapter, approved Manufacturer's specifications should also be followed regarding spacing and installation details.

ii. Metal conduits are not necessary for wires and cables which are having the proper fire rating. Metal conduits are required for use in corrosive environment.

e) 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. Deviation from single design shall be justified based on special needs and shall be approved by Civil Defence authorities.

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.

iv. Where manual call points are installed in food preparation environment, where breakable parts resulting from operation may cause risks, the designer consult with and conform to related approved standards.

v. The manual call points shall be installed on all escape routes and in particular all stairwell entrances and all exits to open air.

vi. The manual call points shall be installed so that they are conspicuous, unobstructed and accessible.

vii. Distribution of the manual call points should be such that travel distance should not be more than 45m to reach the nearest manual call point.

viii. These figures to be reduced to 25m and 16m in limited mobility areas, and where processes of the area result in a likelihood of rapid fire development.

ix. Manual Call Point shall be installed within 1.5m from exit door way opening and shall be mounted on both sides of grouped opening over 12.2m width and 1.5m each side of opening.

x. The manual call points shall be installed generally at the height of (1.1 – 1.4) m, above floor level and in plain, accessible, well-lit and free-hindrances places.

xi. Where disable people are expected to operate, height to be lowered to (91cm-1.2m).

3. Requirements for Smoke and Heat Detectors.

a) Recessed Mounting.

i. Unless tested and listed for recessed mounting, detectors shall not be recessed into the mounting surface.

b) Detector Provision.

i. Detectors shall be provided in all rooms, halls, storage areas, basements, attics, lofts, spaces above suspended ceilings, and other subdivisions and accessible spaces as well as the inside of all store rooms , elevator shafts, dumbwaiter shafts, and chutes.

ii. Where inaccessible areas contain combustible material, they shall be made accessible and shall be protected by a detector(s) unless otherwise specified in (next item iii).

iii. Detectors shall not be required in combustible blind spaces if any of the following conditions exist:

1. Where the ceiling is attached directly to the underside of the supporting beams of a combustible roof or floor deck.

2. Where the concealed space is entirely filled with a non-combustible insulation (In solid joist construction, the insulation shall be required to fill only the space from the ceiling to the bottom edge of the joist of the roof or floor deck.)

3. Where there are small concealed spaces over rooms, provided any space in question does not exceed 4.6 m^2 in area.

4. In spaces formed by sets of facing studs or solid joists in walls, floors, or ceilings where the distance between the facing studs or solid joists less than 150 mm.

iv. Detectors shall not be required below open grid ceilings if all of the following conditions exist:

1. Openings of the grid are 6.4 mm (¼ in.) or larger in the least dimension.

2. Thickness of the material does not exceed the least dimension.

3. Openings constitute at least 70 percent of the area of the ceilingmaterial.

v. Detectors shall not be required in concealed, accessible spaces above suspended ceilings that are used as a return air plenum provided that smoke detection is included at each connection from the plenum to the Air Conditioning and Ventilation System and is connected to the Control Panel. (E.g. In a system meeting the requirements of NFPA 90A, or by the use of Air-sampling type smoke detection at each extract from the plenum.

vi. Detectors shall not be required underneath accessible under-floor spaces (e.g. under open loading docks or platforms and their covers) if all of the following conditions exist:

1. Space is not accessible for storage purposes or entrance of unauthorized persons and is protected against the accumulation of wind-borne debris.

2. Space contains no equipment such as steam pipes, electric wiring, shafting, or conveyors.
3. Floor over the space is tight.
4. No flammable liquids are processed, handled, or stored on the floor above.

4. Heat Detectors.

a) General

i. Heat-sensing fire detectors of the fixed-temperature or rate-compensated, spot-type shall conform to latest publishing of either EN, ISO or UL.

ii. Line-type heat detectors shall conform to latest publishing of either EN, ISO or UL.

iii. UL detector shall be classified as to the temperature of operation and marked with a color code in accordance with Table 8.1

Table 8.1: Color Coding for Heat Detectors

TEMPERATURE CLASSIFICATION	TEMPERATURE RATING RANGE ºC	MAXIMUM CEILING TEMPERATURE ºC	COLOR CODE
Low	39 – 57	28	Uncolored
Ordinary	58 – 79	47	Uncolored
Intermediate	80 – 121	69	White
High	122 – 162	111	Blue
Extra High	163 – 204	152	Red
Very Extra High	205 – 259	194	Green
Ultra-High	260 – 302	249	Orange

b) Location.

i. Spot-type heat-sensing fire detectors shall be located on the ceiling not less than 100 mm from the sidewall or on the sidewalls between 100 mm and 300 mm from the ceiling. See Figure 8.1.

ii. In the case of solid joist construction, detectors shall be mounted at the bottom of the joists.

iii. In the case of beam construction 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.

iv. Line-type heat detectors shall be located on the ceiling or on the sidewalls not more than 500 mm from the ceiling.

v. In the case of solid joist construction, detectors shall be mounted at the bottom of the joists.

vi. In the case of beam construction 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.

vii. Where a line-type detector is used in an application other than open area protection, the manufacturer's published instructions shall be followed.

c) Temperature.

i. Detectors having fixed-temperature or rate-compensated elements shall be selected in accordance with Table 8.1 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.

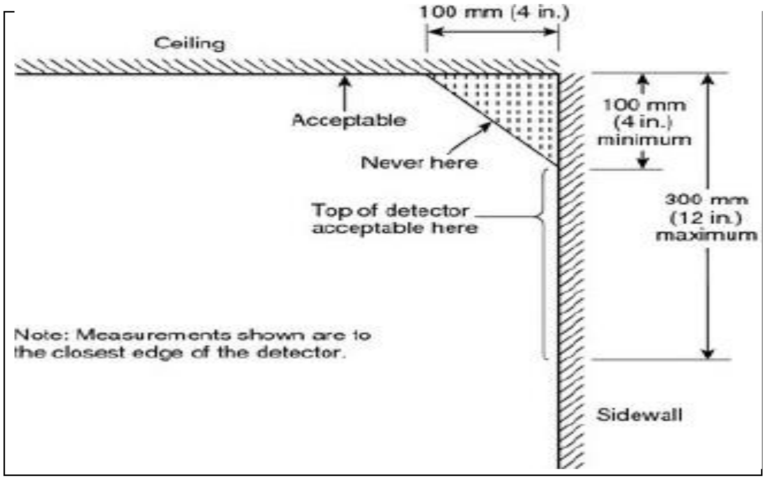


Figure 8.1: Location of spot-type detectors

d) Spacing.

i. Smooth Ceiling Spacing.

a) One of the following requirements shall apply:

- ✓ 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.
- ✓ All points on the ceiling shall have a detector within a distance equal to 0.7 times the listed spacing (0.7S).
- ✓ For irregularly shaped areas, the spacing between detectors shall be permitted to be greater than the listed spacing, provided 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.

e) Solid Joist Construction.

i. The spacing of heat detectors, where measured at right angles to the solid joists, shall not exceed 50 percent of the smooth ceiling spacing.

f) 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 smooth ceiling spacing.

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 area.

g) Sloping Ceilings.

i. Peaked

- ✓ A row of detectors shall first be spaced and located at or within 900 mm of the peak of the ceiling, measured horizontally. The number and spacing of additional detectors, if any, shall be based on the horizontal projection of the ceiling in accordance with the type of ceiling construction.

ii. Shed

- ✓ Sloping ceilings shall have a row of detectors located on the ceiling within 900 mm (3 ft) of the high side of the ceiling measured horizontally, spaced in accordance with the type of ceiling construction. The remaining detectors, if any, shall be located in the remaining area on the basis of the horizontal projection of the ceiling.

iii. Roof Slope Less Than 30 Degrees.

- ✓ 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.

h) **High Ceilings.**

i. On ceilings 3 m to 9.1 m high, heat detector linear spacing shall be reduced in accordance with Table 8.2 prior to any additional reductions for beams, joists, or slope, where applicable.

Table 8.2: Ceiling Height and spacing reduction factor

CEILING HEIGHT (M)	MULTIPLE BY REDUCTION FACTOR OF
0 to 3.05	1
3.06 to 3.66	0.9
3.67 to 4.27	0.84
4.28 to 4.88	0.77
4.89 to 5.49	0.71
5.50 to 6.10	0.64
6.11 to 6.71	0.58
6.72 to 7.32	0.52
7.33 to 7.93	0,46
7.94 to 8.54	0.40
8.55 to 9.14	0.34

5. Spot-Type Smoke Detectors.

a) **General**

i. Spot-type smoke detectors shall conform to latest publishing of either EN, UL or ISO.

ii. The selection and placement of Spot-Type 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 alarms or improper operation after installation.

iii. Unless specifically designed and listed for the expected conditions, spot-type smoke detectors shall not be installed if any of the following ambient conditions exist:

- Temperature below 0°C (32°F)
- Temperature above 38°C (100°F)
- Relative humidity above 93 percent
- Air velocity greater than 1.5 m/sec (300 ft/min)

iv. The location of spot-type 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.

Note: The common sources of aerosols, particles and moisture's that may affect or influence the performance of smoke detectors can be referred from Table A.17.7.1.9 (a) of NFPA 72:2010.

v. Detectors shall not be installed until after the cleanup of all construction works is completed and finalized. Any detectors installed during construction 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.

vi. Location and Spacing.

a) General

- 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-exist ambient air flows that could exist in the protected compartment. The design shall account for the contribution of the following factors in predicting detector response to the anticipated fires to which the system is intended to respond:
  - Ceiling shape and surface.
  - Ceiling height.
  - Configuration of contents in the protected area.
  - Combustion characteristics and probable equivalence ratio
  - Of the anticipated fires involving the fuel loads within the protected area.
  - Compartment ventilation.
  - Ambient temperature, pressure, altitude, humidity, and atmosphere.

- If the intent is to protect against a specific hazard, the detector(s) shall be permitted to be installed closer to the hazard in a position where the detector can intercept the smoke.
- Spot-type smoke detectors shall be located on the ceiling not less than 100 mm from a sidewall to the near edge or, if on a sidewall, between 100mm and 300 mm down from the ceiling to the top of the detector.
- To minimize dust contamination, smoke detectors, where installed under raised floors, shall be mounted only in an orientation for which they have been listed. **See Figure 8.7.**

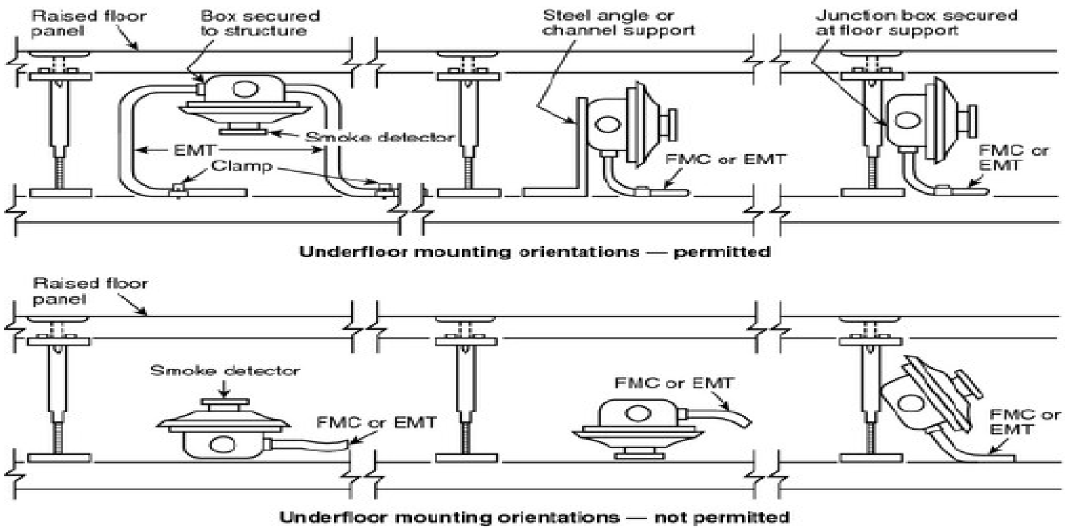


Figure 8.7: Mounting of smoke detectors in raised floor.

- On smooth ceilings, spacing for spot-type smoke detectors, in the absence of performance based design criteria, shall be permitted to be located using not more than 9.1 m spacing.
- In all cases, the manufacturer's published instructions shall be followed.
- Other spacing shall be permitted to be used depending on ceiling height, different conditions, or response requirements.
- For smooth ceilings, all points on the ceiling shall have a detector within a distance equal to 0.7 times the selected spacing.

vii. For solid joist and beam construction, spacing for spot-type smoke detectors shall be as follows:

- Solid joists shall be considered equivalent to beams for smoke detector spacing guidelines. For level ceilings the following shall apply:

  - For ceilings with beam depths of less than 10 percent of the ceiling height (0.1 H), smooth ceiling spacing shall be permitted.
  - For ceilings with beam depths equal to or greater than 10 percent of the ceiling height (0.1 H) and beam spacing 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.
  - For waffle or pan-type ceilings with beams or solid joists no greater than 600 mm deep and no greater than 3.66 m center-to-center spacing, the following shall be permitted:
    - ✓ Smooth ceiling spacing including those provisions permittedfor irregular areas.
    - ✓ Location of spot-type smoke detectors on ceilings or on the bottom of beams.
  - For corridors 4.5 m in width or less having ceiling beams or solid joists perpendicular to the corridor length, the following shall be permitted:
    - ✓ Smooth ceiling spacing including those provisions permitted for irregular areas.

    - ✓ Location of spot-type smoke detectors on ceilings, sidewalls, or the bottom of beams or solid joists
  - For rooms of 84 m² area or less, only one smoke detector shall be required.
- For sloped ceilings with beams running parallel to (up) the slope, spacing shall comply with the following:
  - The spacing for level beamed ceilings shall be used.
  - The ceiling height shall be taken as the average height over slope.
  - For slopes greater than 10 degrees, the detectors located at one-half the spacing from the low end shall not be required.
  - Spacing shall be measured along a horizontal projection of the ceilings.
- For sloped ceilings with beams running perpendicular to (across) the slope, spacing shall comply with the following:
  - The spacing for level beamed ceilings shall be used.
  - The ceiling height shall be taken as the average height over slope.
- For sloped ceilings with solid joists, the detectors shall be located on the bottom of the joist.

6. Air-Sampling Type Smoke Detector.

a) General

- Air-sampling type smoke detectors shall conform to either of; EN 54-20, ISO 7240-20 or UL268.

- Air-sampling type smoke detectors are particularly applicable in the following situations:
  - Where very early detection is required
  - Where access for maintenance is limited
  - Where the protected area is particularly challenging in terms of environment (hot, cold & humidity) and/or contamination (dust, & dirt)
  - Where smoke is difficult to detect due to high airflow's or large volume/high ceiling spaces
- Air-sampling type smoke detectors are available with different classes of sensitivities which shall be considered for optimum design and application.
- A single ASD detector may be able to provide several alarms signals corresponding to different Classes.
- Some Air-sampling type smoke detectors are approved as “normal sensitivity detectors, however, they may be configured to be high or enhanced sensitivity if required for the application.
- For the purposes of this code, the following applications are recommended:
  - Very high sensitivity: Used for surveillance and very early warning in high value or high risk areas, particularly for rooms with electronic data processing equipment, for rooms containing artifacts or objects of particularly high value, and for rooms or cabinets containing equipment or machinery supporting a critical process or service.
  - Enhanced sensitivity: Applied as space surveillance in areas where the detection of smoke using normal spot-type smoke detection is challenging, particularly; for areas with ceiling height over 25m, areas with high air flows (more than 10 air changes per hour) and where early staff alarm is required.
  - Normal sensitivity: Typically applied in place of standard spot-type smoke detection's where harsh environment, aesthetics, concealment and/or easy maintenance access are factors, particularly in heritage buildings, prison cells, ceiling void, floor voids, cold storage andrestricted access areas.

b) Location and Spacing

- For ceiling mount ASD each sampling hole shall be treated as a spot-type smoke detector for the purpose of location and spacing. (See clause 6.5).
- For applications with high airflow, sampling at air return grilles shall be provided.
- For smoke detection within an air-conditioning duct the probes shall be sampling from the top third of the duct and be installed in accordance with the manufacturer recommendation.
- For areas with ceiling heights over 10m and where stratification is likely to occur vertical sampling shall be provided, vertical sampling holes shall be spaced no more than 3 meters apart in the top third and no more than 8 meters apart in the middle third, sampling is not required in the bottom third.

c) Maximum air sample transport time from the farthest sampling point to the detector shall be in accordance with the detector listing/instructions and shall not exceed 120 seconds.

d) Sampling pipe networks shall be designed in accordance with the design rules, tables and/or software supplied by the manufacturer to ensure that the performance of the system is in accordance with the detector listing and/or the design objectives.

e) Sampling pipe network design details shall include calculations showing the flow characteristics of the pipe network and each sample hole.

f) Air-sampling type smoke detectors shall give a trouble signal if the airflow is outside the manufacturer’s specified range.

g) In-line filter used on the pipe network shall be included in the listing for the air- sampling type smoke detector.

h) The sampling holes and in-line filter (if used) shall be maintained in accordance with the manufacturer's published instructions.

i) Air-sampling network piping and fittings shall be airtight and permanently fixed.

j) Labeling requirements

- Sampling system piping shall be conspicuously identified as "SMOKE DETECTOR SAMPLING TUBE — DO NOT DISTURB," or equivalent as follows:
    - At changes in direction or branches of piping.
    - At each side of penetrations of walls, floors, or other barriers.
    - At intervals on piping that provide visibility within the space, but no greater than 6 m.
- Sampling holes shall be clearly labeled unless specifically intended to be concealed in which case a clear plan of their location shall be provided.

7. Optical /Projected Beam–Type Smoke Detectors.

a) General

- Optical beam-type smoke detectors shall conform to latest publishing of either EN, ISO or UL.
- Optical beam-type smoke detectors are particularly applicable in the following situations:
    - Where a large open area requires detection
    - Where ceiling heights are very high and there is a high risk of stratification

b) The maximum distance between multiple optical beam–type smoke detectors protecting a single space shall be in accordance with the manufacturer's published instructions and shall not exceed 15m See Figure 8.8.

c) Where the likelihood of stratification is high detectors shall be provided at intermediate heights in addition to the detectors mounted on the ceiling.

- Where the likely stratification height is known the intermediate detectors shall be mounted at this height and be spaced in accordance with the requirements (item b above)
- Where the likely stratification height is unknown the intermediate beams shall be positioned to ensure that they will be obscured by a rising plume of smoke sufficient to cause an alarm.

    - The requirement of above item shall either be demonstrated by a full scale smoke test on the installed system.
    - The maximum distance between beams shall be less than the height above the floor divided by 4.

d) The beam length shall not exceed the maximum permitted by the equipment listing.

e) If reflectors are used with optical beam-type smoke detectors, the reflectors shall be installed in accord-ance with the manufacturer's published instructions.

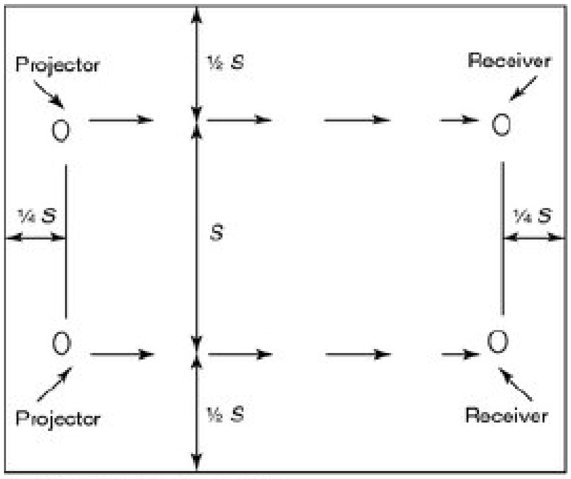


Figure 8.8: Spacing of Optical Beam-Type Smoke Detector

f) An optical beam–type smoke detector shall be considered equivalent to a row of spot- type smoke detectors for level and sloping ceiling applications.

g) Optical beam–type smoke detectors and reflectors shall be mounted on stable surfaces to prevent false or erratic operation due to movement.

h) 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 alarms.

i) The light path of optical beam–type smoke detectors shall be kept clear of opaque obstacles at all times.

j) On sloping ceilings (peaked or shed), optical beam-type detectors shall first be located within 900 mm (3 ft) of the highest point in the ceiling, measured horizontally. The number and spacing of additional detectors, if any, shall be based on the horizontal projection of the ceiling Peaked.

8. Raised Floors and Suspended Ceilings.

a) Spaces beneath raised floors and above suspended ceilings shall be treated as separate rooms for smoke detector spacing purposes. Detectors installed beneath raised floors or above suspended ceilings, or both, including raised floors and suspended ceilings used for environmental air, shall not be used in lieu of providing detection within the room.

b) For raised floors 400mm and above the floor level or containing combustible materials, the following shall apply:

- ➢ Detectors installed beneath raised floors shall be spaced in accordance with spot type requirements and Figure 8.7.
- ➢ Where the area beneath the raised floor is also used for environmental air, detector spacing shall also conform to conditions for Heating, Ventilation and Air-Condition (HVAC), stated in this chapter.

c) For suspended ceilings which are 800mm and more from the ceiling level and/or containing combustible materials, the following shall apply:

- ➢ Detector spacing above suspended ceilings shall conform to the requirements of spot type detectors for the ceiling configuration.
- ➢ Where detectors are installed in ceilings used for environmental air, detector spacing shall also conform to requirements under Heating, Ventilation and Air-Conditioning (HVAC) in this chapter.

9. Partitions.

a) Where partitions extend to within 15 percent of the ceiling height, the spaces separated by the partitions shall be considered as separate rooms.

10. Heating, Ventilating, and Air Conditioning (HVAC).

a) In spaces served by air-handling systems, detectors shall not be located lesser than 1m where airflow prevents operation of the detectors.

b) Detectors installed in plenums shall comply with the following:

- 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.
- Detector spacing and locations shall be selected on the basis of anticipated airflow patterns and fire type.
- Detectors placed in environmental air ducts or plenums shall not be used as a substitute for open area detectors. Where detectors are used for the control of smoke spread, the requirements shall follow the section under Smoke Detectors for Control of Smoke Spread.

11. Spot-Type Detectors

a) Combination and multi-sensor smoke detectors that have a fixed-temperature element as part of the unit shall be selected in accordance with Table 8.1 for the maximum ceiling temperature expected in service.

b) Holes in the back of a detector shall be covered by a gasket, sealant, or equivalent means, and the detector shall be mounted so that airflow from inside or around the housing does not prevent the entry of smoke during a fire or test condition.

12. High-Rack Storage.

a) The location and spacing of smoke detectors for high-rack storage shall address the commodity, quantity, and configuration of the rack storage. See Figure 8.9 and Figure 8.10.

13. High Air Movement Areas.

a) **General.**

- The purpose and scope of this section shall be to provide location and spacing guidance for smoke detectors intended for early warning of fire in high air movement areas. Such detectors shall not be used in raised floor or suspended ceiling areas (concealed spaces).

b) Location.

- Smoke detectors shall not be located directly in the airstream of supply registers.

c) Spacing.

- Smoke detector spacing shall be in accordance to Table 8.3 and Figure 8.11.

d) HVAC Mechanical Rooms.

- Where HVAC mechanical rooms are used as an air plenum for return air, the spacing of smoke detectors shall not be required to be reduced based on the number of air changes.

e) Video Image Smoke Detection.

- Video image smoke detection systems and all of the components thereof, including hardware and software, shall be listed for the purpose of smoke detection.
- Systems shall be designed in accordance with a performance-based design approach.

f) Other Detectors

- There are other types detectors used such as Radiant Energy–Sensing Fire Detectors, Flame Detectors, Spark/Ember Detectors, Video Image Flame Detection, Video Smoke detectors, Combination technologies, Multi-Criteria, and Multi-Sensor Detectors. The selection, spacing, location and installation of these detectors shall be based on the associated criteria such as follows

  i. Size of the fire that is to be detected
  ii. Fuel involved
  iii. Sensitivity of the detector
  iv. Field of view of the detector
  v. Distance between the fire and the detector
  vi. Radiant energy absorption of the atmosphere
  vii. Presence of extraneous sources of radiant emissions
  viii. Purpose of the detection system
  ix. Response time required
  x. Structural features, size, and shape of the rooms and bays
  xi. Occupancy and uses of the area
  xii. Ceiling height
  xiii. Ceiling shape, surface, and obstructions
  xiv. Ventilation
  xv. Ambient environment
  xvi. Burning characteristics of the combustible materials present
  xvii. Configuration of the contents in the area to be protected

- In addition, Manufacturer's specifications shall be followed based on the different application and design characteristics.

Table 8.3: Smoke Detector Spacing Based on Air Movement

MINUTES PER AIR CHANGE	AIR CHANGES PER HOUR	SPACING PER DETECTOR (M^2)
1	60	11.61
2	30	23.23
3	20	34.84
4	15	46.45
5	12	58.06
6	10	69.68

7	8.6	81.29
8	7.5	83.61
9	6.7	83.61
10	6	83.61

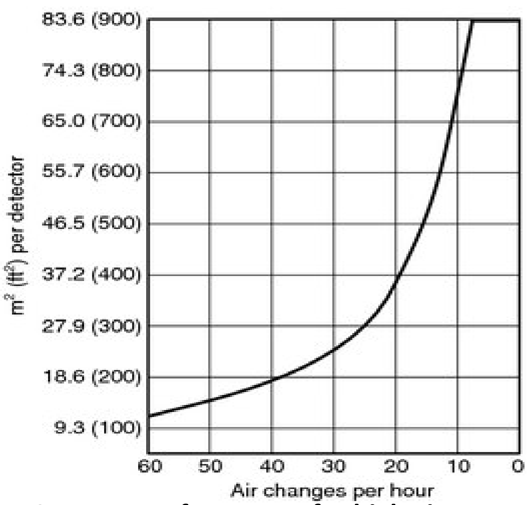


Figure 8.11: Area of coverage for high air movement areas

14. Sprinkler Water-flow Alarm-Initiating Devices.

a) Activation of the initiating device shall occur within 90 seconds of water-flow 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.

b) Movement of water due to waste, surges, or variable pressure shall not initiate an alarm signal.

15. Detection of the Operation of Other Automatic Extinguishing Systems.

a) The operation of fire extinguishing systems or suppression systems shall initiate an alarm signal by alarm-initiating devices installed in accordance with their individual listings.

16. Supervisory Signal-Initiating Devices.

a) Control Valve Supervisory Signal-Initiating Device.

- 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.
- 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.

- The off-normal signal shall not be restored at any valve position except normal.
- 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.

17. Pressure Supervisory Signal-Initiating Device.

a) 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.

b) The following requirements shall apply to pressure supervisory signal-initiating devices:

- 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.
- The off-normal signal shall be initiated when the required pressure increases or decreases by 70 kPa (10 psi).
- 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).
- 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 percent of the minimum operating pressure of the steam-operated equipment supplied.

18. Water Level Supervisory Signal-Initiating Device.

a) 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.

b) 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 (3 in.) or rises 76 mm (3 in.).

c) A supervisory signal-initiating device for other than pressure tanks shall initiate a low-water level signal when the water level falls 300 mm (12 in.).

19. Smoke Detectors for Control of Smoke Spread.

a) Classifications.

- 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:
  i. Area detectors that are installed in the related smoke compartments
  ii. Detectors that are installed in the air duct systems
  iii. Video image smoke detection that is installed in related smoke compartments

b) Purposes.

- To prevent the re-circulation of dangerous quantities of smoke, a detector approved for air duct use shall be installed on the supply side of air-handling systems as required by NFPA 90A, Standard for the Installation of Air- Conditioning and Ventilating Systems.

c) Application.

- Area Smoke Detectors within Smoke Compartments

i. 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.

20. Smoke Detection for the Air Duct System.

a) Supply Air System.

- Where the detection of smoke in the supply air system is required by other NFPA standards, a detector(s) listed for the air velocity present and that is located in the supply air-duct downstream of both the fan and the filters shall be installed. Additional smoke detectors shall not be required to be installed in ducts where the air duct system passes through other smoke compartments not served by the duct.
- A detector(s) listed for the air velocity present shall be located where the air leaves each smoke compartment, or in the duct system before the air enters the return air system common to more than one smoke compartment.
- Additional smoke detectors shall not be required to be installed in ducts where the air duct system passes through other smoke compartments not served by the duct.

- Where total coverage smoke detection is installed in all areas of the smoke compartment served by the return air system, installation of air duct detectors in the return air system shall not be required, provided their function is accomplished by the design of the area detection system. See Figure 8.12 and 8.13.

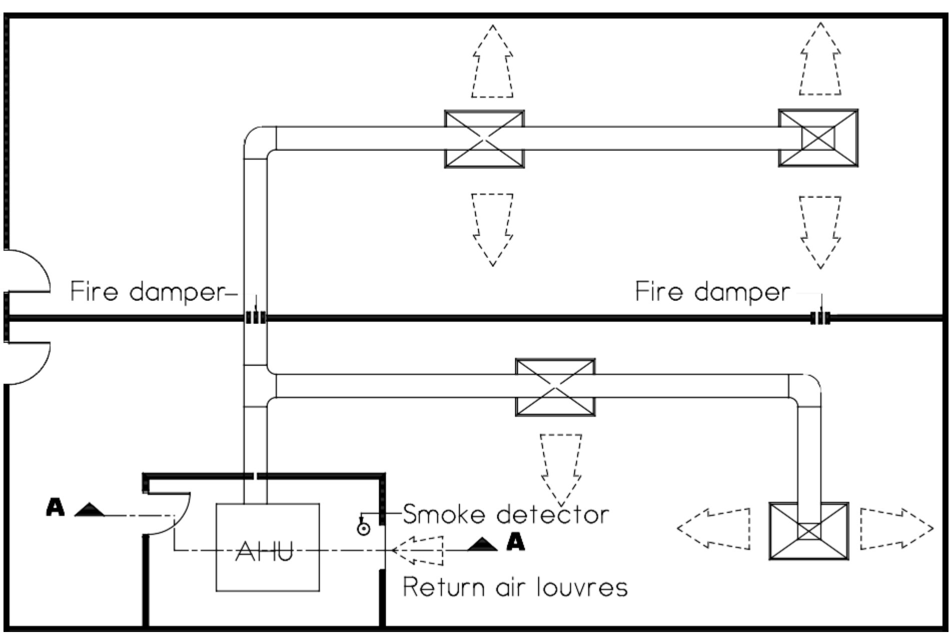


Figure 8.12: Smoke detector located at return air louvers.

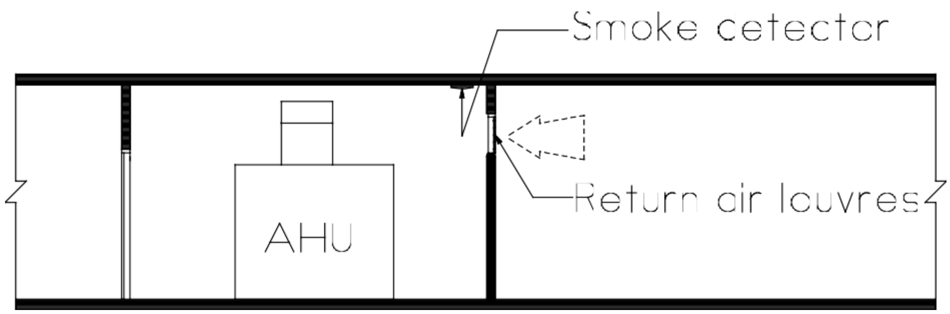


Figure 8.13: Location of smoke detector along return air stream

- 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.

- 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.
- 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.
- 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.

21. Smoke Detectors for Door Release Service.

a) 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.

b) Where smoke door release is accomplished directly from the smoke detector(s), the detector(s) shall be listed for releasing service.

c) Smoke detectors shall be of the photoelectric, ionization, or other approved type.

d) If the depth of wall section above the door is 610 mm (24 in.) 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.

e) If the depth of wall section above the door is greater than 610 mm (24 in.) 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 shall apply.

f) If the depth of wall section above the door is greater than 610 mm (24 in.) on both sides, two ceiling-mounted or wall-mounted detectors shall be required, one on each side of the doorway shall apply.

g) 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 shall apply.

h) If the separation between doorways exceeds 610 mm (24 in.), each doorway shall be treated separately shall apply.

i) Each group of doorway openings that exceeds 6.1 m (20 ft.) in width measured at its overall extremes shall be treated separately shall apply.

j) 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.

k) If ceiling-mounted smoke detectors are to be installed on a smooth ceiling for a single or double doorway.

- On the center-line of the doorway
- No more than 1.5 m (5 ft.) measured along the ceiling and perpendicular to the doorway.

22. Building Fire Alarm Systems.

a) Protected premises fire alarm systems that serve the general fire alarm needs of a building or buildings shall include the following systems or functions where applicable:

- Manual alarm signal initiation
- Automatic alarm signal initiation
- Monitoring of abnormal conditions in fire suppression systems
- Activation of fire suppression systems
- Activation of fire safety functions
- Activation of alarm notification appliances
- Emergency voice/alarm communications
- Guard’s tour supervisory service
- Process monitoring supervisory systems
- Activation of off-premises signals
- Combination systems
- Integrated systems

b) System Requirements.

- Actuation Time. Actuation of alarm notification appliances or emergency voice communications, fire safety functions, and annunciation at the protectedpremises shall occur within 10 seconds after the activation of an initiatingdevice.
- 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.
- 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.
- 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.
- 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.
- If a second automatic fire detector selected for positive alarm sequence is actuated during the alarm investigation phase, notification signals in accordance with the building evacuation or relocation plan and remote signals shall be automatically and immediately activated.
- 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.
- The system shall provide means for bypassing the positive alarm sequence.
- 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.
- 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.
- 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.

- Each interconnected fire alarm control unit shall be separately monitored for alarm, supervisory, and trouble conditions.
- Interconnected fire alarm control unit alarm signals shall be permitted to be monitored by zone or by combined common signals.
- 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.
- All non–fire alarm components shall be listed for fire alarm use or for fireconditions

c) Combination Systems

- Speakers used as alarm notification appliances on fire alarm systems shall also be permitted to be used for non-emergency purposes, provided that condition i or ii is met:
  I. The emergency command center is constantly attended by trainedpersonnel
  II. The speakers and associated audio equipment are installed or located with safeguards to resist tampering or maladjustment of those components essential for intended emergency notification.
- Speakers used as alarm notification appliances on fire alarm systems shall also be permitted to be used for mass notification systems.
- 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:
  i. Signals associated with life safety
  ii. Signals associated with property protection
  iii. Trouble signals associated with life and/or property protection
  iv. All other signals
- Live voice instructions originating from the protected premises fire or mass notification systems shall override all previously initiated signals andshall have priority over both of the following:
  i. Any subsequent automatically initiated signals on that channel
  ii. Remotely generated mass notification messages
- Signals from carbon monoxide detectors and carbon monoxide detection systems transmitted to a fire alarm system shall be permitted to be supervisory signals.

d) Alarm Signal Initiation — Detection Devices

- 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.

e) Alarm Signal Initiation — Sprinkler Systems.

- Where required to be electronically monitored, water-flow alarm-initiating devices shall be connected to a dedicated function fire alarm control unit designated as “sprinkler water-flow and supervisory system,” and permanently identified on the control unit and record drawings.
- Where water-flow alarm-initiating devices are connected to a building fire alarm system, a dedicated function fire alarm control unit shall not be required.
- The number of water-flow alarm–initiating devices permitted to be connected to a single initiating device circuit shall not exceed five.

f) Supervisory Signal Initiation — Sprinkler Systems.

- Where required to be electronically monitored, supervisory signal-initiating devices shall be connected to a dedicated function fire alarm control unit designated as “sprinkler water-flow and supervisory system,” and permanently identified on the control unit and record drawings.
- Where supervisory signal-initiating devices are connected to a building fire alarm system, a dedicated function fire alarm control unit shall not be required.
- The number of supervisory signal-initiating devices permitted to be connected to a single initiating device circuit shall not exceed 20.

g) Alarm Signal Initiation — Fire Suppression Systems Other Than Sprinklers.

- Where required to be monitored and a building fire alarm system is installed, the actuation of a fire suppression system shall annunciate an alarm or supervisory condition at the building fire alarm control unit.

h) Supervisory Signal Initiation — Fire Suppression Systems Other Than Sprinklers.

- Where required to be monitored and a building fire alarm system is installed, an off-normal condition of a fire suppression system shall annunciate a supervisory condition at the building fire alarm control unit.
- Supervisory signals that latch in the off-normal state and require manual reset of the system to restore them to normal shall be permitted.

i) Signal Initiation — Fire Pump.

- Where fire pumps are required to be monitored and a building fire alarm system is installed, a pump running signal shall be permitted to be a supervisory or alarm signal.

j) Fire Alarm and Supervisory Signal Initiation — Releasing Service Control Units.

- Releasing service control units shall be connected to the protected premises fire alarm system.
- Fire alarm and supervisory signals generated at the releasing control unit shall be annunciated at a protected premises fire alarm unit.
- Where required, 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.
- If a valve is installed in the connection between a suppression system and an initiating device, the valve shall be supervised.

k) Trouble Signal Initiation.

- 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 signal. This provision shall include junction boxes installed outside of buildings to facilitate access to the initiating device circuit.

l) Fire Alarm and Mass Notification System Notification Outputs.

- Occupant Notification.
  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.
- Notification Appliances in Exit Stair Enclosures, Exit Passageways, and Elevator Cars.
  i. Visible notification signal appliances shall not be required in exit stair enclosures, exit passageways, and elevator cars.

m) Notification Zones.

- Notification zones shall be consistent with the emergency response or evacuation plan for the protected premises.
- 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.

n) Circuits for Addressable Notification Appliances.

- 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.

23. Suppression System Actuation.

a) Fire alarm control units used for automatic or manual activation of a fire suppression system shall be listed for releasing service.

b) Releasing devices for suppression systems shall be listed for use with releasing service control units.

c) 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.

d) Operation of a disconnect switch or a disable function shall cause a supervisory signal at the fire alarm control unit.

e) The disconnect shall be a physical switch and not be accomplished by using software.

f) 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. If the releasing control unit is located in a protected premises 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.

g) 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.

24. Elevator Recall for Fire Fighters' Service.

a) 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.

b) 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.
c) A lobby smoke detector shall be located on the ceiling within 6.4 m of the center line of each elevator door within the elevator bank under control of the detector.
d) Smoke detectors shall not be installed in un-sprinklered elevator hoist-ways unless they are installed to activate the elevator hoist-way smoke relief equipment.
e) If ambient conditions prohibit installation of automatic smoke detection, other automatic fire detection shall be permitted.
f) When actuated, any detector that has initiated firefighters' recall shall also be annunciated at the building fire alarm control unit and required remote annunciators.

25. Visual Warning – for elevators.

a) 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.
b) Where lobby detectors are used for other than initiating elevator recall, the signal initiated by the detector shall also initiate an alarm signal.
c) For each elevator or group of elevators, an output(s) shall be provided for the elevator visual warning signal in response to the following:

- Activation of the elevator machine room initiating devices
- Activation of the elevator hoist way initiating devices

26. Elevator Shutdown.

a) 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.
b) 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.
c) If pressure or water flow switches are used to shut down elevator power immediately upon or prior to the discharge of intended water from sprinklers, the use of devices with time-delay switches or time-delay capability shall not be permitted.

d) 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.
e) The initiating devices shall be monitored for integrity by the fire alarm control unit

27. Elevator Shutdown.

a) 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.
b) 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.
c) 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.
d) 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.
e) The initiating devices shall be monitored for integrity by the fire alarm control unit

28. HVAC Systems.

a) 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.
b) 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.
c) 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.
d) Where interconnected as a combination system, a Firefighter's Smoke Control Station (FSCS) shall be provided to perform manual control over the automatic operation of the system's smoke control strategy.

e) 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 performance of the smoke control strategy.

29. Door Release Service.

a) All detection devices used for door hold-open release service shall be monitored for integrity.

b) All door hold-open release and integral door release and closure devices used for release service shall be monitored for integrity.

c) Magnetic door holders that allow doors to close upon loss of operating power shall not be required to have a secondary power source.

30. Door Unlocking Devices.

a) 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.

b) All exits shall unlock upon receipt of any fire alarm signal by means of the fire alarm system serving the protected premises.

c) 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.

d) All doors that are required to be unlocked by the fire alarm system shall remain unlocked until the fire alarm condition is manually reset.

31. Public Mode Audible Requirements.

a) To ensure that audible public mode signals are clearly heard, they shall have a sound level at least 15 dB above the average ambient sound level or 5 dB above the maximum sound level having a duration of at least 60 seconds, whichever is greater, measured 1.5 m above the floor in the area required to be served. Refer to Table 8.4 for the sound level based on location.

b) A fire alarm system arranged to stop or reduce ambient noise shall produce a sound level at least 15 dB above the reduced average ambient sound level or 5 dB above the maximum sound level having a duration of at least 60 seconds after reduction of the ambient noise level, whichever is greater, measured 1.5 m above the floor in the area required to be served.

32. Private Mode Audible Requirements.

a) To ensure that audible private mode signals are clearly heard, they shall have a sound level at least 10 dB above the average ambient sound level or 5 dB above the maximum sound level having a duration of at least 60 seconds, whichever is greater, measured 1.5 m above the floor in the area required to be served.

b) A system arranged to stop or reduce ambient noise shall be permitted to produce a sound level at least 10 dB above the reduced average ambient sound level or 5 dB above the maximum sound level having a duration of at least 60 seconds after reduction of the ambient noise level, whichever is greater, measured 1.5 m above the floor.

33. Sleeping Area Requirements.

a) Audible appliances shall be installed to provide signals for sleeping areas. They shall have a sound level of at least 15 dB above the average ambient sound level or 5 dB above the maximum sound level having a duration of at least 60 seconds or a sound level of at least 75 dB, whichever is greater, measured at the pillow level in the area required to be served.

b) If any barrier, such as a door, curtain, or retractable partition, is located between the notification appliance and the pillow, the sound pressure level shall be measured with the barrier placed between the appliance and the pillow.

34. Location of Audible Notification Appliances for a Building or Structure.

a) If ceiling heights allow, wall-mounted appliances shall have their tops above the finished floors at heights of not less than 2290 mm and below the finished ceilings at distances of not less than 150 mm.
b) Ceiling-mounted or recessed appliances shall be permitted.

35. Location of Audible Notification Appliances for Wide Area Signal-ling.

a) Audible notification appliances for wide area signaling shall be installed in accordance with the approved design documents, and the manufacturer's installation instruction to achieve the required performance.

Table 8.4 - Average Ambient Sound Level According to Location

Location	Average Ambient Sound Level (dBA)
Business occupancies	55
Educational occupancies	45
Industrial occupancies	80
Institutional occupancies	50
Mercantile occupancies	40
Mechanical rooms	85
Piers and water-surrounded structures	40
Places of assembly	55
Residential occupancies	35
Storage occupancies	30
Thoroughfares, high-density urban	70
Thoroughfares, medium-density urban	55
Thoroughfares, rural and suburban	40
Tower occupancies	35
Underground structures and windowless buildings	40
Vehicles and vessels	50

36. Visible Characteristics — Public Mode.

a. Light, Color, and Pulse Characteristics.

- 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.
- A maximum pulse duration shall be 0.2 second with a maximum duty cycle of 40 percent.
- The pulse duration shall be defined as the time interval between initial and final points of 10 percent of maximum signal.
- Lights used for fire alarm signal-ling only or to signal the intent for complete evacuation shall be clear or nominal white and shall not exceed 1000 cd (effective intensity).
- Lights used to signal occupants to seek information or instructions shall be clear, nominal white or other color as required by the emergency plan.

b. Appliance Location.

- Visual alarm signals (flashers) shall be used in areas where audio alarm signal is not effective, not feasible to type of occupancy (i.e. operating theaters in hospitals, extremely noisy environment like engine room, intensive care units in health care occupancies) or in areas where audio alarm requires the aid of visual alarm.
- Wall-mounted appliances shall be mounted such that the entire lens is not less than 2030 mm and not greater than 2440 mm above the finished floor.

c. Spacing in Rooms.

- Spacing of wall and ceiling mounted visible appliances shall be in accordance with Table 8.5 and Table 8.6 accordingly.

Table 8.5 - Room Spacing for Wall-Mounted Visible Appliances

Maximum Room Size		Minimum Required Light Output (Effective Intensity, cd)		
m	ft	One Light per Room	Two Lights per Room (Located on Opposite Walls)	Four Lights per Room (One Light per Wall)
6.10 x 6.10	20 x 20	15	NA	NA
8.53 x 8.53	28 x 28	30	Unknown	NA
9.14 x 9.14	30 x 30	34	15	NA
12.2 x 12.2	40 x 40	60	30	15
13.7 x 13.7	45 x 45	75	Unknown	19
15.2 x 15.2	50 x 50	94	60	30
16.5 x 16.5	54 x 54	110	Unknown	30
16.8 x 16.8	55 x 55	115	Unknown	28
18.3 x 18.3	60 x 60	135	95	30
19.2 x 19.2	63 x 63	150	Unknown	37
20.7 x 20.7	68 x 68	177	Unknown	43
21.3 x 21.3	70 x 70	184	95	60
24.4 x 24.4	80 x 80	240	135	60
27.4 x 27.4	90 x 90	304	185	95
30.5 x 30.5	100 x 100	375	240	95
33.5 x 33.5	110 x 110	455	240	135
36.6 x 36.6	120 x 120	540	305	135
39.6 x 39.6	130 x 130	635	375	185

Table 8.6 - Room Spacing for Ceiling-Mounted Visible Appliances

Maximum Room Size		Maximum Ceiling Height		Minimum Required Light Output (Effective Intensity); One Light (cd)
m	ft	m	ft	
6.1 × 6.1	20 × 20	3.0	10	15
9.1 × 9.1	30 × 30	3.0	10	30
12.2 × 12.2	40 × 40	3.0	10	60
13.4 × 13.4	44 × 44	3.0	10	75
15.2 × 15.2	50 × 50	3.0	10	95
16.2 × 16.2	53 × 53	3.0	10	110
16.8 × 16.8	55 × 55	3.0	10	115
18.0 × 18.0	59 × 59	3.0	10	135
19.2 × 19.2	63 × 63	3.0	10	150
20.7 × 20.7	68 × 68	3.0	10	177
21.3 × 21.3	70 × 70	3.0	10	185
6.1 × 6.1	20 × 20	6.1	20	30
9.1 × 9.1	30 × 30	6.1	20	45
13.4 × 13.4	44 × 44	6.1	20	75
14.0 × 14.0	46 × 46	6.1	20	80
15.2 × 15.2	50 × 50	6.1	20	95
16.2 × 16.2	53 × 53	6.1	20	110
16.8 × 16.8	55 × 55	6.1	20	115
18.0 × 18.0	59 × 59	6.1	20	135
19.2 × 19.2	63 × 63	6.1	20	150
20.7 × 20.7	68 × 68	6.1	20	177
21.3 × 21.3	70 × 70	6.1	20	185
6.1 × 6.1	20 × 20	9.1	30	55
9.1 × 9.1	30 × 30	9.1	30	75
15.2 × 15.2	50 × 50	9.1	30	95
16.2 × 16.2	53 × 53	9.1	30	110
16.8 × 16.8	55 × 55	9.1	30	115
18.0 × 18.0	59 × 59	9.1	30	135
19.2 × 19.2	63 × 63	9.1	30	150
20.7 × 20.7	68 × 68	9.1	30	177
21.3 × 21.3	70 × 70	9.1	30	185

- Visible notification appliances shall be installed in accordance with Table 8.5, using one of the following:
  i. A single visible notification appliance.
  ii. Two visible notification appliances located on opposite walls.
  iii. Two groups of visible notification appliances, where visual appliances of each group are synchronized, in the same room oradjacent space within the field of view. This shall include synchronization of strobes operated by separate systems.
  iv. More than two visible notification appliances or groups of synchronized appliances in the same room or adjacent space withinthe field of view that flash in synchronization.

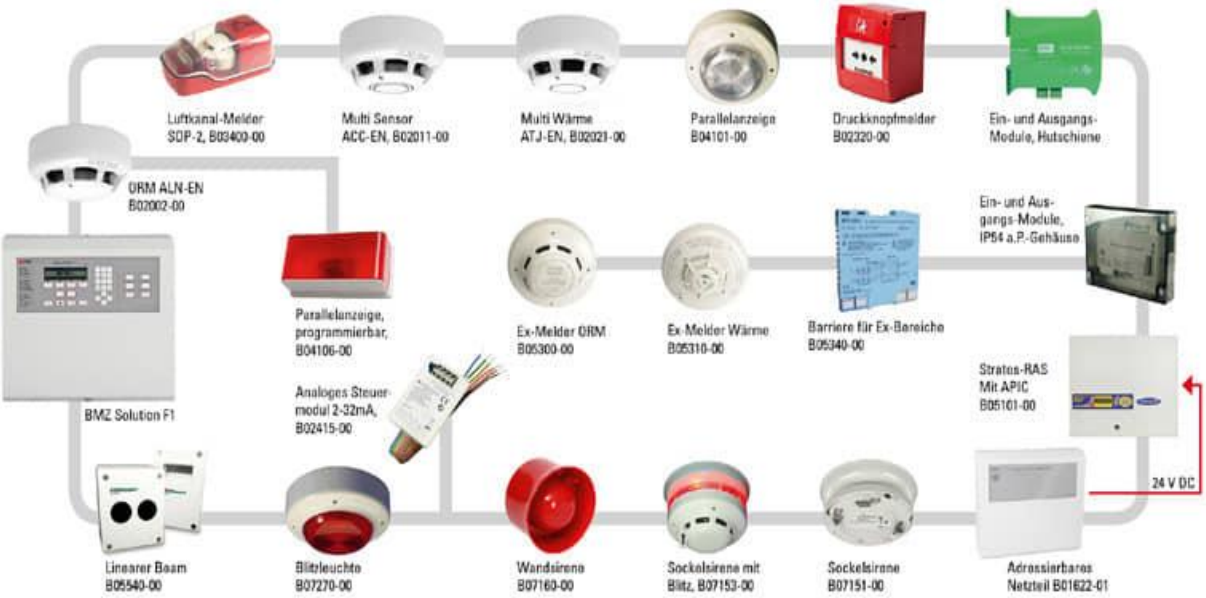
- Room spacing in accordance with Table 8.5 for wall-mounted appliances shall be based on locating the visible notification appliance at the halfway distance of the wall.
- In square rooms with appliances not centered or in non-square rooms, the effective intensity (cd) from one visible wall-mounted notification appliance shall be determined by maximum room size dimensions obtained either by measuring the distance to the farthest wall or by doubling the distance to the farthest adjacent wall, whichever is greater, as required by Table 8.3 .
- If a room configuration is not square, the square room size that allows the entire room to be encompassed or allows the room to be subdivided into multiple squares shall be used.
- If ceiling heights exceed 9.14 m (30 ft), ceiling-mounted visible notification appliances shall be suspended at or below 9.14 m (30 ft) or wall-mounted visible notification appliance shall be installed in accordance with Table 8.3.
- Table 8.4 shall be used if the ceiling-mounted visible notification appliance is at the center of the room. If the ceiling-mounted visible notification appliance is not located at the center of the room, the effective intensity (cd) shall be determined by doubling the distance from the appliance to the farthest wall to obtain the maximum room size.

d. Spacing in Corridors.
- The installation of visible notification appliances in corridors 6.1 m or less in width shall be in accordance with the requirements of Table 8.5 or 8.6 accordingly.
- In a corridor application, visible appliances shall be rated not less than 15 cd.
- Corridors greater than 6.1 m wide shall also comply with the spacing requirements for rooms in accordance with Table 8.3 or 8.4 accordingly.

e. Visible notification appliances shall be located not more than 4.57 m from the end of the corridor with a separation not greater than 30.4 m between appliances.
f. If there is an interruption of the concentrated viewing path, such as a fire door, an elevation change, or any other obstruction, the area shall be treated as a separate corridor.
g. In corridors where more than two visible notification appliances are in any field of view, they shall flash in synchronization.

h. Wall-mounted visible notification appliances in corridors shall be permitted to be mounted on either the end wall or the side wall of the corridor not more than 4.57 m from the end of the corridor with a separation not greater than 30.4 m between appliances.

37. Conventional Fire Alarm Control Panels



a) What is a conventional fire alarm control panel?

- ➢ Conventional fire alarm panels are more of a traditional fire protection system, and they're also the most common type of fire alarm system in commercial settings.
- ➢ They're an analog system and despite advances in technology, conventional panels remain an ideal option in many circumstances.
- ➢ A conventional alarm system protects a structure by dividing it into zones. Typically, in multi-story buildings, each floor is its own zone.
- ➢ A series of initiating devices and notification devices work together to create different zones throughout the structure that all connect to the conventional fire alarm control panel.

b) How does a conventional fire alarm system work?

- ➢ The conventional alarm system works by using increased electrical currents to notify the control panel of a change in atmosphere.
- ➢ Initiating devices in a particular zone are set at a certain threshold and when that threshold is surpassed by things like smoke or heat, the electrical current increases and sends a signal to the control panel.

- For example, smoke detectors identify a change in the amount of particles within the air or carbon monoxide is detected by identifying an increase in the zone's carbon monoxide levels.

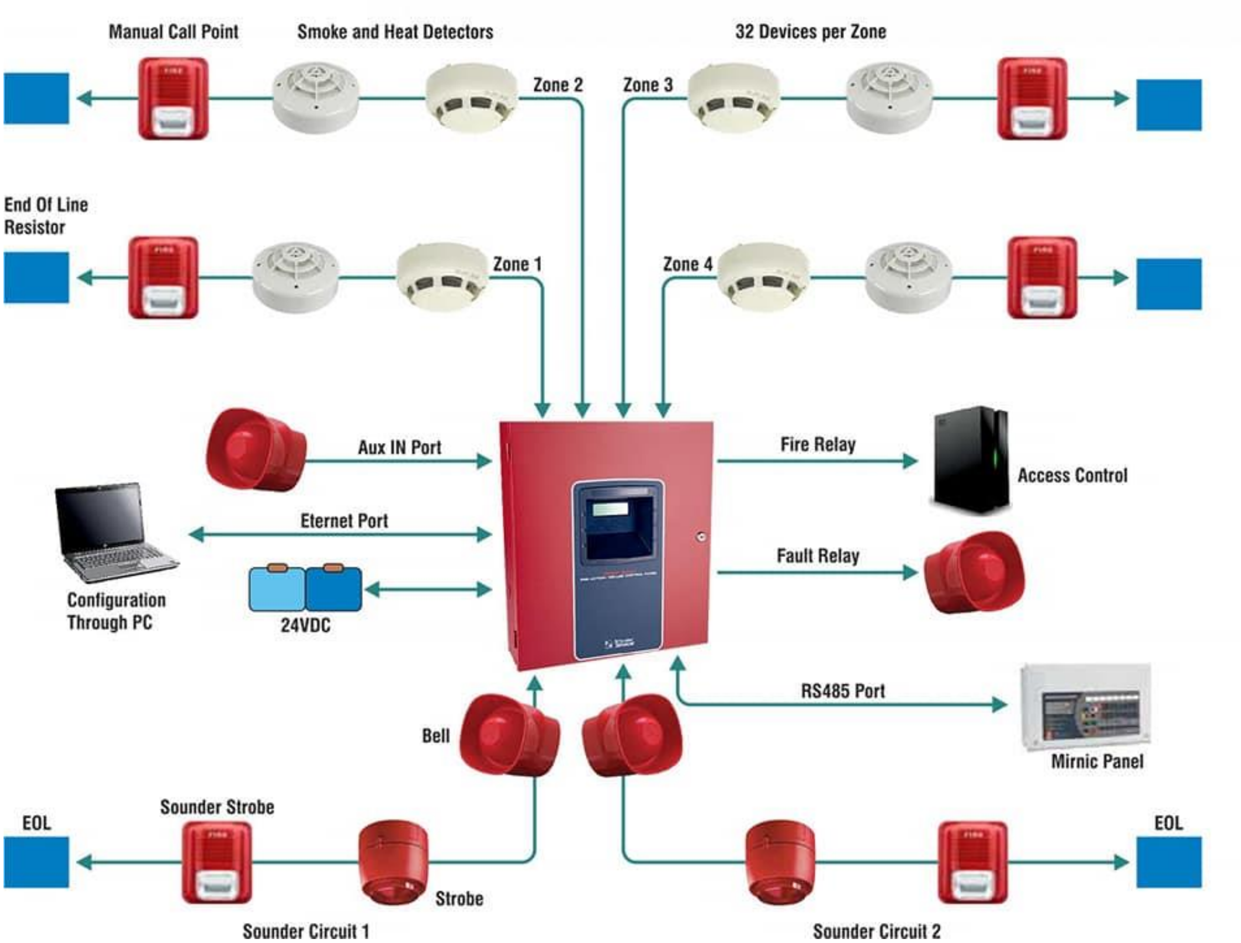
c) Where conventional fire alarm control panels can be used

- A fire alarm conventional panel can be used anywhere, but they're ideal for small businesses, single story buildings, buildings with a simple layout, or smaller structures in general where just a couple of zones can cover the entire building.

d) Features & benefits of conventional fire alarm systems

- Perhaps one of the biggest advantages of a conventional fire panel system is its cost-effectiveness.
- Despite its significantly lower cost, a conventional control panel still remains an incredibly reliable option when it comes to protecting valuable assets.
- A conventional fire alarm panel is simple to set up and doesn't require any extensive changes to existing systems as they're easily integrated with other manufacturers' devices. They also don't require any costly configurations.

38. Addressable Fire Alarm Systems:



a) An Overview

- You're shopping for a fire alarm system for your residence or commercial property, you may have noticed there are many types of systems, with different features, customized for all sorts of properties.
- You may also have noticed "addressable fire alarm systems" among the varieties.
- If you've never heard of it, read on! We're here to answer some commonly asked questions about addressable fire alarm systems and provide our two cents about whether they're worth the investment.

b) What is an addressable fire alarm system?

- Addressable fire alarms are fire protection systems where each device within the system has its own “address” or location. (Hence the name!) Each device detects changes in its immediate atmosphere to determine the exact location of a fire within the building.
- The system tracks its progress through the building, allowing rescue personnel to evacuate occupants from dangerous areas proactively.
- Unlike conventional systems installed to create individual zones, an addressable fire alarm system consists of networks, one interface, and central monitoring location; linking all smoke, fire, gas, emergency, and security devices throughout a home or property.

c) What is the difference between a conventional and addressable alarm system?

- Conventional fire alarm systems are analog, hardware-based systems that communicate through wiring.
- They feature no programmable options tailored to the building’s needs and notify the authorities of an emergency through a phone landline, cellular network, or wireless internet connection.
- Addressable alarm systems are much more modern. They operate digitally rather than analog when communicating between the system’s devices and emergency services. Each device within the system works as a team to isolate and pinpoint the location of an emergency within the building.

d) How does an addressable alarm system work?

- Addressable alarm systems convert an analog signal created by voltage variations to binary code via the system’s integrated computer.
- That code then digitally transfers information from the individual safety devices throughout the building to the primary control panel. Because of this digital communication, an addressable system can transfer a much wider variety of information to its control panel than a conventional analog system can.

e) Are addressable alarm systems better than conventional systems?

- The answer to that question depends entirely upon your individual needs. But in terms of advanced features, technology, and responsiveness- we have to say yes.
- First of all, conventional alarm systems just aren’t as safe as addressable systems. Because of its analog design, there may be limitations on how precisely a traditional system can identify the location of an emergency, resulting in delayed response times.
- This may not be a massive issue if you’re protecting a smaller space with only a few zones, but lags in a security system’s swiftness can have dangerous consequences no matter what size space you’re covering.
- Addressable systems are designed to detect issues immediately and efficiently alert emergency personnel in record time. They’re fully programmed and can target the emergency’s exact starting point, current status, and progression through the building.
- Also, conventional systems are more susceptible to false alarms. This can pose a significant safety hindrance and cost you plenty of money in the long run for false alarm fines.

- Addressable systems are self-diagnosing and can monitor the performance of each device connected to the system. They can pinpoint defects in the fire alarm system wiring and even detect the buildup of debris and contaminants that may inhibit performance. This cuts down on false alarms and ensures the entire system is in optimal working order.
- And since each device has its own address, each element can be tested and monitored independently, making regular fire alarm testing much easier and, again, cutting down on false alarms.
- And finally, a traditional fire alarm system can't compete with the personalization of an addressable system.
- You can customize it for optimal cooperation with your building's unique design. For example, you may configure evacuation notifications based upon detection and building layout to control occupant traffic and reduce crowding and chaos in the event of an emergency evacuation.
- Most addressable systems even have the ability to maintain a log of incidents so you may review patterns in the system's operation over time.

f) Pros and Cons of an Addressable Fire Alarm System:

- **Pros**

  - Less hardware and fewer wires.
  - Faster, more reliable detection.
  - Shorter response time from emergency services.
  - Pinpoint accuracy of emergency locations within the building.
  - Separate device "addresses" means easier troubleshooting for problems.
  - More customization than an analog system.
  - Intelligent features like logging and self-diagnostics.
  - Less ongoing costs when compared to conventional systems.

- **Cons**

  - Setup and configuration of an addressable system cost more than a conventional system.
  - Integrating different brand devices into the system may be an issue.
  - Initial installation may take a bit longer than a conventional system.

g) Do you need an addressable alarm system?

- That all depends upon the type of structure that you need to protect and the people who inhabit it.
- When it comes to multi-story buildings like skyscraper hotels or apartments, an addressable system is by far the safest option. The same applies to large complexes or properties with complicated layouts like hospitals, university campuses, and even historic buildings.

- That said, there's really no rule that says you can't install an addressable system in your personal home or a rental property.
- An addressable system can provide extra safety when rapid response is especially critical. For instance, in cases when very young children, elderly folks, or inhabitants with disabilities need more time and direction to evacuate the premises.
- Frequent travelers who find themselves away from home for extended periods may also benefit from an addressable fire alarm over a slower, less sophisticated analog system.

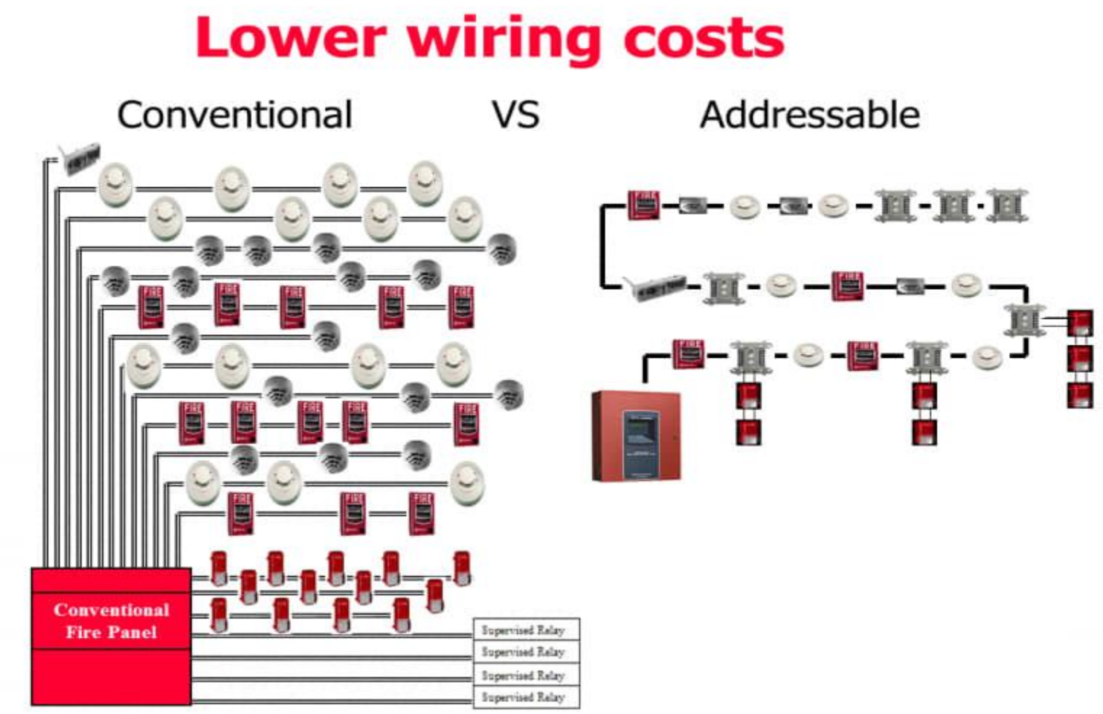
h) The Bottom Line

- Timing is critical when there's a fire anywhere, which is why advancements in fire safety systems are so important.
- Instead of sounding each alarm as a fire spreads, the newest addressable fire alarm systems can detect smoke and automatically sound every alarm where the danger's headed, saving more lives in the process.
- We happen to think the peace of mind an addressable fire alarm brings is well worth it, and lucky for us, this tech is available to anyone. Even if you don't live in a sprawling palatial estate.
- Modern fire safety systems, including addressable panels from brands like Honeywell, offer enhanced protection by detecting smoke and sounding alarms strategically, potentially saving lives.

i) Disadvantages of conventional fire alarm systems

- Despite their long standing reputation of being budget-friendly and effective in decreasing catastrophic loss, there is one very notable disadvantage to having a conventional fire alarm panel.
- While the system utilizes zones to narrow down the source of the problem, the initiating devices are only able to give the conventional fire panel a general location of the suspected fire.
- Newer systems with more advanced technology are able to pinpoint exact locations.
- Overall, a conventional fire alarm panel is a great investment.
- If you think a conventional fire alarm system may be the next step in safeguarding your building, the experts at Control Fire Systems are standing by to offer you their honesty and expertise. Contact us today to see if a conventional fire alarm system is right for you or order a qualified fire alarm inspection from one of our technicians.

39. Difference between Addressable and Conventional Fire Alarm Systems



- Fatalities and dire losses to collateral and property attributed to fires have led to a lot of introspection with regard to fire safety and protocol for businesses, homeowners, and even institutions.
- According to a report by Industrial Safety Review, an average of 25,000 people die every year as a result of fires. What's worse is that the report also revealed that approximately 42 women and 21 men die due to fires in India on a daily basis. Although there is no conclusive and validated data on the economic losses attributed to fires in India, the fatalities itself are enough to alert the population to take fire safety more seriously. In the light of these dangerous situations and also to abide by the stringent code and regulations laid down by the governing bodies, one must be aware of the different kinds of fire alarms. But first, it is important to understand what a fire alarm is.
- A fire alarm is a device that links various different free detecting devices to the central control panel. At a broad level, there are two types of fire alarm systems – one is addressable fire alarm system and second is the conventional fire alarm system.
- In this blog, let's delve deeper to get a better understanding of these vital systems. Here are some of the differentiating points when it comes to addressable and conventional alarm systems.

a) The Functioning

- Simply put, with addressable systems, since every fire detecting device has its own address, one is able to pinpoint the precise location of the fire in a large building or even a complex.
- This triggers control panel systems and enables the authorities to act quickly. In a conventional system, the devices are connected to the control panel in separate zones by individual wires.
- These systems will not be able to pinpoint the exact location of the fire; rather it will give you an idea of which general area the fire is.
- Conventional alarms are better suited for small spaces such as retail outlets, single offices, and compact homes.

b) The Installation

- Since each zone connected to the conventional fire alarm panel needs its own individual wire, the installation process is tedious and time-consuming.
- On the other hand, addressable systems are wired with one wire which loops and connects all the devices to the panel.
- Since there is just one cable in question, the addressable systems are easier to install in comparison.
- This also means that the addressable fire alarm systems can be installed in a shorter time.

c) The Purpose

- In most scenarios, addressable alarms exist to help to pinpoint the exact location of the fire so as to save time and resources.
- Conventional alarm panels exist to simply raise the alarm.
- For small establishments, since the space is so small, pinpointing the exact location becomes redundant.
- In the case of small premises, the ease of evacuation and identification of the fire makes a conventional system substantial for the structure.
- Addressable devices are far more intelligent than conventional devices. They can be individually programmed for the sensitivity to the smoke. So if detector is in the kitchen or Room then they can be programmed for less sensitivity so that they will not raise false alarm.
- Similarly they can be programmed to behave differently at different times.

d) The Scale

- The deciding factor between whether or not to go with an addressable fire alarm system or a conventional one is scale.
- It all boils down to how many rooms need to be covered. For example, for single rooms, the fire can be identified easily and action can be taken immediately.
- So there is no real requirement for an addressable system. The complex installation is compensated with a lower price point, and the safety of people and property is not compromised.

40. Material Approval

a) 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, Approved and Registered by the Civil Defence Material Approval Department.

b) The above requirement applies to all the products with or without international listing, registration or approval.

41. Further References

a) The following International Codes and Standards were referred, studied and consulted for this chapter. Further details where applicable can be referred to in these Codes and Standards. Also see XV. ACKNOWLEDGEMENT OF INTERNATIONAL CODES AND STANDARDS.

- NFPA 72: National Fire Alarm and Signaling Code.
- NFPA 70: National Electrical Code®
- NFPA 75: Standard for the protection of computer EDP/ Clean Agents.
- NFPA 76: Standard for the fire protection of telecommunication facility.
- NFPA 110: Standard for Emergency and Standby Power Systems.
- NFPA 111: Standard on Stored Electrical Energy Emergency and Standby Power Systems.
- NFPA 170: Standard for Fire Safety and Emergency Symbols.
- BA 6266: Fire Protection for electronic equipment installation – code of practice.
- FIA COP: Code of Practice for Design, Installation Commissioning & Maintenance of

Chapter No.: 5

Flammable and Combustible liquid used

In this Chapter:

- Storage, handling and use of Flammable and combustible liquids
- Minimum required separation distances from flammable and combustible liquid storage
- Maximum Allowed Quantity of flammable and combustible liquids

Intent of the Chapter:

- To provide guidelines to designers, users, producers, distributors and those involved with safe handling, storage and use of Flammable and Combustible liquids
- To restrict flammable and combustible liquids to maximum allowed quantities occupancy wise.

1. Definitions:

1.1. General:

2.1.1. Shall

It is a mandatory requirement from Civil Defence.

2.1.2. Should

It is a suggested requirement recommended by Civil Defence but not mandatory.

2.1.3. Listed

Approved and registered by individual EGPC, Civil Defence material department.

2.1.4. Gallon. U.S. Standard and Kilogram

1 U.S. gal = 3.785 UL. 1 Kg = 1.8 Liter, Approx. (Units used in this chapter are either Kilograms or

2.1.5. **US Gallons.** Conversion of Liter to Kg without knowing specific density, Liter conversion to Kg is approximate.)

2.1.6. Kilogram

1 Kg = 2.20.lb (Pounds)

2.1.7. Barrel

A unit of volume used in the petroleum industry that is equal to 0.159 m3 (159 L or 42 gal).

2.1.8. Boiling Point

The temperature at which the vapor pressure of a liquid equals the surrounding atmospheric pressure.

2.1.9. Flash Point

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.

2.1.10. Vapor Pressure

The pressure, measured in pounds per square inch, absolute (psia), exerted by a liquid.

2.1.11. Material Safety Data Sheet (MSDS)

It is a document that gives detailed information about the nature of that particular chemical, such as

a) Physical and chemical properties

b) Health, safety, fire and environmental hazards

c) Handling, storage and transportation requirements

2.1.12. Low Flammable Limit (LFL) or Lower Explosive Limit (LEL)

The concentration of a flammable vapor in air below which ignition will not occur. It is also known as Lower Explosive Limit.

2.1.13. Fire Point

The lowest temperature at which a liquid will ignite and achieve sustained burning when exposed to a test flame. (ASTM D 92)

2.1.14. Maximum Allowable Quantity (MAQ)

The maximum quantity of flammable and combustible liquid permitted in a control area.

2.1.15. UN Numbers

UN number identifies and classifies hazardous substance and articles within the frame work of international transport.

2.1.16. Grounding

The process of bonding one or more conductive objects to the ground, so that all objects are at zero (0) electrical potential.

2.1.17. High Hazard Level 2 Contents

Contents that present deflagration hazard or a hazard from accelerated burning. for the purpose of this code, this includes, Class I, Class II or Class IIIA liquids that are used or stored in normally open containers or systems, or in closed containers or systems at gauge pressure of 15 psi (103 kPa) or greater.

2.1.18. High Hazard Level 3 Contents

Contents that readily support combustion or that present a physical hazard. This includes, Class I, Class II or Class IIIA liquids that are used or stored in normally closed containers or in a closed systems at gauge pressure of less than 15 psi (103 kPa).

2.1.19. Refinery

A plant in which flammable or combustible liquids are produced on a commercial scale from crude petroleum, natural gasoline or other hydrocarbon sources.

2.1.20. Solvent Distillation Unit

An appliance that distills a flammable or combustible liquid to remove contaminants and recover the liquid.

2.1.21. Staging

Temporary storage in a process area of liquids in containers, intermediate bulk containers and portable tanks.

2.1.22. Terminal

That portion of a property where liquids are received by tank vessel, pipelines, tank car or tank vehicle and are stored or blended in bulk for the purpose of distributing such liquids by tank vessel, pipeline, tank car, tank vehicle, portable tank or container.

2.1.23. Control Area

Area or building or portion of building within which flammable and combustible liquids are allowed to be stored, dispensed, used, handled in quantities that do not exceed maximum allowable quantities (MAQ).

1.2. Liquids

1.2.1. Flammable Liquid

Any liquid that has a closed-cup flash point below 100°F (37.8°C).

1.2.1.1. Class I Flammable Liquid

Any liquid that has a closed-cup flash point below 100°F (37.8°C) and a vapor pressure not exceeding an absolute pressure of 40 psia (2068.6 mm Hg at 100°F (37.8°C).

1.2.1.2. Class IA Flammable Liquid

Liquids that have flash points below 73°F (22.8°C) and boiling points below 100°F (37.8°C). Examples are Di-ethyl Ether, Ethylene Oxide, and Light Crude Oils.

1.2.1.3. Class IB Flammable Liquid

Liquids that have flash points below 73°F (22.8°C) and boiling points above 100°F (37.8°C). Examples are Motor and Aviation Gasoline, Toluene, Lacquers, Lacquer Thinner.

1.2.1.4. Class IC Flammable Liquid

Liquids that have flash points at or above 73°F (22.8°C) but below 100°F (37.8°C). Examples are xylene, some paints, some solvent based Cements.

1.2.2. Combustible Liquid

Any liquid that has a closed-cup flash point at or above 100°F (37.8°C).

1.2.2.1. Class II Combustible Liquid

Any liquid that has a flash point at or above 100°F (37.8°C) and below 140°F (60°C). Examples are Diesel Fuel, Paint Thinner.

1.2.2.2. Class IIIA Combustible Liquid

Any liquid that has a flash point at or above 140°F (60°C) and below 200°F (93°C). Examples are Home Heating Oil

1.2.2.3. Class IIIB Combustible Liquid

Any liquid that has a flash point above 200°F (93°C) Examples are Cooking Oils, Lubricating Oils, Motor Oils.

1.2.3. Hazardous Material or Chemical

Material presenting dangers beyond the fire problems relating to flash point and boiling point. These hazards and dangers can arise from, but not limited to , toxicity, reactivity, instability or corrosivity.

1.2.4. Liquefied Gas

A gas, other than in solution, that in a packaging under the charged pressure exists both as a liquid and a gas at a temperature of 20°C (68°F).

1.2.5. Unstable Liquid

A liquid that, in the pure state or as commercially produced or transported, will vigorously polymerize, decompose, undergo condensation reaction, or become self-reactive under conditions of shock, pressure, or temperature.

1.2.6. Water miscible Liquid

A liquid that mixes in all proportions with water without the use of chemical additives, such as emulsifying agents.

1.2.7. Cryogenic Fluid

A fluid with a boiling point lower than -130°F (-90°C) at an absolute pressure of 14.7 psi (101.325 kPa)

1.2.8. Crude Petroleum

Hydrocarbon mixtures that have a flash point below 150°F (65.6°C) and that have not been processed in a refinery.

1.2.9. Liquid

Any material

a. That has fluidity greater than that of 300 penetration asphalt when test in accordance with ASTM D 5

b. Is a viscous substance for which specific melting point cannot be determined but that is determined to be liquid in accordance with ASTM D 4359

1.2.10. Fast Moving Consumer Goods (FMCG)

Retail products that are consumed by the consumers on a day-to-day basis such as cleaning solvents, perfumes, paints etc.

1.3. Storage

1.3.1. Storage Tank

Any vessel having a liquid capacity that exceeds 230 L (60 gal), is intended for fixed installation, and is not used for processing.

1.3.2. Atmospheric Tank

A storage tank that has been designed to operate at pressures from atmospheric through a gauge pressure of 6.9 kPa (1.0 psig) (i.e., 760 mm Hg through 812 mm Hg) measured at the top of the tank.

1.3.3. Low-Pressure Tank

A storage tank designed to withstand an internal pressure above a gauge pressure of 6.9 kPa (1.0 psig) but not more than 103.4 kPa (15 psig or 1 bar gauge) measured at the top of the tank.

1.3.4. Portable Tank

Any closed vessel having a liquid capacity over 230 L (60 gal) and not intended for fixed installation.

1.3.5. Secondary Containment Tank

A tank that has an inner and outer wall with an interstitial space (annulus) between the walls and that has a means for monitoring the interstitial space for a leak.

1.3.6. Above-ground Tank

A tank that is installed above grade, at grade, or below grade without backfill.

1.3.7. Protected Above-ground Tank

An atmospheric above-ground storage tank that is listed and approved with Standards for Protected Above-ground Tanks for Flammable and Combustible Liquids, or an equivalent test procedure that consists of a primary tank provided with protection from physical damage and fire-resistive protection from exposure to high intensity liquid pool fire.

1.3.8. Vault

An enclosure consisting of four walls, a floor, and a top for the purpose of containing a liquid storage tank and not intended to be occupied by personnel other than for inspection, repair, or maintenance of the vault, the storage tank, or related equipment.

1.3.9. Container

Any vessel of 450 L (119 gal) or less capacity used for transporting or storing liquids.

1.3.10. Closed Container

A container as herein defined, so sealed by means of a lid or other device that neither liquid no vapor will escape from it at ordinary temperatures. Closed container is not allowed to have any vents, either automatic, fixed or pressure operated.

1.3.11. Safety Can

A listed container, of not more than 20 L (5.3 gal) capacity, having a spring-closing lid and spout cover and so designed that it will safely relieve internal pressure when subjected to fire exposure.

1.3.12. Fire Resistant Above-ground Storage Tank

An atmospheric above-ground storage tank with thermal insulation that has been evaluated for Resistance to physical damage and for limiting the heat transferred to the primary tank when exposed to hydrocarbon fuel fire. It is listed in accordance with UL 2080.

1.3.13. Floating Roof Tank

Floating roof tank incorporates any of the following.

A. A closed-top pontoon or double-deck metal floating roof in an open-top tank constructed in Accordance with API Standard 650, Welded Steel Tanks for Oil Storage.
B. A fixed metal roof with ventilation at the top and roof eaves constructed in, accordance with API 650 and containing a closed-top pontoon or double-deck metal floating roof meeting the requirements of API 650.
C. A fixed metal roof with ventilation at the top and roof eaves constructed in accordance with API 650 and containing a metal floating cover supported by liquid tight metal floating devices that provide sufficient buoyancy to prevent the liquid surface from being exposed when, half of the flotation is lost

1.3.14. Pressure Vessel

A container or other component designed in accordance with the ASME Boiler and Pressure Vessel Code.

1.3.15. Bulk Storage Tank

The term bulk storage applies to following liquids storage arrangements

A. The storage of flammable / combustible liquid in fixed tanks that exceeds 60 gallons. (230 L) capacity

B. The storage of flammable and combustible liquids in portable tank that exceeds 660 gallons (2500 L) capacity

C. The storage of flammable and combustible liquids in intermediate bulk containers that exceeds 793 gallons (3000 L) capacity.

1.3.16. Intermediate Bulk Container

Any closed vessel having a liquid capacity not exceeding 793 gal (3000 L) and intended for storing and transporting liquids.

INTERMEDIATE BULK CONTAINERS FOR ILLUSTRATIO

BULK STORAGE TANKS FOR ILLUSTRATION

1.4. Fuel Dispensing

1.4.1. Motor Fuel Dispensing Facility (Gas Station)

That portion of a property where motor fuels are stored and dispensed from fixed equipment into the fuel tanks of motor vehicles or marine craft or into approved containers, including all equipment used in connection therewith.

1.4.2. Fleet Vehicle Fuel Dispensing Facility

A motor fuel dispensing facility at a commercial, industrial, governmental, or manufacturing property where motor fuels are dispensed into the fuel tanks of motor vehicles that are used in connection with the business or operation of that property by persons within the employ of such business or operation.

1.4.3. Marine Motor Fuel Dispensing Facility

A motor fuel dispensing facility at or adjacent to shore, a pier, a wharf, or a floating dock where motor fuels are dispensed into the fuel tanks of marine craft.

1.4.4. Major Repair Garage

A building or portions of a building where major repairs, such as engine overhauls, painting, body and fender work, and repairs that require draining of the motor vehicle fuel tank are performed on motor vehicles, including associated floor space used for offices, parking, or showrooms.

1.4.5. Minor Repair Garage (Service Station)

A building or portions of a building used for lubrication, inspection, and minor automotive maintenance work, such as engine tune-ups, replacement of parts, fluid changes (e.g., oil, antifreeze, transmission fluid, brake fluid, air conditioning refrigerants, etc.), brake system repairs, tire rotation, and similar routine maintenance work, including associated floor space used for offices, parking, or showrooms.

1.4.6. Dispensing Device

A dispensing device that consists of one or more individual units intended for installation in conjunction with each other, mounted above a dispensing area typically within the gas station canopy structure and characterized by the use of an overhead hose reel.

1.4.7. Dispensing Device, Overhead Type

A dispensing device that consists of one or more hose outlets with nozzles, known as multi-product dispensers, mounted on the dispensing equipment, usually located under a canopy.

1.4.8. Vapor Processing Equipment

Those components of a vapor processing system that are designed to process vapors or liquids captured during transfer or filling operations.

2. Flammable and Combustible Liquids

2.1. The Flash Point and the Risks

2.1.1. Flash point measurements are made using several different test methods but common operation.

The liquid being tested is placed in a small sample cup and heated to a certain temperature.

A small pilot flame is introduced into the cup, and the operator observes if vapors in the cup ignites. If the vapor does not ignite, the liquid is heated further, incrementally and the pilot flame is reintroduced.

These steps are repeated until ignition occurs and temperature of the liquid at ignition marks its 'Flash Point'.

2.1.2. The storage, processing, handling and use of liquids at temperatures above flash point can produce ignitable vapour, causing fire and explosion accidents.

2.1.3. The risk involved in storage, usage and handling of flammable and combustible liquids shall be evaluated based on the following principles.

a. Analysis of fire and explosion hazards of the operation.

b. Analysis of emergency relief from process vessels, taking into consideration the properties of the materials used and the fire protection and control measures taken.

c. Analysis of applicable facility design requirements (Separation distances, fire ratings etc.)

d. Analysis of requirements for liquid handling, transfer and use.

e. Analysis of local conditions such as exposure to and from adjacent properties and exposure to floods, earthquakes and windstorms.

f. Analysis of the emergency response capabilities of the in-house emergency services and Civil Defence specialization.

2.1.4. As a general guideline, this chapter provides the requirements related to storage, handling, transfer, dispensing and usage of flammable and combustible liquids. This chapter shall be read and refereed in conjunction with other chapters of this code where referred.

2.1.5. NFPA 30, NFPA 30A, NFPA 30 Handbook, EPA, EGPC Municipality Hazardous Material guidelines have been referred for this chapter. Consultants, contractors, owners and House of Expertise shall refer to these documents for further details, requirements, specifications and design considerations.

2.2. Applicability of this chapter

2.2.1. Requirements of this chapter shall not apply to the following

a. Any liquid that have melting point at or above 38°C.

b. The material which are not 'liquid' as defined in 1.2.17

c. Any Cryogenic fluid or liquefied gas.

d. Any liquid that does not have flash point but which is capable of burning in certain condition

e. Any aerosol product.

f. Any mist, spray or foam.

g. Transportation of flammable and combustible liquids.

h. Storage, handling and use of fuel oil tanks and containers connected with oil burning equipment.

2.3. General Requirements for Flammable and Combustible Liquid Storage

2.3.1. The general requirements for storage of Flammable and Combustible Liquids shall comply with Table 13.1. These requirements shall apply to all the flammable and combustible liquids storage, usage, handling and dispensing, and shall be complied along with requirements of all the following sections of this chapter.

Table 13.1: General Requirements for Flammable and Combustible Liquid Storage

ITEMS	REQUIREMENTS
1. CONTROL OF IGNITION SOURCE	Precautions shall be taken to prevent the ignition of flammable vapors from sources such as the following:

	a) Open flames b) Lightning c) Hot surfaces d) Radiant heat e) Smoking f) Cutting and welding g) Spontaneous ignition h) Frictional heat or sparks i) Static electricity j) Electrical spar k) Stray currents l) Ovens, furnaces, and heating equipment m) Hot Work
2. GENERAL	I. Inside liquid storage rooms shall not exceed 46 m. II. Class I liquids shall not be permitted in basement areas. III. The storage of any liquids shall not physically obstruct means of egress. IV. Wood at least 25 mm nominal thickness shall be permitted to be used for shelving, racks, dunnage, scuff-boards , floor overlay, and similar installations. V. Where storage is on racks, a minimum 1.2 m wide aisle shall be provided between adjacent rack sections and any adjacent storage of liquids. Main aisles shall be a minimum of 2.4 m wide. VI. Solid pile and palletized storage in liquid warehouses shall be arranged so that piles are separated from each other by at least 1.2 VII. Aisles shall be provided and arranged so that no container or portable tank is more than 6 m from an aisle. Main aisles shall be a minimum of 2.4 m wide.
3. WARNING SIGNS	i. Adequate Warning Signs shall be provided where flammable and combustible liquids are stored, used, handled or dispensed, such as "NO SMOKING",

	“FLAMMABLE LIQUID, KEEP AWAY”, “NO OPEN FLAMES” etc.	
		
4. ELECTRICAL AREA CLASSIFICATION	i. Electrical Area Classification shall comply with **NFPA 70 Class I designated areas** with **Table 13.1.a.,** for Class I liquid storage areas and areas where Class II OR Class III liquids are stored or handled at or above their flash points. ii. A classified area shall not extend beyond a floor, wall, roof or other solid partition that has no openings within the classified area. See **Figure 13.1. and 13.2.**	

Table 13.1.a.: Electrical Area Classification			
LOCATION	**DIVISION**	**ZONE**	**EXTENT OF CLASSIFIED AREA**
1. INDOOR EQUIPMENT-WHERE FLAMMABLE VAPOUR-AIR MIXTURE CAN EXIST UNDER NORMAL CONDITION	1	0	The entire area associated with such equipment where flammable gases or vapours are present continuously for long period of time.
	1	1	Area within 1.5 m of any edge of such equipment, extending in all direction
	2	2	Area between 1.5 m and 2.5 m of any edge of such equipment, extending in all directions including space up to 1 m above floor or grade level within 1.5 m to 7.6 m horizontally from any edge of such equipment
2. OUTDOOR EQUIPMENT-WHERE FLAMMABLE VAPOUR-AIR MIXTURE CAN EXIST UNDER NORMAL CONDITION	1	0	The entire area associated with such equipment where flammable gases or Vapours are present continuously for long period of time.
	1	1	Area within 1 m of any edge of such equipment, extending in all direction

	2	2	Area between 1 m and 2.5 m of any edge of such equipment, extending in all directions including space up to 1 m above floor or grade level within 1 m to 3 m horizontally from any edge of such equipment
3. INDOOR– TANK STORAGE INSTALLATIONS INSIDE BUILDINGS	1	1	All equipment located below grade level.
	2	2	Any equipment located at or above grade level.

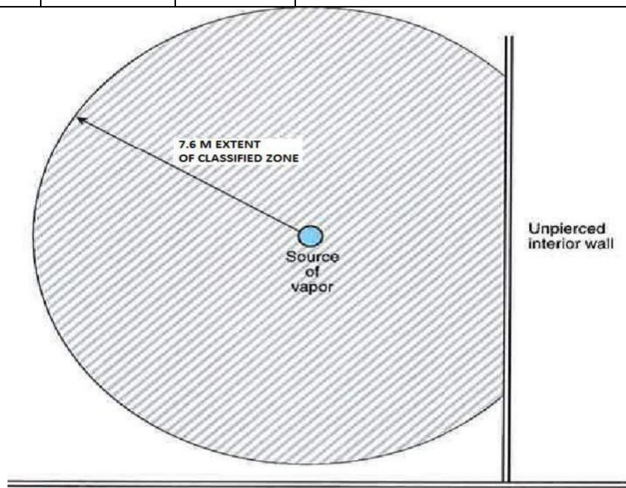


Figure 13.1.: Extent of Classified Area– Classified Area blocked by wall

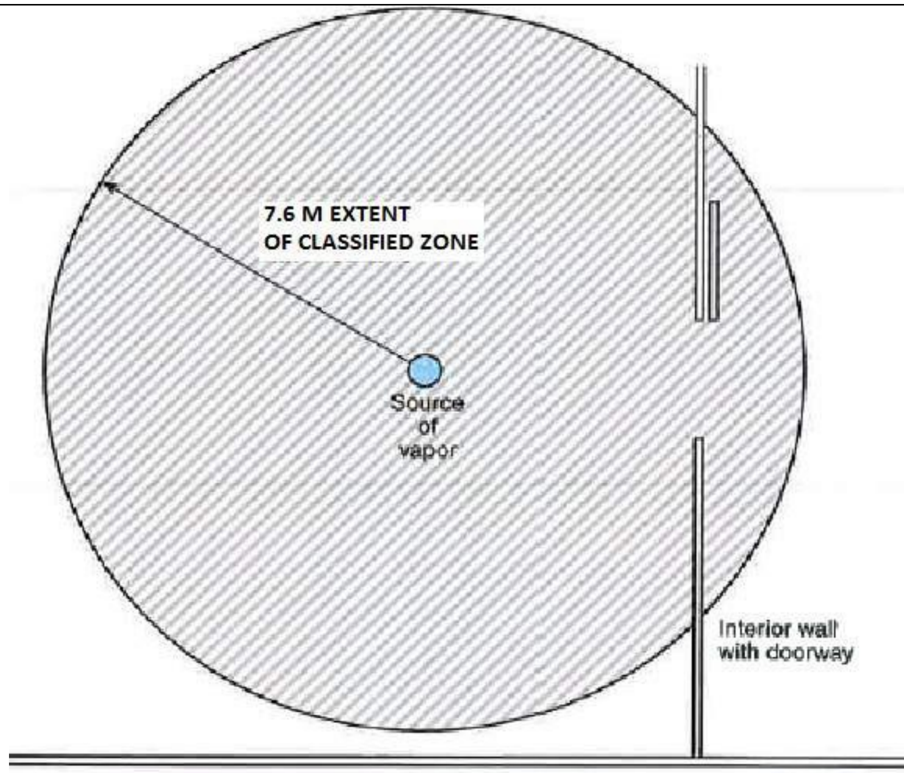


Figure 13.2.: Extent of Classified Area– Classified Area extends through wall opening

4. TANK—ABOVEGROUND, FIXED ROOF	1	0	i.Inside fixed roof tank ii. Area inside of vent piping or vent opening.
	1	1	i. Area inside dike where dike height is greater than the distance from the tank to the dike for more than 50% of the tank circumference. ii. Within 1.5 m of open end of vent, extending in all directions.
	2	2	i. within 3 m from shell, ends, or roof of the tank, including area inside dike up to top of the dike wall. ii. Area between 1.5 m and 3 m from open end of vent, extending in all directions.
5. TANK—ABOVEGROUND, FLOATING ROOF WITH FIXED OUTER ROOF	1	0	Area between the floating the floating and fixed roof sections and within the shell.
6. 7. TANK—ABOVEGROUND, FLOATING ROOF WITH FIXED NO OUTER ROOF	1	1	Area above the floating roof and within the shell.
LOCATION	**DIVISION**	**ZONE**	**EXTENT OF CLASSIFIED AREA**
7. TANK VAULT—INTERIOR	1	1	Entire interior volume, if Class I Liquids are stored within.

8. UNDERGROUND TANK FILL OPENING	1	1	Any pit, box or space below grade level, if any part is within a Division 1 or 2 or Zone 1 or 2 classification location.
	2	2	Up to 0.5 m above grade level within a horizontal radius of 3 m from a loose fill connection and within a horizontal radius of 3 m from loose fill connection and within a horizontal radius of 1.5 m from a tight fill connection.
9. VENT-DISCHARGING UPWARDS	1	0	Area inside the drum or container
	1	1	Within 1 m of the open end of vent, extending in all directions
	2	2	Area between 1 m and 1.5 m of open end of vent, extending in all directions.
10. DRUM AND CONTAINER FILLING– OUTDOOR OR INDOOR	1	0	Area inside the drum or container.
	1	1	Within 1 m of vent and fill openings, extending in all directions.
	2	2	Area between 1 m and 1.5 m from vent or fill opening, extending in all directions, up to 0.5 m above floor or grade level within a horizontal radius of 3 m from vent or fill opening
11. INDOOR-PUMPS, BLEEDERS, WITHDRAWAL FITTINGS	2	2	Within 1.5 m of any edge of such devices, extending in all directions, including up to 1 m above floor or grade level within 7.6 m horizontally from any edge of such devices.
12. OUTDOOR-PUMPS, BLEEDERS, WITHDRAWAL FITTINGS	2	2	Within 1 m of any edge of such devices, extending in all directions, including up to 0.5 m above floor or grade level within 3 m horizontally from any edge of such devices.
13. PITS AND SUMPS- WITHOUT MECHANICAL VENTILATION	1	1	Entire area within a pit or sump if any part is within Division 1 or 2 or Zone 1 or 2 classifies location.
14. PITS AND SUMPS- WITH ADEQUATE MECHANICAL VENTILATION	2	2	Entire area within a pit or sump if any part is within Division 1 or 2 or Zone 1 or 2 classifies location.
15. PITS AND SUMPS CONTAINING VALVES, FITTINGS OR PIPING AND NOT WITHIN A DIVISION 1 OR 2 OR ZONE 1 OR 2 CLASSIFIED LOCATION	2	2	Entire pit or sump

16. OUTDOOR-DRAINAGE DITCHES, SEPARATORS, IMPOUNDING BASINS	2	2	Area up to 0.5 m above ditch, separator or basin, including area up to 0.5 m above grade within 4.5 m horizontally from any edge
17. TANK VEHICLE AND TANK CAR– LOADING THROUGH OPEN DOME	1	0	Area inside of tank.
	1	1	Within 1 m of edge of dome, extending in all directions
	2	2	Area between 1 m and 4.5 m from edge of dome, extending in all directions.

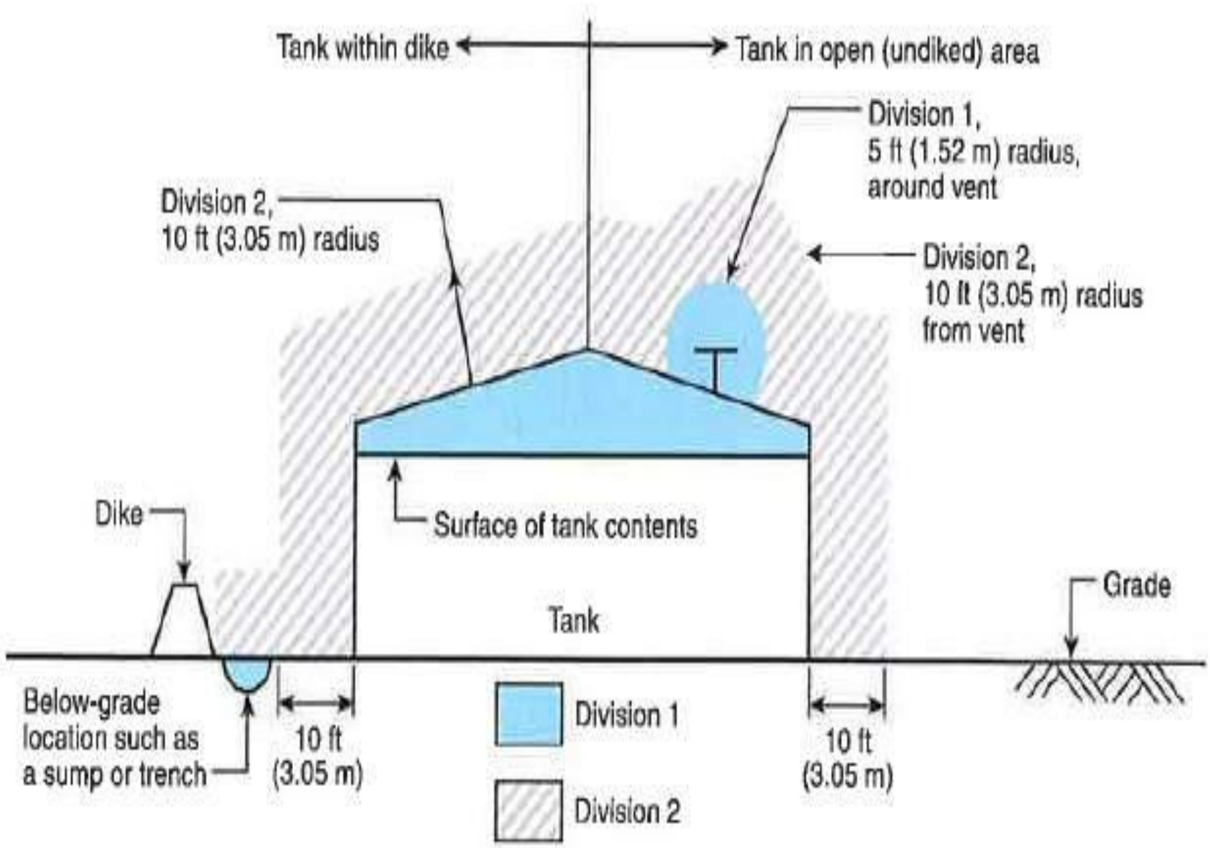


Figure 13.3.: Area Classification of any Above ground Tank– Division System

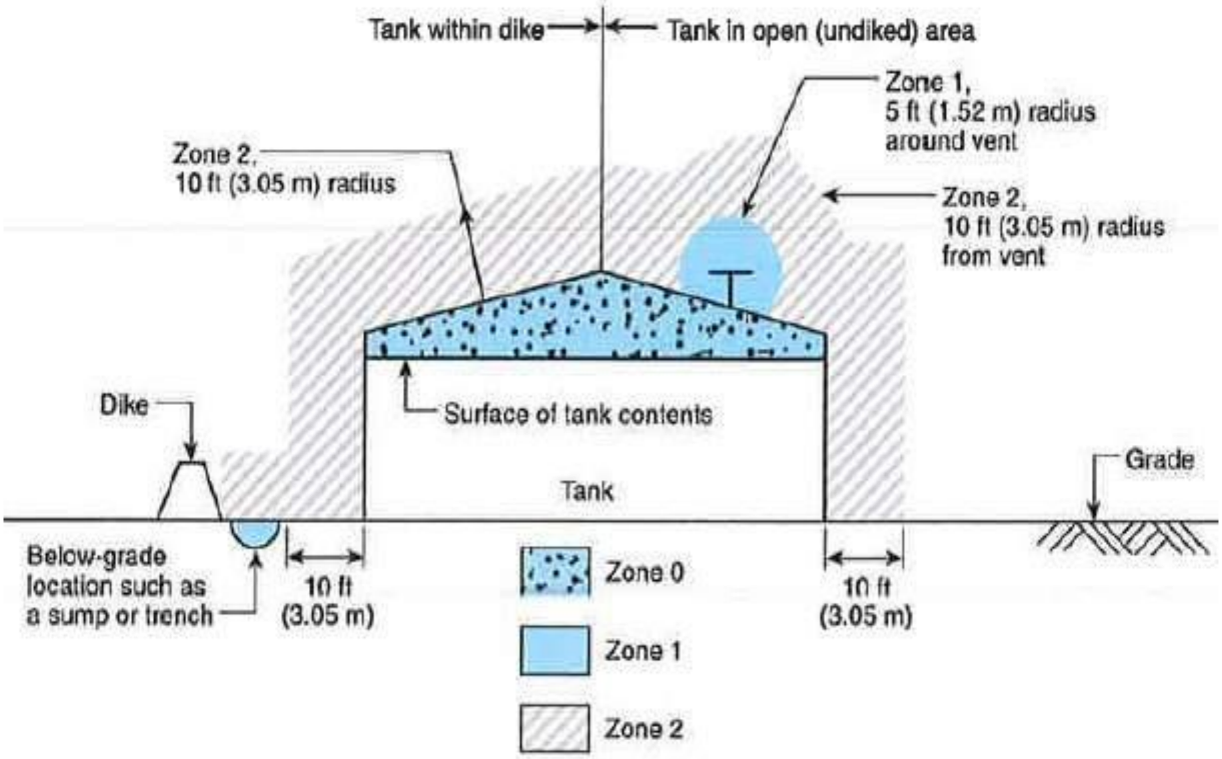
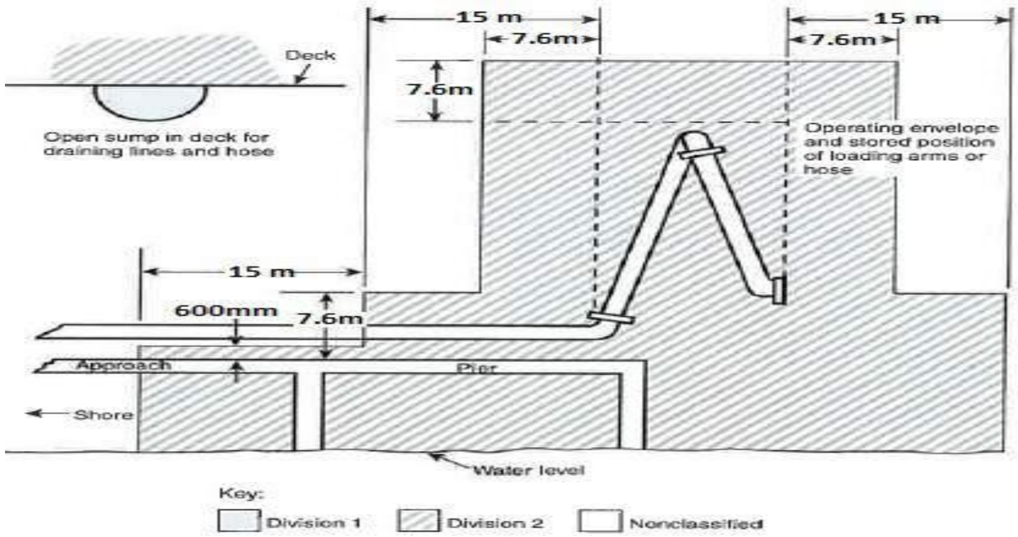


Figure 13.4.: Area Classification of any Above ground Tank– Zone System



(1) The "source of vapor" is the operating envelope and stored position of the outboard flange connection of the loading arm (or hose).
(2) The berth area adjacent to tanker and barge cargo tanks is to be Division 2 to the following extent:
(a) 25 ft (7.6 m) horizontally in all directions on the pier side from the portion of the hull containing cargo tanks.
(b) From the water level to 25 ft (7.6 m) above the cargo tanks at their highest position.
(3) Additional locations can be classified as required by the presence of other sources of flammable liquids on the berth, or by Coast Guard or other regulations.

Figure 13.5.: Area Classification of Marine Terminal

Table 13.1: General Requirements for Flammable and Combustible Liquid Storage

ITEM	REQUIREMENTS
5. ELECTRICAL INSTALLATIONS IN CLASSIFIED AREAS	i. Electrical Area Classification shall not be required for indoor liquid storage where all containers, intermediate bulk containers and portable tanks are sealed and are not opened. ii. Electrical area classification shall not be required for dispensing of quantities that do not exceed 0.5 L including but not limited to tinting of paints and coatings. iii. For liquid storage rooms that are totally enclosed within the building, electrical wiring and utilization equipment for Class I Liquid and Class II, Class III liquids heated at or above their flash points, shall be Class I, Division 2 (Zone 2). iv. For liquid storage rooms that are totally enclosed within the building, electrical wiring and utilization equipment for Class II and Class III Liquid storage shall be suitable for ordinary purpose. v. Class I, Division 1 electrical equipment and wiring must be used in the immediate vicinity of any points where ignitable vapor releases are expected, such as areas involving transfer operations.

6. IPING 6. PIPING	i. The design, fabrication, assembly, test and inspection of piping systems shall be suitable for working pressures and structural stresses to be encountered by the piping systems. ii. Liquid piping material, valves, faucets, couplings, flexible connectors, fittings and other pressure containing parts shall comply with ASME B31, Code for pressure Piping. iii. Piping system shall be maintained liquid tight. iv. Low melting point materials such as aluminum, copper, brass, plastics or non-ductile materials such as cast iron shall be permitted to be used underground within pressure and temperature limitations of ASME B31. v. Piping material shall be compatible with the liquids being handled. vi. Joints shall be designed and installed in liquid tight manner by welded flanged, threaded or mechanical attachment methods. vii. Class I liquid joint systems are recommended to be welded at all locations. viii. Flexible connectors shall be listed and approved in accordance with international test standards. ix. Pipe joints dependent upon the friction characteristics of combustible materials for mechanical continuity or liquid tightness of piping shall only be used outside of buildings and above ground. x. Piping systems shall be supported and protected against physical damage and stresses arising from settlement, vibration, expansion or contraction. xi. Load bearing piping supports located in high fire exposure risk shall be protected by fire resistive construction, fire resistant protective coatings or water spray systems etc. in accordance with API 2218, Fireproofing Practices in Petroleum and Petrochemical Processing Plants. xii. Above ground piping shall be protected with corrosion coatings xiii. Underground piping shall be protected for corrosion with coatings and Cathodic protection. xiv. Installation and Testing of Piping shall comply with NFPA 30, NFPA 30A and ASME B31.
7. VENTILATION	i. Ventilation for the rooms storing flammable and combustible materials shall be in accordance with Standard
8. SPILL CONTAINMENT AND DRAINAGE	i. The containment, drainage and spill control requirements apply to the storage of liquids in containers greater than 10bGal. (38L) stored in rooms and warehouses. ii. Storage areas shall be designed and operated to prevent the discharge of liquids to public waterways, public sewers, adjoining property or public ways. iii. Spill containment shall be achieved by any of the following. a. Noncombustible, liquid-tight raised sills, curbs or ramps of suitable height at exterior openings.

	b. Noncombustible, liquid-tight raised sills, curbs or ramps of suitable height, or other flow-diverting structures at interior openings. c. Sloped floors d. Open grate trenches for floor drains that are connected to a properly designed drainage system. e. Wall scuppers that discharge to a safe location or to a properly designed drainage system. iv. Emergency management procedure and emergency action plans shall address proper collection and disposal of spills/drains.

Table 13.1.b.: Separation of Incompatible Liquids

DANGEROUS GOODS	UN CLASS	REQUIREMENTS
1. Explosives	1.1	Must not be stored in the same room.
2. Flammable Gases	2.1	Must be separated by at least 5 meters.
3. Non-Flammable And Non Toxic Gases	2.2	Must be separated by at least 5 meters.
4. Toxic Gases	2.3	Must not be stored in the same room.
5. Flammable Solids	4.1	Must be separated by at least 5 meters
6. Substance Liable To Spontaneous Combustion	4.2	Must be separated by at least 5 meters
7. Substance Which In Contact With Water, Emits Flammable Gas	4.3	Must not be stored in the same room. It must be in separate room protected by alternative fire protection system
8. Oxidizing Substances	5.1	Must not be stored in the same room.
9. ORGANIC PEROXIDES	5.2	Must not be stored in the same room.
10. TOXIC SUBSTANCES	6.1	Must be separated by at least 5 meters.
11. INFECTIOUS SUBSTANCES	6.2	Special approval from various authorities is required.
12. RADIOACTIVE MATERIALS	7	Special approval from various authorities is required.
13. CORROSIVE SUBSTANCES	8	Must be separated by at least 5 meters.
14. MISCELLANEOUS HAZARDOUS	9	Must be separated by at least 3 meters.

Table 13.1: General Requirements for Flammable and Combustible Liquid Storage	
ITEM	**REQUIREMENTS**
9. OTHER REQUIREMENTS	i. Other requirements for flammable and combustible liquids such as but not limited to, Emergency venting of Above ground liquid storage tanks, Processes facilities and specific operations facilities using flammable and combustible liquids, Explosion protection, Emission mitigation etc. Shall be as per NFPA 30, NFPA 30A, IFC, API and relevant international codes and standards. ii. Fire Detection and Alarm System shall be provided for all the enclosed spaces and shall be in accordance with Chapter 4. Fire Detection and Alarm System. iii. All facilities storing above ground flammable and combustible liquids, either indoor or outdoor, shall be provided with Automatic Fire Protecting systems. Selection and design criteria of such Fire Protection System shall be in accordance with relevant tables of Chapter 6. Fire Protection Systems. iv. All facilities storing flammable and combustible liquids shall have required means of egress, travel distances, v. Fire extinguishers shall be provided throughout facilities soring flammable and combustible liquids in accordance with Chapter 3. Fire Extinguishers. vi. Adequate Hazard identification signs, Electrical Classification signs, signs for Health effects of hazardous materials shall be provided at all facilities storing, handling an dispensing flammable and combustible liquids.

2.4. Outdoor Tank Storage (Fixed Tank and Fixed System Tank)	
2.6.1. The storage of Flammable and Combustible Liquids in Tanks in any occupancies, indoor or outdoor shall comply with the general requirements of **Table 13.1. General Requirements,** This section and **Table 13.4. Storage of liquids in Tanks.** **2.6.2.** This section shall apply to "Fixed Tanks" of following capacity a. Fixed tanks that exceed 60 Gallons. (230 L) capacity. b. Portable tank that exceed 660 Gallons. (2500 L) capacity. c. Intermediate Bulk Containers that exceed 793 Gallons (3000 L) capacity. **2.6.3.** Any portable tanks not exceeding 660 Gal (2500 L) capacity and intermediate Bulk containers not exceeding 793 Gal (3000 L) capacity but are connected to a "fixed" system, closed or otherwise, shall comply with this section.	
Table 13.4.: Storage of Liquids in Outdoor Fixed Tanks	
ITEM	**REQUIREMENTS**
1. GENERAL	i. Storage of Class II and Class III liquids heated at or above their flash points shall follow the requirements for Class I Liquids. ii. Tanks shall be permitted to be of any shape, size or type provided they are tested, approved and listed for The purpose. iii. Metal tanks shall be welded, riveted and caulked, or bolted or constructed using combination of any of these methods. iv. Tanks designed and intended for above ground use shall not be used as underground tanks. v. Tanks designed and intended for underground use shall not be used as above ground tanks.
2. DESIGN AND CONSTRUCTION OF STORAGE TANKS	i. Tanks shall be of steel or other approved non-combustible material. ii. tanks constructed of combustible material shall be specifically approved and Listed for the type of liquid and type of storage method. iii. Unlined concrete tanks shall be permitted to be used for storing liquids that have a gravity of 40^0 API or heavier. iv. An engineering evaluation shall be made if the specific gravity of the liquid to be stored exceeds that of water or if the tank is designed to contain liquids at a liquid temperature below -18^0 C. iv. See Section 6. For tank material approvals and test standards.
3. VENTING	i. Storage tanks shall be vented to prevent the development of vacuum or pressure above 1 psi, above maximum operating pressure, that can distort the tank or exceed the rated design pressure. ii. Normal vents shall be at least as large as the largest filling or withdrawal connection, but in no case shall be less than 32 mm nominal inside diameter. iii. Normal vents shall be located above the maximum normal liquid level. iv. Normal venting shall be provided for primary tanks and each primary compartment of compartmented tanks.

	v. Vents shall be sized and designed and installed as per API Standard 2000. vi. For tanks equipped with vents that permit pressures to exceed a gauge pressure of 2.5 psi and for low pressure tanks and pressure vessels, the outlet of all vents and vent drains shall be arranged to discharge in a manner that prevents localized overheating of or flame impingement on any part of the tank if vapors from the vents are ignited. vii. Above ground storage tanks shall have emergency relief venting in the form of integral construction or a device that will relieve excess internal pressure caused by an exposure to fire.
4. CORROSION PROTECTION	i. Metal used to fabricate the tank shall be thick enough to compensate for internal corrosion expected during the design life of the tank or other approved means of corrosion protection shall be provided. ii. As external corrosion protection, all underground tanks shall be provided with Cathodic protection system that is properly engineered, installed and maintained as per international standards, unless listed and certified as corrosion resistant tank. iii. Where geographical area demands or where engineering analysis requires additional corrosion protection, an internal protection such as additional metal thickness and corrosion resistant coating and linings shall be provided for all tanks.
5. COMMISSIONING AND TESTING5. **5. COMMISSIONING AND TESTING**	i. All tanks, whether shop built or field welded, field erected, shall be tested before they are placed in service. ii. All tanks shall have permanent listing and approval standard marking on the tanks as evidence of compliance. iii. Permanent test records and test results shall be maintained by the owner. iv. Where static head of the bottom of the tank, when filled with liquid, exceeds 10 psi, the tank and its piping shall be hydrostatically pressure tested to a pressure equal to the static head of the liquid filled tank. v. Before the tank is placed in service, all leaks or deformations shall be corrected in an approved manner. vi. All above ground tanks and connections shall be tested for tightness after installation and before placed in service, in accordance with PEI RP200, Recommended Practice for installation of above ground storage systems for motor vehicle fueling and STI R931, Double wall AST Installation and Testing Instructions. vii. Underground tanks shall be tested for tightness at operating pressure with air, inert gas or water.

6. PERIODIC TESTING AND INSPECTION	i. Each tank shall be tested periodically as per manufacturer's instructions and as required by applicable standards to ensure the integrity of the tank. ii. Refer to NFPA 329, Recommended Practice for Handling Releases of Flammable and Combustible Liquids and Gases, for testing of underground tanks. iii. Refer to API 653, STI SP001, API 12R1 and API RP2350 for Tank Inspection, Repair, Alteration, and Reconstruction and overfill protection of storage tanks.

7. ABOVE GROUND STORAGE TANKS	**1. LOCATION** i. Tank location shall be such that it shall not jeopardize structures, property and lives of own or the neighbors. ii. Above ground storage tanks shall be spaced and installed in accordance with latest edition of PEI RP200, Recommended Practice for Installation of Above ground Storage Systems for Motor Vehicle Fueling. iii. The values in **Table 13.4.b.** and **Table 13.4.c.** shall be derived from the reference **Table 13.4.a.** iv. Location of above-ground storage tanks storing flammable and combustible liquids (Class I, Class II OR Class IIIA), other than Class III B, shall be in compliance with **Table 13.4.b.** v. Location of Above ground storage tanks storing Boil-Over Liquids and Unstable Liquids shall comply with **Table13.4.c.** vi. Dike subdivision criteria shall comply with **Table 13.4.e.** vii. Location of Above ground storage tanks storing Class III B liquids shall comply with Table **13.4.f.** viii. Minimum shell to shell separation between above-ground storage tanks shall be as per Table 13.4.g.

TANK CAPACITY IN GALLONS	MINIMUM DISTANCE FROM ANY BUILDING IN SAME PROPERTY AND FROM NEAREST PUBLIC WAY (A)	MINIMUM DISTANCE FROM PROPERTY LINE, INCLUDING OPPOSITE SIDE OF PUBLICWAY (B)
275 OR LESS	1.5 m	1.5 m
276—750	1.5 m	3 m
751– 12,000	1.5 m	4.5 m
12,001– 30,000	1.5 m	6 m
30,001– 50,000	3 m	9 m
50,001– 100,000	4.5 m	15 m
100,001– 500,000	7.6 m	24 m
500,001– 1,000,000	10.6 m	30 m
1,000,001– 2000,000	13.6 m	41 m
2,000,001– 3,000,000	16.6 m	50 m
3,000,001 OR MORE	18 m	53 m

TANK CAPACITY IN GALLONS	MINIMUM DISTANCE FROM ANY BUILDING IN SAME PROPERTY AND FROM NEAREST PUBLIC WAY (A)	MINIMUM DISTANCE FROM PROPERTY LINE, INCLUDING OPPOSITE SIDE OF PUBLICWAY (B)
275 OR LESS	1.5 m	1.5 m
276—750	1.5 m	3 m
751– 12,000	1.5 m	4.5 m
12,001– 30,000	1.5 m	6 m
30,001– 50,000	3 m	9 m
50,001– 100,000	4.5 m	15 m
100,001– 500,000	7.6 m	24 m
500,001– 1,000,000	10.6 m	30 m
1,000,001– 2000,000	13.6 m	41 m
2,000,001– 3,000,000	16.6 m	50 m
3,000,001 OR MORE	18 m	53 m

Table 13.4.b.: Location of Above ground Tanks for Liquids, Class I, Class II or Class IIIA			
TYPE OF TANK	**PROTECTION**	**MINIMUM DISTANCE IN METERS FROM ANY BUILDING IN SAME PROPERTY AND FROM NEAREST PUBLIC WAY**	**MINIMUM DISTANCE IN METERS FROM PROPERTY LINE,INCLUDING OPPOSITE SIDE OF PUBLICWAY**
1. FLOATING ROOF			
1.1. INTERNAL PRESSURE < 2.5 PSI	Exposure protection	1/6 X Diameter of Tank	0.5 X Diameter of Tank
	None	1/6 X Diameter of Tank	Diameter of Tank but not more than 53 m.
1.2. INTERNAL PRESSURE > 2.5 PSI	Exposure protection	1.5 X A **(Table 13.4.a.)** but not more than 7.6 m	1.5 X B **(Table 13.4.a.)** but not more than 7.6 m
	None	1.5 X A **(Table 13.4.a.)** but not more than 7.6 m	3 X B **(Table 13.4.a.)** but not more than 15 m
2. VERTICAL (WEAK ROOF TO SHELL)			
2.1. INTERNAL PRESSURE < 2.5 PSI	Foam System	1/6 X Diameter of Tank	0.5 X Diameter of Tank
	Exposure protection	1/3 X Diameter of Tank	Diameter of Tank
	None	1/3 X Diameter of Tank	2 X Diameter of Tank but not more than 106 m.
2.2. INTERNAL PRESSURE > 2.5 PSI	Exposure protection	1.5 X A **(Table 13.4.a.)** but not more than 7.6 m	1.5 X B **(Table 13.4.a.)** but not more than 7.6 m
	None	1.5 X A **(Table 13.4.a.)** but not more than 7.6 m	3 X B **(Table 13.4.a.)** but not more than 15 m
3. HORIZONTAL/VERTICAL TANKS WITH RELIEF VENTING			
1. FLOATING ROOF			
1.1. INTERNAL PRESSURE < 2.5 PSI	Exposure protection	1/6 X Diameter of Tank	0.5 X Diameter of Tank
	None	1/6 X Diameter of Tank	Diameter of Tank but not more than 53 m.
1.2. INTERNAL PRESSURE > 2.5 PSI	Exposure protection	1.5 X A **(Table 13.4.a.)** but not more than 7.6 m	1.5 X B **(Table 13.4.a.)** but not more than 7.6 m
	None	1.5 X A **(Table 13.4.a.)** but not more than 7.6 m	3 X B **(Table 13.4.a.)** but not more than 15 m
2. VERTICAL (WEAK ROOF TO SHELL)			
2.1. INTERNAL PRESSURE < 2.5 PSI	Foam System	1/6 X Diameter of Tank	0.5 X Diameter of Tank

	Exposure protection	1/3 X Diameter of Tank	Diameter of Tank
2.2. INTERNAL PRESSURE > 2.5 PSI	None	1/3 X Diameter of Tank	2 X Diameter of Tank but not more than 106 m.
	Exposure protection	1.5 X A **(Table 13.4.a.)** but not more than 7.6 m	1.5 X B **(Table 13.4.a.)** but not more than 7.6 m
	None	1.5 X A **(Table 13.4.a.)** but not more than 7.6 m	3 X B **(Table 13.4.a.)** but not more than 15 m
3. HORIZONTAL/VERTICAL TANKS WITH RELIEF VENTING			
3.1. INTERNAL PRESSURE < 2.5 PSI	Foam System	0.5 X A **(Table 13.4.a.)**	0.5 X A **(Table 13.4.a.)**
	Exposure protection	A **(Table 13.4.a.)**	B **(Table 13.4.a.)**
	None	A **(Table 13.4.a.)**	2 X B **(Table 13.4.a.)**
3.2. INTERNAL PRESSURE > 2.5 PSI	Exposure protection	1.5 X A **(Table 13.4.a.)** but not more than 7.6 m	1.5 X B **(Table 13.4.a.)** but not more than 7.6 m
	None	1.5 X A **(Table 13.4.a.)** but not more than 7.6 m	3 X B **(Table 13.4.a.)** but not more than 15 m
4. FIRE RESISTANT ABOVE GROUND TANK			
4.1. INTERNAL PRESSURE < 2.5 PSI		0.5 X A **(Table 13.4.a.)**	0.5 X B **(Table 13.4.a.)**
4.2. INTERNAL PRESSURE > 2.5 PSI		1.5 X A **(Table 13.4.a.)** but not more than 7.6 m	3 X A **(Table 13.4.a.)** but not more than 15 m

Table 13.4.c.: Location of Above ground Tanks for Boil-Over Liquids and Unstable Liquids			
1. FLOATING ROOF			
1.1. BOIL-OVER LIQUID	Exposure protection	1/6 X Diameter of Tank	0.5 X Diameter of Tank
	None	1/6 X Diameter of Tank	Diameter of Tank
2. FIXED ROOF			
2.1. BOIL-OVER LIQUID	Foam System	1/3 X Diameter of Tank	Diameter of Tank
	Exposure protection	1/3 X Diameter of Tank	2 X Diameter of Tank
	None	2/3 X Diameter of Tank	4 X Diameter of Tank but not more than 106 m.
3. HORIZONTAL/VERTICAL TANKS WITH RELIEF VENTING OF INTERNAL PRESSURE < 2.5 PSI			
3.1. UNSTABLE LIQUID	Foam System	Not less than 7.6 m	B **(Table 13.4.a.)** but not more than 7.6 m
	Exposure protection	Not less than 15 m	2.5 X B **(Table 13.4.a.)** but not more than 15 m
	None	Not less than 30 m	5 X B **(Table 13.4.a.)** but not more than 30 m
4. HORIZONTAL/VERTICAL TANKS WITH RELIEF VENTING OF INTERNAL PRESSURE > 2.5 PSI			
4.1. UNSTABLE LIQUID	Foam System	Not less than 15 m	2 X B **(Table 13.4.a.)** but not more than 15 m
	Exposure protection	Not less than 30 m	4 X B **(Table 13.4.a.)** but not more than 30 m
	None	Not less than 45 m	8 X B **(Table 13.4.a.)** but not more than 45 m

Table 13.4.: Storage of Liquids in Outdoor Fixed Tanks	
ITEM	**REQUIREMENTS**
7. ABOVEGROUND STORAGE TANKS	**2. OPEN DIKE OR BUND** i. Dike shall be constructed to provide containment around the tank or group of tanks. ii. Dike shall be sized to hold 110% of volume of largest tank within the dike, excluding the volume of other tank(s) within the dike. iii. Minimum clear space of 3 meters shall be maintained all around the dike. iv. The dike wall shall be minimum half diameter away from the tanks contained within the dike. v. Construction of dike wall shall be with concrete, solid masonry or steel, designed to be liquid tight and to withstand hydrostatic head by released tank content. vi. The height of Diked areas for tanks containing Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100oF (37.8°C), located in extremely porous soils may require special treatment to prevent seepage of hazardous quantities of liquids to low lying areas or waterways in case of spills the walls of earthen dikes shall be restricted to an average interior height of six feet above interior grade. (4) Dikes may be higher than an average of six feet above interior grade where provisions are made for normal and necessary emergency access to tanks, valves and other equipment, and safe egress from the diked enclosure. vii. Dike shall be provided with drain arrangements to remove the firefighting agent, water with uniform slop of 1% away from the tank towards the sump. viii. Dike containing two or more tanks shall be subdivided by intermediate drain or dikes as per type of tanks and their quantities mentioned in **Table 13.4.e.** ix. Subdivision shall be intermediate drain or minimum ½ m high intermediate dike. Main dike height shall be minimum of intermediate dike. x. The aggregate capacity subdivision requirement shall exclude the individual tank subdivision. xi. For example, Volume of the tank $V = \pi d^2 h/4$, Required Volume of Dike = L X B X H Where, V-Volume of the tank, d-diameter of the tank, h– height of the tank L-length of the dike, B-Breadth of the dike, H-height of the dike $V=20{,}016\ m^3$, Volume of Dike = Minimum 100.1 m x 100 m x 2 m

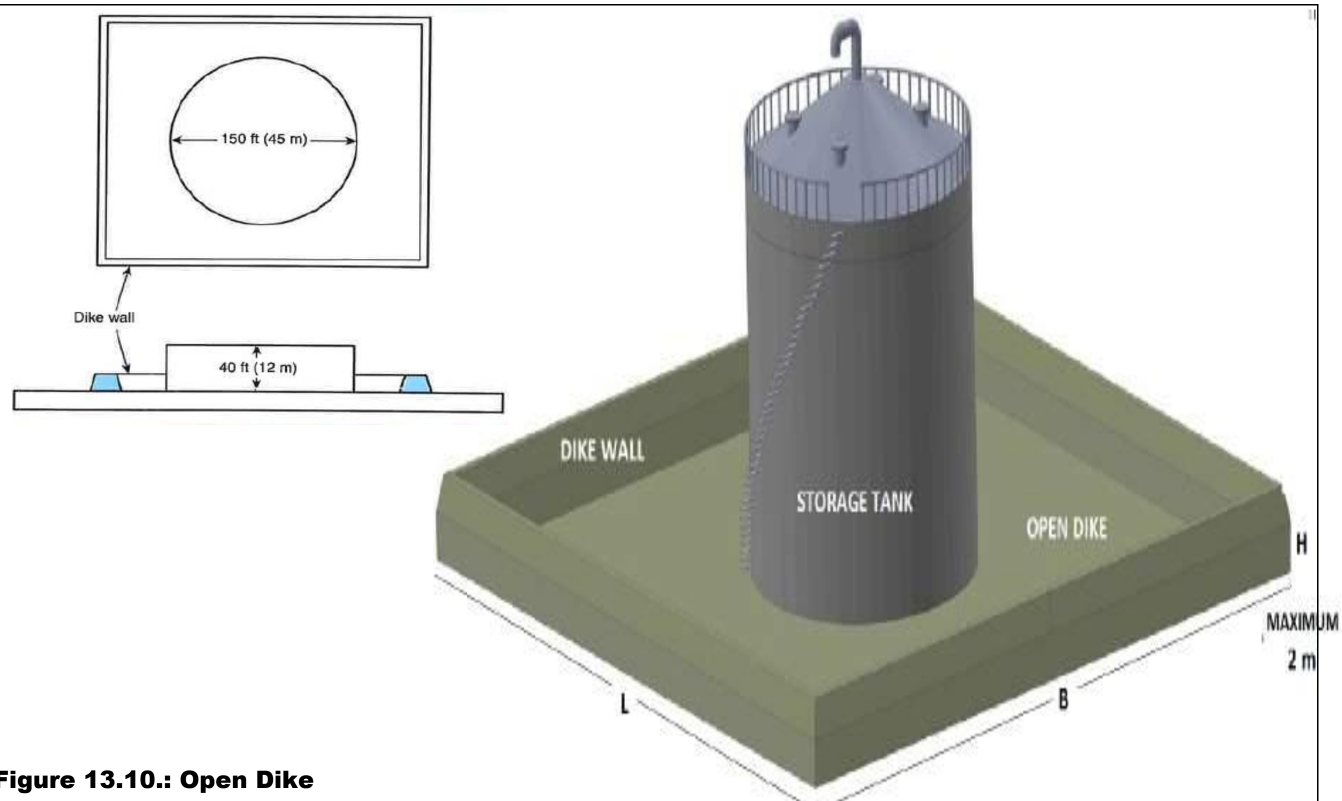


Figure 13.10.: Open Dike

Table 13.4.: Storage of Liquids in Outdoor Fixed Tanks		
TANK CAPACITY IN GALLONS	STABLE LIQUID	CLASS I AND UNSTABLE LIQUID
1. INDIVIDUAL TANK	**INDIVIDUAL CAPACITY**	
1.1. WEAK SEAM ROOF TANK	OVER 420,000 Gal. (1,590 m^3)	Irrespective of capacity
1.2. VERTICAL CONE ROOF TANK	OVER 100,000 Gal. (380 m^3)	Irrespective of capacity
1.3. HORIZONTAL TANK, OVER	OVER 100,000 Gal. (380 m^3)	Irrespective of capacity
2. GROUP OF TANKS	**AGGREGATE CAPACITY**	
2.1. WEAK SEAM ROOF TANK	OVER 630,000 Gal. (2.390 m^3)	Irrespective of capacity
2.2. VERTICAL CONE ROOF TANK	OVER 150,000 Gal. (570 m^3)	Irrespective of capacity
2.3. HORIZONTAL TANK, OVER	OVER 150,000 Gal. (570 m^3)	Irrespective of capacity

Table 13.4.f.: Location of Above ground Tanks for Class IIIB Liquids		
TANK CAPACITY IN GALLONS	MINIMUM DISTANCE IN METERS FROM ANY BUILDING IN SAME PROPERTY (A)	MINIMUM DISTANCE IN ME-TERS FROM PROPERTY LINE, IN-CLUDING OPPOSITE SIDE OF PUBLICWAY (B)
12,000 OR LESS	1.5 m	1.5 m
12,001– 30,000	1.5 m	3 m

30,001– 50,000	3 m	3 m
50,001– 100,000	3 m	4.5 m
100,001 OR MORE	4.5 m	4.5 m

Table 13.4.g.: Minimum Shell to Shell Separation Distance between Storage Tanks

TYPE OF TANK	TANK DIAMETER	CLASS I OR CLASS II LIQ-	CLASS III A LIQUIDS
1. FLOATING ROOF			
	Less than or equal to 45 m	1/6 X Sum of adjacent tank Diameters but not less than 1m	1/6 X Sum of adjacent tank Diameters but not less than 1m
	More than 45 m With Remote Im-pounding	1/6 X Sum of adjacent tank Diameters	1/6 X Sum of adjacent tank Diameters
	More than 45 m With Open Diking	1/4 X Sum of adjacent tank Diameters	1/4 X Sum of adjacent tank Diameters
2. FIXED OR HORIZONTAL			
	Less than or equal to 45 m	1/6 X Sum of adjacent tank Diameters but not less than 1m	1/6 X Sum of adjacent tank Diameters but not less than 1m
	More than 45 m With remote Im-pounding	1/4 X Sum of adjacent tank Diameters	1/6 X Sum of adjacent tank Diameters
	More than 45 m With Open Diking	1/3 X Sum of adjacent tank Diameters	1/4 X Sum of adjacent tank Diameters

Table 13.4.: Storage of Liquids in Outdoor Fixed Tanks	
ITEM	**REQUIREMENTS**
	4. TANK SHELL TO SHELL SEPARATION i. Above ground tanks storing Class I, Class II or Class IIIA stable liquids shall be Separated from shell to shell as per Table 13.4.f. ii. The minimum spacing for stable and Class III B liquids shall be 1 m. iii. Horizontal tanks shall be treated as fixed roof tanks for separation calculations. iv. Diameter of one tank shall be added to the diameter of adjacent tank to get sum of adjacent tank diameters', where there are two tanks. v. Where there are multiple tanks adjacent to each other, diameters of two adjacent tanks shall be added to get the 'sum of adjacent tank diameters' which is the required separation distance. For example, in Figure 13.12., a. Separation distance, D12= Diameter of tank 1+ Diameter of tank 2. b. Separation distance, D24= Diameter of tank 2+ Diameter of tank 4. vi. Minimum horizontal separation between an LPG container, other than 125 Gal capacity and Class I, Class II or Class IIIA liquid tank, other than 660 Gal., shall not be less than 6 m. vii. Where flammable and combustible liquid storage tanks are within a diked area, the LPG containers, if any, shall be outside the diked area and at least 1 m away from the center line of the wall of the diked area. viii. If a tank storing Class I, Class II or Class IIIA liquid operates at pressures exceeding a gauge pressure of 2.5 psi or is equipped with emergency relief venting that will permit pressures to exceed 2.5 psi, it shall be separated from LPG container by distance as per Table 13.4.f.

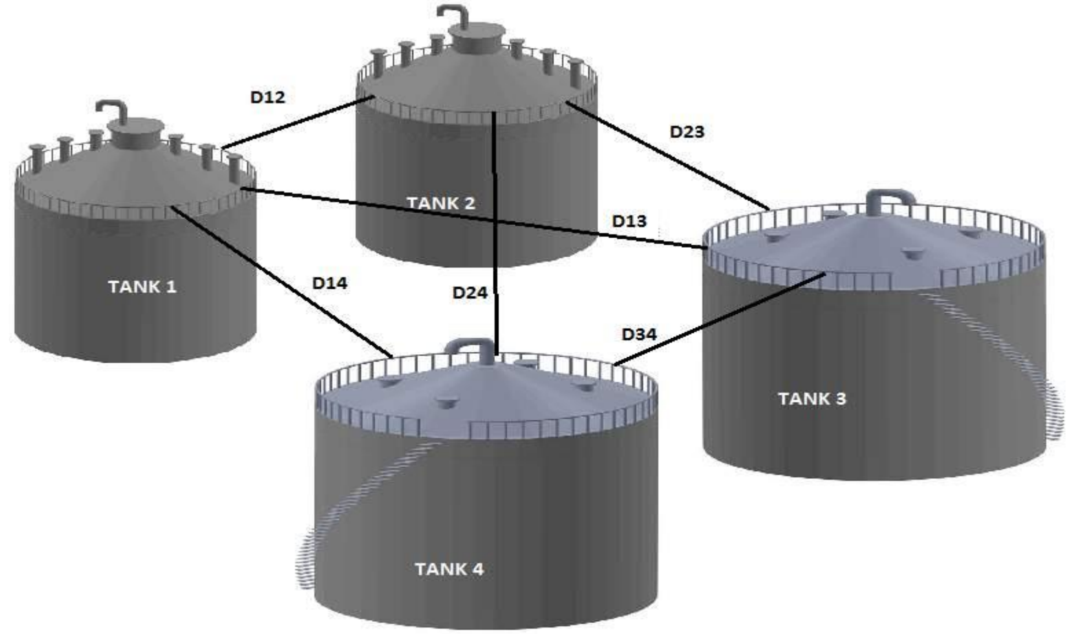


Figure 13.12.: Shell to Shell Tank Separation

4. Operational Requirements :

4.1. The operational safety related to flammable and combustible liquid storage, handling and usage and management methodology used to identify, evaluate and control hazards shall comply with **Table 13.10.**

Table 13.10.: Operational Requirements

ITEM	REQUIREMENTS
1. GENERAL	i. The fire protection system shall be maintained in proper operating condition, in accordance with design intent. ii. The quantity and quality of the water supply and extinguishing agents, if any, shall be continuously monitored in accordance with **Chapter 9** and manufacturer's recommendations and approved design basis. iii. Permanent connections between fire water system and process system shall be prohibited. iv. The emergency management system shall be established and maintained in accordance with **Section 5.** v. Maintenance and operational procedures shall be established and implemented to control leakage and prevent spillages. vi. Combustible waste materials and residues in operating areas shall be kept to a minimum, stored in covered metal container and disposed of daily. vii. Aisles established for movement of personnel shall be clearly marked and shall not be obstructed.

2. HAZARD ANALYSIS	i. All operation involving flammable and combustible liquid or aerosol shall be reviewed on continuous basis to ensure fire and explosion hazards are addressed by fire prevention, fire control and emergency management procedures. The evaluation shall include but not limited to following. a. Analysis of fire and explosion hazard of the operation. b. Analysis of emergency relief from process vessels. c. Analysis of applicable facility design requirements. d. Analysis of applicable requirements for liquid handling, transfer, and use. e. Analysis of local conditions such as exposure to and from adjacent properties and other possible natural calamities. f. Analysis of the compatibility and response from all emergency services and mutual aids. ii. Such hazard analysis shall be revisited and reviewed whenever there are changes in the premises, changes in conditions, such as, but not limited to, a. When major change takes place in management of the facility. b. When change occurs in the materials involved in the process. c. When changes occurs in the process, process controls and related equipment. d. When changes occur in operation procedures. e. When notable change occur in the property and nearby property constructions. f. When changes occur in emergency management procedures.
3. HOTWORK AND CONTROL OF IGNITION	i. Precaution shall be taken to prevent the ignition of liquids or aerosol and related flammable vapors due to sources such as open flames, lighting, hot surface, radiation heat, smoking, fabrication, friction, static electricity and stray current. ii. Smoking shall be permitted only in designated areas. iii. Proper hot work permit system shall be established and implemented. iv. All metallic equipment such as tanks, machineries, and piping shall be properly bonded and grounded.
4.EMERGENCY PREPAREDNESS	i. An approved means for prompt notification of fire or emergency to emergency team within plant, to relevant authority and Civil Defence shall be established and properly maintained. ii. Following methods shall be used for monitoring as appropriate: a. Personnel observation and patrolling. b. Process monitoring equipment to measure abnormality in pressure and temperature parameters and possible spill or leakage that could occur. c. Provision of gas detectors to continuously monitor the area where facility is unattended. d. Provision of Fire detection and alarm system. iii. The fire protection system must be maintained in proper operating condition in-line with design intent.

	iv. The quantity and quality of the water supply and extinguishing agents (where used) shall be continuously monitored in line with engineering standards and manufacturer's recommendation. Permanent connection between fire water system and any process system must be prohibited. v. Emergency management system and preparedness procedures must be established and maintained. vi. Maintenance and operational procedures must be established and implemented to control leakage and prevent spillages. vii. Combustible waste materials and residues in operating area shall be kept to a minimum, stored in covered metal containers and disposed of daily. viii. Aisles established for movement of personnel and emergency responders, fire access etc. shall be clearly marked and shall not be occupied or obstructed. ix. Proper management methods used to identify, evaluate and control the security hazard involved in the processing and handling liquids and aerosols must be established and implemented. This includes but not limited to sabotage and other malicious attacks.

5 . Emergency Management System (EMS)

5.1. The Emergency Management System (EMS) must be established in accordance with **Table 13.11.**

Table 13.11.: Emergency Management System (EMS)

ITEM	REQUIREMENTS
1. EMS	i. Plans and corresponding response procedures that will ensure preparedness to handle following scenarios. a. Fire / Explosion b. Spillage c. Occupant Evacuation d. All other emergency that are expected. ii. EMS shall address following as minimum: a. Emergency management roles and responsibilities b. Risk based emergency scenarios c. Emergency Actions d. Emergency Evacuation Plans e. List of available resources f. Communication plan and procedures

	g. Periodic tests, drills and exercise requirements h. Monitoring and review of EMS. iii. Emergency scenarios shall be some or all of the following as applicable to the facility: a. Natural hazards such as flood, lightening, earth quakes etc b. Spillage c. Fire. iv. Designate personnel as part of Emergency Response Management Team (ERMT) to manage the emergency situation. Such individuals shall be: a. competent and qualified to their assigned roles b. Trained and equipped to preform safely their assigned work. c. Knowledgeable of the risk and their possible solutions. v. Identify specific roles and responsibilities of each member of the ERMT vi. Emergency management system shall provide all activities, from the notification of an emergency incident, through incident stabilization, up to the recovery from the impact of the incident. It shall be addressed for each of the emergency scenario. vii. Emergency Reporting Procedure and Communication Plan shall be established. This shall be coordinated with Civil Defense where required. These shall consist of the following information: a. Information about the Alarm system other Emergency Communication facilities b. Emergency contact details of the facility c. Procedure for the dissemination of relevant Information d. Procedure for Reporting of incidents and outcomes. viii. Emergency Evacuation Plan shall be prepared which includes: a. Emergency personnel in charge, including their duties b. Escape Routes, Exit maps and Diagrams. **, Table 5.1.8** c. Procedures for evacuation d. Location of fire –fighting equipment e. Assembly Points. ix. Ensure that the employees, especially the emergency personnel are trained and certified in the use of Fire-fighting equipment through an approved training institution. x. Conduct Mock-up Drills and Exercises (Emergency Actions and Evacuation) in order to: a. Evaluate the Emergency Management Program b. Test or validate the procedures or plans and identify its deficiencies c. Clarify roles and responsibilities d. Validate training and education of the appointed emergency personnel xi. Emergency Plans and procedures shall be reviewed periodically to ensure applicability to the current condition of the facility and its operation.

6. Flammable and Combustible Liquid Storage Material Test Standards and Approvals.

6.1. 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 the Civil Defence and Approval Department.

6.1.2. There is no year of edition mentioned against any test standards. 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 Above ground 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 above ground 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.

Fire Protection Systems

In this Chapter:

- Details of various Fire Protection Systems
- Application of Fire Protection Systems
- Design criteria for various hazards
- Inspection and Maintenance of Fire Systems

Intent of the Chapter:

- To provide protection for life and property from fire through Fire Protection Systems such as Standpipes, Hydrants, Sprinkler systems and other types of fire suppression systems.
- To ensure properly designed Fire systems and adequate quantity of water is available for Fire Fighters.
- To ensure Fire systems are designed, installed, Inspected and maintained as per international standards

1. General

1.1. The provision of Fire Protection systems is to provide automatic as well as manual approach to extinguish fires. Along with their Firefighting equipment, Civil Defense Fire- fighters also utilize Fire Protection Systems installed in occupancies, to manually fight fires thereby protecting the property and lives of people. Thus a well-designed and well-functioning Fire Protection System in any occupancy is very important. Fire Protection or Fire Extinguisher can be achieved with various techniques and mechanisms. However,basically the concepts behind all the extinguishing measures are one or more of the following:

- Physically separate the combustible material from the flame
- Removing or Reducing the Oxygen supply
- Reducing temperature of the combustible or the flame
- Introducing the chemicals that modify the combustion chemistry

1.2. This section of the code deals with the requirements for application, design, installation and maintenance of following types of internationally accepted and approved Fire Protection Systems.

- Water Based Fire Protection Systems
- Gas and Chemical Based Fire Protection Systems
- Other types of Fire Extinguishers, Extinguishing Agents, Extinguishing methods and mechanisms which are not part of this code shall obtain approval from Civil Defense.

2. Definitions

2.1. Water Based Fire Protection Systems

2.1.1. Water is the most widely used and available fire-extinguishing agent. Water is inexpensive, abundant (See 2.1.2), and 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 suchas Standpipe System, Automatic Sprinkler Systems, Water Spray Systems, Water MistSystems, Fire Hydrant Systems, and Foam Systems etc.

2.2. Gas and Chemical Based Fire Protection Systems

2.2.1. 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.

2.3. Standpipe Systems

2.3.1. The vertical portion of the Water Based Fire Protection system piping that delivers the water supply for Hose connections (and sprinklers in 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.

2.3.2. Two types of Standpipe Systems are approved by the Civil Defence based on the building specifications and floor areas. One is Dry Type Standpipe Systems and second is Wet Type Standpipe Systems. These standpipe systems are further categorized into Class I, Class II and Class III Standpipe Systems.

2.3.3. Combined Standpipe Systems with a common riser providing water supply to both hose connections as well as Sprinkler systems are not allowed by Civil Defence.

2.4. Dry Standpipe Systems or Dry Riser System

2.4.1. Dry riser systems are normally dry without permanent water connection to it and depend on the Civil Defense 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 and connected to the 65mm diameter landing (Fire Department) valve outlets coupled or uncoupled with 65mm diameter, 30 m long re-in forced rubber lined (RRL) hose with multipurpose hose nozzle that are placed inside a cabinet for the use of Civil Defence Department personnel or other trained firefighting personnel.

2.5. Wet Standpipe Systems or Wet Riser System

2.5.1. 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 Civil Defence department personnel or other trained firefighting personnel. In addition four way breeching inlets located at ground level are connected to bottom of the wet riser to pump water from the Civil Defence fire truck as supplementary water supply.

2.6. Fire Hose Reel System

2.6.1. Fire hose reel systems are also normally pressurized with water having permanent water supply from fire water pumps and fire water storage tanks. Fire hose reel system comprises of one or multiple vertical riser pipes or horizontal runs of piping that are connected to the 25 mm dia bore, 30 m long fire hose reels located at all the floors. System includes permanent fire pumps and fire water tanks.

2.7. Fire Hose Rack System

2.7.1. Fire hose rack systems are also normally 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 bore, 30 m long fire hose, folded vertically and attached over the pins in an approved manner and located at all the floors. System includes permanent fire pumps and fire water tanks.

2.8. Class I System

2.8.1. Class I systems comprises of 65 mm diameter Landing Valve outlets coupled or uncoupled with 65mm diameter, 30 m long re-in forced rubber lined (RRL) hose with multipurpose hose nozzle for the use of Civil Defence department personnel or other trained firefighting personnel.

2.9. Class II System

2.9.1. Class II systems comprises of 25 mm diameter bore for Hose Reel System or 40 mm diameter bore for Hose Rack System, 30 m long dual reinforced rubber hose 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 Civil Defence fire fighters.

2.10. Class III System

2.10.1. Class III system is a combination of both Class I & Class II systems for the use of occupants and as well as Civil Defence use. In general the class I system equipment's are installed in lower level or compartment and class II system equipment's in upper level or compartment of a cabinet.

2.10.2. Alternatively, because of the multiple use, class III stand pipe system comprising 65 mm diameter landing valve with 65 mm x 40 mm easily removable adapter and coupled with 40 mm diameter, 30 m long fire hose and nozzle may be permitted as a special cases.

2.11. Automatic Sprinkler System

2.11.1. The sprinklers are the devices which consist of an orifice to discharge water is normally closed by a disc or cap held in place by temperature sensitive element such as fusible link or quartz bulbs. Convicted heat from a fire causes operation of one or more thermally sensitive sprinklers, thereby permitting water to be discharged directly over the fire affected area. A typical sprinkler system consists essentially of a piping network, connected to a permanent water supply and control valves feeding automatic water sprinklers spaced regularly throughout the protected premises, incorporating local and fire department service alarms.

2.12. Water Spray System

2.12.1. Similar to automatic Sprinkler system, it is an automatic or manually actuated fixed piping network system connected to a fixed water supply and equipped with water spray nozzles designed to provide a specific water discharge and distribution over the protected surfaces or area.

2.13. Water Mist System

2.13.1. Similar to Automatic Sprinkler System, water mist system is an automatic or manual fire protection system connected to a fixed water supply network and using special spray nozzles discharging very fine water sprays (i.e., water mist). The water discharged to produce small particles of water (mist effect) which absorbs heat, displaces oxygen, or blocks radiant heat in order to control or suppress fire in an environment where water damage and water quantity is a concern. Water-mist systems are available in both High Pressure & Low Pressure versions. Water-mist systems can also be used as alternatives to sprinkler systems in certain applications.

2.14. Fire Hydrant System

2.14.1. Fire Hydrant is an exterior valve connection to water supply that provides one or more hose connections. As a system it is a water supply piping network system having one or more outlets and that is used to supply hose and fire department pumpers with water on private property. Where connected to a public water system, the private hydrants are supplied by a private service main that begins at the point of service, usually at a manually operated valve near the property line.

2.14.2. Fire Hydrant system can also be a Fire Hydrants distributed through piping network with permanent Water Tank and Pumps for the pressurized water supply which is normally a requirement for private property protection without public water system.

2.15. Foam System

2.15.1. 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. A fixed Foam system is a complete installation in which foam concentrate and water are mixed in foam station thus creating required foam which then is piped from foam station, discharging through fixed delivery outlets to the hazard to be protected with permanently installed pumps where required.

2.15.2. Foam system can also be mobile with 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.

2.16. Clean Agent System

2.16.1. Clean Agents are essentially the fire extinguishing agents which are electrically non-conducting, vaporize readily and leave no residue upon evaporation. Clean agents are Halon replacements which are broadly classified into two categories. Halocarbon compounds such as Hydrobromofluorocarbons (HBFC), Hydro-fluorocarbons (HFC), Hydrochlorofluorocarbon (HCFC), per fluorocarbons (FC or PFC) and Fluoroiodocarbons (FIC). Fluoroketone (FK), Inert Gases such as Nitrogen and Argon or blends of these gases.

2.16.2. See V. COMMITMENT TO BEST PRACTICE, section 2. ENVIRONMENTAL MANAGEMENT and SUSTAINABILITY on ‘Acceptable and Approved Clean Agent Systems’

2.16.3. All clean agent systems should be listed in NFPA 2001, latest version and designed in accordance with this standard.

2.16.4. These Clean agents can be either discharged as ‘Total Flooding’ which is the act and mechanism of discharging agent through distribution piping network and through nozzles for the purpose of achieving a specified minimum agent concentration throughout a hazard to extinguish fire OR can be discharged as ‘Local Application’ where a system consisting of a supply of Clean agent arranged to discharge directly on the burning material.

2.17. Carbon Dioxide (CO2) System

2.17.1. Carbon Dioxide is a nonconductive gas which extinguishes fire by Oxygen Reduction principle. This can be achieved through various mechanisms such as Automatic Total flooding, local application and Manual Hose lines. Total flooding is supply of carbon dioxide arranged with storage tank, piping distribution and nozzles to discharge into, and fill to the proper concentration, an enclosed space or enclosure around the hazard. Similarly Local application is discharging CO2 directly on the burning surface. Manual hose lines consist of a hose and nozzle assembly connected by fixed piping network and CO2 storage tank or connected directly to a supply of CO2. CO2 system should be applied for the protection of unmanned areas.

2.18. Dry Chemical System

2.18.1. Dry Chemical is a powder composed of very small particles, usually sodium bicarbonate-, potassium bicarbonate-, or ammonium phosphate-based with added particulate material supplemented by special treatment to provide resistance to packing, resistance to moisture absorption (caking), and the proper flow capabilities. Dry chemical has Oxygen reduction, Cooling and Radiation Shielding properties which is used to extinguish fires by various automatically and manually operating mechanisms such as total flooding, Local application, and Hand Hose line.

2.19. Wet Chemical System

2.19.1. Wet Chemical normally is an aqueous solution of organic or inorganic salts or a combination thereof that forms an extinguishing agent with Oxygen reducing and cooling properties. This agent is then discharged through piping or tubing network triggered by expellant gas pressure.

3. Application

3.1. Building Classification and Application of Fire Protection Systems

3.1.1. Abbreviations below are used to guide through the selection and application of Fire Protection Systems in the following sections of this code.

DRS Dry Riser System
WR Wet Riser System
FHR Fire Hose Reel System
AS Automatic Sprinkler System
PAS Pr-action Sprinkler System
WSS Water Spray System
WMS Water Mist System
YFH Yard Fire Hydrant System
FSS Foam Sprinkler System
FIS Foam Injection System
DCS Dry Chemical System
WCS Wet Chemical System
CAS Clean Agent System
CDS Carbon Dioxide System
FM Foam Monitor
FE Portable Fire Extinguisher

3.2. Non-industrial and Non-storage occupancies

3.2.1. All occupancies with more than 20,000 m^2 plot area, usually with cluster of all types of buildings shall be provided with Yard Fire Hydrant Systems with dedicated Fire Pump set and water tank.

3.2.2. The selection of Fire Protection Systems for Non-Industrial and Non Storage occupancies shall be as per Table 9.1.

3.2.3. Auxiliary occupancies such as Electrical rooms, Telephone Rooms, Generator Rooms, Anesthetizing Rooms, Laboratories etc., connected with and part of the primary or predominant occupancies shall comply with the requirements of Table 9.2.

3.3. Industrial occupancies

3.3.1. All Industrial premises more than 3600 m^2 plot area shall be provided with Yard Fire Hydrant Systems.

3.3.2. All Industrial occupancies having more than 3 floors above Fire Access Level shall be fully protected with Automatic Sprinkler System. In such occupancies, where application of water as extinguishing medium is not appropriate due to the water reactive material presence, a suitable other extinguishing system and method shall be proposed.

3.3.3. All High Hazard Industrial occupancies where gasoline and other flammable liquids are handled, used, or stored under such conditions that involve possible release of flammable vapors; where grain dust, wood flour or plastic dust, aluminum or magnesium dust, or other explosive dusts are produced; where hazardous chemicals or explosives are manufactured, stored, or handled; where materials are processed or handled under conditions that might produce flammable flying; and where other situations of similar hazard exist in manufacturing, processing, extracting, coating and treating activities are held and the industries identified in Table 9.3, a Fire risk analysis report of the facility, approved Fire Consultant shall be furnished for Civil Defence authority's jurisdiction.

3.3.4. Fire Protection System for Industrial Occupancies shall be as per Table 9.3.

3.4. Storage occupancies

3.4.1. All Storage occupancies with premises more than 3600 m2 plot area shall be provided with Yard Fire Hydrant Systems.

3.4.2. Storage occupancies having more than 3 floors above Fire Access Level shall be fully protected with Automatic Sprinkler System. In such occupancies, where application of water as extinguishing medium is not appropriate due to the water reactive material presence, a suitable other extinguishing system and method shall be proposed.

3.4.3. All Storage occupancies where Explosives and Flammable solids, liquids and gases are stored, a Fire risk analysis report prepared by Fire Consultant approved Civil Defense, complete with material data sheet and specifications, method of storage details shall be furnished for Civil Defence authority's jurisdiction.

3.4.4. Selection of Fire Protection System for Storage Occupancies shall be as per Table 9.4.

Table 9.1: Building Classification and Application of Fire Protection Systems								
LOCATION	LARGEST FLOOR / SINGLE LARGEST COMPARTMENTAREA LESS THAN OREQUAL TO 900 M^2	LARGEST FLOOR / SINGL LARGEST COMPARTMENTAREA MORE THAN900 M^2	LOW DEPTH UNDERGROUND BUILDING WITH LESS THAN OR EQUALTO 2 BASEMENTS AND BASEMENT AREA LESS THAN OR EQUAL TO 900 M^2	HIGH DEPTH UNDERGROUND BUILDING WITH MORE THAN 2 BASEMENTS OR BASEMENTAREA MORE THAN 900 M^2	LOWRISE BUILDING WITH HEIGHT LESS THAN OR EQUAL TO 15 M	MIDRISE BUILDING WITH HEIGHT 15 M TO 23 M	HIGHRISE BUILDING WITH HEIGHT MORE THAN 23 M	SPRINKLER SYSTEM IS REQUIRED IFFOLLOWINGCONDITION EXISTS (See Chapter 1, Table 1.7 for reference)
ANIMAL HOUSING	DRS	WRS	DRS AS	WRS AS	DRS	WRS AS	WRS AS	Total Area ismore than 2230 m^2
ASSEMBLY	WRS AS	WRS AS	WRS AS	WRS AS	WRS AS	WRS AS	WRS AS	Unconditional
BUSINESS	DRS	WRS AS	DRS AS	WRS AS	DRS	WRS	WRS AS	
DAYCARE AND RESIDENTIAL BOARD /CARE	DRS AS	WRS AS	DRS AS	WRS AS	DRS AS	WRS AS	WRS AS	Unconditional
DETENTIO AND CORRECTIONAL	WRS PAS	WRS PAS	WRS PAS	WRS PAS	WRS PAS	WRS PAS	WRS PAS	Unconditional
EDUCATIONAL	DRS	WRS AS (If not with open corridor)	DRS AS	WRS AS	DRS AS (If not withopen corridor)	WRS AS	WRS AS	Total Area ismore than 1860 m^2 No of Basement More than 1
HEALTHCARE AND AMBULATORY	WRS AS	WRS AS	WRS AS	WRS AS	WRS AS	WRS AS	WRS AS	Unconditional
HOTEL	WRS AS	WRS AS	WRS AS	WRS AS	WRS AS	WRS AS	WRS AS	Unconditional

LABOR ACCOMMODATION	DRS	WRS	DRS AS	WRS AS	DRS	WRS AS	WRS AS	Total Area oflargest compartmentis more than 1860 m^2
MERCANTILE	DRS	WRS	DRS AS	WRS AS	DRS	WRS AS	WRS AS	Total Area oflargest compartmentis more than 1115 M^2
MULTIPLE AND MIXED OCCUPANCIES	DRS	WRS AS	DRS AS	WRS AS	DRS AS	WRS AS	WRS AS	
RESIDENTIAL APARTMENT	DRS	WRS	DRS AS	WRS AS	DRS	WRS	WRS AS	
STAFF ACCOMMODATION AND LODGING/ROOMING HOUSE	DRS	WRS	DRS AS	WRS AS	DRS	WRS AS	WRS AS	
VILLAS - PRIVATE	IT IS RECOMMENDED TO THE OWNER TO PROVIDEDOMESTIC SPRINKLER SYSTEM FE			AS	IT IS RECOMMEND - ED TO THE OWNER TO PROVIDE DOMESTIC SPRINKLER SYSTEM FE	AS	AS	Area is morethan 1115 M^2
VILLAS – COMMERCIAL GROUP	YFH	YFH	YFH AS	WRS AS YFH	YFH	YFH	WRS AS YFH	

4. DESIGN REQUIREMENTS

4.1. Dry Riser Systems

4.1.1. Dry riser system shall be provided in occupancies and criteria as mentioned in Table 9.1, Table 9.3 and Table 9.4

4.2. Fire Hose Station locations

4.2.1. Class III fire hose stations which are combination of class I & Class II hose connections, shall be located preferably inside the stair enclosure at typical floorsand beside the exit ways at ground floor.

4.2.2. The Fire Hose Station should be clearly visible beside the exit way or stairway. Additional fire hose stations along the exit access corridor, horizontal exit or in the car park floors shall be installed such that all portions of each floor are within 30 m from the fire hose station while measured along the natural path of travel from the hose station.

4.2.3. 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 while the fire hose reel or Fire hose rack shall be installed at a height of not less than 1200 mm and not more than 1500 mm from the finished floor level.

4.3. Flow & Pressure Requirements

4.3.1. Maximum residual pressure at any point within the Class II system shall not exceed 12 bar. The minimum flow and residual pressure required at the hydraulically remotest and /or top most 25 mm fire hose reel outlet shall be not less than 6.5 GPM at 6 bar.

4.3.2. Maximum residual pressure at any point within the Class II system shall not exceed12 bar. The minimum flow and residual pressure required at the hydraulically remotest and /or top most 40 mm fire hose rack outlet shall be not less than 100 GPM at 6 bar.

4.3.3. Maximum residual pressure at any point within the Class I system shall not exceed 12bar. The minimum flow and residual pressure required at the hydraulically remotest and /or top most fire hose outlet shall be not less than 250 GPM at 6.9 bar. If the residual pressure exceeds 7 bar at the fire hose connection, an approved pressure reducing valve shall be introduced to restrict the pressure to 7 bar.

4.4. Fire water demand & Hydraulic Calculations

4.4.1. The Fire water demand for the firefighting system for occupancies having floor area less than 900 m² shall be calculated based on the flow rates of fire hose outlets installed in the system.

4.4.2. The minimum flow rate at hydraulically most remote 25 mm diameter hose reel shall be 6.5 GPM at the residual pressure of 6 bar and for the hydraulically remotest 40 mm dia hose rack valve shall be 100 GPM at the residual pressure of 6 bar. Hydraulic calculations shall be performed to determine the fire water demand, pressure andpipe sizes required for hose reel system installed.

4.5. Pipe Sizes

4.5.1. The minimum pipe size for serving a single fire hose reel shall not be less than 25 mm die and the pipe line serving two or more hose reels shall not be less than 50 mm dia.

4.5.2. The minimum pipe size of each dry riser shall be not less than 100 mm dia while the branches for a Landing valve shall be not less than 65 mm dia.

4.5.3. In case of horizontal dry riser pipelines, the minimum pipe sizes for serving a single 65 mm dia hose valve shall be not less than 65 mm dia and the pipe line serve two or more hose valve shall be not less than 100 mm diameter.

4.6. Fire Pump set

4.6.1. Fire Pump shall be located at the lowest level of the building, pumping water upwards. Fire pumps at levels higher than the lowest level of the building with water supply feeding downwards is not allowed.

4.6.2. Fire pump set for buildings required to have Dry Riser System shall consists of one Main Electric Pump and one standby Diesel driven pump having minimum flow of 100 GPM with pressure requirements according to the hydraulic calculations.

4.7. Fire Water tanks

4.7.1. Fire water shall be stored in a permanent 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 60 minutes of fire pump set capacity.

4.7.2. The fire water tanks shall be provided with a filling connection directly from line with a float operated valve for automatic refilling. The tanks shall be provided with drain arrangement, overflow connection, level indicators, low level switch, and other necessary accessories.

4.7.3. Fire water tanks shall be located and constructed such that the fire pump set gets flooded water supply in case of fire pumps are horizontal centrifugal type.

4.7.4. Where the situation does not permits to provide flooded water supply, negative suction arrangement is permitted for fire hose reel pump set by providing an automatic priming arrangement complete priming tank & accessories as required.

4.8. Wet Riser Systems

4.8.1. Wet Riser Systems shall be provided with Class III system. Class III system fire hose station shall consists of a 25 mm fire hose reel or 40 mm fire hose rack & 65 mm dia landing valve with hoses & nozzles. Hose stations shall be located preferably inside stair enclosure at typical floors and beside each exit way at the ground floor.

4.8.2. Additional fire hose station along the exit access corridor or horizontal exit or in the car park floors shall be installed such that all portions of each floor are within 30 m from the fire hose station while measured along the natural path travel from the hose station.

4.8.3. 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 while the fire hose reel shall be installed at a height of not less than 1200 mm and not more than 1500 mm from the finished floor level.

4.8.4. Additionally a roof manifold consisting of 3 nos of 65 mm dia landing valve outlets shall be provided at the topmost point (at roof level) of hydraulically remotest standpipe riser for testing purposes.

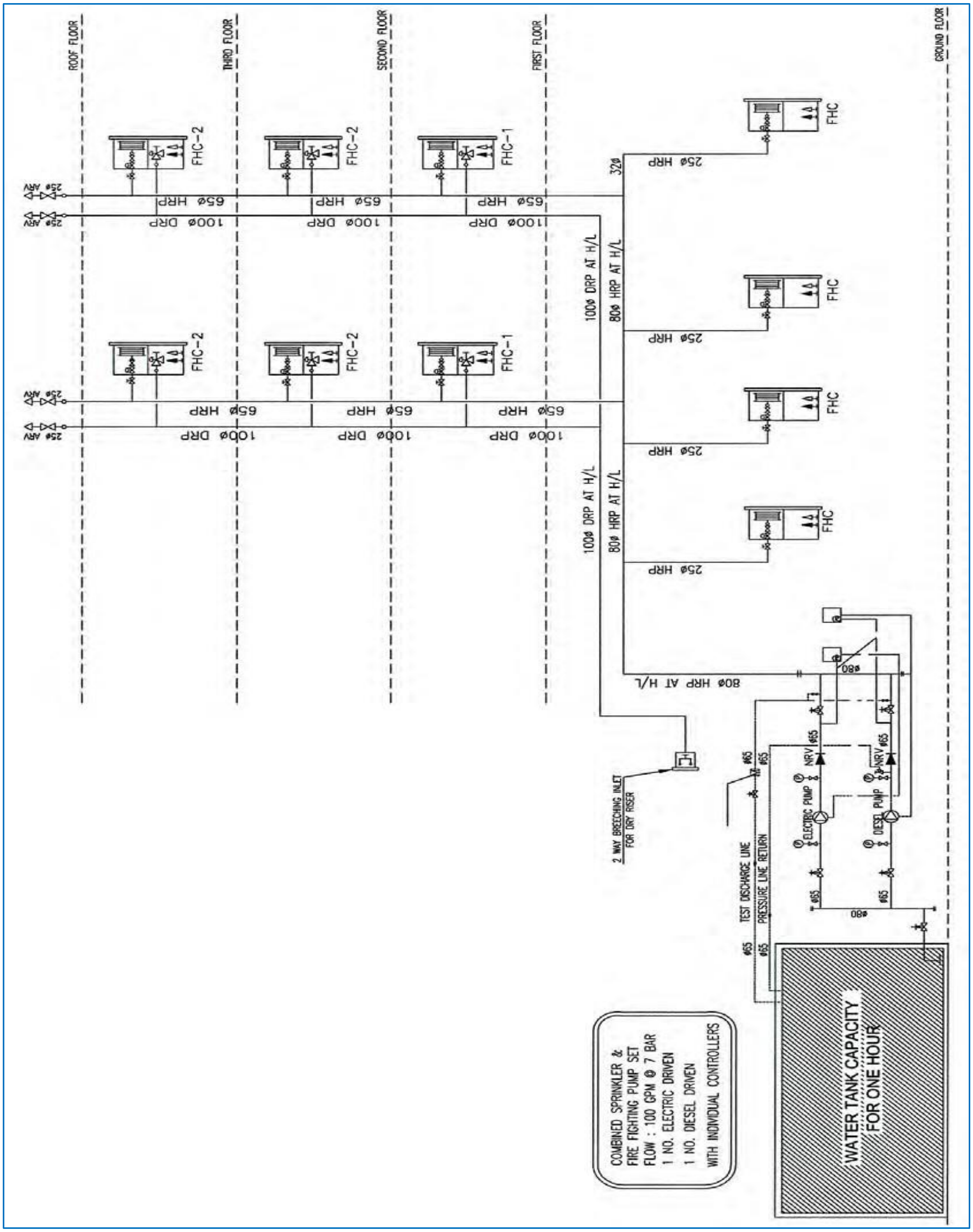


Figure 9.1:

Example 1: Typical Arrangement of Dry Riser with Fire Hose Reel System

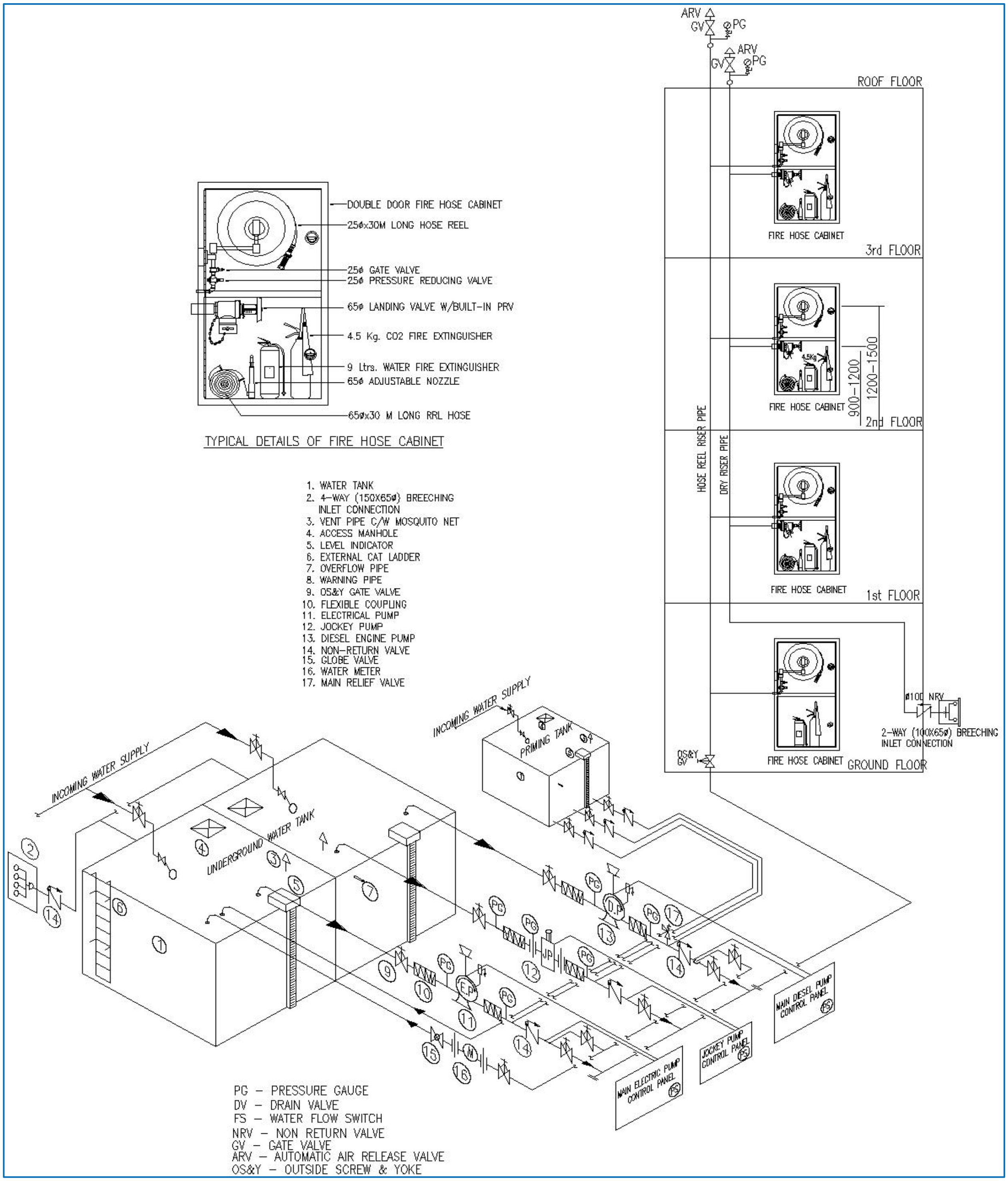


Figure 9.2:

Example2: Typical schematic of Fire Pump, Dry riser with Fire Hose Reel Systemwith Priming Tank

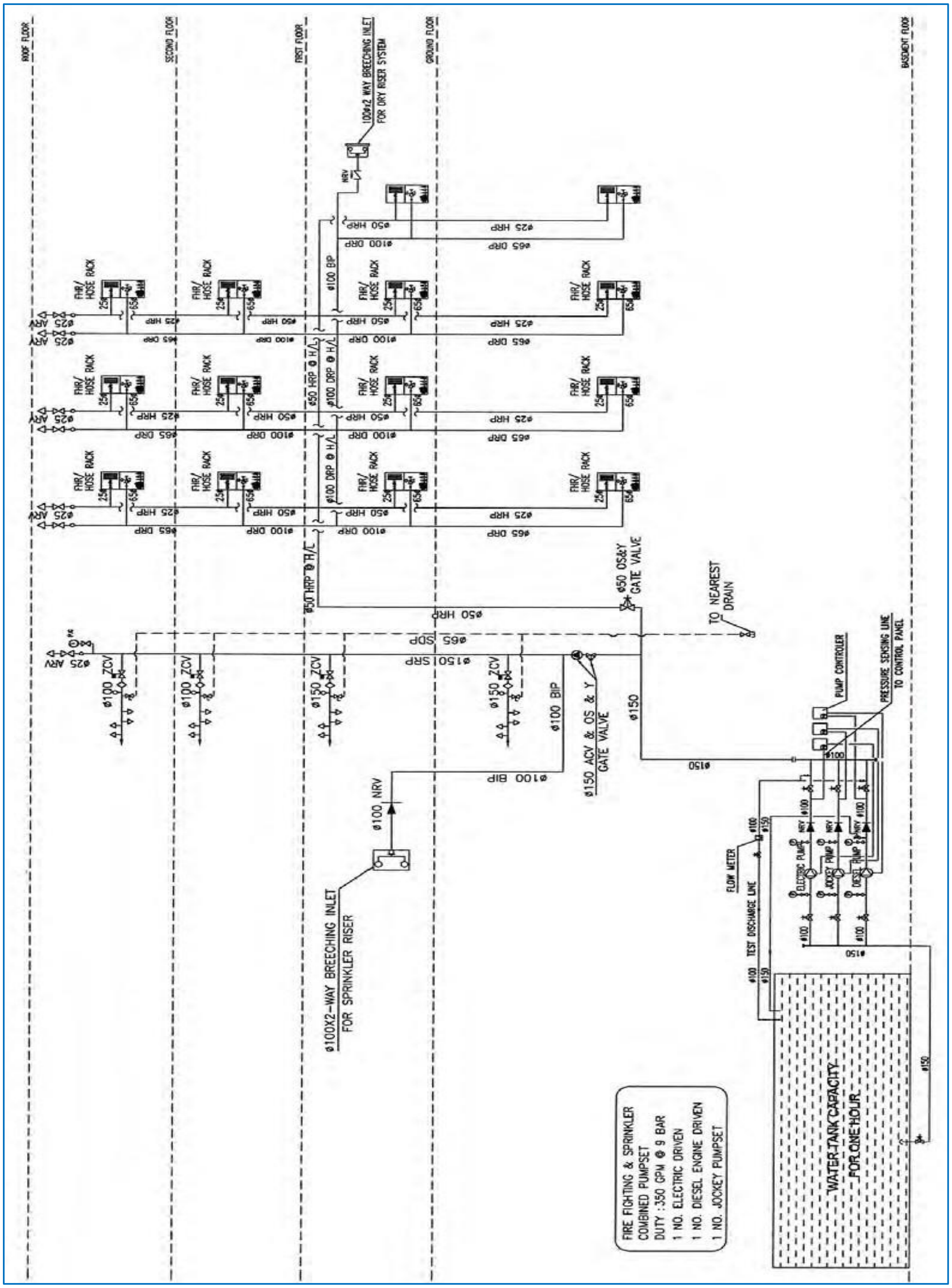


Figure 9.3:

Example 3: Typical schematic of Sprinkler provision along with Dry riser andFire Hose Reel System

4.9. Flow & Pressure Requirements

4.9.1. Where two or more wet risers are installed in a system, all wet risers shall be interconnected at the bottom of the risers.

4.9.2. Maximum pressure at any point within the fire hose reel system shall not exceed 12 bar. The minimum flow & residual pressure required at the hydraulically remotest and / or top most fire hose reel shall be not less than

4.9.3. 6.5 GPM at 4.5 bar and If the residual pressure exceeds 7 bar at the fire hose reel connection, an approved pressure reducing valve (PRV) shall be introduced to restrict the pressure to 7 bar.

4.9.4. 4.10.3. The minimum flow & residual pressure required at the hydraulically remotest and /or top most 65 mm dia Landing valve shall be not less than 250 GPM at

4.9.5. 6.9 bar. Maximum residual pressure at any 65mm dia landing valve outlet shall not exceed 12 bar. If the residual pressure exceeds 7 bar at the landing valve outlet, the Landing valve shall be have built in pressure regulating type to restrict the pressure to 7 bar.

4.9.6. If static pressure at any Landing valve exceeds 12 bar, an approved pressure reducing valve (PRV) station shall be introduced to restrict the static & residual pressure within 12 bar.

4.9.7. Pressure reducing valve station shall consist of by-pass arrangement having all equipment & accessories same as in the main connection as shown in Figure 9.4 below. The rated working pressure of all devices including pressure reducing valve installed on upstream side of PRV shall be higher than the inlet pressure of PRV station.

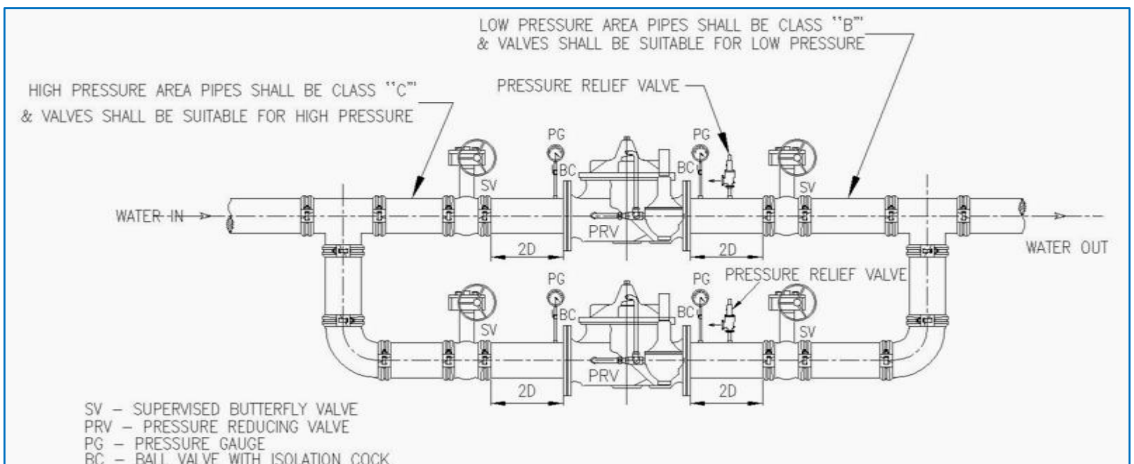


Figure 9.4: Typical Arrangement of Pressure Reducing Valve (PRV) Stations in Fire Fighting System.

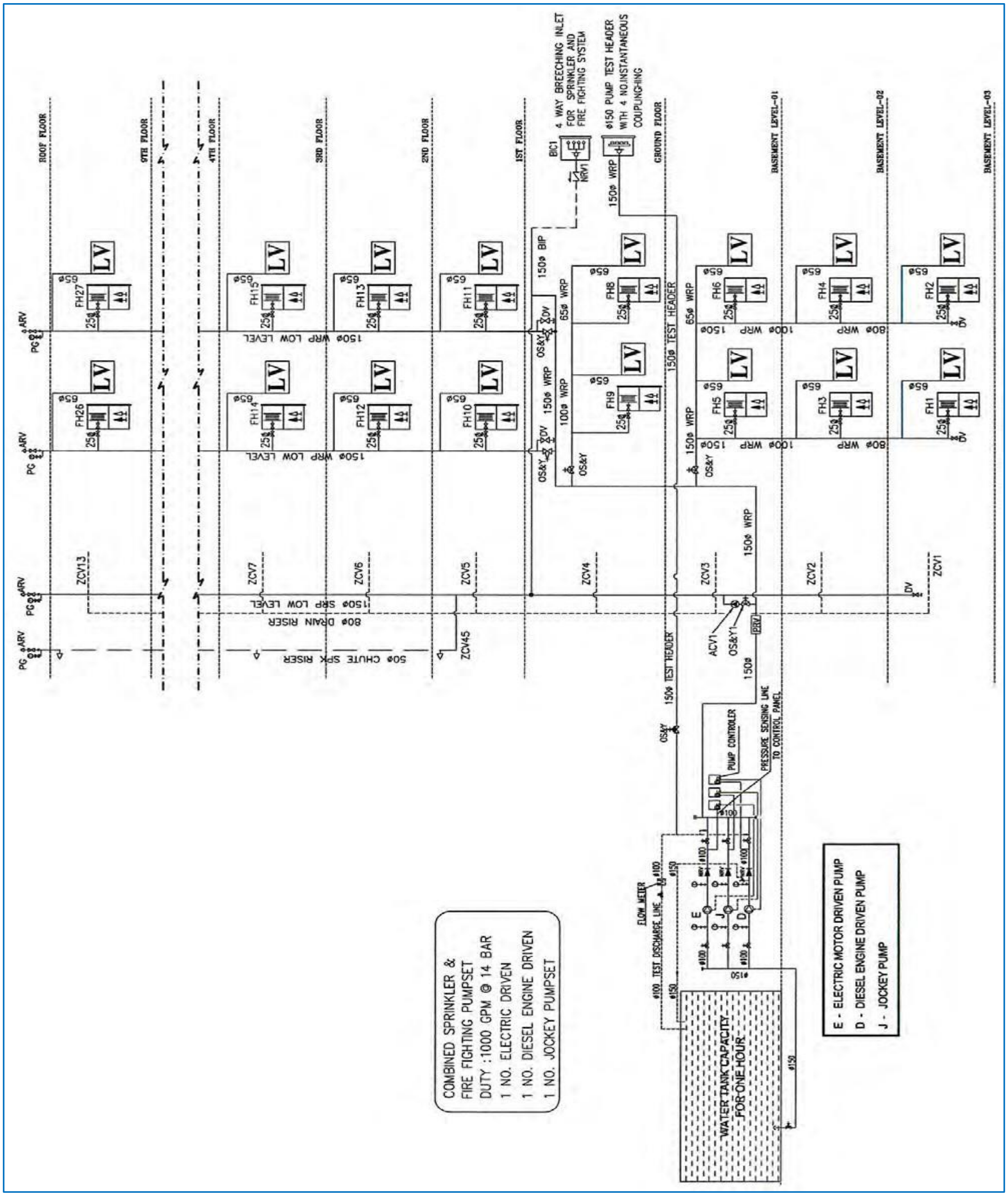


Figure 9.5: Typical schematic of sprinkler provision and wet riser system with tapping forLanding Valve (LV) at stair enclosure and locating Hose reels at typical floor areas.

4.10. Zoning of Wet riser system:

4.10.1. Multiple wet risers' zoning system shall be established in high rise buildings where pressure reducing valve station is utilized with single fire pump set instead of multiple pumping station, to restrict pressure limit within 12 bar at any Landing valve outlet. Refer the Figure 9.6 which shows typical arrangement of multiple wet riser zones with single fire pump set.

4.10.2. However, the pressure at any point of wet riser system shall not exceed 24 bar at any point of time with Fire Pump set to cut-off at 140% of rated operational pressure.

4.10.3. If pressure exceeds this limit, multiple fire pumping stations complete with dedicated fire water tanks for each pumping station shall be provided. Refer to Figure 9.7.

4.11. Fire Water Demand

4.11.1. The Fire water demand shall be calculated based on the flow rates of landing valves and fire hose reels or racks installed in the wet riser system. The minimum flow rate at the hydraulically remotest 65 mm dia landing valve in a wet riser shall be not less than 250 GPM at the residual pressure of 7 bar.

4.11.2. The minimum flow rate at hydraulically remotest 25 mm dia hose reel in a fire fighting system shall be 6.5 GPM at the residual pressure of 4.5 bar and for the hydraulically remotest 40 mm dia hose valve in a fire fighting system shall be 100 GPM at the residual pressure of 4.5 bar.

4.11.3. The minimum flow rate of class I & class III hydraulically remotest vertical wet riser system shall be not less than 500 GPM while the horizontal wet riser system where there are 3 or more landing valves, the minimum flow rate shall be not less than 750 GPM.

4.11.4. The minimum flow rate for each additional standpipe shall be 250 GPM with total demand need not exceed more than 1250GPM or 1000 GPM if the building is fullyprotected by an automatic sprinkler system.

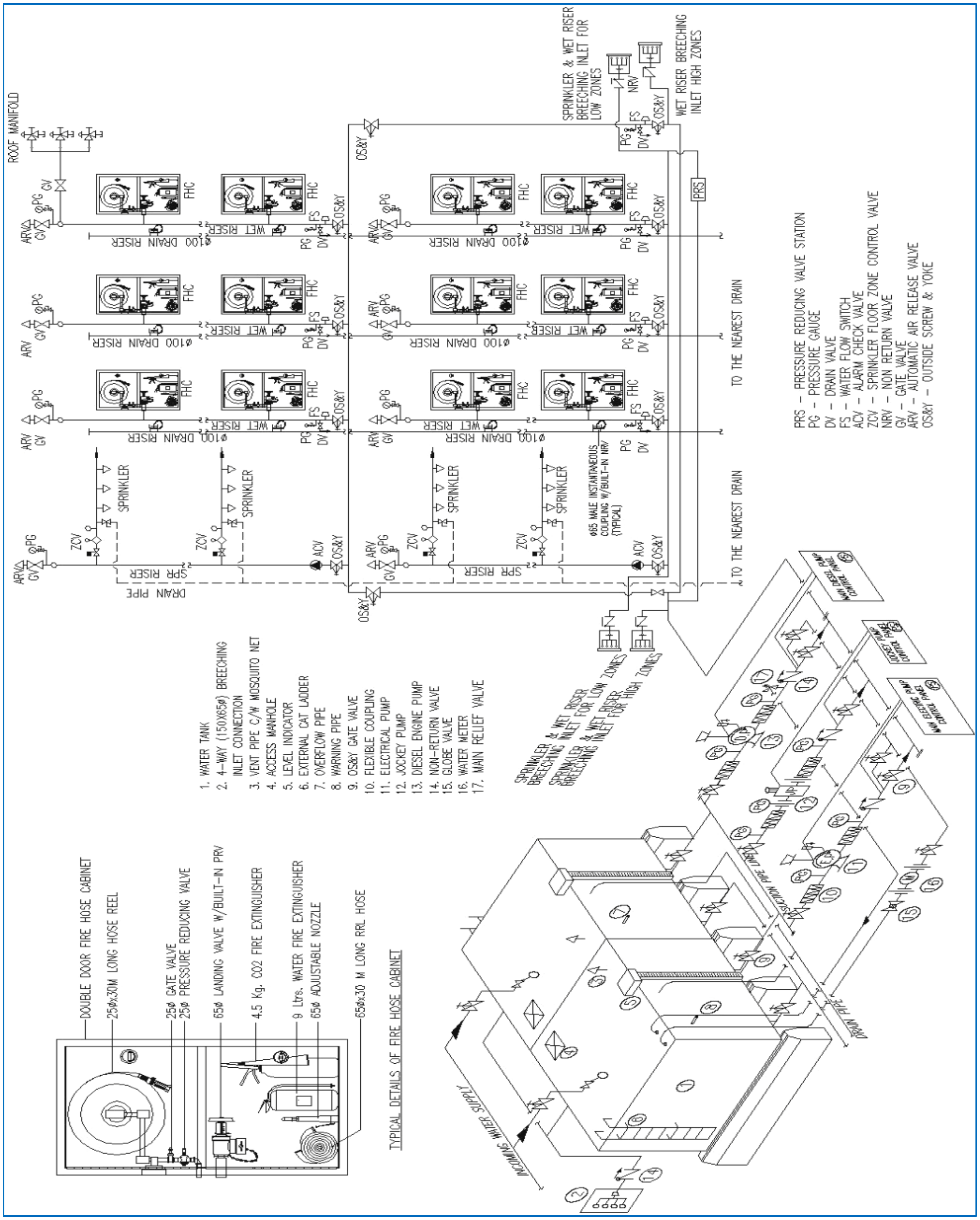


Figure 9.6:

Typical Arrangement of Two Zone Wet Riser System for High Rise Buildings.

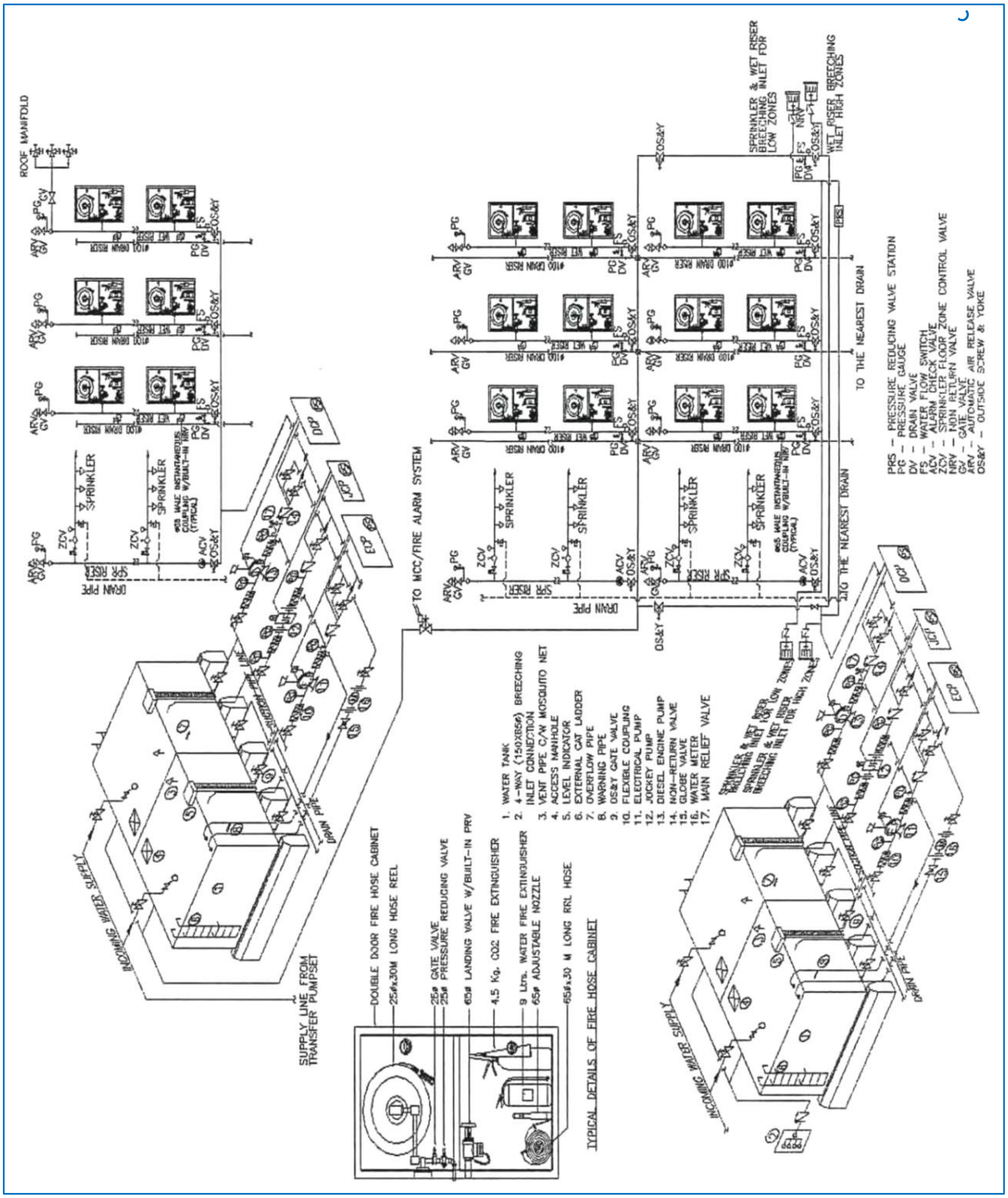


Figure 9.7: Typical Arrangement of Multiple Zones Wet Riser System for High Rise Buildings.

Example 1.

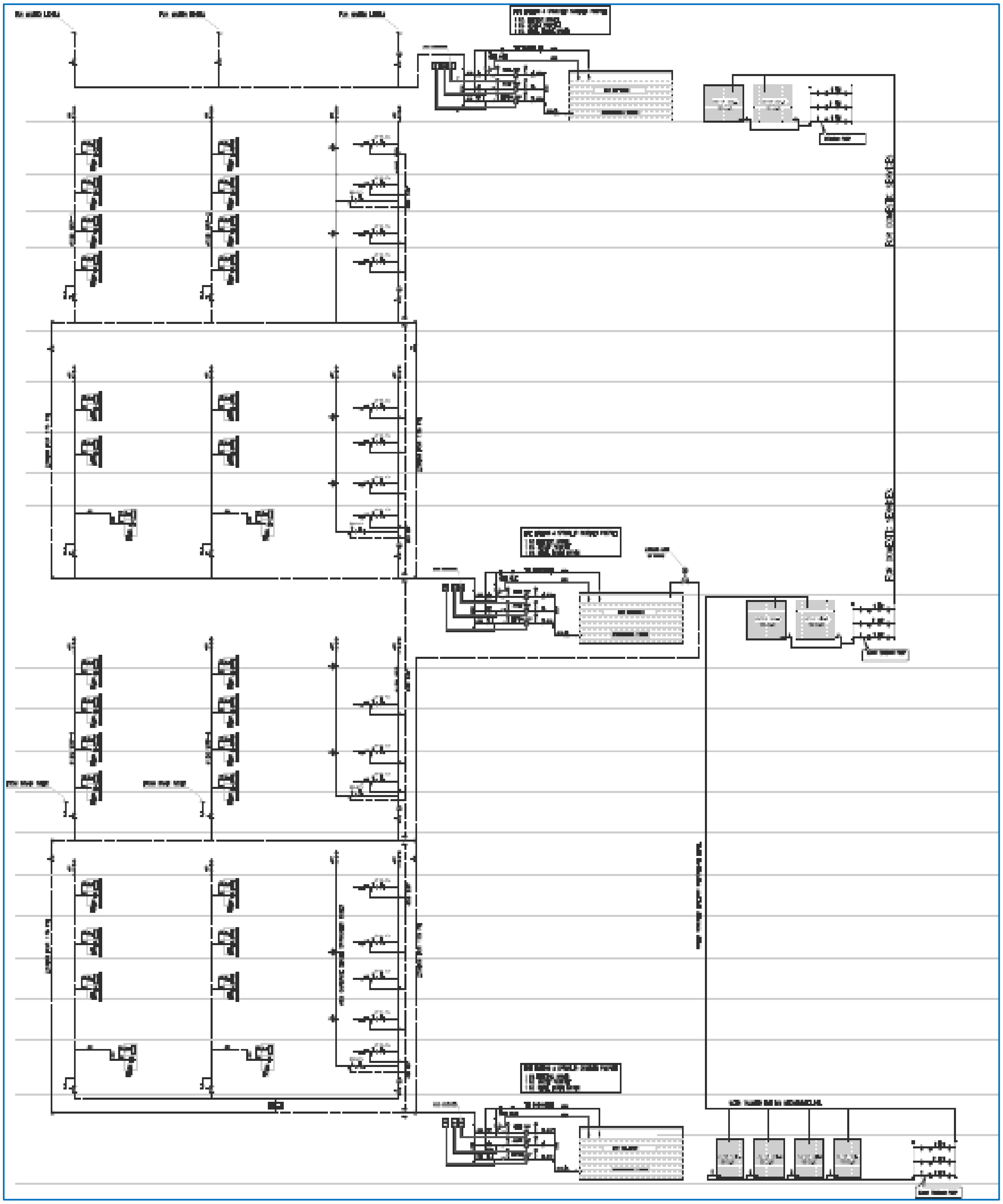


Figure 9.7A: Typical Arrangement of Multiple Zones Wet Riser System for High Rise Buildings.

Example 2.

4.12. Combined System Water Demand

4.12.1. If the fire water supply is combined for both sprinkler and wet riser stand pipe system, the fire water demand shall be established as follows.

4.12.2. In the buildings fully protected by an automatic sprinkler system, the fire water demand as established in section 4.12 for the wet riser system is permitted to serve sprinkler system without adding additional water demand to it.

4.12.3. In the buildings partially or not protected by sprinkler system, the fire water demand as established in section 4.12 for the wet riser system shall be increased by adding the hydraulically calculated sprinkler fire water demand to it.

4.12.4. If the Hydraulically Calculated sprinkler system water demand including the hose stream allowance exceeds the wet riser water demand as established in section 4.12, the larger of the two demand values shall be proposed.

4.13. Hydraulic Calculations

4.13.1. Hydraulic calculations shall be performed to determine the fire water demand, pressure and pipe sizes required for a stand pipe system.

4.13.2. The hydraulic calculation shall be performed using the Civil Defence listed and approved software based on following criteria:

i. Two numbers of landing valves on top most point of the hydraulically mostunfavorable wet riser providing 250 GPM flow at 7 bar per outlet and One Landing valve outlet on the topmost point of adjacent wet risers 250 GPM flow at 7 bar per outlet.

ii. If 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 fire departmentvalve outlet at the topmost point of each adjacent wet riser pipes providing 250 GPM flow at 7 bar per outlet

4.13.3. The total fire water demand need not exceed 1250 GPM in any case, to determine the common supply pipe which is feeding all the wet riser pipes.

4.14. Pipe Sizes

4.14.1. The minimum pipe sizes shall be determined according to the hydraulic calculations. However, the minimum pipe size of each wet riser shall be not less than 150 mm dia while the branches for each Landing valve shall be not less than 65 mm dia.

4.14.2. In case of horizontal wet riser pipe, the minimum pipe sizes for serving a single 65mm dia Landing valve shall be not less than 65 mm dia and the pipe line which serve two Landing valve shall be not less than 100 mm diameter and more thantwo shall be served by not less than 150 mm diameter.

4.14.3. Water supply connection for fire hose reels can be tapped either directly from the 150 mm dia main wet riser or from the 65 mm dia branch line for landing valve.

4.14.4. Feeder main pipes and riser pipes for wet riser system shall be independent from the sprinkler system piping. Common feeder main and riser piping shall not be permitted for wet riser and sprinkler system.

4.15. Fire Pump Sets

4.15.1. Fire Pump shall be located at the lowest level of the building, pumping water upwards. Fire pumps at levels higher than the lowest level of the building with water supply feeding downwards is not allowed.

4.15.2. In a typical wet riser system, the fire pump set shall consists of one Main Electric driven Pump, one standby Diesel driven pump and one Electric Jockey pump having minimum flow and pressure according to the hydraulic calculation to supply fire water demand of the system.

4.15.3. Wherever pressure limitations and Hydraulic calculations demand for multiple pump sets, each pump set shall be separate, consisting of above mentioned group of pumps with separate Water tanks.

4.16. Fire Water tanks

4.16.1. Fire water shall be stored in a water tank having two compartments or in two tanks with total effective fire water reserve to cater the pumping demand of not less than 60 minutes of fire pump set capacity. Fire water tank capacity shall be increased based on type of Hazard and Occupancies based on NFPA 13.

4.16.2. The fire water tanks shall be provided with a filling connection directly from DEWA line with a float operated valve for automatic refilling.

4.16.3. The fire water tanks shall be provided with drain arrangement, overflow connection, access manhole, ladders, level indicators, low level switch and other necessary accessories as required by the Civil Defence.

4.16.4. Fire water tanks shall be constructed / located such that the fire pump sets gets flooded water supply in case of fire pumps are horizontal centrifugal type.

4.16.5. Where the situation does not permits to provide flooded water supply arrangement, the tanks below the pumps may be acceptable by providing vertical turbine type fire pumps as shown in Figure 9.8.

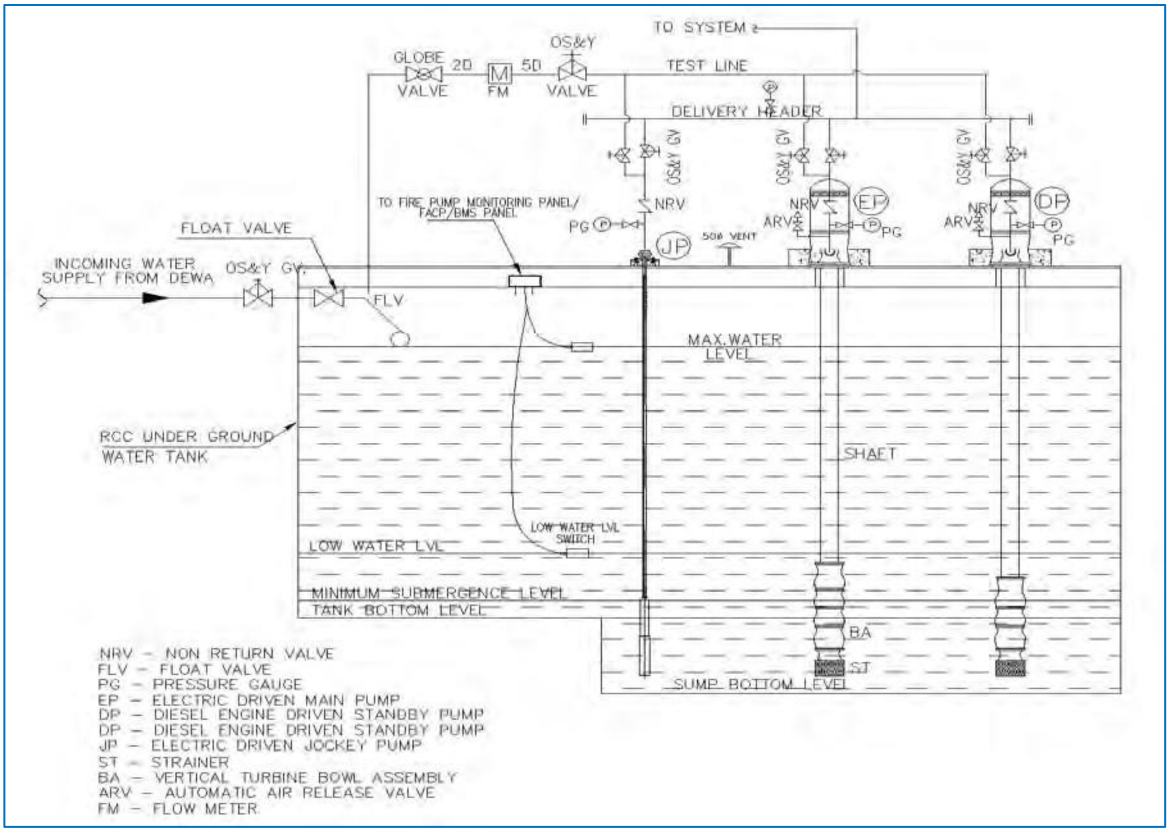


Figure 9.8: Typical Arrangement of Fire Pumping system with Vertical Turbine Pumps.

4.17. Test Risers and Drains

4.17.1. There shall be a drain riser with not less than 100 mm dia installed beside the wet riser pipe.

4.17.2. Drain risers shall be fitted with 65 mm dia instantaneous male coupling with built-in spring loaded non return valve with blank cap beside each landing valve outlet to facilitate the landing valve test during routine testing.

4.17.3. The drain riser shall be terminated back to fire water tank or to open drain.

4.17.4. Additionally a roof manifold consisting of 3 nos of 65 mm dia landing valve outlets shall be provided at the topmost point (at roof level) of hydraulically remotest standpipe riser for testing purposes.

4.17.5. Each wet riser shall be provided with drain arrangements having not less than 50 mm dia on downstream side of riser isolation valve and where ever the riser pipe changes its direction which leaves water trapped in that sections.

4.18. Location & Protection of Wet riser Pipe

4.18.1. All the firefighting system including hose reel, dry & wet riser piping in any building, shall be installed within a protected enclosure having fire resistance rating of not less than 2 hours.

4.18.2. If the building is fully protected by an automatic sprinkler system, the protection of fire-fighting riser pipe shall be with 1 hour fire resistant enclosure

4.18.3. All steel pipes & fittings used for firefighting service shall be painted in Red. Where the situation does not permit due to the interior architecture finish, the pipe may be painted in other color by marking the firefighting pipe with RED colored band at every 3 meters with directional arrow marks indicating water flow direction.

5. Sprinkler System

5.1. General

5.1.1. This section depicts the design requirements of Automatic Sprinkler systems in all types of occupancies. The purpose of sprinkler system is to detect, control and extinguish the fire by discharging water automatically to provide protection for the occupant's life and property.

5.1.2. 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.

5.1.3. The sprinkler system also consists of required control valves, installation Alarm Check Valve (ACV), Floor Zone Control Valves (ZCV),

5.1.4. Alarm Check Valves (ACV) and Floor Zone Control Valves (ZCV) shall be located inside stair enclosure at a higher level than required 'Headroom' for the stairs.

5.2. Types of Sprinkler Systems

5.2.1. There are three types of sprinkler systems generally used and approved by the Civil Defence.

i. Wet Sprinkler System
ii. Dry Pipe Sprinkler System
iii. Pre-action Sprinkler System

5.3. Wet Sprinkler System

5.3.1. The Wet Pipe System is the simplest and most common type of fire sprinkler installation. This system employs automatic and closed-type sprinklers heads which are connected to a water-filled piping system. The sprinklers contain either a heat responsive glass bulb or fusible element that prohibits water from discharging from the sprinkler's orifice. The water is contained until such time as the heat from the fire activates the element, causing its release, allowing the water to discharge.

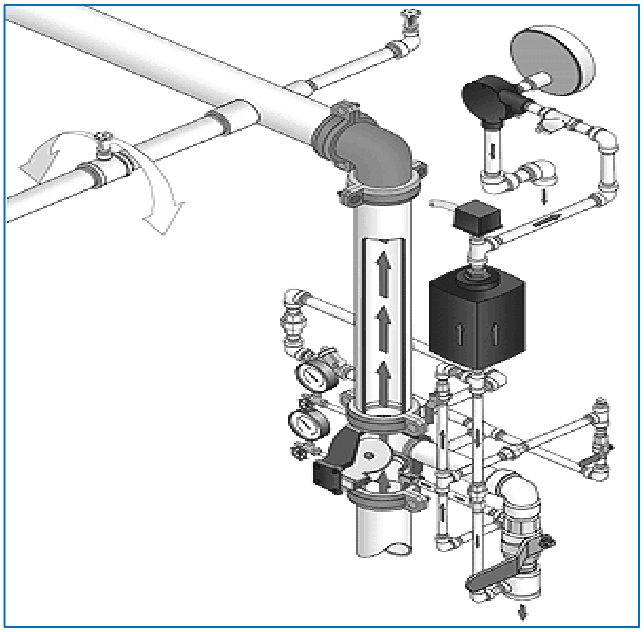


Figure 9.9: A Typical Arrangement of Wet Sprinkler System

5.4. Dry Pipe Sprinkler System

5.4.1. A Dry Pipe Sprinkler System is a system which employs automatic and closed-type sprinkler heads which are connected to a piping system containing compressed air or nitrogen, rather than water. This type of system is used where the area being protected will be unable to maintain a constant year-round temperature of at least 40 degrees Fahrenheit (4°C), like cold or freezer rooms.

5.4.2. Water would freeze in the piping, rendering the system inoperable, even causing severe damage should the system components crack or break. Dry Pipe Systems are frequently installed in areas subject to freezing temperatures, such as cold storage areas, coolers and freezers, special purpose laboratories and processing units.

5.4.3. In case of cold or freezer rooms where the temperature is less than 4°C, ensure that the air inside the piping is free from moisture (by using dry air or nitrogen). Volume and compressor calculations shall be taken into consideration when designing the system.

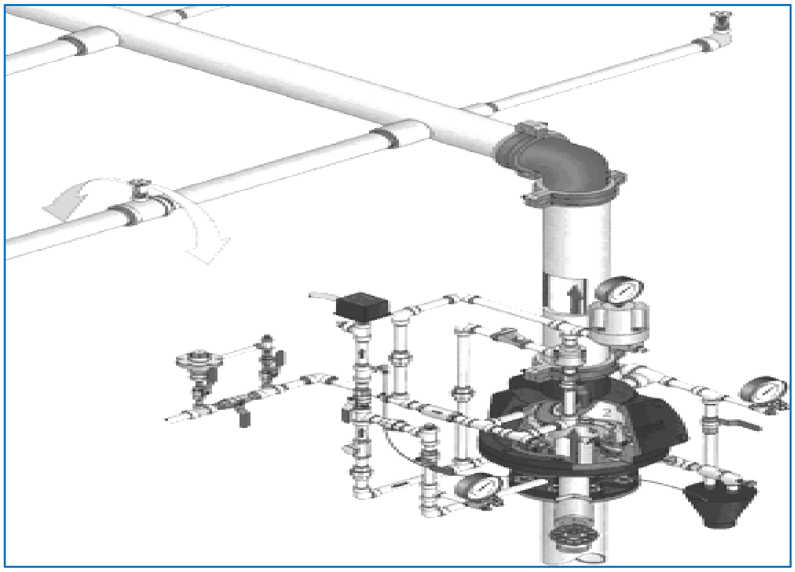


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Figure 9.10: A Typical Arrangement of Dry Sprinkler System

5.5. Pre-action Sprinkler system

5.5.1. 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.

5.5.2. These systems are typically used in applications where the accidental discharge of water would be catastrophic to the usage occupancy (for example; computer servers, lift machine rooms, telecommunications equipment, and high voltage electrical components).

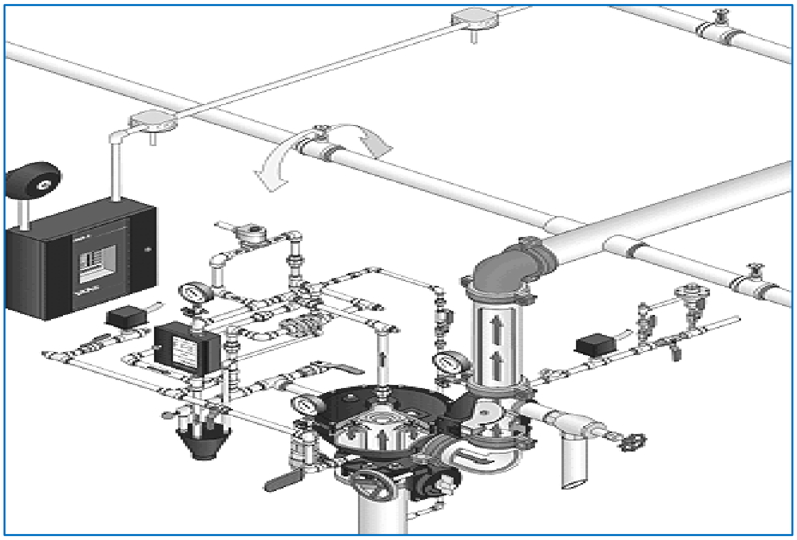


Figure 9.11: A Typical Arrangement of Pre-action Sprinkler System

5.6. Types of Sprinkler Heads

5.6.1. There are two types of sprinkler heads based on the sensing element.

i. Quartz Bulb type: A sprinkler that has sensing element consist of glass bulb filled with quartz liquid for sensing the surrounding temperature.

ii. Fusible Link type: A sprinkler that has sensing element consist of solder type fusible link for sensing the surrounding temperature.

5.7. Types of Sprinkler Heads based on Discharge pattern

5.7.1. There are several types of sprinkler heads based on the discharge pattern.

i. Upright Sprinkler head: A sprinkler designed to be installed in such a way that thewater spray is directed upwards against the deflector.

ii. 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 twotypes based on its mounting application.

iii. Recessed pendent sprinkler: A sprinkler in which all or part of the body, other thanthe shank thread, is mounted within a recessed housing.

iv. Concealed pendent sprinkler: A recessed sprinkler with cover plates.

v. Conventional Sprinkler head: A sprinkler that is designed to install both pendent orup-right position.

vi. Side wall Sprinkler head: A sprinkler having special deflectors that are designed to dis-charge 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 behindthe sprinkler.

5.8. Types of Sprinkler Heads based on coverage

5.8.1. There are two types of sprinkler heads based on the coverage.

i. Standard Coverage: A type of spray sprinkler with maximum coverage areas asspecified in Table 9.5.

ii. Extended Coverage: A type of spray sprinkler with maximum coverage areas than astand-ard coverage.

5.9. Types of Sprinkler Heads based on Sensing Element

5.9.1. There are two types of sprinkler heads based on the response.

i. Standard Response type: A type of spray sprinkler that meets the fast responsecriteria that have a thermal element with an RTI of 80 (meters-seconds) 1/2 or more.

ii. Fast (Quick) Response type: A type of spray sprinkler that meets the fast response criteria that have a thermal element with an RTI of 50 (meters-seconds) 1/2 or less.

5.10. Sprinklers Operating Temperature

5.10.1. Operating temperature of the sprinklers proposed 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 Table 9.5 below.

Table 9.5: Sprinkler Temperature ratings and color coding

MAXIMUM CEILING TEMPERATURE (IN °C)	REQUIRED OPERATING TEMPERATURE OF SPRINKLER (IN °C)	TEMPERA-TURE CLASSI-FICATIONS	GLASS BULB COLOR	COLOR CODEOF SOLDER TYPE SPRINKLER
Up to 38°C	57°C, 68°C (Q.B. type) or 60 °C, 74°C (Solder type)	Ordinary	Orange orRed	Uncolored or Black
Above 38°C up to 66 °C	79°C, 93°C (Q.B. type) or 100°C(Solder type)	Intermediate	Yellow or Green	White
Above 66 °C up to 107 °C	141 °C (Q.B. Type)or 187 °C (Solder type)	High	Blue	Blue

5.11. Sprinkler Operating Response

5.11.1. Thermal sensitivity is a measure of the rapidity with which the thermal element operates as installed in a specific sprinkler. The response time index (RTI) is a measure of the sensitivity of the sprinkler's thermal element as installed in a specific sprinkler. There are two types of sprinklers generally used, Standard Response and Quick or Fast Response.

5.11.2. In light hazard occupancies, all the sprinklers used shall be of Quick or Fast response type sprinklers. In general view, the quick or fast response sprinklers consists of 3 mm thick Quartz glass bulb.

5.11.3. In Ordinary hazard & storage hazard, either quick response or standard responsesprinklers are permitted to use. In general view, the standard response sprinklersconsists of 5 mm thick quartz glass bulb.

5.12. Sprinkler Thread, Orifice & K-Factor

5.12.1. Standard sprinklers shall have the thread size of not less than ½" (12.7mm) NPT having nominal orifice size of ½" (12.7mm) with K-factor 5.6 (Metric factor 80).

5.12.2. Extended coverage sprinklers shall have their thread size, orifice size and K- factor depending upon their approval listing and may vary upon the manufacturers.

5.12.3. Sprinklers having a K-factor exceeding K-5.6 (80) and having ½ in. (15 mm) NPT shall not be permitted to install in new sprinkler systems.

5.12.4. Where design density required is greater than 8.1 LPM/Sq.Mtrs (2.1 GPM/Sq.Mtrs) but lesser than 13.9 LPM/ Sq.mtrs (3.7 GPM/Sq.mtrs), the sprinklers having K-factor 8.0 (Metric factor K-116) shall be used.

5.12.5. If the design density required is greater than 13.9 LPM/ Sq.mtrs (3.7 GPM/Sq.mtrs), the sprinklers having K-factor 11.2 (Metric factor K-161) or higher shall be used as per the approval listing.

5.13. Sprinkler Zone Limitations

5.13.1. The maximum area of any single sprinkler zone in a floor shall be not more than the floor area specified in the Table 9.6 given below. The water supply to the sprinklers supplied by any one sprinkler system riser or combined system riser shall be not more than the specified maximum floor area.

5.13.2. Where the floor area exceeds the limit as specified in the Table 9.6, an additional water supply risers shall be proposed for every maximum sprinkler zone in each floor complete with sprinkler Alarm check Valve (ACV) assembly and riser isolation valve.

5.13.3. In addition, a floor zone control valve (ZCV) assembly shall be proposed at every floor where the tapping is taken from the sprinkler riser.

5.13.4. Alarm Check Valves (ACV) and Floor Zone Control Valves (ZCV) shall be located inside stair enclosure at a higher level than required 'Headroom' for the stairs.

5.14. Sprinkler Operating Pressure

5.14.1. 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.

5.14.2. The maximum operating pressure in a sprinkler system shall not be more than 12 bar.

5.14.3. Where higher operating pressure is used for the sprinkler system, all the sprinklers, pipes and fittings shall be rated for the higher operating pressure, however the operating pressure shall not be more than 16 bar in any case.

5.15. Sprinkler Design Density & Water Supply Requirements

5.15.1. The minimum required design density of water discharge over the protected surface area shall be determined based on the occupancy and hazard classification and shall be determined by the any one of the following methods:

i. Density / AMAO (Assumed Maximum Area of Operation) method;
ii. Room design method.

5.16. Density / AMAO Method

5.16.1. In density / AMAO (Assumed Maximum Area of Operation)method, sprinkler fire water demand shall be calculated by hydraulic calculation method based on certain amount of water within a specified period over the certain area (AMAO) of protected space and shall be not less than as specified in the Table 9.7 below.

5.17. Room Design Method

5.17.1. In room design, sprinkler fire water demand shall be calculated by hydraulic calculation method based on either a single largest room that requires higher water demand or multiple number of rooms that has communication openings between them those requires higher water demand. The design density shall be provided based on the hazard occupancy of each room. In this case the highest water demand shall be the fire water demand required for sprinkler system.

5.17.2. Where room design method is used and the design AMAO is a corridor protected by a single row of sprinklers with protected openings, the maximum number of sprinklers that need to be calculated shall be not less than five in case of standard sprinklers or all sprinklers within 23 linear meters length of corridor in case of extended coverage sprinklers.

5.17.3. Where room design method is used and the design AMAO is a service chute supplied by a separate sprinkler riser, the maximum number of sprinklers that needs to be calculated shall be not less than seven with minimum flow of 60 LPM (15.8 GPM).

5.18. Combined Sprinkler & Wet Riser system Water Demand

5.18.1. The sprinkler water demand shall be calculated based on the hydraulic calculations according to the occupancy hazard classification, density of water discharge and design AMAO (Assumed Maximum Area of Operation) of sprinklers as stated in the Table 9.7.

5.18.2. Hand line hose stream water demand shall be added to the sprinkler water demand according to the type firefighting hose system proposed based on the occupancy classification as specified in the table 9.7.

5.18.3. However, If the fire water supply is combined for both sprinkler and stand pipe wet riser system, the fire water demand shall be established as follows:

5.18.3.1. In the buildings fully protected by an automatic sprinkler system, thefire water demand established for the wet riser system is permitted to serve sprinkler system without adding additional water demand init.

5.18.3.2. In the buildings partially or not protected by sprinkler system, the fire water demand established for the wet riser system shall be increased by adding the hydraulically calculated sprinkler fire waterdemand in it.

5.18.3.3. If the wet riser system demand calculated exceeds the sprinkler system demand including the hose stream allowance, the larger of the two demand value shall be proposed depending on the hazard.

5.19. Hydraulic Calculations

5.19.1. Computerized Hydraulic calculations shall be performed to determine the fire water demand, pressure and pipe sizes required for a sprinkler system installed in all types of occupancies.

5.19.2. The hydraulic calculation shall be performed using the Civil Defence listed and approved software. Following criteria shall be used for Hydraulic calculations.

5.19.3. Sprinkler system that is protecting an occupancy hazard that requires greatest water demand situated anywhere within the occupancy for the design & density of discharge according to the occupancy classification.

5.19.4. Sprinkler system that is protecting an occupancy hazard that is located hydraulically farthest point from the source of fire water supply system within the occupancy for the design & density of discharge according to the occupancy classification.

5.19.5. Sprinkler system that is protecting an occupancy hazard that is located hydraulically topmost point from the source of fire water supply system within the occupancy for the design & density of discharge according to the occupancy classification.

5.19.6. The fire water source shall be selected based on the above criteria, whichever is the greater requirement.

5.20. Pipe Sizes

5.20.1. The minimum pipe sizes shall be determined according to the hydraulic calculations. However, the minimum pipe sizes shall be not less than the diameters specified in the Table 9.6 below.

Table 9.6: Number of sprinkler heads allowed per pipe size

NOMINAL STEEL PIPEØ IN MM	IN LIGHT HAZARDOCCUPANCY	IN ORDINARY & STORAGE HAZARDOCCUPANCY	IN LIGHT, ORDINARY & STORAGE HAZARD (ABOVE FALSE CEILING AND BELOW RAISED FLOOR)
25 mm	2	2	2
32 mm	3	3	4
40 mm	5	5	7
50 mm	10	10	15
65 mm	30 or as perhydraulic calculations	20 or as perhydraulic calculations	30 or as per hydrauliccalculations.
80 mm	60 or as perhydraulic calculations.	40 or as perhydraulic calculations	60 or as per hydrauliccalculations.
100 mm	100 or as perhydraulic calculations.	100 or as perhydraulic calculations.	100 or as per hydrauliccalculations.
150 mm	230 or as per zone area limitation of 4831 m^{2}, whichever is greater subject to hydraulic calculation.	275 or as per zone area limitation of 3716 m^2, whichever is greater subject to hydraulic calculation	300 or as per hydraulic calculations.
150 mm	Maximum area limitation for High and Extra HazardSprinkler Zone is 3716 m^2		

5.20.2. In case of horizontal wet riser pipe, the minimum pipe sizes for serving a single 65 mm dia Landing valve shall be not less than 65 mm dia and the pipe line which

6. Certification of Fire Pumps

6.1. The below mentioned criteria shall be applicable to centrifugal single – stage and multistage pumps of horizontal or vertical shaft design and positive displacement pumps of the horizontal or vertical shaft design which are limited and intended for fire protection system only:

6.1.1. Each pump, driver, controlling equipment, power supply and arrangement and liquid supply shall be tested and certified by a listed laboratory approved by the Civil Defence Authority.

6.1.2. The fire pump unit, consisting of a pump, driver, controller and fittings shall perform in compliance with this standard as an entire unit when installed or when components have been replaced. The selected fire pump is required to be verified with the listing before application.

6.1.3. All the materials used in pump construction shall be tolerance dependent and selected based on the corrosion potential of the environment, fluids used and operational conditions. Engines shall have a nameplate indicating the listed horsepower rating available to drive the pump.

6.1.4. All the equipment, materials or services shall be included in a listing published by the approved testing laboratory. The laboratories shall be concerned with evaluation of products or services that maintains periodic inspection of production of equipment's or materials or periodic evaluation of services and meets the suitable standards for a specified purpose.

6.1.5. A single entity should be designated as having unit responsibility for the pump driver, controller, transfer switch equipment and accessories. It shall hold the accountability to answer and resolve any and all problems regarding the proper installation, compatibility, performance and acceptance of the equipment. Unit responsibility shall lie with the installer until the equipment is accepted and officially handed over to the building owner. This shall not affect manufacturer/supplier warranties.

6.1.6. Installation personnel shall be qualified or shall be supervised by persons who are qualified in the installation, inspection and testing of fire protection systems. Qualifications or certification of the personnel shall be provided at any time when requested by the Civil Defence Authorities. The installation team shall be registered, licensed or certified by the Civil Defence Authority.

7. Fire pump location and arrangement

7.1. The proposed fire pump set for any water based suppression system including fire hydrants shall consists each of the following:

i. Main Electric Pump
ii. Standby Diesel driven Pump
iii. Electric Jockey Pump

Two electrical pumps can be used, one as duty and another as standby. The power supply forthe 2 electrical pumps shall reliable and be independent of each other.

7.2. Fire Pumps shall be located at the lowest level of the building pumping upwards. Fire pumps at levels higher than the lowest level of the building with water supply feeding downwards is not allowed.

7.3. Pumps shall have minimum flow and pressure according to the hydraulic calculation to supply fire water to sprinklers system, landing valves and hydrants.

7.4. A common fire pump set is acceptable to feed both sprinkler and wet riser system. In such case, the fire pump set capacity shall be not less than the highest fire demand calculated.

7.5. Fire pumps and fire water tanks shall have protected and dedicated access from the fire engine access level.

7.6. Transfer fire pumps and transfer fire water tanks are to be located on mechanical floors and shall not be located on the roof top.

7.7. Any building higher than 21 m in habitable height from the lowest level of the building, shall require a transfer pump set and a transfer water tank located on the mechanical floor.

7.8. Fire Pump for Hydrants

7.8.1. Hydraulic calculation shall be provided to size up the fire pump required for the fire hydrant network. Separate pumps may be required to address pressure fluctuation within the hydrant network.

7.8.2. Each fire pump flow rate shall be a minimum of 1000 GPM for hydrant demand at minimum pump pressure of 10.3 bar.

8. Inspectors Test & Drains

8.1. Inspectors Test

8.1.1. For all high-rise buildings, an approved Auto Zone Check valve shall be considered for each floor Zone Control Valve, to enable the automatic checking of the Flow switch and simulation of sprinkler activation. (See V. COMMITMENT TO BEST PRACTICE, Water Conservation)

8.1.2. For non-high-rise buildings, an approved alarm test valve shall be provided in each sectional or floor zone control valve assembly on downstream side of water flow switch. The test valve shall be not less than 25 mm diameter in size having 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.

8.1.3. 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 languages.

8.1.4. Where test valve is 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 languages.

8.2. **Drains**

8.2.1. The complete sprinkler system piping shall be designed and installed in such a way that the entire water can be drained.

8.2.2. A main drain valve shall be installed on each sprinkler system main riser on downstream side of an Alarm Check valve. The system main drain valve can be a part of an alarm check valve.

8.2.3. The size of main drain valve (alarm check valve) shall not be less than 50mm dia. Auxiliary drains shall be provided where a change in piping direction prevents drainage of system piping through the main drain valve.

8.2.4. In addition, where sectional zone or floor control valve is provided, it shall be provided with a drain connection having a minimum size not less than 25 mm diameter to drain that portion of the system controlled by the sectional valve. A listed and approved combined test & drain valve is permitted to use in sectional or floor zone control valve assembly.

8.2.5. A drain riser shall be installed beside the sprinkler system riser pipe.

8.2.6. 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 outside the building wall, 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.

8.2.7. The drain riser may be permitted to terminate back to 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. See Figure 9.12 for illustrations.

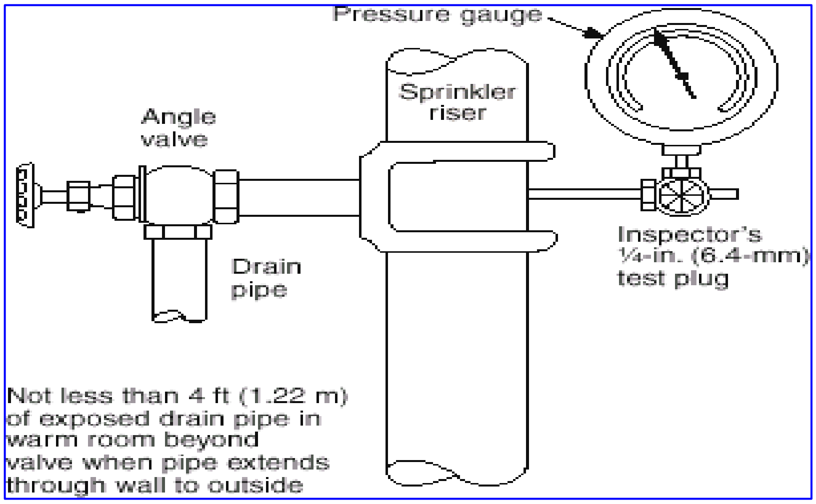


Figure 9.12: Drain and pressure gauge connection for System Riser

9. Classification of Fire Hazards for Sprinkler Design

9.1. Occupancies shall be classified as four classes based on its use and content of materials stored or handled to determine the sprinkler design, installation, water discharge, fire pump and storage requirements.

9.2. Light Hazard

9.2.1. The areas and occupancies which are used for non-industrial uses and contains low quantity and less combustible materials which are expected to release less heat release rates during fire condition shall be classified as light hazard occupancies.

9.3. Ordinary Hazard

9.3.1. The areas and occupancies used for processing and handling of mainly ordinary combustible materials unlikely to develop intensely burning fires in the initial stages shall be classified as ordinary hazard occupancies. Ordinary Occupancies shall be further sub classified in to two groups:

9.3.2. Ordinary Hazard, Group-1: The areas and occupancies which are used for commercial & industrial uses and contains medium quantity and moderate combustible materials and the storage's 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.

9.3.3. 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 storage's up to 3.6 mtrs which are expected to release moderate heat release rates and the storage's up to 2.4 mtrs which are high heat release rates during fire condition shall be classified as Ordinary Hazard group-2.

9.4. Extra High Hazard

9.4.1. The areas and occupancies used for processing and handling abnormal fire loads, likely to produce exceptionally intense fires with high rates of heat release and with high storage heights. Extra high hazard occupancies shall be further classified in to two groups:

9.4.1.1. Extra High 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 ratesduring fire condition and having less or no combustible or flammable liquids & gases shall be classified as Extra high hazard group-1.

9.4.1.2. Extra High 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.

9.5. Special / Storage Hazard

9.5.1. The areas and occupancies used for miscellaneous storage purposes having storage height greater than 3.6 mtrs shall be classified in to storage hazard occupancies. Storage hazard occupancies shall be further sub classified in to eight classes as described below:

9.5.1.1. Commodity Class -1 Class I commodity are the Noncombustible materials that are stored directlyon wooden pallets, single layer corrugated cartons with or without pallets &shrink wrapped or paper wrapped as unit load with or without pallets.

9.5.1.2. Commodity Class-2 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.

9.5.1.3. Commodity Class-3 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 byweight of group C plastics products may also be considered as class 3 commodities.

9.5.1.4. Commodity Class-4 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.

9.5.1.5. Group –A Plastics : Examples of Group A plastic materials are ABS (acrylonitrile-butadiene- styrene copolymer), Acetal (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, Polypropylene, Polystyrene, Polyurethane, PVC (polyvinyl chloride — highly plasticized, with plasticizer content greater than 20 percent) (rarely found), SAN (styrene acrylonitrile) and SBR (styrene-butadiene rubber).

9.5.1.6. Group –B Plastics : Examples of Group B plastic materials are Cellulosics (cellulose acetate, cellulose acetate butyrate, ethyl cellulose), Chloroprene rubber, Fluoroplastics (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.

9.5.1.7. Group – C Plastics : Examples of Group C plastic materials are Fluoroplastics (PCTFE — polychlorotrifluoroethylene; 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).

9.5.1.8. Rolled paper Store

9.5.1.8.1. Rolled paper storage facility can be further subdivided in to fourclasses based on its weight to determine the sprinkler system design criteria.

i. Heavy weight Class: Heavyweight class shall include paperboard and paper stock having a basis weight per 92.9 m^2 of 9.1 kg.

ii. Medium weight Class: Medium weight class shall include all the broadrange of papers having a basis weight per 92.9 m^2 of 4.5 kg to 9.1 kg.

iii. Lightweight class: Light weight class shall include all papers having a basis weight per 92.9 m^2 of 4.5 kg.

9.5.1.8.2. Tissue shall include the broad range of papers of characteristic gauzy texture, which, in some cases, are fairly transparent such ascrepe wadding and the sanitary class including facial tissue, papernapkins, bathroom tissue, and toweling.

10. Sprinkler System Design Requirements

10.1. This section shall be the guideline for design of Sprinkler System for all occupancies other than storage occupancies.

10.2. The sprinkler system shall include dedicated or combined fire water pump & water tanks, water supply riser, alarm check valve, breeching inlet, floor zone control valves, feeder main piping, cross main piping, branch piping and sprinklers.

10.3. An automatic air release valve shall be installed at top most point of each riser with an isolation ball valve.

10.4. A supervised control valve shall be installed at bottom of each sprinkler riser on upstream side of an Alarm check valve for isolation of the corresponding riser for repair & maintenance purposes.

10.5. An approved pressure gauge shall be installed on bottom & top of each sprinkler riser and Alarm check valve with a control valve (gauge cock) having drain arrangement.

10.6. Pressure relief valves shall be installed on a gridded wet sprinkler system to relieve the pressure when exceeds 12.1 bar.

10.7. Each level or fire compartment zone shall be provided with a zone control valve assembly consists of a supervised isolation valve, a water flow switch, a pressure gauge with isolation valve, inspectors test valve and sectional drain valve.

10.8. Maximum protection coverage & spacing of extended coverage Pendent / Upright / sidewall sprinklers shall be not less than that prescribed by the approval listing.

10.9. For systems with multiple hazard classifications, the hose stream allowance and water supply shall be the requirements for the highest hazard classification within the system.

10.10. Hose Demand.

10.10.1. An allowance for inside and outside hose shall not be required where tankssupply sprinklers only.

10.10.2. Where pumps taking suction from a private fire service main supply to sprinklers only, the pump need not be sized to accommodate inside andoutside hose. Such hose allowance shall be considered in evaluating theavailable water supplies.

10.10.3. Water allowance for outside hose shall be added to the sprinkler requirement at the connection to the city main or a yard hydrant, whicheveris closer to the system riser.

10.11. Where inside hose stations are planned or are required, the following shall apply:

i. A total water allowance of 50 gpm (190 LPM) for a single hose station installationshall be added to the sprinkler requirements.

ii. A total water allowance of 100 gpm (380 LPM) for a multiple hose station installation shall be added to the sprinkler requirements.

iii. The water allowance shall be added in 50 gpm (190L/min) increments beginning at the most remote hose station, with each increment added at the pressure requiredby the sprinkler system design at that point.

10.12. Where the combined sprinkler system demand and hose stream allowance exceeds the requirements of Standpipe and Hose Systems' water demand, the higher demand shall be used.

10.13. For partially sprinklered buildings, the sprinkler water demand shall be added to the water requirements of Standpipe and Hose Systems.

11. Sprinkler System Design Requirements for all occupancies other than Storage Occupancies

11.1. Design criteria shall be as per Table 9.7, which depicts Hazard Identification, Sprinkler spacing, Design density, Sprinkler Area of operation, Hose Stream allowance and duration of discharge requirements.

Table 9.7: Sprinkler Design Criteria for all occupancies Other Than Storage Occupancies

LOCATION	HAZARD CATEGORY	STANDARD SPRINKLERS		SIDEWALL SPRINKLERS		DESIGN DENSITY [L/min]/ m² (gpm)	AREA OF OPERATION Ft ² (m²)	HOSE STREAM AL-LOWANCE LPM (GPM)	WATER TANK DU-RATION (MINUTES)
		MAXIMUM COVERAGE (m²)	SPACING (m)	MAXIMUM COVERAGE (m²)	SPACING (m)				
se ceiling concealed& false floor spaces	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60
e Cylinder Charging Plants.	Extra(Group 1)	NFPA 51A, *Standard for Acetylene Cylinder Charging Plants*, open or closed head sprinkler system.				12.2 (0.30)	2500 (232)	1900 (500)	60
Engine Test Facilities, test cell	NFPA 423, *Standard for Construction and Protection of Aircraft Engine Test Facilities*					20.4	-	950 (250)	30
rcraft Hangers	Extra (Group 1)	9.3	Max 3.7 Min 1.8	-	-	12.2 (0.30)	2500 (232)	1900 (500)	90
Terminal Buildings, amp Drainage, and ding Walkways	Ordinary(Group1)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	6.1 (0.15)	1500 (140)	950 (250)	60
erminal, Baggage, nd mail handlingar-eas	Ordinary(Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60
Housing Facilities.	Need quick responsetype	Refer to NFPA 13 ,Standard for the Installation of Sprinkler Systems				-	-	-	-
Archives	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60
phalt Saturating	Extra (Group 2)	9.3	Max 3.7 Min 1.8	-	-	16.3 (0.40)	2500 (232)	1900 (500)	120
Attics Unused	Light Hazard	21	Max 4.6 Min 1.8	18.2	Max 4.27 Min 1.8	4.1 (0.10)	1500 (140)	100	60
Auditoriums	Light Hazard	21	Max 4.6 Min 1.8	18.2	Max 4.27 Min 1.8	4.1 (0.10)	1500 (140)	100	60
omobile Parking	Ordinary(Group1)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	6.1 (0.15)	1500 (140)	950 (250)	60
Bakeries	Ordinary (Group1)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	6.1 (0.15)	1500 (140)	950 (250)	60
age manufacturing	Ordinary (Group1)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	6.1 (0.15)	1500 (140)	950 (250)	60

Table 9.7: Sprinkler Design Criteria for all occupancies Other Than Storage Occupancies

LOCATION	HAZARD CATEGORY	STANDARD SPRINKLERS		SIDEWALL SPRINKLERS		DESIGN DENSITY [L/min]/ m² (gpm)	AREA OF OPERATION Ft ² (m²)	HOSE STREAM AL-LOWANCE LPM (GPM)	WATER TANK DU-RATION (MINUTES)
		MAXIMUM COVERAGE (m²)	SPACING (m)	MAXIMUM COVERAGE (m²)	SPACING (m)				
Fire control rooms	Ordinary (Group1)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	6.1 (0.15)	1500 (140)	950 (250)	60
Spreading Room.	NFPA 850, *Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations*					12.2 (0.30)	2500 (232)	-	-

able Tunnels.	NFPA 850, *Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations*					12.2 (0.30)	2500 (232)	-	-
Canneries	Ordinary (Group1)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	6.1 (0.15)	1500 (140)	950 (250)	60
parking areas	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60
Cereal Mills	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60
al Plants (Ordinary)	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60
Churches	Light Hazard	21	Max 4.6 Min 1.8	18.2	Max 4.27 Min 1.8	4.1 (0.10)	1500 (140)	100	60
yperbaric bers.	Refer to NFPA 13 ,Standard for the Installation of Sprinkler Systems					8.1 (0.20)	-	-	-
Cleanrooms.	-	-	6.1 (3.7 vertical)	-	-	8.1 (0.20)	(279)	-	-
aving heaters, s, furnaces	Refer to NFPA 13 ,Standard for the Installation of Sprinkler Systems					-	-	-	-
Clubs	Light Hazard	21	Max 4.6 Min 1.8	18.2	Max 4.27 Min 1.8	4.1 (0.10)	1500 (140)	100	60
le Hydraulic fluiduse areas	Extra (Group 1)	9.3	Max 3.7 Min 1.8	-	-	12.2 (0.30)	2500 (232)	1900 (500)	90
d Gases and Fluids in Portable	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	(278)	950 (250)	60

Table 9.7: Sprinkler Design Criteria for all occupancies Other Than Storage Occupancies

LOCATION	HAZARD CATEGORY	STANDARD SPRINKLERS		SIDEWALL SPRINKLERS		DESIGN DENSITY [L/min]/ m² (gpm)	AREA OF OPERATION Ft ² (m²)	HOSE STREAM AL-LOWANCE LPM (GPM)	WATER TANK DU-RATION (MINUTES)
		MAXIMUM COVERAGE (m²)	SPACING (m)	MAXIMUM COVERAGE (m²)	SPACING (m)				
tionary Containers, nders, and Tanks									
fectionary products	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60
nference Rooms	Light Hazard	21	Max 4.6 Min 1.8	18.2	Max 4.27 Min 1.8	4.1 (0.10)	1500 (140)	100	60
Corridors	Light Hazard	21	Max 4.6 Min 1.8	18.2	Max 4.27 Min 1.8	4.1 (0.10)	1500 (140)	100	60
roducts cturing	Ordinary (Group1)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	6.1	1500 (140)	950 (250)	60
products processing	Ordinary (Group1)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	6.1 (0.15)	1500 (140)	950 (250)	60
Data processing	Light Hazard	21	Max 4.6 Min 1.8	18.2	Max 4.27 Min 1.8	4.1 (0.10)	1500 (140)	100	60
tion and Correctional	Light Hazard	21	Max 4.6 Min 1.8	18.2	Max 4.27 Min 1.8	4.1 (0.10)	1500 (140)	100	60
Die Casting	Extra (Group 1)	9.3	Max 3.7 Min 1.8	-	-	12.2 (0.30)	2500 (232)	1900 (500)	90
Distilleries	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60

Dry Cleaners	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60	
Duct systems	Refer to NFPA 13 ,Standard for the Installation of Sprinkler Systems					1.9	-	-	-	
Educational	Light Hazard	21	Max 4.6 Min 1.8	18.2	Max 4.27 Min 1.8	4.1 (0.10)	1500 (140)	100	60	
lectronic plants	Ordinary (Group1)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	6.1 (0.15)	1500 (140)	950 (250)	60	
ency Diesel Generators ombustion Turbines.	NFPA 850, *Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations*					10.2	-	-	-	
rgency generator set	Ordinary	12	Max 4.6	9.3	Max 3	8.1	1500 (140)	950 (250)	60	

Table 9.7: Sprinkler Design Criteria for all occupancies Other Than Storage Occupancies

LOCATION	HAZARD CATEGORY	STANDARD SPRINKLERS		SIDEWALL SPRINKLERS		DESIGN DENSITY [L/min]/ m² (gpm)	AREA OF OPERATION Ft ² (m²)	HOSE STREAM AL-LOWANCE LPM (GPM)	WATER TANK DU-RATION (MINUTES)	S Z
		MAXIMUM COVERAGE (m²)	SPACING (m)	MAXIMUM COVERAGE (m²)	SPACING (m)					
rooms	(Group2)		Min 1.8		Min 1.8	(0.20)				
Feed Mills	Ordinary(Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60	
ire Pump Room	Refer to NFPA 13 ,Standard for the Installation of Sprinkler Systems					10.2	-	-	-	
ble and Combustible Liquids	Extra(Group 2)	NFPA 30, *Flammable and Combustible Liquids Code.*						1900 (500)	120	
able Liquids Spraying	Extra Group 2	9.3	Max 3.7 Min 1.8	-	-	16.3 (0.40)	2500 (232)	1900 (500)	120	
Flow Coating	Extra(Group 2)	9.3	Max 3.7 Min 1.8	-	-	16.3 (0.40)	2500 (232)	1900 (500)	120	
arages (Repair)	Ordinary(Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60	
ge collection rooms	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60	
ss manufacturing	Ordinary (Group1)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	6.1 (0.15)	1500 (140)	950 (250)	60	
oducts cturing	Ordinary(Group1)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	6.1 (0.15)	1500 (140)	950 (250)	60	
nasium, Health club,	Light Hazard	21	Max 4.6 Min 1.8	18.2	Max 4.27 Min 1.8	4.1 (0.10)	1500 (140)	100	60	
Horse Stables	Ordinary(Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60	
Hospitals	Light Hazard	21	Max 4.6 Min 1.8	18.2	Max 4.27 Min 1.8	4.1 (0.10)	1500 (140)	100	60	
tors, and Waste and andling Systems and ent. ½ in. (13 mm) ori- d ordinary tempera- e-rated sprinklers	Refer to NFPA 82 *Standard on Incinerators and Waste and Linen Handling Systems and Equipment*									
rial Furnaces Using a	Refer to NFPA 86C *Standard for Industrial Furnaces Using a Special Processing Atmosphere*									

Table 9.7: Sprinkler Design Criteria for all occupancies Other Than Storage Occupancies

LOCATION	HAZARD CATEGORY	STANDARD SPRINKLERS		SIDEWALL SPRINKLERS		DESIGN DENSITY [L/min]/m² (gpm)	AREA OF OPERATION Ft ² (m²)	HOSE STREAM AL-LOWANCE LPM (GPM)	WATER TANK DU-RATION (MINUTES)	S Z
		MAXIMUM COVERAGE (m²)	SPACING (m)	MAXIMUM COVERAGE (m²)	SPACING (m)					
l Process Atmosphere										
tion TechnologyEquip-ment.	NFPA 75,*Standard for the Protection of Electronic Computer/Data Processing Equipment*, they shall be valved separately from other sprinkler s									
Institutional	Light Hazard	21	Max 4.6 Min 1.8	18.2	Max 4.27 Min 1.8	4.1 (0.10)	1500 (140)	100	60	
ories UsingChemicals.	Class A and B – Ordinary Hazard Group 2 Class C and D – Ordinary Hazard Group 1					8.1 (0.20) 6.1 (0.15)	140	950 (250)	60	
Laundries	Ordinary(Group1)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	6.1 (0.15)	1500 (140)	950 (250)	60	
Leather Goods Manufacturing	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60	
ries less than 900 m²	Light Hazard	21	Max 4.6 Min 1.8	18.2	Max 4.27 Min 1.8	4.1 (0.10)	1500 (140)	100	60	
es more than 900 m2 area	Ordinary(Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60	
t machine rooms,	Ordinary(Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60	
Lobbies	Light Hazard	21	Max 4.6 Min 1.8	18.2	Max 4.27 Min 1.8	4.1 (0.10)	1500 (140)	100	60	
Machine Shops	Ordinary(Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60	
tenance workshops	Ordinary(Group1)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	6.1 (0.15)	1500 (140)	950 (250)	60	
nufactured Homes building	Extra(Group 2)	9.3	Max 3.7 Min 1.8	-	-	16.3 (0.40)	2500 (232)	1900 (500)	120	
Terminals, Piers, and Wharves	NFPA 307, *Standard for the Construction and Fire Protection of Marine Terminals, Piers, and Wharves*									
anical plant Rooms	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60	
Meeting Rooms	Light Hazard	21	Max 4.6	18.2	Max 4.27	4.1	1500	100	60	

Table 9.7: Sprinkler Design Criteria for all occupancies Other Than Storage Occupancies

N	HAZARD CATEGORY	STANDARD SPRINKLERS		SIDEWALL SPRINKLERS		DESIGN DENSITY [L/min]/m² (gpm)	AREA OF OPERATION Ft ² (m²)	HOSE STREAM AL-LOWANCE LPM (GPM)	WATER TANK DU-RATION (MINUTES)	S Z T (
		MAXIMUM COVERAGE (m²)	SPACING (m)	MAXIMUM COVERAGE (m²)	SPACING (m)					
			Min 1.8		Min 1.8	(0.10)	(140)			
ile	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60	4
truding	Extra (Group 1)	9.3	Max 3.7 Min 1.8	-	-	12.2 (0.30)	2500 (232)	1900 (500)	90	3
orks	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60	4

neous stores	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60	4
building assemblies	Extra (Group 2)	9.3	Max 3.7 Min 1.8	-	-	16.3 (0.40)	2500 (232)	1900 (500)	120	3
s	Light Hazard	21	Max 4.6 Min 1.8	18.2	Max 4.27 Min 1.8	4.1 (0.10)	1500 (140)	100	60	4
pose halls	Light Hazard	21	Max 4.6 Min 1.8	18.2	Max 4.27 Min 1.8	4.1 (0.10)	1500 (140)	100	60	4
s	Light Hazard	21	Max 4.6 Min 1.8	18.2	Max 4.27 Min 1.8	4.1 (0.10)	1500 (140)	100	60	4
ilm	Extra Hazard (Group 2)	6	2.4max	-	-	16.3	NFPA 40, *Standard for the Storage and Handling o* *Nitrate Film*, one sprinkler shall be provided for e			
Homes	Light Hazard	21	Max 4.6 Min 1.8	18.2	Max 4.27 Min 1.8	4.1 (0.10)	1500 (140)	100	60	4
	Light Hazard	21	Max 4.6 Min 1.8	18.2	Max 4.27 Min 1.8	4.1 (0.10)	1500 (140)	100	60	4
Boilers.	NFPA 850, *Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations*					10.2	-	-	-	-
Quenching	Extra(Group 2)	9.3	Max 3.7 Min 1.8	-	-	16.3 (0.40)	2500 (232)	1900 (500)	120	3
nd Furnaces.	Refer to NFPA 86C *Standard for Industrial Furnaces Using a Special Processing Atmosphere*									
Restaurants, Food ervice, Seating areas,	Ordinary (Group1)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	6.1	1500 (140)	950 (250)	60	4

Table 9.7: Sprinkler Design Criteria for all occupancies Other Than Storage Occupancies

N	HAZARD CATEGORY	STANDARD SPRINKLERS		SIDEWALL SPRINKLERS		DESIGN DENSITY [L/min]/ m² (gpm)	AREA OF OPERATION Ft ² (m²)	HOSE STREAM AL-LOWANCE LPM (GPM)	WATER TANK DU-RATION (MINUTES)	S Z T ((
		MAXIMUM COVERAGE (m²)	SPACING (m)	MAXIMUM COVERAGE (m²)	SPACING (m)					
Pulp Mills	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60	4
ocess Plants	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60	4
Board turing	Extra (Group 1)	9.3	Max 3.7 Min 1.8	-	-	12.2 (0.30)	2500 (232)	1900 (500)	90	3
vays	Light Hazard	21	Max 4.6 Min 1.8	18.2	Max 4.27 Min 1.8	4.1 (0.10)	1500 (140)	100	60	4
Rooms	Light Hazard	21	Max 4.6 Min 1.8	18.2	Max 4.27 Min 1.8	4.1 (0.10)	1500 (140)	100	60	4
d Wharves	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60	4
rocessing	Extra(Group 2)	9.3	Max 3.7 Min 1.8	-	-	16.3 (0.40)	2500 (232)	1900 (500)	120	3
Manufacturing	Extra (Group 1)	9.3	Max 3.7 Min 1.8	-	-	12.2 (0.30)	2500 (232)	1900 (500)	90	3
ces	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60	4
& Publishing Houses	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60	4
(Inks with flash elow 38 ºC	Extra (Group 1)	9.3	Max 3.7 Min 1.8	-	-	12.2 (0.30)	2500 (232)	1900 (500)	90	3

n Plastic.	-	3				76		1900 (500)	20 (per sprinkler)	
ial	Light Hazard	21	Max 4.6 Min 1.8	18.2	Max 4.27 Min 1.8	4.1 (0.10)	1500 (140)	100	60	4
plication areas	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60	4
nt seating areas	Light Hazard	21	Max 4.6 Min 1.8	18.2	Max 4.27 Min 1.8	4.1 (0.10)	1500 (140)	100	60	4

Table 9.7: Sprinkler Design Criteria for all occupancies Other Than Storage Occupancies

N	HAZARD CATEGORY	STANDARD SPRINKLERS		SIDEWALL SPRINKLERS		DESIGN DENSITY [L/min]/ m² (gpm)	AREA OF OPERATION Ft ² (m²)	HOSE STREAM AL-LOWANCE LPM (GPM)	WATER TANK DU-RATION (MINUTES)	S Z T (
		MAXIMUM COVERAGE (m²)	SPACING (m)	MAXIMUM COVERAGE (m²)	SPACING (m)					
nt service areas	Ordinary (Group1)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	6.1 (0.15)	1500 (140)	950 (250)	60	4
nts, Food courts	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60	4
eas,	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60	4
Compounding	Extra (Group 1)	9.3	Max 3.7 Min 1.8	-	-	12.2 (0.30)	2500 (232)	1900 (500)	90	3
Drying	Extra (Group 1)	9.3	Max 3.7 Min 1.8	-	-	12.2 (0.30)	2500 (232)	1900 (500)	90	3
Milling	Extra (Group 1)	9.3	Max 3.7 Min 1.8	-	-	12.2 (0.30)	2500 (232)	1900 (500)	90	3
eclaiming	Extra (Group 1)	9.3	Max 3.7 Min 1.8	-	-	12.2 (0.30)	2500 (232)	1900 (500)	90	3
/ulcanizing	Extra (Group 1)	9.3	Max 3.7 Min 1.8	-	-	12.2 (0.30)	2500 (232)	1900 (500)	90	3
s	Extra (Group 1)	9.3	Max 3.7 Min 1.8	-	-	12.2 (0.30)	2500 (232)	1900 (500)	90	3
rooms,	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60	4
oms	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60	4
Cleaning	Extra(Group 2)	9.3	Max 3.7 Min 1.8	-	-	16.3 (0.40)	232	1900 (500)	120	3
Extraction	Ordinary Hazard (Group 2)	10.2 l/min/m² if using NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection* 6.5 l/min/m² if using NFPA 16, *Standard for the Installation of Foam-Wa-terSprinkler and Foam-Water Spray Systems*								
	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60	4
y stores	Ordinary	12	Max 4.6	9.3	Max 3	8.1	1500	950	60	4

Table 9.7: Sprinkler Design Criteria for all occupancies Other Than Storage Occupancies

LOCATION	HAZARD CATEGORY	STANDARD SPRINKLERS	SIDEWALL SPRINKLERS	DESIGN DENSITY	AREA OF OPERATION	HOSE	WATER	S

		MAXIMUM COVERAGE (m²)	SPACING (m)	MAXIMUM COVERAGE (m²)	SPACING (m)	[L/min]/ m² (gpm)	Ft ² (m²)	STREAM AL-LOWANCE LPM (GPM)	TANK DU-RATION (MINUTES)
	(Group2)		Min 1.8		Min 1.8	(0.20)	(140)	(250)	
ousekeeping aterial	Ordinary (Group1)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	6.1 (0.15)	1500 (140)	950 (250)	60
on hazardous ry chemical	Ordinary (Group1)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	6.1 (0.15)	1500 (140)	950 (250)	60
Textile Blending	Extra (Group 1)	9.3	Max 3.7 Min 1.8	-	-	12.2 (0.30)	2500 (232)	1900 (500)	90
Textile Carding	Extra (Group 1)	9.3	Max 3.7 Min 1.8	-	-	12.2 (0.30)	2500 (232)	1900 (500)	90
tile Manufacturing	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60
Textile Opening	Extra (Group 1)	9.3	Max 3.7 Min 1.8	-	-	12.2 (0.30)	2500 (232)	1900 (500)	90
Textile Picking	Extra (Group 1)	9.3	Max 3.7 Min 1.8	-	-	12.2 (0.30)	2500 (232)	1900 (500)	90
Theaters	Light Hazard	21	Max 4.6 Min 1.8	18.2	Max 4.27 Min 1.8	4.1 (0.10)	1500 (140)	100	60
e Manufacturing	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60
obacco Products Manufacturing	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60
e Generator Bearings	NFPA 850, *Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations*					12.2 (0.30)	464	1900 (500)	120
Generator, under erating Floor	Need foam-water sprinkler system	12.2 (0.30)				12.2	464	1900 (500)	120
Upholstering	Extra (Group 1)	9.3	Max 3.7 Min 1.8	-	-	12.2 (0.30)	2500 (232)	1900 (500)	90
lity LP-Gas Plants.	Refer to NFPA 59, *Utility LP-Gas Plant Code*					10.2		1000	120

Table 9.7: Sprinkler Design Criteria for all occupancies Other Than Storage Occupancies

LOCATION	HAZARD CATEGORY	STANDARD SPRINKLERS		SIDEWALL SPRINKLERS		DESIGN DENSITY [L/min]/ m² (gpm)	AREA OF OPERATION Ft ² (m²)	HOSE STREAM AL-LOWANCE LPM (GPM)	WATER TANK DU-RATION (MINUTES)
		MAXIMUM COVERAGE (m²)	SPACING (m)	MAXIMUM COVERAGE (m²)	SPACING (m)				
sh and Paint Dipping	Extra(Group 2)	9.3	Max 3.7 Min 1.8	-	-	16.3 (0.40)	2500 (232)	1900 (500)	120
ooling Towers., led Fan Decks	6.11 LPM/m² (1.6 GPM/m²) on the under-side of the fan deck ex-tension.	NFPA 214, *Standard on Water-Cooling Towers.*				14.26	-	1900 (500)	60
Cooling Towers., fan f counterflow towers	NFPA 214, *Standard on Water-Cooling Towers.*					20.4	-	1900 (500)	60
ooling Towers., fan f crossflow towers	NFPA 214, *Standard on Water-Cooling Towers.*					13.45	-	1900 (500)	60

Cooling Towers., fill of crossflow towers	NFPA 214, *Standard on Water-Cooling Towers*.					20.4	-	1900 (500)	60	
Vood Machining	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60	
d Product Assembly	Ordinary (Group2)	12	Max 4.6 Min 1.8	9.3	Max 3 Min 1.8	8.1 (0.20)	1500 (140)	950 (250)	60	

Note: All special hazards such as diesel engines, boilers, turbines, ovens, cooling towers, aircraft hangers, chemical processes, laboratories, solvent extraction, flammable materials, marine terminals, cable tunnels and others, shall comply with the appropriate NFPA standard and Civil Defense requirements. Material Safety Data Sheet (where applicable) with risk assessment report shall be provided to verify the type of hazard and design of the applicable fire protection system.

Also see Table 9.3 and Table 9.4 for Facility/ Hazard Risk Analysis requirements

1. Special Design Consideration for

1.1. Atriums.

1.1.1. Glass walls and inoperable windows shall be permitted if Automatic sprinklers are spaced along both sides of the glass wall and the inoperable window at intervals notto exceed 72 in. (1830 mm).

1.1.2. The automatic sprinklers specified above are located at a distance from the glasswall not to exceed 305 mm and arranged so that the entire surface of the glass iswet upon operation of the sprinklers.

1.1.3. The glass wall is of tempered, wired, or laminated glass held in place by a gasket system that allows the glass framing system to deflect without breaking (loading) theglass before the sprinklers operate.

1.1.4. The automatic sprinklers are not required on the atrium side of the glass wall and the inoperable window where there is no walkway or other floor area on the atriumside above the main floor level.

1.1.5. Listed quick-response or listed residential sprinklers shall be used throughout alldwelling units.

1.1.6. The draft stop and closely spaced sprinkler requirements of NFPA 13 shall not berequired for convenience openings complying with NFPA 101, 8.6.8.2, where the convenience opening is within the dwelling unit.

2. Sprinkler System Design Requirements for Storage Occupancies

2.1. General

2.1.1. Sprinkler protection criteria are based on the assumption that roof vents and draft curtains are not being used.

2.1.2. The sprinkler system criteria specified are intended to apply to buildings with ceiling slopes not exceeding 2 in 12 (16.7 %) unless modified by a specific sections.

2.1.3. The maximum building height shall be measured to the underside of the roof deck or ceiling.

2.1.4. Early suppression fast-response (ESFR) sprinklers shall be used only in buildings equal to, or less than, the height of the building for which they have been listed.

2.1.5. The sprinkler system design shall be based on the storage height and clearance to ceiling that routinely or periodically exist in the building and create the greatest water demand. Where storage is placed above doors, the storage height shall be calculated from the base of storage above the door.

2.1.6. For ceiling heights that exceed 9.14 m, and where the distance between the ceiling height and top of storage exceeds 6.1 m, protection shall be provided for the storage height that would result in a 6.1 m distance between the ceiling height and top of storage.

2.1.7. For dry pipe systems and pre-action systems, the area of sprinkler operation shall beincreased by 30 percent without revising the density

2.1.8. Densities and areas shall be selected so that the final area of operation after the 30 percent increase is not greater than 557.4 m²

2.2. Preferred K-factors of Sprinkler Heads for Storage Occupancies

2.2.1. Testing has shown that when greater than 3.05 m clearance between storage top and sprinklers is inevitable, larger orifice sprinklers (K-11.2 and larger) will produce better results than smaller orifice sprinklers due to larger droplets penetrating the fire plume and/or more water discharging, thereby creating more cooling of atmosphere and building and more water penetration to the burning surfaces. Therefore, using larger orifice sprinklers is normally better not only as density requirements go higher but also as clearances exceed 13.05 m.

2.2.2. Table 9.8 suggests preferred K-factors of certain design densities for Storage applications.

Table 9.8: Preferred K-factors for Storage applications

STORAGE APPLICATION	DESIGN DENSITIES	PREFERRED K- FACTORS
General Storage	Less than 0.20 gpm (8.2 LPM)	K-5.6 (80) or Larger
Rack Storage	0.20 gpm (8.2 LPM) – 0.34 gpm (13.9 LPM)	K-8 (115) or Larger
Rubber Tire Storage, Roll Paper Storage, Baled Cotton Storage	More than 0.34 gpm (13.9 LPM)	K-11.2 (161) or Larger

2.2.3. The use of quick-response spray sprinklers for storage applications shall be permitted when listed for such use.

2.2.4. Large drop, control mode specific application and ESFR sprinklers are permitted to protect ordinary hazard, storage of Class I through Class IV commodities, plastic commodities, miscellaneous storage, and other storage

3. Design criteria for Storage Occupancies

3.1. Design criteria for Storage occupancies shall be as per following tables which depict Commodity Classification, Storage Type, Storage Height, required Design density, Sprinkler Area of operation, Hose Stream allowance and duration of discharge requirements.

3.2. Idle Wooden Pallets

3.2.1. Wood pallets can be stored outside or outside in a detached structure. Where wooden idle pallets are stored indoors, such arrangement in an occupancy shall beprotected with automatic sprinkler system.

3.2.2. Control Mode (design/area) design criteria for idle wooden pallets stored indoorsshall be as per Table 9.9.

3.2.3. Large Drop design requirement for idle wooden pallets stored indoors and on floorshall be as per Table 9.10.

Table 9.9: Control Mode (design/area) design requirement for idle wooden pallets stored indoors

TABLE 9.9:. CONTROL MODE (DESIGN/AREA) DESIGN REQUIREMENT FOR IDLE WOODEN PALLETS STORED INDOORS								
INDOOR STORAGE ARRANGEMENT	K-FACTOR	MAXIMUM STORAGE HEIGHT	MAXIMUM CEILING HEIGHT	REQUIRED DESIGN DENSITY Gpm (LPM)	AREA OF SPRINKLER OPERATION FT ^{2} (m^2)		TOTAL COMBINED INSIDE AND OUTSIDE HOSEGpm (LPM)	WATER TANK DURATION (MINUTES)
					HIGH TEMP SPRINKLER	ORDINARY TEMP SPRINKLER		
ON FLOOR	8 (115) or Larger	< 1.8 m	6.1 m	0.20 (8.2)	2000 (186)	3000 (279)	500 (1900)	90
	11.2 (160) or larger	< 2.4 m	9.1 m	0.45(18.3)	2500 (232)	4000 (372)	500 (1900)	90
	16.8 (242)	< 6.1	9.1 m	0.60(24.5)	-	2000 (186)	500 (1900)	90
ON FLOOR OR RACK WITHOUT SOLID SHELVES	11.2 (161) or larger	2.4 m - 3.7 m	9.1 m	0.60(24.5)	3500 (325)	6000 (557)	500 (1900)	90
		3.7 m - 6.1 m	9.1 m	0.60(24.5)	4500 (418)	-	500 (1900)	90

Table 9.10: Large Drop design requirement for idle wooden pallets stored indoors and on floor

TABLE 9.10: LARGE DROP SPRINKLER DESIGN REQUIREMENT FOR IDLE WOODEN PALLETS STORED INDOORS AND ON FLOOR								
TYPE OFSYSTEM	K-FACTOR / ORIENTATION	MAXIMUM STORAGE HEIGHT	MAXIMUM CEILING HEIGHT	NUMBER OF DESIGN SPRINKLERS BY MINIMUM PRESSURE			TOTAL COMBINED INSIDE AND OUTSIDE HOSE Gpm (LPM)	DURATION MINUTES
				25 psi	50 psi	75 psi		
WET	11.2 (160) Upright	< 6.1 m	9.1 m	15	15	15	500 (1900)	90
DRY	11.2 (160) Upright	< 6.1 m	9.1 m	25	25	25	500 (1900)	120

11.1.1. Specific Application (K-factor 16.8) design requirement for idle wooden pallets stored indoors and on floor shall be as per Table 9.11.

11.1.2. Specific Application (K-factor 19.6) design requirement for idle wooden pallets stored indoors and on floor shall be as per Table 9.12.

11.1.3. ESFR design requirement for idle wooden pallets stored indoors and on floor shall be as per Table 9.13.

11.2. Idle Plastic Pallets

11.2.1. Plastic idle pallets can be stored outside or in a detached structure. Where Plastic idle pallets are stored indoors, such arrangement in an occupancy shall be protected with automatic sprinkler system.

11.2.2. Indoor storage of plastic pallets shall be permitted to be protected with automatic sprinkler system in accordance with the following arrangement:

i. Maximum storage height of 3.05 m
ii. Maximum ceiling height of 9.1 m
iii. Sprinkler density 0.6 gpm/ft2 (24.4 mm/min) over 2000 ft2 (186 m2)
iv. Minimum sprinkler K-factor of 16.8

11.2.3. Where stored in cutoff rooms, the following shall apply:

i. The cutoff rooms shall have at least one exterior wall.
ii. The plastic pallet storage shall be separated from the remainder of the buildingby 3 hour–rated fire walls.
iii. The storage shall be protected by sprinklers designed to deliver 0.6 gpm/ft^2(24.5 LPM) for the entire room or by high-expansion foam and sprinklers designed to deliver 0.30 gpm/ft^2 (12.2 LPM) for the entire room.

11.2.4. ESFR design requirement for Plastic idle pallets stored indoors shall be as per Table 9.14.

11.3. Class I, II, III and IV Commodities, Stored Palletized, solid piled or on shelves

11.3.1. Up to 3.7 m storage height

14.4.1.1. Design requirements for palletized, solid piled, in shelf or in racks Storage ofcommodities, Class I through Class IV, with storage height of less than 3.7 mshall be as per Table 9.15.

11.3.2. 3.7 m to 6.1 m storage height

14.4.2.1. Design requirements for palletized, solid piled, in shelf or in racks Storage of commodities, Class I through Class IV, with storage height of 3.7 m to 6.1 shall be as per Table 9.16.

11.3.3. 6.1 m to 6.7 m storage height

14.4.3.1. Design requirements for palletized, solid piled, in shelf or in racks Storage ofcommodities, Class I through Class IV, with storage height of 6.1 m to 6.7 m shall be as per Table 9.17.

11.3.4. 6.7 m to 7.6 m storage height

14.4.4.1. Design requirements for palletized, solid piled, in shelf or in racks Storage ofcommodities, Class I through Class IV, with storage height of 6.7 m to 7.6 m shall be as per Table 9.18.

14.4.4.2. The densities selected from Table 9.16, Table 9.17 and Table 9.18 shall bemodified in accordance with storage heights as per Figure 9.13 without revising the design area.

Table 9.11: Specific Application (K-factor 16.8) design requirement for idle wooden Palletsstored indoors and on floor

TABLE 9.11: SPECIFIC APPLICATION (K-FACTOR 16.8) SPRINKLER DESIGN REQUIREMENT FOR IDLE WOODEN PALLETS STORED INDOORS AND ON FLOOR							
TYPE OF SYSTEM	K-FACTOR/ ORIENTATION	MAXIMUM STORAGE HEIGHT	MAXIMUM CEILING HEIGHT	NUMBER OF DESIGN SPRINKLERS	MINIMUM OPERATING PRESSURE (PSI)	TOTAL COMBINED INSIDE AND OUT-SIDE HOSE Gpm (LPM)	WATER TANK DURATION (MINUTES)
WET	16.8 (240) Upright	6.1 m	9.1 m	15	15 psi	500 (1900)	90
DRY	16.8 (240) Upright	6.1 m	9.1 m	15	15 psi	500 (1900)	120

Table 9.12: Specific Application (K-factor 19.6) design requirement for idle wooden pallets stored indoors and on floor

TABLE 9.12: SPECIFIC APPLICATION (K-FACTOR 9.6) SPRINKLER DESIGN REQUIREMENT FOR IDLE WOODEN PALLETS STORED INDOORS AND ON FLOOR							
TYPE OF SYSTEM	K-FACTOR/ ORIENTATION	MAXIMUM STORAGE HEIGHT	MAXIMUM CEILING HEIGHT	NUMBER OF DESIGN SPRINKLERS	MINIMUM OPERATING PRESSURE (PSI)	TOTAL COMBINED INSIDE AND OUT-SIDE HOSE Gpm (LPM)	WATER TANK DURATION (MINUTES)
WET	16.8 (280) Pendent	6.1 m	9.1 m	15	16psi	500 (1900)	90
WET	16.8 (280) Pendent	6.1 m	10.6 m	15	25psi	500 (1900)	90
WET	19.6 (280) Pendent	6.1 m	12.1 m	15	30psi	500 (1900)	90

TABLE 9.13: ESFR SPRINKLER REQUIREMENTS FOR IDLE WOODEN PALLETS STORED INDOORS

STORAGE ARRANGEMENT	COMMODITY	MAXIMUM STORAGE HEIGHT (m)	MAXIMUM CEILING HEIGHT (m)	NOMINAL K-FACTORS FOR THE TYPE OF SPRINKLERORIENTA-TION		MINIMUM OPERAT-INGPRES-SURE (PSI)	HOSE ALLOWANCE	WATER TANK DU-RATION (MINUTES)
				UPRIGHT	PENDENT			
ON FLOOR OR RACKS WITHOUT SOLID SHELVES	IDLE WOODEN PALLETS	7.6	9.1	-	14 (201)	50	250 GPM (950) LPM	60
				-	16.8 (242)	35		
				-	22.4 (322)	25		
				-	25.2 (363)	15		
		7.6	9.8	-	14 (201)	60		
				-	16.8 (242)	42		
				-	-	-		
				-	-	-		
		9.1	10.7	-	-	-		
				-	-	-		
				-	22.4 (322)	35		
				-	25.4 (360)	30		
		10.7	12.2	-	14 (201)	75		
				-	16.8 (242)	52		
				-	22.4 (322)	40		
				-	25.2 (363)	25		
		12.2	13.7	-	22.4 (322)	25		
				-	25.2 (363)	40		
ON FLOOR	IDLE WOODEN PALLETS	-	-	-	-	-	250 GPM (950) LPM	60
				-	-	-		
		6.1	9.1	-	14 (201)	50		
				-	16.8 (240)	35		
			10.7	-	14 (201)	75		
				-	16.8 (240)	35		

TABLE 9.14: ESFR SPRINKLER REQUIREMENTS FOR IDLE PLASTIC PALLETS STORED IN-DOORS

STORAGE AR-RANGEMENT	COMMODITY	MAXIMUM STORAGE HEIGHT (m)	MAXIMUM CEILING HEIGHT (m)	NOMINAL K-FACTORS FOR THE TYPE OF SPRINKLERORI-ENTATION		MINIMUM OP-ERATING PRESSURE (PSI)	HOSE AL-LOWANCE	WATER TANK DURATION (MINUTES)
				UPRIGHT	PENDENT			
ON FLOOROR RACKS WITHOUT SOLID SHELVES	IDLE PLAS-TICPALLETS	7.6	9.1	-	14 (201)	50	250 GPM (950) LPM	60
				-	16.8 (242)	35		
				-	-	-		
				-	-	-		
		7.6	9.8	-	14 (201)	60		
				-	16.8 (242)	42		
				-	-	-		
				-	-	-		
		-	-	-	-	-		
				-	-	-		
				-	-	-		
				-	-	-		
		10.7	12.2	-	14 (201)	75		
				-	16.8 (242)	52		
				-	-	-		
				-	-	-		
		-	-	-	-	-		
				-	-	-		

Table 9.14: ESFR design requirement for idle Plastic pallets stored indoors

Table 9.15: Class I, II, III and IV Commodities Stored Palletized, solid piled or on shelves with storage height of Up to 3.7 m

TABLE 9.15: CLASS I – CLASS IV COMMODITIES STORED UP TO 3.7 M HEIGHT

STORAGE ARRANGEMENT	COMMODITY CLASS	MAXIMUM STORAGE HEIGHT	MAXIMUM CEILING HEIGHT	REQUIRED DESIGN DENSITY Gpm (LPM)	AREA OF SPRINKLER OPERATION FT ^{2} (m^2)	IN RACK SPRINKLER	TOTAL COMBINED INSIDE AND OUTSIDEHOSE, Gpm (LPM)	WATER TANK DURATION (MINUTES)
PALLETIZED, BIN BOX, SHELF, IN RACK,	I	< 3.7 m	-	0.15 (6.1)	1500 (140)	No need	250 (950)	90
	II	< 3 m	-	0.15 (6.1)	1500 (140)	No need	250 (950)	90
		3 m – 3.7 m	-	0.20 (8.1)	1500 (140)	No need	250 (950)	90
	III	< 3.7 m	-	0.20 (8.1)	1500 (140)	No need	250 (950)	90
	IV	< 3 m	-	0.20 (8.1)	1500 (140)	No need	250 (950)	90
PALLETIZED, BIN BOX, SHELF	IV	3 m – 3.7 m	-	0.20 (8.1)	1500 (140)	No need	250 (950)	90
IN RACK	IV	3 m – 3.7 m	-	0.30 (12.2)	2500 (232)	No need	500 (1900)	120

Table 9.16: Class I, II, III and IV Commodities Stored Palletized, solid piled or on shelves with storage Height 3.7 m to 6.1 m storage height

TABLE 9.16: CLASS I – CLASS IV COMMODITIES STORED OVER 3.7 M UP TO 6.1 M HEIGHT							
AISLE WIDTH & ENCAPSULA-TION	COMMOD-ITYCLASS	IN RACK SPRIN-KLERS	CEILING SPRINKLER WATER DEMAND , gpm (LPM)				
			WITH IN RACK SPRINKLERS		WITHOUT IN RACK SPRINKLERS		
			SINGLE OR DOUBLE ROW RACKS		SINGLE OR DOUBLE ROW RACKS		MULTIPLE ROW RACKS	
			HIGH TEMPERATURE CEILING SPRINKLER & OR-DINARY TEMPERATURE RACK SPRINKLER	ORDINARY TEMPERA-TURE CEILING SPRIN-KLER & ORDINARYTEM-PERATURE RACK SPRINKLER	HIGH TEM-PERATURE CEILING SPRINKLERS	ORDINARY TEMPERA-TURE CEILING SPRINKLERS	HIGH TEM-PERATURE CEILING SPRINKLERS	ORDINARY TEMPERATURE CEILING SPRIN-KLERS
1.2 M ENCAP-SULATED	I	No Need	0.30	0.35	0.55*	0.55	-	-
	II	No Need	0.30	0.35	0.55*	0.55	-	-
	III	1 LEVEL	0.35	0.39	-	-	-	-
	IV	1 LEVEL	0.48	0.55 (22.4)	-	-	-	-
1.2 M NOT ENCAPSULATED	I	No Need	0.23	0.26	0.32	0.37	-	-
	II	No Need	0.26	0.3	0.38	0.44	-	-
	III	No Need	0.29	0.33	0.43	0.49	-	-
	IV	No Need	0.39	0.44	0.58	0.60*	-	-
2.4 M ENCAP-SULATED	I	No Need	0.25	0.28	0.47	0.54	-	-
	II	No Need	0.25	0.28	0.47	0.54	-	-
	III	1 LEVEL	0.28	0.32	-	-	-	-
	IV	1 LEVEL	0.39	0.45 (18.3)	-	-	-	-
2.4 M NOT ENCAPSULATED	I	No Need	0.19	0.22	0.29	0.33	-	-
	II	No Need	0.21	0.24	0.33	0.37	-	-
	III	No Need	0.24	0.28	0.37	0.42	-	-
	IV	No Need	0.32	0.37	0.49	0.57	-	-

- Single Point Design Only

Table 9.17: Class I, II, III and IV Commodities Stored Palletized, solid piled or on shelves with storage height 6.1 m to 6.7 m storage height

TABLE 9.17: CLASS I – CLASS IV COMMODITIES STORED OVER 6.1 M UP TO 6.7 M HEIGHT								
			CEILING SPRINKLER WATER DEMAND , gpm (LPM)					
			WITH IN RACK SPRINKLERS		WITHOUT IN RACK SPRINKLERS			
			SINGLE OR DOUBLE ROW RACKS		SINGLE OR DOUBLE ROW RACKS		MULTIPLE ROW RACKS	
AISLE WIDTH & ENCAPSULATION	COMMODITY CLASS	IN RACK SPRINKLERS	HIGH TEMPERATURE CEILING SPRINKLER & ORDINARY TEMPERA-TURE RACK SPRIN-KLER	ORDINARY TEMPERATURE CEILING SPRINKLER & ORDINARY TEMPERATURE RACK SPRINKLER	HIGH TEMPERATURE CEILING SPRIN-KLERS	ORDINARY TEMPERATURE CEILING SPRIN-KLERS	HIGH TEMPERATURE CEILING SPRIN-KLERS	ORDINARY TEMPERATURE CEIL-ING SPRINKLERS
1.2 M ENCAP-SULATED	I	1 LEVEL	0.30	0.35	-	-	-	-
	II	1 LEVEL	0.30	0.35	-	-	-	-
	III	1 LEVEL	0.35	0.39	-	-	-	-
	IV	1 LEVEL	0.47	0.55	-	-	-	-
1.2 M NOT ENCAPSULATED	I	No Need	0.23	0.26	0.32	0.37	-	-
	II	No Need	0.26	0.29	0.385	0.44	-	-
	III	No Need	0.29	0.33	0.43	0.49	-	-
	IV	No Need	0.39	0.44	0.58	0.60*	-	-
2.4 M ENCAP-SULATED	I	1 LEVEL	0.24	0.275	-	-	-	-
	II	1 LEVEL	0.24	0.275	-	-	-	-
	III	1 LEVEL	0.28	0.32	-	-	-	-
	IV	1 LEVEL	0.39	0.45	-	-	-	-
2.4 M NOT ENCAPSULATED	I	No Need	0.19	0.22	0.29	0.33	-	-
	II	No Need	0.21	0.24	0.325	0.37	-	-
	III	No Need	0.24	0.28	0.37	0.42	-	-
	IV	No Need	0.32	0.37	0.495	0.57	-	-

Table 9.18: Class I, II, III and IV Commodities Stored Palletized, solid piled or on shelves with storage height 6.7 m to 7.6 m storage height

TABLE 9.18: CLASS I – CLASS IV COMMODITIES STORED OVER 6.7 M UP TO 7.6 M HEIGHT								
AISLE WIDTH & ENCAPSULATION	COMMODITY CLASS	IN RACK SPRINKLERS	CEILING SPRINKLER WATER DEMAND , gpm (LPM)					
			WITH IN RACK SPRINKLERS		WITHOUT IN RACK SPRINKLERS			
			SINGLE OR DOUBLE ROW RACKS		SINGLE OR DOUBLE ROW RACKS		MULTIPLE ROW RACKS	
			HIGH TEMPERATURE CEILING SPRINKLER& ORDINARY TEMPERATURE RACK SPRINKLER	ORDINARY TEMPERATURE CEILING SPRINKLER& ORDINARY TEMPERATURE RACK SPRINKLER	HIGH TEMPERATURE CEILING SPRINKLERS	ORDINARY TEMPERATURE CEILING SPRINKLERS	HIGH TEMPERATURE CEILING SPRINKLERS	ORDINARY TEMPERATURE CEILING SPRINKLERS
1.2 M ENCAPSULATED	I	1 LEVEL	0.305	0.35	-	-	-	-
	II	1 LEVEL	0.305	0.35	-	-	-	-
	III	1 LEVEL	0.35	0.39	-	-	-	-
	IV	1 LEVEL	0.475	0.55	-	-	-	-
1.2 M NOT ENCAPSULATED	I	No Need	0.23	0.26	0.32	0.355	-	-
	II	No Need	0.255	0.29	0.38	0.44	-	-
	III	No Need	0.275	0.325	0.43	0.49	-	-
	IV	1 LEVEL	0.39	0.44	-	-	-	-
2.4 M ENCAPSULATED	I	1 LEVEL	0.24	0.275	-	-	-	-
	II	1 LEVEL	0.24	0.275	-	-	-	-
	III	1 LEVEL	0.28	0.32	-	-	-	-
	IV	1 LEVEL	0.39	0.45	-	-	-	-
2.4 M NOT ENCAPSULATED	I	No Need	0.19	0.22	0.29	0.28	-	-
	II	No Need	0.21	0.24	0.325	0.37	-	-
	III	No Need	0.24	0.275	0.37	0.42	-	-
	IV	1 LEVEL	0.32	0.37	-	-	-	-

Table 9.20: ESFR Sprinkler System for palletized or solid piled I, II, III and IV commodities

TABLE 9.20: ESFR REQUIREMENTS FOR PALLETIZED OR SOLID PILED CLASS I, II, III AND IV COMMODITIES STORAGE

STORAGE ARRANGEMENT	COMMODITY	MAXIMUM STORAGE HEIGHT	MAXIMUM CEILING HEIGHT	NOMINAL K-FACTORS FOR THE TYPE OF SPRINKLER ORIENTATION		MINIMUM OPERATING PRESSURE (PSI)	HOSE ALLOWANCE	WATER TANK DURATION (MINUTES)
				UPRIGHT	PENDENT			
PALLETIZED OR SOLID PILED	CLASS I, II, III, IV	6.1	7.6	14 (201)	14 (201)	50	250 GPM (950 LPM)	60
				16.8 (242)	16.8 (242)	35		
				-	22.4 (322)	20		
				-	25.2 (363)	15		
		7.6	9.1	14 (201)	14 (201)	50		
				16.8 (242)	16.8 (242)	35		
				-	22.4 (322)	20		
				-	25.2 (363)	15		
		7.6	9.8	14 (201)	14 (201)	60		
				-	16.8 (242)	42		
		9.1	10.7		14 (201)	75		
				16.8 (242)	16.8 (242)	52		
				-	22.4 (322)	-		
				-	25.2 (363)	-		
		10.7	12.2	-	14 (201)	75		
				16.8 (242)	16.8 (242)	52		
				-	22.4 (322)	40		
				-	25.2 (363)	25		
		10.7	13.7	-	22.4 (322)	40		
				-	25.2 (363)	40		
		12.2	13.7	-	22.4 (322)	40		
				-	25.2 (363)	40		

Table 9.21: Commodities I, II, III & IV Stored in Single, Double or Multiple Racks Up to 7.6 m storage height

TABLE 9.21: LARGE DROP AND NOMINAL K-FACTOR WET SPRINKLER SYSTEM DESIGN REQUIREMENTS FOR CLASS I, II, III & IV

TYPE OF SYSTEM	COMMODITY CLASS	MAXIMUM STORAGE HEIGHT	MAXIMUM CEILING HEIGHT	LARGE DROP TYPE NOMINAL K-FACTOR 11.2 (160) / ORIENTATION		K-FACTOR 16.8 (240) NUMBER OF SPRINKLERS BY MINIMUM DESIGN PRESSURE / ORIENTATION				K-FACTOR 19.6 (280) NUMBEROF SPRINKLERS BY MINIMUM DESIGN PRESSURE / ORIENTATION			HOSE AL-LOWANCE	DURATION MINUTES
				NUMBER OF SPRINKLERS	DESIGN PRESSURE	10 PSI (0.7 BAR)	15 PSI (1 BAR)	22 PSI (1.5 BARS)	35 PSI (2.4 BARS)	16 PSI (1.1 BARS)	25 PSI (1.7 BARS)	30PSI (2.1 BARS)		
WET	I, II	6.1	9.1	15 / upright	25 psi	15 / upright	-	-	-	15 / pendent	-	-	500 (1900)	120
		7.6	9.1	20 / upright	25 psi	15 / upright	-	-	-	15 / pendent	-	-	500 (1900)	120
	III	6.1	9.1	15 / upright	25 psi	-	15 / upright	-	-	15 / pendent			500 (1900)	120
		7.6	9.1	15+ 1 level of in-rack/upright	25 psi	-		15 / upright		15 / pendent			500 (1900)	120
		7.6	10.6	15+ 1 level of in-rack/upright	25 psi	-	15+ 1 level of in-rack / upright	-	-	-	15 / pendent	15 / pendent	500 (1900)	120
	IV	6.1	7.6	15/upright	50 psi	-	-	15 / upright	-	15 / pendent	-	-	500 (1900)	120
		6.1	9.1	20/ upright 15 / upright	50 psi 75 psi	-	-	15 / upright	- -	15 / pendent	- -	- -	500 (1900) 500 (1900)	120 120
		7.6	9.1	15+ 1 level of in-rack/upright	50psi	-	-	15 / upright	-	15 / pendent	-	-	500 (1900)	120
		7.6	10.6	20+ 1 level of in-rack/upright 15+ 1 level of in-rack/upright	50 psi 75 psi	-	-	20+ 1 level of in-rack/ up-right	15+ 1 level of in-rack/ Upright	-	-	-	500 (1900) 500 (1900)	120 120
PRE-ACTION OR DRY	I,II	6.1	9.1	25 / upright	25 psi	-	25 / upright	-	-	-	-	-	500 (1900)	120
		7.6	9.1	30 / upright	25 psi	-	30 / upright	-	-	-	-	-	500 (1900)	120
	III	6.1	9.1	25 / Upright	25 psi	-	25 / upright	-	-	-	-	-	500 (1900)	120

Table 9.22: ESFR Sprinkler system for Commodities I, II, III & IV Stored in Single, Double or Multiple Racks Up to 7.6 m storage height

TABLE 9.22: ESFR FOR CLASS I, II, III AND IV COMMODITIES STORED IN SINGLE, DOUBLE OR MULTIPLE ROW RACKS UP TO 7.6 M HEIGHT

STORAGE ARRANGEMENT	COMMODITY	MAXIMUM STORAGE HEIGHT (m)	MAXIMUM CEIL-INGHEIGHT (m)	NOMINAL K-FACTORS FOR THE TYPE OF SPRINKLER ORIENTATION		MINIMUM OPERATING PRESSURE (PSI)	HOSE ALLOW-ANCE	WATER TANK DU-RATION (MINUTES)
				UPRIGHT	PENDENT			
SINGLE-ROW, DOU-BLE-ROW, AND MULTIPLE ROW RACK (NO OPEN-TOP CONTAINERS)	CLASS I, II, III, OR IV,ENCAPSULATED OR NOT ENCAPSU-LATED	6.1	7.6	14 (201)	14 (201)	50	250 GPM (950) LPM	60
				16.8 (242)	16.8 (242)	35		
				-	22.4 (322)	25		
				-	25.2 (363)	15		
		7.6	9.1	14 (201)	14 (201)	50		
				16.8 (242)	16.8 (242)	35		
				-	22.4 (322)	25		
				-	25.2 (363)	15		
			9.8*	14 (201)	14 (201)	60		
				16.8 (242)	16.8 (242)	42		
			10.7	14 (201)	14 (201)	75		
				16.8 (242)	16.8 (242)	52		
				-	22.4 (322)	35		
				-	25.2 (363)	20		
			12.2	-	14 (201)	75		
				-	16.8 (242)	52		
				-	22.4 (322)	40		
				-	25.2 (363)	25		
			13.7	-	14 (201)	90		
				-	16.8 (242)	63		
					22.4 (322)	40		
					25.2 (363)	40		

Table 9.23: LARGE DROP AND NOMINAL K-FACTOR WET SPRINKLER SYSTEM DESIGN REQUIREMENTS FOR CLASS I,II,III & IV COMMODITIES STORED IN SINGLE, DOUBLE OR MULTIPLE RACKS OVER 7.6 M

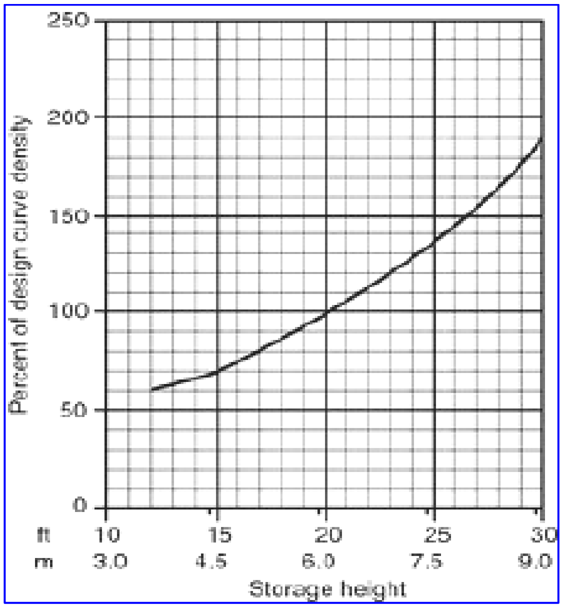


Figure 9.13: Ceiling Sprinkler Density modification according to Height of Storage

11.4. Large drop and Nominal K-factor Design for palletized or solid piled commodities

11.4.1. The Pre-action or dry-type sprinkler system is only allowed for palletized or solid piled class I, II and III commodities with storage height of 7.6 m or less and designnumber of sprinklers for such systems shall be 25 with design pressure of 25 psi.

11.4.2. Design Requirements for large drop and nominal k-factor wet sprinkler designcriteria shall be as per Table 9.19.

11.5. ESFR Sprinkler System for palletized or solid piled commodities

11.5.1. ESFR Systems

11.5.2. ESFR (Early Suppression Fast Response) protection as defined shall not apply to the following:

i. Rack storage involving solid shelves
ii. Rack storage involving combustible, open-top cartons or containers

11.5.3. ESFR sprinkler systems shall be designed such that the minimum operating pressure is not less than that indicated in Table for type of storage, commodity, storage height, and building height involved.

11.5.4. The design area shall consist of the most hydraulically demanding area of 12 sprinklers, consisting of four sprinklers on each of three branch lines

11.5.5. Where ESFR sprinklers are installed above and below obstructions, the discharge for up to two sprinklers for one of the levels shall be included with those of the other level in the hydraulic calculations.

11.5.6. Design requirements for ESFR sprinkler design criteria for palletized or solid piled class I, II, III & IV commodities shall be as per Table 9.20.

11.6. Class I, II, III & IV Commodities Stored in Single, Double or Multiple Racks

11.6.1. Up to 7.6 m storage height

14.7.1.1. Large drop and K-factor Sprinkler system for racks up to 7.6 m:

14.7.1.1.1. Design requirements for large drop and nominal k-factor wet sprinkler design criteria for class I, II, III & IV commodities stored in single, Double or Multiple Racks up to 7.6 m height shall be as per Table 9.21.

14.7.1.2. ESFR Sprinkler system for racks up to 7.6 m height:

14.7.1.2.1. ESFR design requirements for large drop and nominal k-factor wet sprinkler design criteria for class I, II, III & IV commodities stored in single, Double or Multiple Racks up to 7.6 m height shall be as per Table 9.22.

11.6.2. Over 7.6 m storage height

14.7.2.1. Large drop and K-factor Sprinkler system for racks over 7.6 m height:

14.7.2.1.1. The large drop design and specific control K-factor design criteria are not applicable to Class III and IV commodities stored in excess of 7.6 m.

14.7.2.1.2. The large drop design and specific control K-factor design criteria for class I & II commodities stored in excess of 7.6 m shall be as per Table 9.23.

14.7.2.2. ESFR Sprinkler system for racks over 7.6 m height:

14.7.2.2.1. Requirements for ESFR sprinkler design criteria for Class I, II, III & IV commodities stored in single, Double or Multiple Racks over 7.6 m height shall be as per Table 9.24.

11.7. In-Rack Sprinkler Location for Rack Storage's of Class I Through Class IV Commodities Stored Up to 7.6 m in Height.

11.7.1. In single- or double-row racks without solid shelves, Stored from 3.7 m up to 7.6 m, in-rack sprinklers shall be installed in accordance with Table 9.30.

IN-RACK SPRINKLER SPACING FOR CLASS I, II, III, AND IV COMMODITIESSTORED UP TO 7.6M			
AISLE WIDTH	COMMODITY CLASS		
	I & II	III	IV
1.2	3.7 m	2.4 m	2.4 m
2.4	3.7 m	3.7 m	2.4 m

11.7.2. In single- or double-row racks without solid shelves, Stored from 6.1 m up to 6.7 m, in-rack sprinklers shall be installed in accordance with Table 9.31

11.7.3. In single- or double-row racks without solid shelves, Stored from 6.7 m up to 7.6 m, in-rack sprinklers shall be installed in accordance with Table 9.32

11.7.4. In multiple-row racks no deeper than 4.9 m with aisles 2.4 or wider, with storage height up to 7.6 m, in-rack sprinklers shall be installed in accordance with Table 9.33

11.7.5. In multiple-row racks deeper than 4.9 m or with aisles less than 2.4 m wide, with storage height over 7.6 m in-rack sprinklers shall be installed in accordance with Table 9.33.

11.7.6. In-rack sprinklers at one level only for storage up to and including 7.6 m high shall be located at the first tier level at or above one-half of the storage height.

11.7.7. In-rack sprinklers at two levels only for storage up to and including 7.6 m high shall be located at the first tier level at or above one-third and two-thirds of the storage height.

Table 9.19: Large drop and Nominal K-factor Design for palletized or solid piled commodities, plastic and rubber stored up to 7.6 m

TABLE 9.19: LARGE DROP AND NOMINAL K-FACTOR WET SPRINKLER SYSTEM DESIGN REQUIREMENTS FORALL COMMODITIES, PLASTIC AND RUBBER, STORED UPTO 7.6 M									
STORAGE ARRANGEMENT	COMMODITY CLASS	MAXIMUM STORAGE HEIGHT	MAXIMUM CEILING HEIGHT	LARGE DROP TYPE NOMINAL K-FACTOR 11.2 (161)		K-FACTOR 16.8 (242) NUMBER OF SPRINKLERS BYMINIMUM DESIGN PRESSURE		HOSE ALLOWANCE	WATER TANK DURATION (MINUTES)
				NUMBER OF SPRINKLERS	DESIGN PRESSURE	10 psi (0.7 bar)	22 psi (1.5 bar)		
PALLETIZED	I	7.6	10.7	15	25 psi	-	-	500 (1900)	120
	II	7.6	10.7	15	25 psi	-	-	500 (1900)	120
	III	7.6	10.7	15	25 psi	-	-	500 (1900)	120
	I or II	7.6	9.1	-	-	15	-	500 (1900)	120
	III or IV	7.6	9.1	-	-	-	15	500 (1900)	120
	IV	6.1	9.1	15	50 psi	-	-	500 (1900)	120
	PLASTICS AND RUBBER CARTONED OR EXPOSED UNEXPANDED	6.1	9.1	25	25 psi	-	-	500 (1900)	120
		7.6	9.1	-	-	-	15		
	PLASTIC AND RUBBER CARTONED OR EXPOSED EXPANDED	5.5	7.9	15	50 psi	-	-	500 (1900)	120
SOLID PILED	PLASTICS AND RUBBER CARTONED OR EXPOSED UNEXPANDED	6.1	9.1	15	50 psi	-	-	500 (1900)	120
		7.6	9.1	-	-	-	15		
	I	6.1	9.1	15	25	-	-	500 (1900)	120
	I	7.6	9.1	-	-	15	-	500 (1900)	120
	II	6.1	9.1	15	25	-	-	500 (1900)	120
	II	7.6	9.1	-	-	15	-	500 (1900)	120
	III	6.1	9.1	15	25	-	-	500 (1900)	120
	III	7.6	9.1	-	-	-	15	500 (1900)	120
	IV	6.1	9.1	15	50	-	-	500 (1900)	120
	IV	7.6	9.1	-	-	-	15	500 (1900)	120

Table 9.20: ESFR Sprinkler System for palletized or solid piled I, II, III and IV commodities

TABLE 9.20: ESFR REQUIREMENTS FOR PALLETIZED OR SOLID PILED CLASS I, II, III AND IV COMMODITIES STORAGE								
STORAGE ARRANGEMENT	COMMODITY	MAXIMUM STORAGE HEIGHT	MAXIMUM CEILING HEIGHT	NOMINAL K-FACTORS FOR THE TYPE OF SPRINKLER ORIENTATION		MINIMUM OPERATING PRESSURE (PSI)	HOSE ALLOWANCE	WATER TANK DURATION (MINUTES)
				UPRIGHT	PENDENT			
PALLETIZED OR SOLID PILED	CLASS I, II, III, IV	6.1	7.6	14 (201)	14 (201)	50	250 GPM (950 LPM)	60
				16.8 (242)	16.8 (242)	35		
				-	22.4 (322)	20		
				-	25.2 (363)	15		
		7.6	9.1	14 (201)	14 (201)	50		
				16.8 (242)	16.8 (242)	35		
				-	22.4 (322)	20		
				-	25.2 (363)	15		
		7.6	9.8	14 (201)	14 (201)	60		
				-	16.8 (242)	42		
		9.1	10.7		14 (201)	75		
				16.8 (242)	16.8 (242)	52		
				-	22.4 (322)	-		
				-	25.2 (363)	-		
		10.7	12.2	-	14 (201)	75		
				16.8 (242)	16.8 (242)	52		
				-	22.4 (322)	40		
				-	25.2 (363)	25		
		10.7	13.7	-	22.4 (322)	40		
				-	25.2 (363)	40		
		12.2	13.7	-	22.4 (322)	40		
				-	25.2 (363)	40		

Table 9.21: Commodities I, II, III & IV Stored in Single, Double or MultipleRacks Up to 7.6 m storage height

TABLE 9.21: LARGE DROP AND NOMINAL K-FACTOR WET SPRINKLER SYSTEM DESIGN REQUIREMENTS FOR CLASS I, II, III & IV COMMODITIES STORED IN SINGLE, DOUBLE OR MULTIPLE RACKS UP TO 7.6 M

TYPE OF SYSTEM	COMMODITY CLASS	MAXIMUM STORAGE HEIGHT	MAXIMUM CEILING HEIGHT	LARGE DROP TYPE NOMINAL K-FACTOR 11.2 (160) / ORIENTATION		K-FACTOR 16.8 (240) NUMBER OF SPRINKLERS BY MINIMUM DESIGN PRESSURE / ORIENTATION				K-FACTOR 19.6 (280) NUMBER OF SPRINKLERS BY MINIMUM DESIGN PRESSURE / ORIENTATION			HOSE ALLOWANCE	DURATION MINUTES
				NUMBER OF SPRINKLERS	DESIGN PRESSURE	10 PSI (0.7 BAR)	15 PSI (1 BAR)	22 PSI (1.5 BARS)	35 PSI (2.4 BARS)	16 PSI (1.1 BARS)	25 PSI (1.7 BARS)	30PSI (2.1 BARS)		
WET	I, II	6.1	9.1	15 / upright	25 psi	15 / upright	-	-	-	15 / pendent	-	-	500 (1900)	120
		7.6	9.1	20 / upright	25 psi	15 / upright	-	-	-	15 / pendent	-	-	500 (1900)	120
	III	6.1	9.1	15 / upright	25 psi	-	15 / upright	-	-	15 / pendent			500 (1900)	120
		7.6	9.1	15+ 1 level of in-rack/upright	25 psi	-		15 / upright		15 / pendent			500 (1900)	120
		7.6	10.6	15+ 1 level of in-rack/upright	25 psi	-	15+ 1 level of in-rack / upright	-	-	-	15 / pendent	15 / pendent	500 (1900)	120
	IV	6.1	7.6	15/upright	50 psi	-	-	15 / upright	-	15 / pendent	-	-	500 (1900)	120
		6.1	9.1	20/ upright	50 psi	-	-	15 / upright	-	15 / pendent	-	-	500 (1900)	120
				15 / upright	75 psi				-		-	-	500 (1900)	120
		7.6	9.1	15+ 1 level of in-rack/upright	50psi	-	-	15 / upright	-	15 / pendent	-	-	500 (1900)	120
		7.6	10.6	20+ 1 level of in-rack/upright	50 psi	-	-	20+ 1 level of in-rack/ upright	15+ 1 level of in-rack/ Upright	-	-	-	500 (1900)	120
				15+ 1 level of in-rack/upright	75 psi								500 (1900)	120
PRE-ACTION OR DRY	I,II	6.1	9.1	25 / upright	25 psi	-	25 / upright	-	-	-	-	-	500 (1900)	120
		7.6	9.1	30 / upright	25 psi	-	30 / upright	-	-	-	-	-	500 (1900)	120
	III	6.1	9.1	25 / Upright	25 psi	-	25 / upright	-	-	-	-	-	500 (1900)	120

Table 9.22: ESFR Sprinkler system for Commodities I, II, III & IV Stored in Single, Double or Multiple Racks Up to 7.6 m storage height

TABLE 9.22: ESFR FOR CLASS I, II, III AND IV COMMODITIES STORED IN SINGLE, DOUBLE OR MULTIPLE ROW RACKS UP TO 7.6 M HEIGHT

STORAGE ARRANGEMENT	COMMODITY	MAXIMUM STORAGE HEIGHT (m)		MAXIMUM CEIL-INGHEIGHT (m)	NOMINAL K-FACTORS FOR THE TYPE OF SPRINKLER ORIENTATION		MINIMUM OPERATING PRESSURE (PSI)	HOSE ALLOW-ANCE	WATER TANK DU-RATION (MINUTES)
					UPRIGHT	PENDENT			
SINGLE-ROW, DOU-BLE-ROW, AND MULTIPLE-ROW RACK (NO OPEN-TOPCONTAINERS)	CLASS I, II, III, OR IV,ENCAPSULATED OR NOT ENCAPSU-LATED	6.1		7.6	14 (201)	14 (201)	50	250 GPM (950) LPM	60
					16.8 (242)	16.8 (242)	35		
					-	22.4 (322)	25		
					-	25.2 (363)	15		
			7.6	9.1	14 (201)	14 (201)	50		
					16.8 (242)	16.8 (242)	35		
					-	22.4 (322)	25		
					-	25.2 (363)	15		
				9.8*	14 (201)	14 (201)	60		
					16.8 (242)	16.8 (242)	42		
				10.7	14 (201)	14 (201)	75		
					16.8 (242)	16.8 (242)	52		
					-	22.4 (322)	35		
					-	25.2 (363)	20		
				12.2	-	14 (201)	75		
					-	16.8 (242)	52		
					-	22.4 (322)	40		
					-	25.2 (363)	25		
				13.7	-	14 (201)	90		
					-	16.8 (242)	63		
						22.4 (322)	40		
						25.2 (363)	40		

** Not applicable to storage height of 6.1 m*

Table 9.23: LARGE DROP AND NOMINAL K-FACTOR WET SPRINKLER SYSTEM DESIGN REQUIREMENTS FOR CLASS I,II,III & IV COMMODITIES STORED IN SINGLE, DOUBLE OR MULTIPLE RACKS OVER 7.6 M

TABLE 9.23: LARGE DROP AND NOMINAL K-FACTOR WET SPRINKLER SYSTEM DESIGN REQUIREMENTS FOR CLASS I,II,III & IV COMMODITIES STORED IN SINGLE, DOUBLE OR MULTIPLE RACKS OVER 7.6 M											
TYPE OFSYS-TEM	COMMOD-ITYCLASS	MAXI-MUM STORAGE HEIGHT	MAXI-MUMCEIL-ING HEIGHT	LARGE DROP TYPE NOMINAL K-FACTOR 11.2(160)/ ORIENTA-TION		K-FACTOR 16.8 (240) NUM-BEROF SPRINKLERS BY MINI-MUM DESIGN PRESSURE / ORIENTATION		K-FACTOR 19.6 (280) NUMBER OF SPRINKLERS BY MINIMUM DESIGNPRESSURE /ORIENTA-TION		HOSE ALLOWANCE	DURA-TION MINUTES
				NUMBER OFSPRIN-KLERS	DESIGN PRES-SURE	15 PSI(I BAR)	22 PSI(1.5 BARS)	25 PSI(I.7 BARS)	30 PSI(2.1 BARS)		
WET	I, II	9.1	10.6	20 + 1 level of in rack / up-right	25 PSI	20 + 1 levelof in rack / up-right	-	15 / pendent	-	500 (1900)	120
		10.6	12.1	-	-	-	-		15 / pendent	500 (1900)	120
	III, IV	9.1	10.6	-	-	-	-	15 / pendent	-	500 (1900)	120
		10.6	12.1	-	-	-	-	-	15 / pendent	500 (1900)	120
PRE - AC-TION OR DRY	I, II	9.1	10.6	30 + 1 level of in rack / up-right	25 PSI	30 + 1 levelof in rack / up-right	-	-	-	500 (1900)	120
		10.6	12.1	36 /upright	55 psi		36 /upright	-	-	500 (1900)	120

Table 9.24: ESFR Sprinkler system for Commodities I, II, III & IV Stored in Single, Double or Multiple Racks over 7.6 m height

TABLE 9.24: ESFR REQUIREMENT FOR CLASS I, II, III AND IV COMMODITIES STORED IN SINGLE, DOUBLE OR MULTIPLE ROW RACKS OVER 7.6 M HEIGHT

STORAGE ARRANGEMENT	COMMODITY	MAXIMUM STORAGE HEIGHT (m)			MAXIMUM CEILING HEIGHT (m)	NOMINAL K-FACTORS FOR THE TYPE OF SPRINKLER ORIENTATION		MINIMUM OPERATING PRESSURE	HOSE ALLOWANCE	WATER TANK DURATION (MINUTES)
						UPRIGHT	PENDENT			
SINGLE-ROW, DOUBLE-ROW, AND MULTIPLE-ROW RACK(NO OPEN-TOP CONTAINERS)	CLASS I, II, III, OR IV, ENCAPSULATED OR NOT ENCAPSULATED	9.1			10.7	14 (201)	14 (201)	75	250 GPM (950) LPM	60
						16.8 (242)	16.8 (242)	52		
						-	22.4 (322)	35		
						-	25.2 (363)	20		
			10.7		12.2	-	14 (201)	75		
						-	16.8 (242)	52		
						-	22.4 (322)	40		
						-	25.2 (363)	20		
				12.2	13.7	-	14 (201)	90		
						-	16.8 (242)	63		
						-	22.4 (322)	40		
						-	25.2 (363)	40		

12. Piping Requirements

12.1. Above Ground Piping

12.1.1. The pipes used for sprinkler system installed within or outside the building shall be Factory Galvanized steel, ERW or Seamless pipe manufactured in accordance with ASTM A 53 Gr. B or ASTM A 795 Gr. B, Sch-40 or manufactured as per BS-1387, Class-C (Heavy grade). The pipes used for the entire sprinkler system shall have the approval of Civil Defence.

12.2. Above Ground Pipe Fittings

12.2.1. Pipe fittings of 50 mm and smaller diameter used in above ground piping shall be of factory galvanized, malleable iron or ductile iron, threaded fittings confirming to B16.3, having working pressure not less than 16 bar.

12.2.2. Pipe fittings of 65 mm and larger diameter used in above ground piping shall be of factory galvanized, ductile iron, grooved fittings or Butt welded conforming to ASME B 16.9 & pipe flanges confirming to ASME B16.5, having working pressure not less than system working pressure.

12.3. Under Ground Pipes & Fittings

12.3.1. The pipes used for fire fighting system laid underground shall comply any one of the following requirements:

i. Ductile Iron pipe manufactured conforming to AWWA C 151 & Fittings conforming to AWWA C110 & Joints conforming to AWWA C115 and Anti corrosive protection conforming to AWWA C 105;

ii. Factory Galvanized steel, Seamless pipe manufactured in accordance with ASTM A 53 Gr. B or ASTM A 795 Gr. B, Sch-40 or manufactured as per BS-1387, Class-C (Heavy grade) with epoxy coat and anti-corrosive surface protection. The fittings shall be butt welded or socket welded and joints shall be flanged. All the proposed materials shall have the Civil Defence approval.

iii. Approved HDPE pipes and fittings manufactured conforming to AWWA C906-07 with temperature & pressure rating not less than the system working pressure by taking in to consideration of de-ration factor for temperature, recurring surge & occasional surge pressures.

13. Isolation / Section or floor Control valves

13.1. All the isolation and section control valves installed in the sprinkler system shall be of 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 approved bythe Civil Defence.

13.2. All isolating valves installed in sprinkler system shall be so constructed that in order to shut the valve the spindle must turn clockwise. The hand wheels of all stop valves shall beclearly marked to indicate which direction the wheel is to be turned to close the valve.

13.3. An indication shall also be provided which shows whether the valve is open or shut.

13.4. 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.

13.5. The valve on downstream side of flow meter in the fire pump test line shall be globe type valve for ease of throttling.

13.6. The valves of suction side of fire pumps and water tank outlets shall be O.S.&Y type gate valve only.

13.7. All the valves shall be rated for the system working pressure and water temperature service and approved by the Civil Defence department.

13.8. All the isolation / section or floor control valves shall be installed in an easily accessible & visible locations.

13.9. Isolation and control valves shall be provided with an identification sign board in a visible location in both Arabic & English languages.

13.10. 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 languages.

14. Check Valves

14.1. If case of combined riser pipe is proposed for both sprinkler and landing valves, an approved check valve shall be installed after supervisory control valve of sprinkler zone control valve assembly.

14.2. All the check valves shall be rated for the system working pressure and water temperature service. Same shall be approved by the Civil Defence.

14.3. All the check valves shall be installed in an easily accessible & visible locations.

14.4. Where there is more than one source of water supply, a check valve shall be installed in each connection.

14.5. 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 valves shall be arranged to drain. See Figure 9.16 for illustrations.

Figure 9.17: Alternate Arrangement for Check Valves

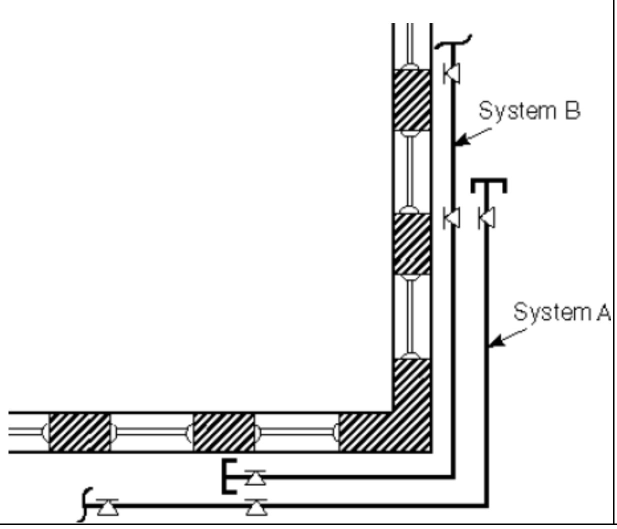
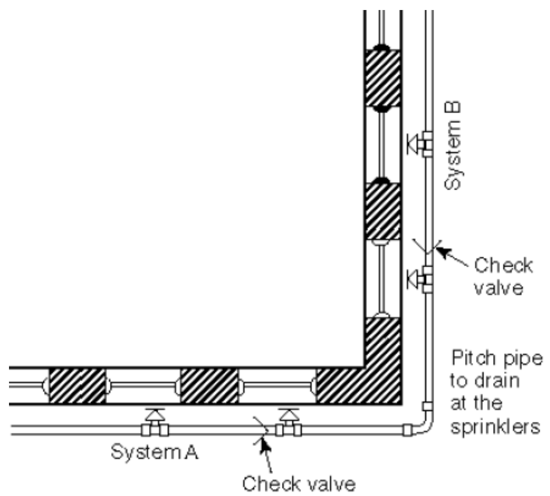


Figure 9.16: Typical Arrangement of Check Valves.



14.6. As an alternate solution, an additional sprinkler shall be installed on each system located around the corner from the system involved. See Figure 9.17 for illustrations.

14.7. A listed back-flow prevention device shall be considered a check valve, and an additional check valve shall not be required.

14.8. Where cushion tanks are used with automatic fire pumps, no check valve is required in the cushion tank connection.

14.9. Check valves shall be installed in a vertical or horizontal position in accordance with their listing.

14.10. Where a single wet pipe sprinkler system is equipped with a fire department connection, the alarm valve is considered a check valve, and an additional check valve shall not be required.

15. Alarm Check Valve (ACV)Assembly

15.1. An Alarm check valve assembly shall be installed in each sprinkler system riser as per the maximum sprinkler protection zone area limitations, which shall consists of the following equipments and accessories.

i. Alarm check Valve complete with trim kits & retarding device;
ii. Water Motor Alarm Gong;
iii. Electric Alarm pressure switch;
iv. Pressure Gauges (Upstream & Downstream)

15.2. Alarm Check Valves

15.2.1. Alarm valve shall be installed in each sprinkler system supply risers complete with required trims in all sprinkler system installations in the office buildings.

15.2.2. The Alarm valve trims shall consist of basic trim with all required pipes, fitting & valves, water motor alarm gong, retard chamber, electric alarm pressure switch, upstream & downstream pressure gauges etc.

15.2.3. The alarm pressure switch shall be interconnected with building fire alarm system to activate the fire alarm.

15.2.4. A 20 mm dia by pass line shall be provided connecting upstream and downstream side of the alarm check to allow the water pressure surge without lifting the valve clapper off its seat, which will prevent the false alarm.

15.2.5. Alarm check valves shall be rated for the system working pressure and water temperature service and approved by the Civil Defence department.

15.2.6. All the check valves shall be installed in an easily accessible & visible locations.

15.2.7. Alarm check valves shall be installed vertically with adequate clearance space around it for testing and maintenance purposes.

15.2.8. Retarding device shall be installed in the alarm line to prevent the false alarm due to the water pressure fluctuation in sprinkler system

15.3. Water Motor Alarm Gong

15.3.1. The sprinkler system shall be fitted with an approved 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.

15.3.2. The pipe work and fittings used shall be galvanized and to the sizes determined by the manufacturers data sheet.

15.3.3. 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.

15.3.4. A 15 mm test valve shall be installed on the installation side of each alarm valve.

15.3.5. Approved identification signs, as shown in Figure 9.18 shall be provided for outside alarm devices. The sign should be located near the device in a conspicuous position and should be worded as follows:

SPRINKLER FIRE ALARM — WHEN BELL RINGSCALL FIRE DEPARTMENT

Figure 9.18: Alarm Identification Sign

15.4. Electric Alarm Pressure Switch

15.4.1. 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.

15.4.2. The pressure switch may be of the diaphragm bellows or bourdon tube operated type, and shall be sufficiently sensitive to operate when only one sprinkler is discharging.

15.4.3. The pressure switch shall be provided with volt free contracts to interconnect with the building fire alarm system for monitoring.

15.4.4. The pressure switch shall be rated for the system working pressure and water temperature service and approved by the Civil Defence department.

16. Control Valves

16.1.1. 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.

16.1.2. 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 fire department connection. See Figure 9.19.

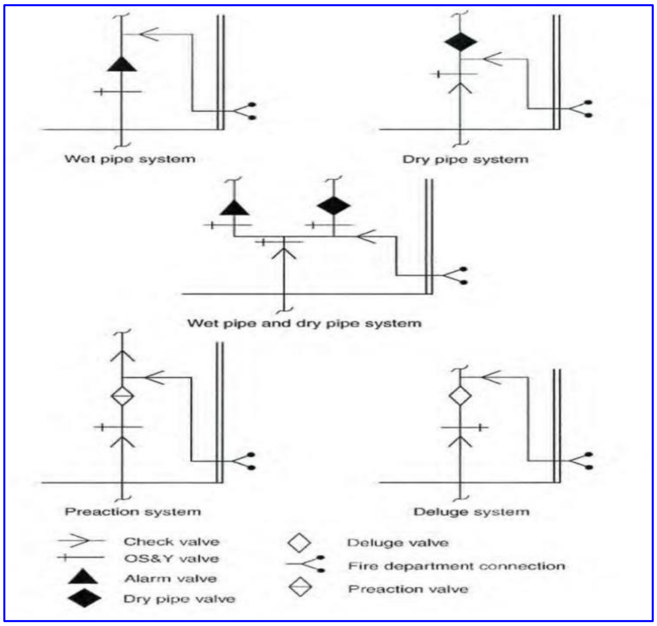


Figure 9.19: Examples of Acceptable Valve Arrangements

17. Supervision.

17.1. 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:

i. Central station, proprietary, or remote station signalling service

ii. Local signalling service that will cause the sounding of an audible signal at a constantly attended point

iii. Valves locked in the correct position

iv. Valves located within fenced enclosures under the control of the owner, sealed in the open position, and inspected weekly as part of an approved procedure

18. Pressure Gauges

18.1. Pressure gauges with a control valve (gauge cock) having drain arrangement shall be installed on upstream and downstream side of alarm check valves to read supply and system pressures.

18.2. Pressure gauges shall be installed on top of each sprinkler riser and in each zone control valve assembly.

18.3. The pressure gauges shall be rated for the system working pressure and water temperature service and approved by the Civil Defence department.

18.4. The maximum reading of the scale shall be 150% of the maximum system pressure and each scale shall have divisions not exceeding 0.2bar.

18.5. All the pressure gauges shall be filled with glycerin liquid to prevent damage of its needles due to the system water pressure surge.

19. Pressure-Reducing Valves

19.1. 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

19.2. 12.1 bar, a listed pressure-reducing valve shall be installed and set for an outlet pressure not exceeding 2.4 bar at the maximum inlet pressure.

19.3. Pressure gauges shall be installed on the inlet and outlet sides of each pressure-reducing valve.

19.4. 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

19.5. 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.

19.6. Means shall be provided downstream of all pressure-reducing valves for flow tests at sprinkler system demand.

20. Section or Floor Zone Control Valve (ZCV) Assembly

20.1. Sectional or floor zone control valve (ZCV) assembly shall be installed where the tapping is taken from the sprinkler riser for each floor and where the floor area exceeds the limit as specified in Table 9.7. See Figure 9.20 for illustrations. Each zone control valve assembly installed in sprinkler system shall comprise:

i. 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.

ii. 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.

iii. Inspector test and drain connections having not less than 25 mm diameter shall be installed on downstream side of flow switch.

iv. Dial pressure gauges suitable for the water pressures shall be fitted so arranged that it can be easily removed for testing and checking without shutting down the water supply. Pressure guage shall be installed between butterfly valve and water flow switch.

v. The minimum distance between water flow switch to the butterfly valve and to the test & drain valve shall be not less than 600mm.

vi. The water flow switch shall be mounted on top of the pipe or as recommended by the original equipment manufacturers data sheet.

vii. All the equipment's of ZCV assembly shall be rated for the system working pressure and water temperature service and approved by the Civil Defence department.

viii. The ZCV assembly shall be installed in an easily accessible & visible locations, preferably inside the star enclosure above the required headroom height.

ix. ZCV assembly shall be provided with an identification sign board in a visible location in both Arabic & English languages.

x. Where ZCV assembly is 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 languages.

xi. ZCV assembly shall be installed such that it has adequate clearance space around it for testing and maintenance purposes.

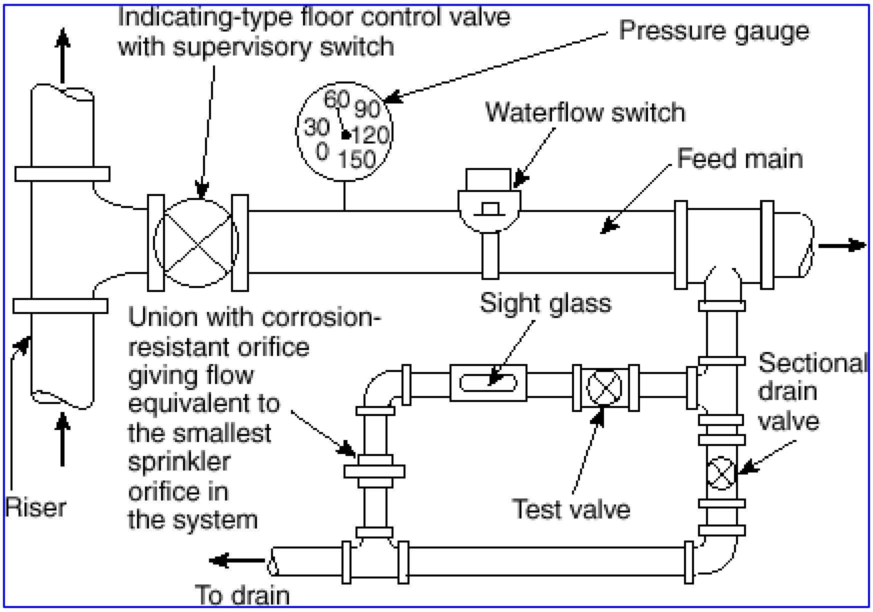


Figure 9.20: Floor Zone Control Valve.

21. Sprinkler Heads Installation

21.1. General

21.1.1. Sprinkler heads shall be installed throughout the building as per the design requirements based on the type of hazard occupancy classifications in all office buildings.

21.1.2. Sprinklers shall be installed in such a way that its maximum protection area does not exceeding the limit according to the hazard occupancy.

21.1.3. Sprinkler shall be installed based on its construction type and performance characteristics without obstructing its discharge pattern. See Figure 9.21 for the discharge pattern for standard upright or pendent sprinkler.

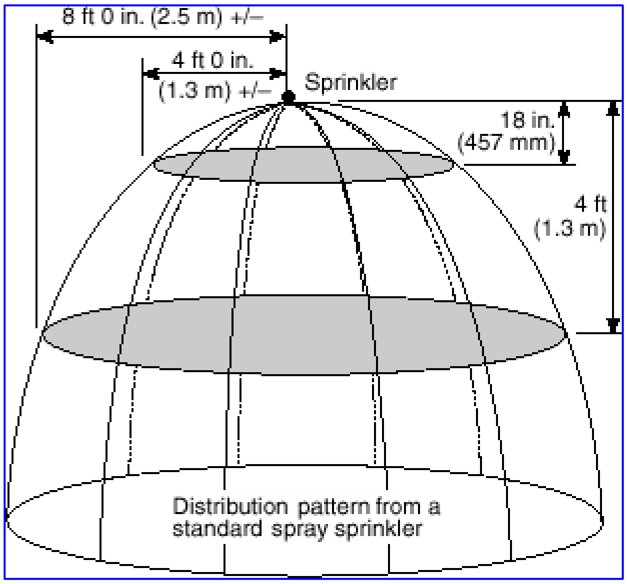


Figure 9.21: Obstructions to Sprinkler Discharge Pattern Development for Standard Upright or Pendent Spray Sprinklers.

21.2. Upright Sprinkler Heads

21.2.1. Upright sprinkler heads shall be installed in such a way that its deflector is facing upright position only with the frame arms parallel to the branch line to minimize the obstruction of its discharge pattern.

21.2.2. Upright sprinklers shall be installed where there is no false ceiling, such as car park, stores, plant rooms, concealed spaces above false ceiling areas etc.

21.2.3. The distance between upright sprinkler deflector to the ceiling shall be not less 25mm and shall be not more than 300 mm.

21.2.4. Where situation does not permits to locate the sprinkler head within 300mm from the ceiling and exceeds 300mm, shall be fitted with a deflector plate made of stainless steel having diameter not less 200mm shall be installed attaching to the deflector.

21.2.5. Upright sprinkler protective caps and straps shall be removed immediately after the commissioning of the sprinkler system.

21.2.6. Upright sprinklers shall be fitted with a protective guard where there is possibilities for accidental damage of sprinkler bulbs.

21.2.7. The minimum distance between the sprinklers to the adjacent sprinkler shall be not less than 1.8 mtrs.

21.2.8. The maximum distance between the standard upright sprinklers to the adjacent standard sprinkler shall be not more than 4.5 mtrs. Where the extended coverage upright sprinklers are used, the maximum distance between sprinklers to sprinkler shall be not more than its approval listing as per the Original equipment manufacturers technical data sheet.

21.2.9. The minimum distance between a upright sprinkler to a wall shall be not less than 100mm.

21.2.10. The maximum distance between a standard upright sprinklers to a wall shall be not more than 2.25 mtrs or ½ of the spacing between the sprinklers.

21.2.11. 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 for less than or equal to 500 mm.

21.2.12. Sprinklers shall be installed under fixed obstructions over 1.2 m wide such as ducts, cable trays, decks, open grate flooring etc.

21.2.13. The minimum clearance between top of storage to the sprinkler head shall be not less than 500mm and shall be 1000mm in special situations for special sprinklers such as ESFR & ELO sprinklers.

21.2.14. Sprinklers under glass or plastic skylights exposed to the direct rays of the sun shall be of the intermediate-temperature classification.

21.2.15. Where there is a vertical change in 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.

21.2.16. 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.

21.2.17. Under obstructed construction, the sprinkler shall be installed in each bay of obstructed construction with the sprinkler deflector located not less than 25 mm to not more than 300mm from the ceiling.

21.2.18. Sprinklers shall be located so as to minimize obstructions to discharge or additional sprinklers shall be provided to ensure adequate coverage of the hazard.

21.2.19. Sprinklers shall be permitted to be spaced on 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.

21.2.20. Obstructions located against the wall and that are not over 762 mm in width shall be permitted to be protected.

21.3. Under obstructed construction, the sprinklers shall be permitted to install as per the Table to avoid obstructions of discharge pattern of an upright sprinkler. See Figure 9.22 for illustration.

Table 9.34: Positioning of Standard upright sprinklers to avoid obstruction of Discharge pattern

DISTANCE FROM SPRINKLERS TOSIDE OF OBSTRUCTION (A)	MAXIMUM ALLOWABLE DISTANCE OFDEFLECTOR ABOVE BOTTOM OF OBSTRUCTION (B)
Less than 300 mm	0 mm
300mm to 450 mm	65 mm
450mm to 600mm	90mm
600mm to 750mm	140mm
750mm to 900mm	190mm
900mm to 1050mm	240mm
1050mm to 1200mm	305mm
1200mm to 1350mm	355mm
1350mm to 1500mm	420mm
1500mm to 1650mm	457mm
1650mm to 1800mm	508mm

21.4. Pendent Sprinkler Heads

21.4.1. Pendent sprinkler heads shall be installed in such a way that its deflector is facing downwards pendent position only with the frame arms parallel to the branch line to minimize the obstruction of its discharge pattern.

21.4.2. Pendent sprinklers shall be installed where there is no false ceiling, such as car park, stores, plant rooms, concealed spaces above false ceiling areas etc.

21.4.3. The distance between pendent sprinkler deflector to the ceiling shall be not less 25mm and shall be not more than 300 mm.

21.4.4. Where situation does not permits to locate the sprinkler head within 300mm from the ceiling and exceeds 300mm, shall be fitted with a deflector plate made of stainless steel having diameter not less 200mm shall be installed attaching to the sprinkler or its deflector.

21.4.5. Pendent sprinkler protective caps and straps shall be removed immediately after the commissioning of the sprinkler system.

21.4.6. Pendent sprinklers shall be fitted with a protective guard where there is possibilities for accidental damage of sprinkler bulbs.

21.4.7. The minimum distance between the sprinklers to the adjacent sprinkler shall be not less than 1.8 m.

21.4.8. The maximum distance between the standard pendent sprinkler to the adjacent standard sprinkler shall be not more than 4.5 mtrs. Where the extended coverage upright sprinklers are used, the maximum distance between sprinklers to sprinkler shall be not more than its approval listing as per the Original equipment manufacturers technical data sheet.

21.4.9. The minimum distance between a pendent sprinklers to a wall shall be not less than 100mm.

21.4.10. The maximum distance between a standard pendent sprinklers to a wall shall be not more than 2.25 mtrs or ½ of the spacing between the sprinklers.

21.4.11. 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 for less than or equal to 500 mm.

21.4.12. Sprinklers shall be installed under fixed obstructions over 1.2 m wide such as ducts, cable trays, decks, open grate flooring etc.

21.4.13. The minimum clearance between top of storage to the sprinkler head shall be not less than 500mm and shall be 1000mm in special situations for special sprinklers such as ESFR & ELO sprinklers.

21.4.14. Sprinklers under glass or plastic skylights exposed to the direct rays of the sun shall be of the intermediate-temperature classification.

21.4.15. Where there is a vertical change in 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.

21.4.16. 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.

21.4.17. Under obstructed construction, the sprinkler shall be installed in each bay of obstructed construction with the sprinkler deflector located not less than 25 mm to not more than 300mm from the ceiling.

21.4.18. Sprinklers shall be located so as to minimize obstructions to discharge or additional sprinklers shall be provided to ensure adequate coverage of the hazard.

21.4.19. Sprinklers shall be permitted to be spaced on 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.

21.4.20. Obstructions located against the wall and that are not over 762 mm in width shall be permitted to be protected.

21.5. Under obstructed construction, the sprinklers shall be permitted to install as per the Table to avoid obstructions of discharge pattern of a pendent sprinkler. See Figure 9.22 for illustrations.

Table 9.35: Positioning of Standard pendent sprinklers to avoid

Obstruction of discharge pattern

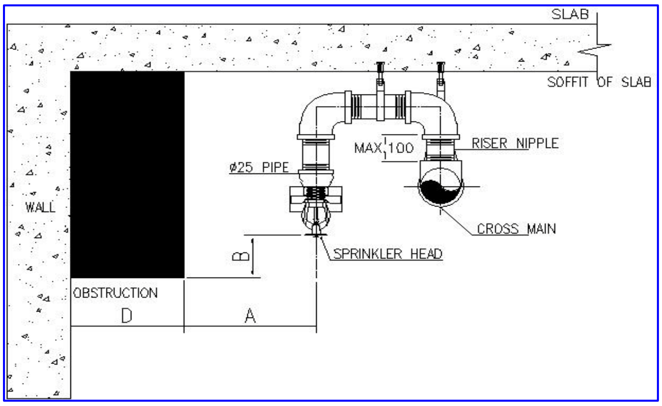
DISTANCE FROM SPRINKLERS TOSIDE OF OBSTRUCTION (A)	MAXIMUM ALLOWABLE DISTANCE OFDEFLECTOR ABOVE BOTTOM OF OBSTRUCTION (B)
Less than 300 mm	0 mm
300mm to 450 mm	65 mm
450mm to 600mm	90mm
600mm to 750mm	140mm
750mm to 900mm	190mm
900mm to 1050mm	240mm
1050mm to 1200mm	305mm
1200mm to 1350mm	355mm
1350mm to 1500mm	420mm
1500mm to 1650mm	457mm
1650mm to 1800mm	508mm

21.6. Recessed / Concealed Pendent Sprinkler Heads

21.6.1. Recessed or Concealed type Pendent sprinkler heads shall be installed in such a way that its deflector is facing downwards pendent position only.

21.6.2. Recessed or Concealed type pendent sprinklers shall be installed in the false ceiling areas, such as Main entrance lobbies, public corridors, office units, restaurants, retail show rooms etc.

21.6.3. Where the ceiling & interior architectural decorative finish is required with good aesthetic look in sensitive areas, the concealed sprinklers with cover plate is recommended according to the interior architect finish.



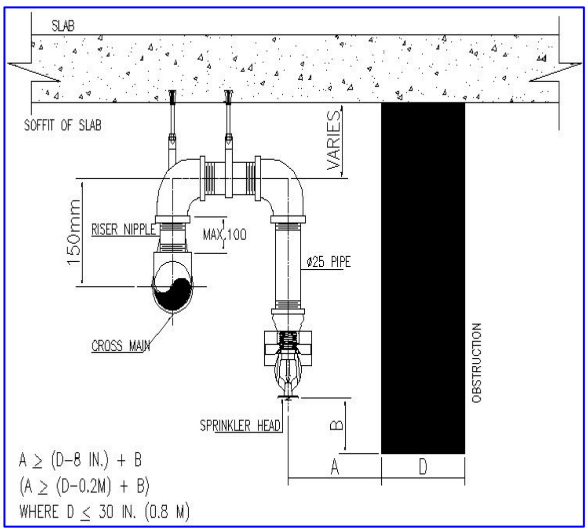


Figure 9.22: Positioning of Standard Pendant (also Upright and recessed) Sprinklers to Avoid Obstructions

21.6.4. Quick / fast response type sprinklers shall be installed in the light hazard areas.

21.6.5. The recessed / concealed pendent sprinklers shall be installed as per the installation guidelines recommended by the original equipment manufacturer.

21.6.6. A listed & approved type flexible drop pipes shall be used for extending the sprinkler drop pipe from the branch pipe to the sprinkler along with approved ceiling support fittings and hardware.

21.6.7. Pendent sprinkler protective caps and straps shall be removed immediately after the commissioning of the sprinkler system.

21.6.8. The minimum distance between the sprinklers to the adjacent sprinkler shall be not less than 1.8 m.

21.6.9. The maximum distance between the standard pendent sprinklers to the adjacent standard sprinkler shall be not more than 4.5 mtrs. Where the extended coverage upright sprinklers are used, the maximum distance between sprinklers to sprinkler shall be not more than its approval listing as per the Original equipment manufacturers technical data sheet.

21.6.10. The minimum distance between a pendent sprinklers to a wall shall be not less than 100mm.

21.6.11. The maximum distance between a standard pendent sprinklers to a wall shall be not more than 2.25 mtrs or ½ of the spacing between the sprinklers.

21.6.12. 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 for less than or equal to 500 mm.

21.6.13. The minimum clearance between top of storage to the sprinkler head shall be not less than 500mm and shall be 1000mm in special situations for special sprinklers such as ESFR & ELO sprinklers.

21.6.14. Sprinklers under glass or plastic skylights exposed to the direct rays of the sun shall be of the intermediate-temperature classification.

21.6.15. Where there is a vertical change in 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.

21.6.16. 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.

21.6.17. Under obstructed construction, the sprinkler shall be installed in each bay of obstructed construction with the sprinkler deflector located flush to the ceiling.

21.6.18. Sprinklers shall be located so as to minimize obstructions to discharge or additional sprinklers shall be provided to ensure adequate coverage of the hazard.

21.6.19. Sprinklers shall be permitted to be spaced on 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.

21.6.20. Obstructions located against the wall and that are not over 762 mm in width shall be permitted to be protected.

21.7. Under obstructed construction, the sprinklers shall be permitted to install as per the Table to avoid obstructions of discharge pattern of a recessed or concealed sprinkler. Refer to Figure 9.22.

Table 9.36: Positioning of Standard Recessed / concealed pendent sprinklers to avoid obstruction of discharge pattern

DISTANCE FROM SPRINKLERS TOSIDE OF OB-STRUCTION (A)	MAXIMUM ALLOWABLE DISTANCE OFDEFLECTOR ABOVE BOTTOM OF OBSTRUCTION (B)
Less than 300 mm	0 mm
300mm to 450 mm	65 mm
450mm to 600mm	90mm
600mm to 750mm	140mm
750mm to 900mm	190mm
900mm to 1050mm	240mm
1050mm to 1200mm	305mm
1200mm to 1350mm	355mm
1350mm to 1500mm	420mm
1500mm to 1650mm	457mm
1650mm to 1800mm	508mm

21.8. Sidewall Sprinkler Heads

21.8.1. Sidewall sprinkler heads shall be installed along a wall side, or 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.

21.8.2. Sidewall sprinklers shall be installed such that its deflectors are aligned parallel to the ceiling or roof.

21.8.3. Sidewall sprinkler shall be shall be installed in 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 point.

21.8.4. Quick / fast response type sprinklers shall be installed in the light hazard areas.

21.8.5. The recessed / concealed pendent sprinklers shall be installed as per the installation guidelines recommended by the original equipment manufacturer.

21.8.6. Sidewall sprinkler protective caps and straps shall be removed immediately after the commissioning of the sprinkler system.

21.8.7. Sidewall sprinklers shall be fitted with a protective guard where there is possibilities for accidental damage of sprinkler bulbs.

21.8.8. The distance between side wall sprinkler deflector to the ceiling shall be not less 100mm and shall be not more than 150 mm. However in non-combustible ceiling areas the distance between side wall sprinkler deflector to 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.

21.8.9. Where soffit 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.

21.8.10. The minimum distance between the sprinklers to the adjacent sprinkler shall be not less than 1.8 m.

21.8.11. In light hazard occupancies, the maximum distance between the standard sidewall sprinklers to 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 approval listing as per the Original equipment manufacturers technical data sheet.

21.8.12. In ordinary hazard occupancies, the maximum distance between the standard sidewall sprinklers to the adjacent standard sprinkler shall be not more than 3.0 m. and the room width shall be not more than 3.0 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 approval listing as per the Original equipment manufacturers technical data sheet.

21.8.13. The minimum distance between a sidewall sprinklers to a wall shall be not less than 100mm.

21.8.14. The maximum distance between a standard sidewall sprinklers to 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 sprinklers.

21.8.15. 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 for less than or equal to 500 mm.

21.8.16. Sprinklers shall be installed under fixed obstructions over 1.2 m wide such as ducts, cable trays, decks, open grate flooring etc.

21.8.17. The minimum clearance between top of storage to the sidewall sprinkler head shall be not less than 500mm.

21.8.18. Sidewall sprinklers under glass or plastic skylights exposed to the direct rays of the sun shall be of the intermediate-temperature classification.

21.8.19. Sidewall sprinklers shall be located so as to minimize obstructions to discharge or additional sprinklers shall be provided to ensure adequate coverage of the hazard.

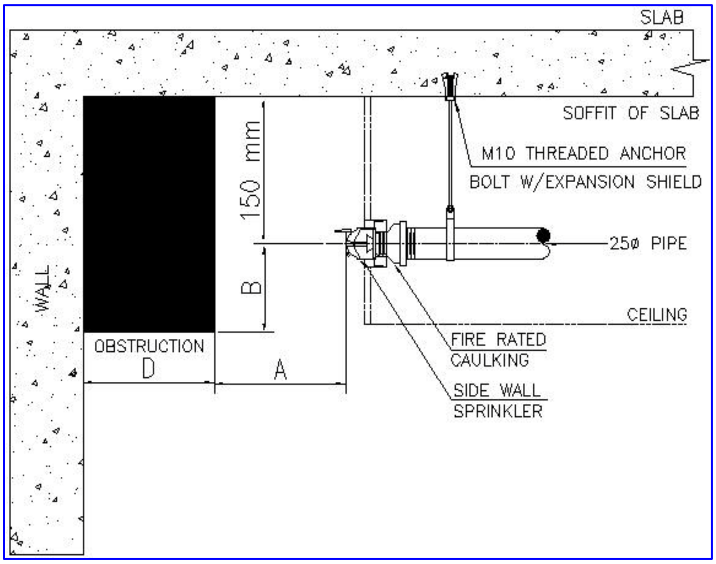
21.8.20. Sidewall sprinklers shall be installed no closer than 1.2 m. from light fixtures or similar obstructions.

21.8.21. The distance between light fixtures or similar obstructions located more than 1.2 m. from the sprinkler shall be in compliance with Table 9.37 and Figure 9.23

Table 9.37: Positioning of Standard sidewall Sprinklers to Avoid Obstructions

DISTANCE FROM SIDEWALL SPRINKLER TO SIDE OF OBSTRUCTION (A)	MAXIMUM ALLOWABLE DISTANCE OFDEFLECTOR ABOVE BOTTOM OF OBSTRUCTION (MM) (B)
Less than 1200 mm	Not Allowed
1200mm to 1500 mm	25 mm
1500mm to 1650mm	50mm
1650mm to 1800mm	75mm
1800mm to 1950mm	100mm
1950mm to 2100mm	150mm
2100mm to 2250mm	175mm
2250mm to 2400mm	225mm
2400mm to 2550mm	275mm
2550mm & above	350mm

21.9. Obstructions projecting from the same wall as the one on which the sidewall sprinkler is mounted shall be in accordance with Table 9.38 and Figure 9.24



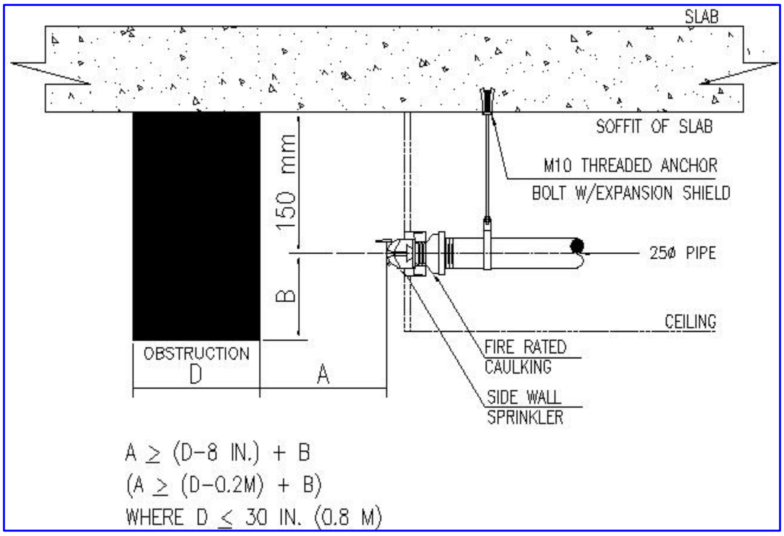


Figure 9.23 (top) and 9.24 (bottom): Positioning of Standard sidewall Sprinklers to Avoid Obstructions along the Wall

Table 9.38: Positioning of Standard sidewall Sprinklers to Avoid Obstructions along theWall

DISTANCE FROM SIDEWALLSPRINKLER TO SIDE OF OBSTRUCTION (A)	MAXIMUM ALLOWABLE DISTANCE OF DEFLECTOR ABOVE BOTTOM OF OBSTRUCTION (MM) (B)
Less than 150 mm	25 mm
150mm to 300mm	50mm
300mm to 450 mm	75 mm
450mm to 600mm	110mm
600mm to 750mm	145mm
750mm to 900mm	175mm
900mm to 1050mm	200mm
1050mm to 1200mm	235mm
1200mm to 1350mm	250mm
1350mm to 1500mm	280mm
1500mm to 1650mm	320mm
1650mm to 1800mm	350mm
1800mm to 1950mm	375mm
1950mm to 2100mm	406mm
2100mm to 2250mm	440mm

22. Distance below Ceilings.

22.1. Under unobstructed construction, the distance between the sprinkler deflector and the ceiling shall be a minimum of 25.4 mm and a maximum of 305 mm throughout the area of coverage of the sprinkler

22.2. Where there is a vertical change in ceiling elevation within the area of coverage of the sprinkler creating a distance of more than 0.91 m 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. Where the distance between the upper ceiling and the sprinkler deflector is less than or equal to 0.91m, the sprinklers shall be permitted to be spaced as though the ceiling was flat provided the obstruction rules and ceiling pocket rules are observed.

22.3. The minimum distance between the heat sources to the sprinklers shall be not less than shown in Table 9.41.

Table 9.41: Minimum spacing between sprinkler to the heat source

HEAT SOURCE	MINIMUM DISTANCE BETWEEN EDGE OF SOURCE TO ORDINARYTEMPERATURE RANGE SPRINKLERS	MINIMUM DISTANCE BETWEEN EDGE OF SOURCE TO ORDINARYTEMPERATURE RANGE SPRINKLERS
Electrical Light Fittings: 0 - 250 watts	300 mm	200mm
Electrical Light Fittings: >250 - 500 watts	450 mm	300mm
Hot water heater or furnace	300mm	150 mm
Front side of wall mounted HVAC diffuser	1000mm	500mm
Side of ceiling or wall mounted HVAC diffuser	750mm	450mm
Un-insulated heat ducts or hot water pipes	500mm	300mm

22.4. Sprinklers shall be provided in concealed spaces (for example, suspended ceiling, and raised floor and behind wall panels) where there are combustibles and services like mechanical ducts, fans, electrical cables and components.

22.5. The depth of the concealed space (suspended ceiling and raised floor) shall not be less than 400mm to accommodate installation of sprinkler pipes.

22.6. Sprinklers in concealed spaces can be exempted if the concealed space is fire compartmented that the concealed spaces of egress corridors and passageways are fire compartmented from the concealed spaces of other parts of the floor.

23. Location & Protection of Sprinkler Riser Pipe

23.1. The protection of sprinkler riser pipe is not mandatory requirement in a building which is fully protected by an automatic sprinkler system,

23.2. All steel pipes & fittings used for firefighting service shall be painted in Red. Where the situation does not permit due to the interior architecture finish, the pipe may be painted in other color by marking the sprinkler pipe with RED colored band at every 3 meters with directional arrow marks.

23.3. Feeder main pipes and riser pipes for sprinkler system shall be independent from the wet riser system piping. Common feeder main and riser piping shall not be permitted for wet riser and sprinkler system.

24. Support of Sprinkler Piping

24.1. Sprinkler system pipe installations shall be adequately supported as per the good engineering practice in accordance with internationally accepted standards.

24.2. All the supports provided for sprinkler system piping shall allow 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.

24.3. 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.

24.4. Vertical risers supported at the bottom of riser at 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.

24.5. Anchor support shall be provided at the base (bottom) of each vertical riser pipes to withstand the total weight of pipe with water and to prevent the movement by an upward thrust in the sprinkler system.

24.6. Horizontal runs of sprinkler pipes shall be supported in such that each support shall be designed to withstand the load 5 times the weight of water filled pipe, plus 115 kg.

24.7. 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.

24.8. However the hangars spacing and hangar rod size which supports horizontal pipes shall be not less than the distance specified in Table 9.43 below:

Table 9.43: Minimum spacing of hangar supports & hangar Rod size

PIPE SIZE	HANGAR SPACING	HANGAR ROD SIZE
25 - 50 mm dia	2 mtrs	10mm
65 - 100 mm dia	2.5 mtrs	12.5mm
150 & 200 mm dia	3 mtrs	16mm

25. Pipe Expansion Joints

25.1. Sprinkler pipes shall be supported in such a way that it allows free movement due to expansion and contraction and the supports shall be installed near the joints, elbows, and tee branches as much as possible.

25.2. Where required special expansion joints & expansion loops shall be provided to allow free movement of pipe installation due expansion and contraction of the building structure and or the piping.

26. Water Hammering Arrestors

26.1. Surge Arrestors of civil defense approved type shall be installed in the sprinkler system to prevent water hammering.

27. Installation of Sign Boards

27.1. Identification signs shall be provided for all sprinkler alarm check valve assemblies, floor zone control valve assemblies, pressure reducing valve stations, inspector test & drain valves, breeching inlets, spare sprinkler cabinets, fire pumps, water tanks, fire pump rooms etc made of non-corrosive material and secured to the equipment's or building wall by corrosion resistant chain & fasteners.

27.2. Hydraulic design information signs shall be posted for all sprinkler system near the alarm check valve assembly & in the fire pump room.

28. Inspection, Testing & Commissioning

28.1. Inspection

28.1.1. All the components and equipment's of sprinkler system shall be thoroughly inspected prior to its installation that they are free from dirt and not mechanically damaged during its transportation.

28.1.2. Sprinkler system installations shall be regularly inspected during the construction stage to ensure that the installations are done in accordance with the Civil Defence approved drawings and good engineering practice in accordance with the internationally acceptable standards approved by the Civil Defence.

28.1.3. In addition all the components of sprinkler system shall be visually inspected at regular intervals not less than quarterly after the commissioning to determine that components are free of corrosion, foreign material, physical damage, tampering, or other conditions that adversely affect system operation.

28.2. Testing & Commissioning

28.2.1. Flushing

i. The complete sprinkler system piping shall be flushed with water to remove the foreign materials or other debris wastes trapped within the pipe line during installation.

ii. Both underground and above ground portions of sprinkler system piping shall be subjected for flushing. The flushing operation shall be continuously done till the clear water comes out from the pipe line.

iii. The water shall be pumped in such that the velocity with in piping shall be not less than 3 meters per second sufficient to lift & flush out any debris. The minimum flow required for flushing shall be not less than hydraulically calculated water demand for the system to produce the velocity of not less than 3 meters per second.

iv. The flushing shall be done prior to the hydrostatic test of piping and installation of any sprinkler heads. The flushing outlet shall be freely let out through the remotest landing valve stand pipe.

v. All the sprinkler cross mains shall be terminated with pipe size of not less than 40 mm diameter and fitted with a gate / ball valve having diameter not less than 40mm dia with a hose adapter fitting.

28.2.2. Hydrostatic Test

i. After flushing of sprinkler system piping, all sections of piping installation shall be subjected hydrostatic test for not less than 1.5 times of the system working pressure or 16 bar whichever is higher value.

ii. The hydrostatic test pressure shall be measured at lowest elevation of the riser pipes of the system and the riser pipe being tested.

iii. In addition, the pressure gauges shall be installed at top most point of the riser pipes and remotest point of the horizontal pipe section being tested and the pressure readings of all gauges shall be recorded at every regular interval of 4 hours and the results shall be satisfactory and acceptable.

iv. The hydrostatic test pressure shall be kept in observation for the period of not less than 24 hours and shall be witnessed and certified the consulting engineer in charge of project.

v. If hydrostatic test of any section of piping is done without fixing of sprinkler heads & other valves, re-test shall be conducted after the installation of all sprinkler system equipment's and the test results shall be satisfactory and must be recorded and approved by the engineer in charge. Test results shall be submitted to the Civil Defence Authorities as & when requested for the proof.

28.2.3. Pressure Settings

i. Pressure settings of pressure reducing valves installed in the PRV stations shall be verified prior to its installation that they are factory set to its required outlet pressure and pressure relief valve installed on downstream side of PRV is set not more than 12.1 bar as per the requirements.

ii. All pressure reducing valves in the sprinkler system shall be verified prior to its installation that they factory set to the required pressure according to the hydraulic calculations and are sealed.

iii. If factory pressure setting seal is found tampered, the same shall be replaced by new one or sent for factory set for validation.

28.2.4. Flow Test

i. Upon the satisfactory completion of the entire installation, flushing and hydrostatic testing of sprinkler system, performance flow test of sprinkler system shall be conducted by any one or more of the following methods as required by the Civil Defence Authorities:

i. By shattering the sprinkler bulbs in a convenient floor / area;
ii. By operating hose valves installed on fire test header at ground level.
iii. By operating test line installed in the fire pump room with the help of flow meter & pressure gauge.

ii. Flow test results shall be satisfactory & results shall be recorded and approved by a civil defense certified fire protection engineer.

iii. A portable flow meter shall be used to test the flow & pressure of a sprinkler head at hydraulically top most & remotest locations.

28.2.5. Physical Test

i. All valves including isolation / control valves, test & drain valves shall be manually opened or closed by turning the hand wheel crank or wrench for its full range and returning it to its normal position.

ii. Supervisory alarm of isolation / control valves shall be tested by closing & opening of the valves and water flow monitoring alarms shall be tested opening test & drain valves. The interface signals at fire alarm control panel shall be verified and recorded.

29. Maintenance

29.1. The entire sprinkler system shall be maintained throughout the year in good working condition by the competent fire protection system maintenance contractors.

29.2. A tag should be attached to all major equipment's such as fire pumps, breeching inlets, alarm valve assemblies, floor / zone control valve assemblies, pressure reducing valves, isolation & check valves etc. for recording the information indicating the date of visual inspection and the date of maintenance carried out and next due date for the inspection and maintenance.

30. Water Spray System

30.1. Introduction

30.1.1. The term Water Spray refers to water that is discharged from specially designed nozzles or devices to produce a predetermined pattern, particle size, velocity and density. The primary distinction between a water spray and a sprinkler system is that of specific coverage versus general area coverage. Water spray systems have typically been provided to protect a specific piece of equipment with surface coverage.

30.1.2. The pattern of the water spray discharged from spray nozzles onto a surface maybe 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/ft2 (L/min/m2) and complete coverage of the area to be protected are also essential elements.

30.1.3. This chapter covers the use and applications of water spray systems for fire suppression, Control and extinguish and describe the components of spray systems and the specialized Uses of the systems. Because of the similarities between sprinkler systems and water spray systems, their water supply requirements, some of the equipment used in the systems, and the hydraulic Calculations for determining water supplies are briefed.

30.1.4. 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. Automaticsystem 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.

30.2. Characteristics of Water Spray System

30.2.1. Generally, water spray can be used effectively to extinguish a Fire, control a fire, protect exposures, and/or prevent a fire.

30.2.2. Water spray extinguishes a fire by cooling it, smothering it with the steam produced, emulsifying or diluting some flammable Liquids, or by a combination ofthese factors.

30.2.3. With its consequent limitation of fire spread, controlled burning may be applied if the burning combustibles cannot be extinguished by water spray or if extinguish is not desirable.

30.2.4. Exposures are protected by applying water spray directly to the exposed structures or equipment to remove or reduce the heat transferred to them fromthe exposing fire. Water spray curtains mounted at a distance from the exposedsurface are less effective than direct application.

30.2.5. It is sometimes possible to use water spray to dissolve, dilute, disperse, or cool flammable or combustible materials before they are ignited by an exposing ignition source.

30.3. Applications of Water Spray System

30.3.1. The nature of the equipment to be protected, the physical and chemical properties of the material involved, and the environment of the hazard should beconsidered when determining the design and effectiveness of the water spray system.

i. Ordinary combustible materials, such as paper, wood, and textiles, particularly to extinguish fires in such materials rather than control them.
ii. Electrical equipment installations, such as transformers, oil switches, androtating electrical machinery
iii. Flammable gases and liquids, particularly to control fires in these materialsand to extinguish types of fires involving combustible liquids.
iv. Flammable liquid and gas tanks, processing equipment, and structures, asprotection against exposure fires.
v. Open cable trays and runs containing electrical cables or Tubing.

30.4. General Design Requirements and Procedures

30.4.1. When designing a deluge system for a particular installation, consideration must be given to the following:

i. Type of hazard
ii. System’s overall purpose
iii. Job specifications
iv. Area to be protected by one Spray/deluge system
v. Water supply
vi. Drainage
vii. Float-able combustible liquids
viii. Equipment shut-down
ix. Corrosive atmospheres
x. Draft curtains
xi. The necessity of explosion-proof electrical equipment

xii. Appropriate equipment

30.4.2. The water density required to extinguish the fire or to absorb the expected heat from exposure or combustion is an important factor. When this has been determined, a nozzle may be selected that will provide that density at a velocity adequate to overcome air currents and to carry the spray to the equipment to beprotected. Each nozzle must have the proper angle of discharge to cover the areato be protected by the nozzle.

30.4.3. Determining the proper density needed for extinguish requires considerableengineering judgment and, in the case of flammable or combustible liquids, depends on such characteristics of the fuel as vapor pressure, flashpoint, viscosity, water solubility, and specific gravity. The density varies between 0.2 gpm and 0.5 gpm/ft2 (8.1 to 20.4 L/min/m2) of protected surface.

30.4.4. For exposure protection of vessels, a density of 0.25 gpm/ft2 (10.2 L/min/m2) should provide sufficient cooling to limit an exposure fire's heat input through the vessel walls. The water density required for exposure protection of structural supports and miscellaneous equipment, such as cable trays and runs, pipe racks, transformers, and belt conveyors, varies from 0.1 to 0.3 gpm/ft2 (4.1 to 12.2 L/min/m2) of exposed surface area. Design densities should be taken care for various distributions

30.4.5. When water spray is used to protect oil-filled electrical equipment, such as transformers and large switch gear, special care must be taken to provide safe electrical clearances. Special fixed water spray nozzles have been developed toprovide adequate spray density and range to accommodate wind, along with asimplified piping arrangement that is spaced safely from energized electrical parts.

30.4.6. The practical location of the piping and nozzles with respect to the surface to which the spray is to be applied or to the zone in which the spray is to be effectiveis determined largely by the physical arrangement and protection needs of the installation requiring protection. Once the criteria are established, the size of the nozzles to be used, the angle of the nozzle discharge cone, and the water pressureneeded can be determined.

30.4.7. The above parameters shall also be coordinated with the manufacturer's recommendations for the Selection and use of Spray Nozzles, location, spacing togive the desired area coverage with hydraulic calculations to establish the appropriate pipe size and water supply requirements.

30.4.8. Pipe size must be calculated hydraulically for each system so that the water at the spray nozzle will have an adequate pressure to provide the necessary flow and spray pattern.

30.4.9. 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.

30.4.10. 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.

30.4.11. The duration of the discharge required varies according to the nature of the hazard, the purpose for which the system is designed, and other factors that canbe evaluated only for each installation.

30.4.12. Water flow demand is specified in terms of the density of a uniformly distributed spray measured in gpm/ft2 (L/min/m2) of area protected. The discharge rate per unit of area depends on whether the spray system is installed to extinguish a fire, to control a fire, or to protect an exposure, and on the characteristics of the materials involved.

30.4.13. Following is an example, with procedure of Water Spray System for LPG gas Tank, which is generally a horizontal Tank. See Figure 9.30.

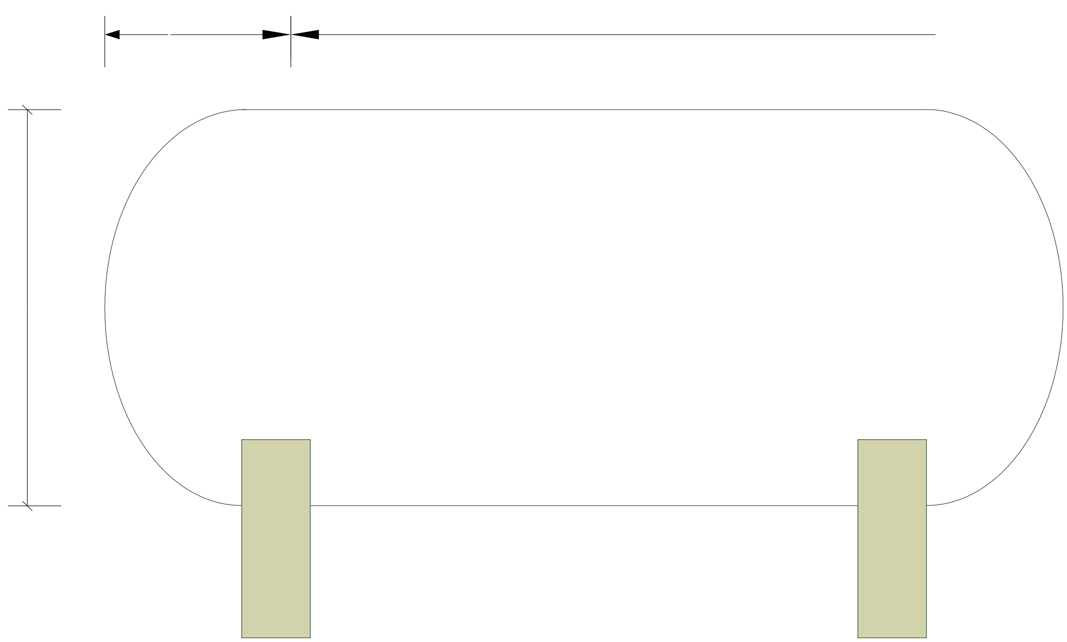


Figure 9.30: Typical Horizontal Tank Dimensions.

30.4.14. Water Spray System for Horizontal Tank

i. Calculate the total area of the Tank

- Calculate the surface area of the Shell, A1= пDL
- Calculate the area of the flat ends, A2= D2/4
- Calculate the area of spherical (Concave or Convex) ends, A3= (D2/4+h2)
- Calculate the area of Hemispherical ends, A4= $D^2/2$
- Total Area of Tank, A = A1+A2+A3+A4

ii. Design Density Water Application Rate shall be d = 10.2 Lpm/M^2 (2.7 Gpm/M^2)
iii. Water Application Rate Required (Theoretical – Lpm) = A X d
iv. Establish minimum Pressure (Bar) required at remotest Nozzle. (As per manufacturer'srecommendations suitable to design density and area of application).
v. Establish minimum Discharge (Lpm) through each Nozzle at the above stated pressure(Bar).
vi. Select number of Nozzles to be provided as per the coverage requirement.
vii. Find water required from each nozzle, = Q/No of nozzles
viii. Select appropriate Nozzle capacity i.e K-factor
ix. Adjust design as per calculated Flow and Pressure required at the tap off point.
x. Provide number of QBD Detectors as per the Coverage requirements

31. Water Mist Specifications

31.1. Introduction

Water mist systems whether low pressure, intermediate pressure or high pressure have been used internationally for 20 years. This relatively new and efficient Technology is gaining increased widespread use in marine, land and offshore applications. Using very small amounts of water in the form of a fine atomized mist or fog means that water usage is minimized and damage to buildings and contents iskept to a minimum. Water mist Technologies invariably use about 10% of the volume of water compared to traditional water sprinkler systems.

31.2. How Does Water Mist Function

Water mist Technologies suppress, control and extinguish fires in three primary ways:

i. Oxygen dilution
ii. Radiant heat attenuation
iii. Cooling

Using small water droplets (<1,000 microns MVD) implies that the droplets have a large surface-area-to-volume ratio meaning that small droplets will absorb heat quickly and vaporize thereby removing the heat away from the fire plume and at the same time causing oxygen displacement. Water mist Technologies ingeniously use the energy of a fire against itself to cause smothering and extinguisher.

31.3. Advantages & Benefits

Some advantages and benefits of water mist Technologies compared to other fire suppression Technologies such as conventional water sprinklers and gaseous fire extinguishing agents are as follows:

43.3.1 Use less water

About 90% less than conventional sprinklers thereby saving costs on infrastructure, system footprint, smaller diameter pipes, fittings and components. This means greater efficiency and better usage of water resources whilst at the same time causing less water damage through flooding.

43.3.2 No airtight enclosure

Water mist systems do not require an air tight enclosure to function unlike gaseous fire agents that require completely air tight enclosures to function properly.

43.3.3 Rapid Cooling

Water mist systems are known to rapidly cool down ambient room temperatures thereby preventing other objects from combusting and lowering ceiling gas temperatures thus reducing the incidence of flash-over phenomena. Gases do notcreate significant cooling of ambient temperatures.

43.3.4 Toxin scrubbing

Water mist systems are known to scrub the environment inside the hazard and settle the toxic combustion by-products to the ground level thereby aiding visibility and improving life tenability. Live fire testing performed in third party accredited laboratories revealed remarkable reduction of carbon monoxide, carbon dioxide and hydrogen fluorides.

43.3.5 Environmentally safe

Water mist systems that do not use chemical additives are environmentally safe and are benign meaning they are safe to use in occupied spaces. Consequently fire protection systems can be activated much sooner thereby reducing smoke and fire related damage to buildings and contents.

43.3.6 Multitude of applications

Water mist systems have been tested and installed in a variety of applications and include Class A, Class B and Class E (electrical) installations.

43.3.7 Stainless steel components

Water mist systems invariably use Stainless steel pipes, fittings and components. This enhances system longevity and reduces maintenance costs spanning the life of the building. Use of Stainless steel pipes means no internal rusting inside pipes and fittings.

43.3.8 Less system clutter

Water mist systems are generally less cumbersome to install as they use less and smaller components thereby reducing clutter and improving aesthetics.

31.4. System Types

43.4.1 Dry Pipe Designs

Open deluge water mist nozzles are installed on the grid pipe work and often a system discharge will be a “total flooding” concept meaning that all nozzles in an opened section or zone will discharge water mist simultaneously during system activation. When a relatively large hazard is required to be protected like a warehouse or factory, it is often necessary to zone off the area into several zones orsections by using approved zone valves.

43.4.2 Wet Pipe Systems

Automatic glass bulb nozzles are used and installed on the grid pipe work. The distribution pipe work is filled and pressurized with water using a small approved jockey pump. The line pressure is maintained at a nominal standby pressure, for example, 16 bar. During a fire incident, only the automatic nozzle(s) that activate swill spray water mist onto the fire. If a fire develops quickly and spreads further, more glass bulbs will shatter and hence more nozzles will activate to flow water mist. In this case a water mist system will resemble a conventional water sprinkler system. Different approved temperature glass bulbs can be used to suit the specific application.

31.5. Nozzle Types

43.5.1 Single Fluid Nozzles

Use water alone and pressure derived from the pump (or pressurized by dry nitrogen gas when storage cylinders are used) and atomization occurs at the nozzle.

43.5.2 Twin-Fluid Nozzles

Use both water and air for water atomization which is created by the interaction of water and gas under pressure inside the nozzle. In this design, there are invariably two pipes to each water mist nozzle, ie one for gas and one for water media.

31.6. Pumps & Pressure Skid Modules

Water mist fire protection systems can use either approved fire pumps, ie electric and or Diesel driven fire pumps or pressure skid modules (PSM’s). Depending on the customer preference and size and complexity of the project, approved electric driven or Diesel driven fire pumps can be used to pump and pressurize the media to the water mist nozzles. Usually lower pressure water mist systems use centrifugal type pumps whereas higher pressure water mist systems use positive displacement reciprocating piston pumps. The pumps must be connected to a clean and reliable water supply at all times. Invariably this includes a water supply tank of sufficient size and capacity. Fire pumps andcontrollers shall be either FM or ULI approved and conform to NFPA20 standards.

Water mist fire protection systems can be configured and supplied as a pressure skid module (PSM) meaning that approved high pressure water cylinders are used for storingthe fire extinguishing media and dry nitrogen cylinders are used for pressurizing the system. The ratio of water storage cylinders to dry nitrogen gas cylinders has to be carefully worked out by the system engineer and must accord with the system product approvals, either FM or ULI etc. Enough water and gas cylinders must be supplied to ensure sufficient continuous water media discharge for adequate fire control and/or extinguisher

Typical illustrations are provided below for both fire pump installations and for pressure skid modules.

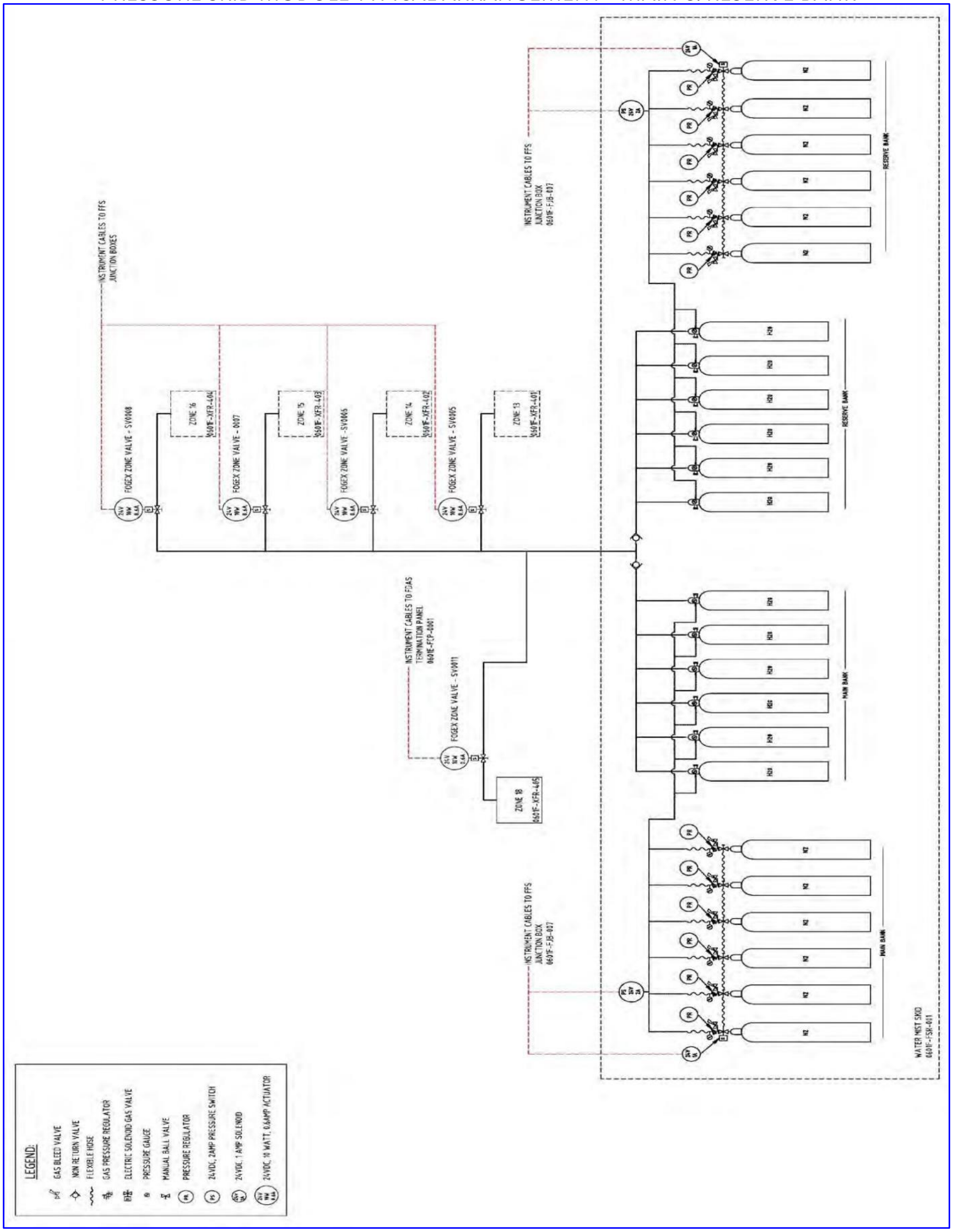
Large scale projects often require multiple pumps to supply the total water demand. In this case pumps are manifold together and are programmed to start sequentially to reduce the power load. FM or ULI Approved non-return valves must be installed between the pumps to prevent water from returning to an idle pump.

Main duty and standby fire pumps shall be supplied and installed wherever possible. If the main duty fire pump fails to start then the standby fire pump will start automatically. Fire pumps can be all electric provided an external dedicated power supply is available at all times otherwise a Diesel backup pump is to be supplied in addition to the main electric fire pump of the same size.

Fire pumps and controllers are to be designed and installed in accordance with NFPA20 & NFPA750 water mist standards latest edition. Pumps shall be designed and sized with 110% pumping capacity and their performance shall not fluctuate by no greater than ±5%. All fire pumps to be used for firefighting purposes must be factory acceptance tested (FAT) in the presence of an independent third party accredited witnessing authority and pump witnessing certificates and pump FAT test reports must accompany all pumps and be provided to the project owner or project consultant.

Pressure Skid modules where used shall have a main bank and a reserve bank to act as a second shot and to act as a standby fire protection system while the main bank is serviced or replenished. See typical arrangement drawing for a pressure skid module.

PRESSURE SKID MODULE TYPICAL ARRANGEMENT - MAIN & RESERVE BANK



31.7. Filters & Strainers

It is essential that all water mist systems installed must have a suitable and approved water basket inline water filter and a suitably approved Y-strainer to capture any dirt fromentering the pumps and causing nozzle blockages. Use of clean potable water is recommended at all times for water mist systems. Y-strainers act as the first stage of filtration and the basket inline filter acts as the second stage of filtration.

Every water mist nozzle shall have a suitable inbuilt Stainless steel sieve to prevent dirt from entering the nozzle and causing blockages. This is the third stage of filtration.

Pressure skid modules do not have to use Y-strainers or basket inline filters because the water inside the internally lined high pressure water storage containers should already have been filtered and be devoid of detritus material. Distilled water shall be used for filling the water storage cylinders.

31.8. Pressure Gauges

Suitable listed or approved pressure gauges shall be installed and used on all pumps and PSM's.

31.9. Section Valves

Suitable listed or approved Stainless steel electric 24VDC solenoid valves shall be used throughout for zoning off sections of the water mist project. Valves must be capable of withstanding the system pressure plus 1.5 times design pressure. Electric zone valves shallbe supervised and report back to the main fire control and alarm panel (FACP).

31.10. Manual Ball Valves

Suitable listed or approved Stainless steel manual ball valves with lockable handles shallbe supplied and used throughout the water mist project. Valves must be capable of withstanding the maximum system operating pressure plus 1.5 times design pressure. This is to include all drainage valves.

31.11. Pressure Switches

Suitable listed or approved pressure sender switches or pressure transducers shall be supplied and used throughout the water mist project. Their function is to monitor the system pressure and report back to the FACP. If multiple zones are used then each zone must have installed at least one pressure switch/transducer to monitor line pressure andreport back to the FACP.

31.12. Fire Detection Systems

Listed or approved fire detection systems shall be supplied and installed. The fire detection systems proposed shall also be compatible with the water mist systems.

31.13. Project Designs & Hydraulics

Every water mist project shall be custom designed and engineered to manufacturer's specifications and relevant NFPA standards. Engineering drawings are to be submitted tothe Authority Having Jurisdiction for approval showing all details such as pipes, fittings, isometric views, system layout of all components, pumps and controllers etc. The water mist supplier shall also prepare and supply hydraulic calculations for the project using anapproved hydraulic software program.

31.14. Design and O&M Manuals

The water mist system supplier shall provide at least one (1) typed and bound set of his systems design and operations and maintenance manual to the project owner or consultant after project completion.

31.15. Commissioning Certificates

Upon project finalization and prior to project handing over, the water mist system manufacturer shall commission the installed system and ensure that all functions are performing satisfactorily. This will usually involve a full system check-list and a cold system discharge test to ensure all pumps & controllers start as required and all nozzles discharge properly. Upon system commissioning, the water mist manufacturer or supplier is to submit to the project owner or consultant as the case may be, a final inspection report and commissioning certificate. Warranty certificates are also required to be submitted during this time.

31.16. Water Mist Applications

Water mist applications are numerous and varied. More water mist standards and test protocols are becoming available every year. Some applications where water mist systemshave been installed successfully to date include:

- Electric transformer substations
- Computer and data rooms
- Electrical switch gear rooms
- Power generation facilities
- Electric cable tunnels

- Road tunnels
- Marine vessels
- Offshore platforms
- Large warehouses
- Petro-chemical refineries
- Residential dwellings and apartments
- High rise hotels and offices
- Airports and port terminals
- Rapid rail transit systems
- Museums, art galleries and libraries
- Military air craft hangars & bunkers
- Large mining machinery and earth-moving equipment
- Conveyor belt systems
- Combustion & gas turbines
- State penitentiaries
- Theatre buildings
- Powder factories
- Oil processing facilities, etc

Water mist manufacturers who have conducted live fire testing at recognized independent fire testing laboratories in the presence of witnessing authorities shall submit their laboratory fire test reports and product approvals obtained from approving authorities to Civil Defence for approval purposes. Applicants of water mist systems whorequire Civil Defence approvals must lodge the proper application forms with Civil Defence.

31.17. Design Considerations

The water mist manufacturer shall design his water mist fire protection systems as per product approvals based on live fire testing performed at independent fire testing laboratories. The system manufacturer shall also observe all relevant fire industry standards and applicable codes. Where industry standards or codes are not specific on a particular matter, then the manufacturer or AHJ recommendations shall be followed andreference to the manufacturer's design, installation and service manuals shall be cross referenced.

The fire system supplier shall not exceed his listings or approvals especially nozzle grid spacing which shall be observed. The nozzle grid spacing or effective coverage area per-nozzle will be stipulated inside the fire test reports as issued by the testing laboratory or approving authority. Distance of nozzles from walls should not exceed half the listed nozzle grid spacing. For example a system that has nozzle grid spacing approved at 4 meters x 4 meters, then the distance of a nozzle from the wall shall not exceed 2 meters.

Similarly, the system manufacturer shall not exceed his listed or approved nozzle vertical distance from floor level. Water mist fire protection system designs shall follow the manufacturer's design manual.

31.18. Standards

Water mist manufacturers and fire protection system designers shall design & supply their water mist fire protection systems to comply as far as is practicable with the following standards:

1. NFPA750 Water Mist Standard, 2003 edition
2. AS4587-1999 Water Mist Standard
3. FM5560 Water Mist Standard, 2008
4. IMO MSC/Circ. 668/728 for machinery spaces and cargo pump rooms
5. IMO MSC/Circ. 1165 for machinery spaces and cargo pump rooms
6. IMO MSC/Circ. 913 for local application systems
7. IMO 800(A) for accommodation spaces, corridors, luxury cabins
8. European Norm EN12845:2004
9. European Norm EN14972
10. NFPA20 Standards "Stationary Fire Pumps for Fire Protection", 1999 edition
11. NFPA13 Standards "Water Sprinkler Systems"
12. CEA 4001:2005-09
13. FM Global – Property Loss Prevention Data Sheets 3-7, "Fire Protection Pumps", June 2009

13. FM Global – Property Loss Prevention Data Sheets 3-7N, 13-4N "Stationary Pumps for Fire Protection", September 2001
14. FM Global – Property Loss Prevention Data Sheets 2-81, "Fire Protection System Inspection, Testing and Maintenance and other Fire Loss Prevention Inspections", January2008

References shall be drawn from the latest editions for the above standards wherever applicable.

32. *FOAM* EXTINGUISHING *SYSTEMS*

35.1 Introduction

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, heat-resistant blanketsover 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 surfacesand filling cavities.

44.1.1. Foams are defined by their expansion ratio, which is the ratio of final foam volume to original foam solution volume before adding air. They are arbitrarily subdivided into three ranges:

- **i.** Low-expansion foam—expansion up to 20:1
- **ii.** Medium-expansion foam—expansion 20 to 200:1
- **iii.** High-expansion foam—expansion 200 to 1000:1.

44.1.2. Fire-fighting foams are used in fixed and portable fire extinguishing systems.

44.1.3. Foam is generated by proportioning foam concentrate with water. Various fixed and portable proportioning devices are used. Discharge devices include nozzles, foam monitors, and sprinklers.

44.2. Different types of Foams and their Applications

44.2.1. A number of types of foaming agents are available, known as foam concentrates, some of which are designed for specific applications. Some are suitable for extinguishing all types of flammable liquids, including water-soluble and foam- destructive liquids. Below are descriptions of the common types of foam agents.

- **i.** Aqueous Film-Forming Foam Agents (AFFF).
- **ii.** Fluoroprotein (FP) Foaming Agents.
- **iii.** Fluoroprotein (FP) Foaming Agents.
- **iv.** Protein (P) Foaming Agents.
- **v.** Low-Temperature Foaming Agents.
- **vi.** Alcohol-Type Foaming Agents (AR).
- **vii.** Medium- and High-Expansion Foaming Agents.
- **viii.** Other Synthetic Hydrocarbon Surfactant Foaming Agents.

44.2.2. Low-expansion foam is used principally to extinguish burning flammable or combustible liquid spill or tank fires by application to develop a cooling, coherentblanket.

44.2.3. A foam blanket covering a tank's liquid surface can prevent vapor transmission for some time, depending on the stability and depth of the foam. Fuel spills are quickly rendered safe by foam blanketing. The blanket may be removed after a suitable period of time; typically it has no detrimental effect on the product with which it comes into contact.

44.2.4. Foams can be used to diminish or halt the generation of flammable vapors from non-burning liquids or solids and may be used to fill cavities or enclosures where toxic or flammable gases may collect.

Foam is of great importance where aircraft's are fueled and operated. Sudden, large fuel spills resulting from aircraft accidents or malfunction require rapid foam application. Hangar fire protection is best accomplished by properly designed foamsystems.

44.2.5. Increasingly, warehouses and buildings storing large quantities of combustible and flammable liquids are protected by foam-water sprinkler systems. The protection required is a function of the type and quantity of liquid stored, building height, and storage configuration.

44.2.6. Foams of the medium- or high-expansion type (20 to 1000 times) may be used to fill enclosures such as basement room areas or holds of ships where fires are difficult or impossible to reach. Here foams act to halt convection and access to air for combustion. Their water content also cools and diminishes oxygen by steam displacement. Foams of this type (with expansion ratios of 400 to 500) may be used to control liquefied natural gas (LNG) spill fires and help disperse the resulting vaporcloud.

44.3. Foam Proportioning

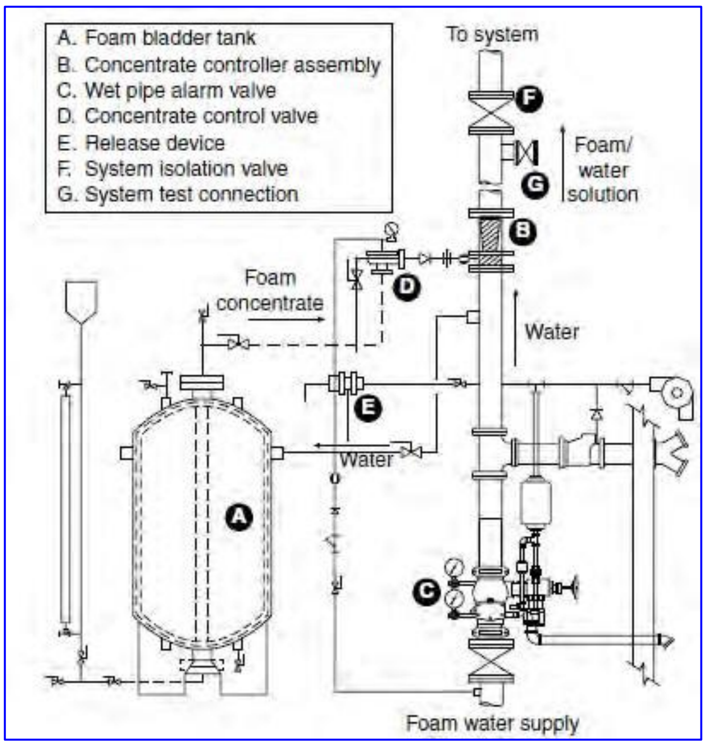
44.3.1. The process of producing and applying fire-fighting air-foams to hazards requires three separate operations, each of which consumes energy. They are (1) the proportioning process, (2) the foam generation phase, and (3) the distribution method.

44.3.2. It is very important that foam concentrate be proportioned accurately into the water stream. Proportioning equipment, foam concentrate, and discharge equipment must be matched to produce the proper solution concentration at system design operating pressures.

44.3.3. If proportioning is low, the foam will be relatively weak and unstable; if too high, the foam may be stiff and concentrate will be wasted, thus reducing effective system operating time. So that a predetermined volume of liquid foam concentrate may be mixed with a water stream to form a foam solution of fixed concentration, the following two general methods are used:

- **i.** Methods that use the pressure energy of the water stream by venturi action and orifices to induct concentrate.
- **ii.** Methods that use external pumps or pressure heads to inject concentrate into the water stream at a fixed ratio to flow.

44.3.4. Following figures show some typical foam system arrangements.



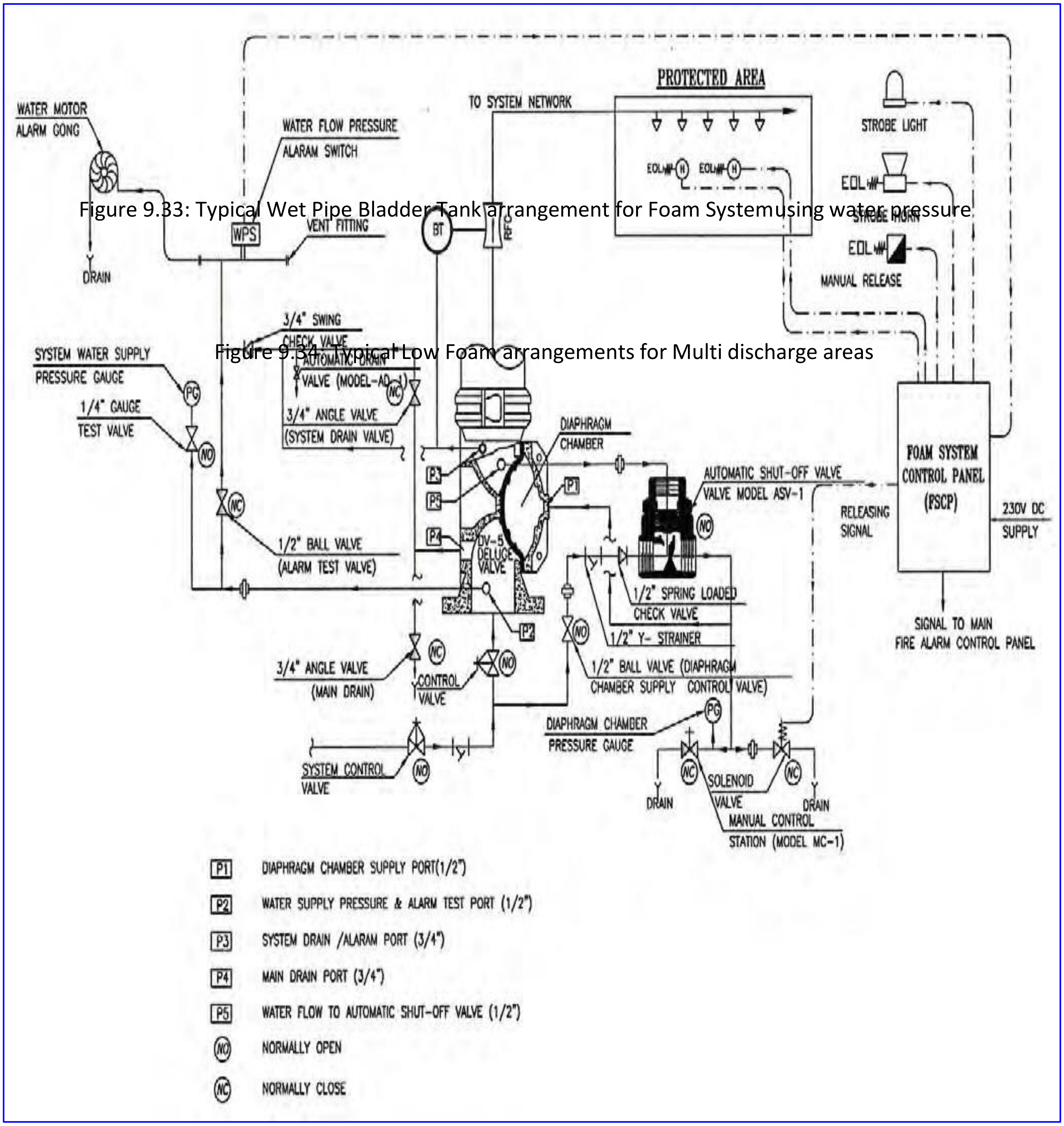
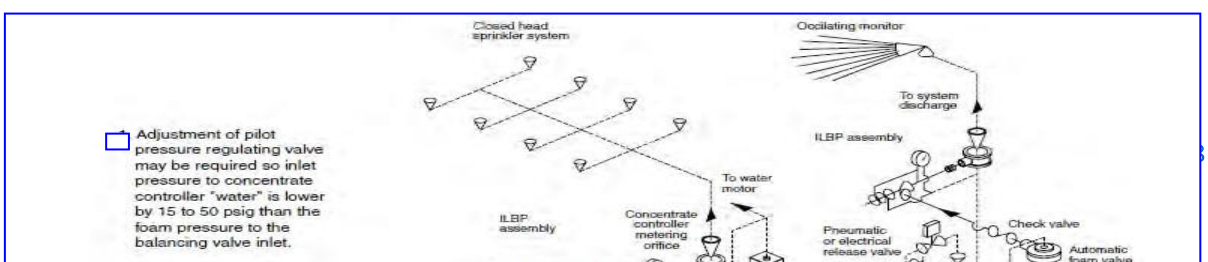


Figure 9.33: Typical Wet Pipe Bladder Tank arrangement for Foam Systemusing water pressure

Figure 9.34: Typical Low Foam arrangements for Multi discharge areas



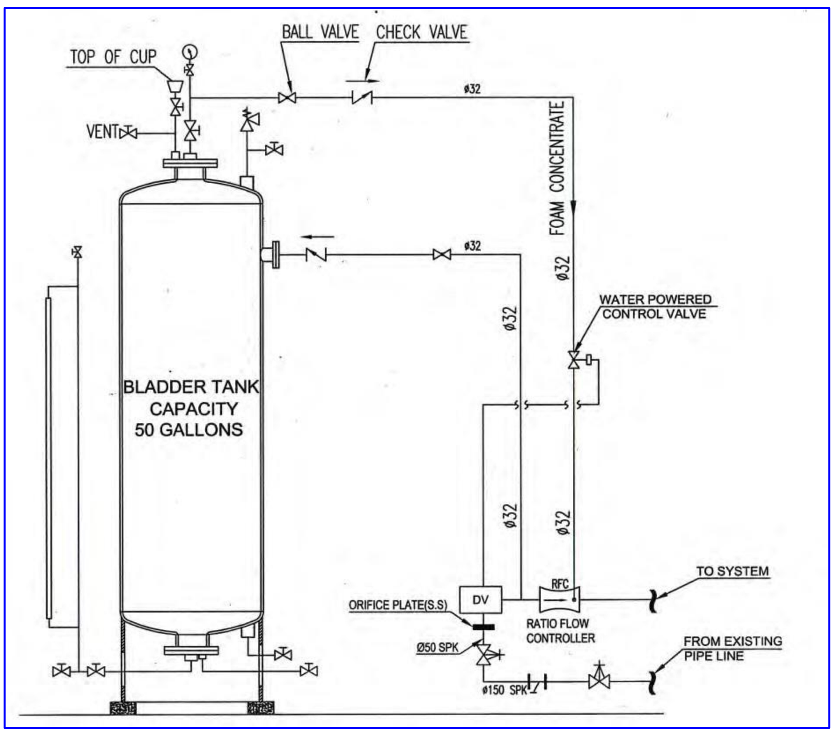


Figure 9.42: Schematic showing an example of Foam System with Fire detection

44.4. Characteristics and Limitations

44.4.1. 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, anyapplication 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.

44.4.2. Foam breaks down and vaporizes its water content under attack by heat and flame. It therefore must be applied to a burning liquid surface in sufficient volume and rateto compensate for this loss, with an additional amount applied to guarantee a residual foam layer over the extinguished liquid.

44.4.3. Foam is unstable and may be broken down easily by a physical or mechanical force, such as a water hose stream.

44.4.4. Certain chemical vapors or fluids may also destroy foam quickly. When certain other extinguishing agents are used in conjunction with foam, severe breakdown of the foam may occur.

44.4.5. Turbulent air or violently uprising combustion gases from fires may divert foam from the burning area.

44.4.6. 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.

44.4.7. Medium- and high-expansion foam systems shall not be used on fires in the following hazards:

- **i.** Chemicals, such as cellulose nitrate, that release sufficient oxygen or otheroxidizing agents to sustain combustion
- **ii.** Energized unenclosed electrical equipment
- **iii.** Water-reactive metals such as sodium, potassium, and NaK (sodium-potassium alloys)
- **iv.** Hazardous water-reactive materials, such as triethyl-aluminum and phosphorus pent-oxide
- **v.** Liquefied flammable gas

44.4.8. The ability of foam to rapidly extinguish flammable liquid fires has contributed to life safety and property conservation. However, with the increasing global environmental awareness, fire-fighting foams are being scrutinized for their potential environmental impact. The primary concerns are toxicity, biodegradability, persistence, treat ability in wastewater treatment plants, and nutrient loading.

44.5. Design Criteria

44.5.1. Manufacturer's Engineering design requirements and recommended application methods must be followed for successful use of foams.

44.5.2. Water-soluble and certain flammable and combustible liquids and polar solvents that are destructive to non-alcohol-resistant foams shall require the use of alcohol- resistant foams.

44.5.3. Automatic Fire detection shall be used for fixed systems except for certain outdoor situations where manually triggered systems can be acceptable based on hazard evaluation.

44.5.4. Minimum of 3% foam-water solution shall be discharged.

44.5.5. Maximum area per sprinkler head shall be of 100 ft² (9.5 m2) and maximum 12 foot (3.7 m) spacing shall be maintained between sprinklers.

44.5.6. Minimum of 60 minute water supply shall be ensured.

44.5.7. Minimum design area for closed-sprinkler systems shall be 5000ft². (476m²). Open- sprinkler systems must discharge over the entire hazard area.

44.5.8. Maximum sprinkler temperature rating of 250 to 300 ° F (121 to 149 °C) at a roof or ceiling, and 135 to 170 °F (57 to 77 °C) for intermediate sprinklers.

44.5.9. The following design criteria shall be followed for foam protection to be fully effective for the flammable and hazardous liquid hazards.

44.5.9.1.1.1.1. The liquid must be below its boiling point at the ambient conditions of temperature and pressure.

44.5.9.1.1.1.2. Care must be taken in application of foam to liquids with a bulk temperature higher than 212°F (100°C). At these fuel temperatures and above, foam forms an emulsion of steam,air, and fuel. This may produce a fourfold increase in volumewhen applied to a tank fire, with dangerous frothing or slipover of the burning liquid.

44.5.9.1.1.1.3. The liquid must not be unduly destructive to the foam used,or the foam must not be highly soluble in the liquid to be protected.

44.5.9.1.1.1.4. The liquid must not be water reactive.

44.5.9.1.1.1.5. The fire must be a horizontal surface fire. Three-dimensional (falling fuel) or pressure fires cannot be extinguished by foam unless the hazard has a relatively high flashpoint and can be cooled to extinguishment by the water in the foam.

44.5.10. The Table 9.44 depicts the basic design requirements for certain hazards to protect with Hand-hose, Monitors or Fixed outlets.

44.5.11. The Table 9.45 Guidelines the basic design guidelines for Foam Water Sprinkler or Foam Water Spray Systems for certain hazards.

44.5.12. The hazards specifically not covered in these tables shall refer to Table 9.7 Design Criteria for Sprinklers for the Hazard Classifications and Design Density requirements.

44.6. Piping and Installation

44.6.1. Refer to sections on Piping, Installation, Testing and Commissioning of Sprinkler Chapters along with Manufacturer's Manuals.

Table 9.44 DESIGN CRITERIA FOR FIXED FOAM OUTLETS, SURFACE AND SUBSURFACE APPLICATION					
HAZARD	FOAM CON-CENTRATERE-QUIRED	WATER DEMAND / DESIGN DENSITY	DESIGN AREA (See 42.4.7 fordetails)	FOAM ADDI-TIONFOR HY-DRAULIC IM-BALANCE	DIS-CHARGE DURATION (MINUTES)
OUTDOOR STORAGE					
FUEL S WITH FLASH POINT 100 ^{O}F- 140 ^{O}F (37 ^{O}C- 37 ^{O}C)	AFFF, FFFP	0.10 gpm/ ft^2		10%	30
FUEL S WITH FLASH POINTS BELOW 100^{O}F (37 ^{O}C) OR LIQUIDS HEATED ABOVE THEIR FLASH POINT	AFFF, FFFP	0.10 gpm/ ft^2		10%	55
CRUDE PETROLEUM	AFFF, FFFP	0.10 gpm/ ft^2		10%	55
INDOOR HYDROCARBON STORAGE TANK (> 37.2 M^2 LIQUID SURFACE AREA)					
FUEL S WITH FLASH POINT 100 ^{O}F- 140 ^{O}F (37 ^{O}C- 37 ^{O}C)	AFFF, FFFP	0.16 gpm/ ft^2		10%	30
FUEL S WITH FLASH POINTS BELOW 100^{O}F (37 ^{O}C) OR LIQUIDS HEATED ABOVE THEIR FLASH POINT	AFFF, FFFP	0.16 gpm/ ft^2		10%	55
CRUDE PETROLEUM	AFFF, FFFP	0.16 gpm/ ft^2		15%	55
AIRCRAFT HANGER	AFFF, FFFP	0.20 gpm/ft^2		15%	10
LOADING & UNLOADING SPILLAGE	AFFF, FFFP	0.10 gpm/ ft^2		10%	15
DIKED AREA	AFFF, FFFP	0.16 gpm/ ft^2		10%	20

Table 9. 45 DESIGN CRITERIA FOR FOAM WATER SPRINKLER & FOAM WATER SPRAY SYSTEMS

HAZARD	FOAM CONCEN-TRATEREQUIRED	WATER DE-MAND / DESIGN DEN-SITY	DESIGN AREA (See 42.4.7 for details)	FOAM AD-DITIONFOR HYDRAULIC IMBALANCE	DISCHAR DURATIO (MINUTE
RACK STORAGE IN METAL CONTAINERS < 5 GALLONS					
LIQUIDS- CLASS IB, IC, II, IIIA	AFFF, FFFP	0.30 gpm/ ft^2	2000 ft^2	10%	15
RACK STORAGE IN METAL CONTAINERS > 5 TO < 60GALLONS					
LIQUIDS- CLASS IB, IC, II, IIIA	AFFF, FFFP	0.30 gpm/ ft^2	3000 ft^2	10%	15
LIQUIDS- CLASS IIIB	AFFF, FFFP	0.30 gpm/ ft^2	2000 ft^2	10%	15
	AFFF, FFFP				
PALLETIZED STORAGE IN METAL CONTAINERS < 5 GALLONS					
LIQUIDS- CLASS IB, IC, II, IIIA	AFFF, FFFP	0.30 gpm/ ft^2	3000 ft^2	10%	15
SPRAY APPLICATION USING FLAMMABLE AND COMBUSTIBLE MATERIALS	AFFF, FFFP	0.40 gpm/ ft^2	5000 ft^2	10%	15
POWDER COATING APPLICATIONS	AFFF, FFFP	0.20 gpm/ ft^2	5000 ft^2		○
DIESEL GENERATOR	AFFF, FFFP	0.30 gpm/ ft^2	5000 ft^2	10%	10

33. Gas Suppression Systems

33.1. Introduction

33.1.1. This guideline describes the requirements for fire prevention and gas extinguishing systems. Generally it is possible to protect valuable goods in data centers, control rooms, server rooms, electrical rooms, BMS rooms, Telephone Rooms, archives and storage's with fire prevention or fire suppression systems. The actual design of thesegas suppression systems shall be based on Civil Defence approved Manufacturer's recommendations, guidelines and calculations through approved software.

33.2. Definitions

33.2.1. Clean Agent.

45.2.1.1. Electrically no conducting, volatile, or gaseous fire extinguishing agent that does not leave a residue upon evaporation.

33.2.2. Design Factor

45.2.2.1. A fraction of the agent minimum design quantity (MDQ) added thereto deemed appropriate due to a specific feature of the protection application ordesign of the suppression system.

33.2.3. Final Design Quantity

45.2.3.1. The quantity of agent determined from the agent minimum design quantityas adjusted to account for design factors and pressure adjustment.

33.2.4. Local Application System.

45.2.4.1. A system consisting of a supply of extinguishing agent arranged to dischargedirectly on the burning material or equipment.

33.2.5. Pre-Engineered System.

45.2.5.1. 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 andtypes of nozzles prescribed by a testing laboratory. The hazards protected bythese systems are specifically limited as to type and size by a testing laboratory based upon 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.

33.2.6. Total Flooding System.

45.2.6.1. A system consisting of an agent supply and distribution network with discharge nozzles designed to achieve a total flooding condition in a hazard volume.

33.3. Gas Extinguishing Systems

33.3.1. For a fire to start and continue to burn, flammable materials, oxygen and a heat source are all required. If one of these components is removed the fire will go out. Most extinguishing methods work by either removing the heat source or the oxygen.

33.3.2. The goal of every fire-fighting system is to minimize damage to people and goods. Onthe one hand it is important to activate the specific fire extinguishing procedure as quickly as possible. On the other hand, the extinguishing technology itself should cause the least possible additional damage.

33.3.3. Water is an excellent extinguishing agent with its capacity to absorb heat and stop fires from burning. However, using water in this way can damage buildings and goods. In areas where maintaining accessibility is a key or where valuable items arestored, water is therefore not always the ideal solution.

33.3.4. Gas extinguishing agents provide the optimal solution for protecting important areas - use of such agents does not result in any additional damage.

33.3.5. However, there are environmental considerations for certain Gas extinguishing agents. See CHAPTER 5. COMMITMENT TO BEST PRACTICES, Section 2. Environmental Management & Sustainability for upcoming issues regarding the acceptability of certain Clean Agents in the industry.

33.3.6. 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.

33.3.7. Advantages of gas extinguishing technology

i. Protection of facility and fittings without water damage
ii. Extinguishing gases are non-conducting
iii. No danger to personnel using electrical plant or machinery
iv. No danger of short circuits either during or after the extinguishingprocess

33.3.8. Ideal Applications

i. Electrical Rooms
ii. LV Rooms
iii. Electronic Equipment Rooms
iv. Telecommunication Rooms
v. Server Rooms
vi. BMS Rooms
vii. IT Data Center
viii. Museums
ix. Mobile Switching Center
x. Storage's
xi. Archives
xii. Machinery
xiii. Cabinets

33.3.9. The following picture shows the principle of gas extinguishing systems. Very important is the proper calculation of the pressure relief to protect the walls, doors and windows due to the over-pressure during the extinguishing process.

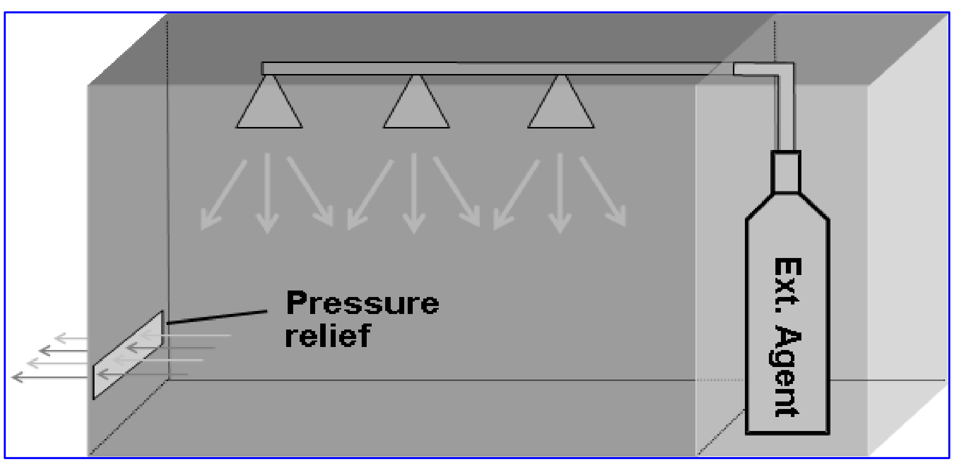


Figure 9.43: Typical Gas Extinguishing system with over-pressure relief

33.4. Agent Storage Bank

33.4.1. Clean Agent Bank and accessories shall be located and arranged so that inspection, testing, recharging, and other maintenance activities are facilitated and interruption of protection is held to a minimum.

33.4.2. Storage containers shall be located as close as possible to or within the hazard or hazards they protect.

33.4.3. Agent storage containers shall not be located where they can be rendered inoperable or unreliable due to mechanical damage or exposure to chemicals or harsh weather conditions or by any other foreseeable cause. Where container exposure to such conditions is unavoidable, then suitable enclosures and protective measures shall be employed.

33.4.4. Storage containers shall be securely installed and secured according to the manufacturer's listed installation manual and in a manner that provides for convenient individual servicing or content weighing.

33.4.5. The cylinders shall be installed so that each individual cylinder can be easily mounted and shall be fitted with a non-return valve (Check valve) to the manifold if there is more than one cylinder to prevent agent loss and to ensure personnel safety if the system is operated when any containers are removed for maintenance.

33.4.6. The quantity of available extinguishing agent (if applicable, the reserve quantity as well) shall be monitored. Any loss in weight or pressure of more than 10% of the extinguishing agent in any cylinder shall be indicated automatically. The checking unit shall be easily manageable with no gas leaking from the bottles during functional testing.

33.4.7. In a clean agent bank of multiple cylinders, only one cylinders size and one filling pressure shall be used.

33.4.8. The filling tolerance per bottle shall be +0/-2.5 % of the nominal filling pressure.

33.4.9. Cylinders shall be supplementary marked with the name of the company responsible for the installation, type of gas, quantity of gas, filling density and degree of pressurization and specifications for the gas used as pressure cushion.

33.5. Cylinder valves

33.5.1. Cylinder valves will be of a pressure seated, high flow rate design incorporating a stainless steel piston with seal, pressure releasing for valve operation, safety disc assembly, pressure actuation outlet port and pressure gauge.

33.5.2. Cylinder valves will be provided with anti recoil plug fitted to the valve discharge outlet to prevent accidental rocketing or spinning of the cylinder in the event of discharge while the cylinder is not securely mounted

33.6. Nozzles

33.6.1. Nozzles shall be arranged centrally and strategically so that a homogenous mixture of the required gas concentration will be achieved.

33.6.2. The maximum protected area per nozzle shall not exceed the manufacturer's recommended range.

33.6.3. Nozzles shall be sited so as not to disperse any combustible materials when gas is discharged. Nozzles shall be arranged so that the effects of discharge do not damage the components being protected.

33.6.4. Nozzles shall be located in the upper area of a flooding zone.

33.6.5. If the flooding zone is higher than 5 m, special care shall be taken to get an even distribution of gas by installing nozzles at intermediate levels.

33.6.6. Suitable protective arrangements shall be made in environments where nozzles could be fouled. In rooms with electrical and electronic risks the nozzles shall be made of corrosion resistant materials.

33.7. Area valves

33.7.1. Area valves shall be located outside the flooding zone. No flammables shall be stored in the immediate vicinity of an area valve.

33.7.2. Area valves shall be arranged so that they will not open when subjected to:

i. Operating environmental vibrations
ii. Vibrations arising from the valve at the storage cylinder opening
iii. From other selector valves openings

33.7.3. Automatic actuation of an area valve shall be powered by static weight and/or pneumatic and/or electrical means. The unit shall be designed in such a way that checking for proper functioning on site can be achieved without discharging gas.

33.7.4. If it is possible to release the extinguishing agent, even though the mechanism used to automatically open the area valve has failed, the emergency release mechanism shall not circumvent national codes for personnel safety nor the equipment requiredto prevent damage from excess pressure being exerted by the gas discharged into the flooding zone.

33.7.5. Area valves shall open automatically and simultaneously with the opening of a cylinder valve. Pressure relief devices shall discharge gas into the atmosphere away from windows, ventilation, openings, etc; in no case shall this constitute a hazard to personnel. Safety valves shall be assembled vertically.

33.8. Pipe and fittings

33.8.1. Pipes and pipe connections shall be made of metal (seamless welding) and be able to withstand the pressures as specified and calculated and any low temperature encountered.

33.8.2. The test pressure for the Inert Gas Systems' pipe between the cylinders and the area valve should have 1.5 times of the service pressure. (i.e. 200-300 bar cylinder – test pressure and pipe pressure resistance should be 300-450 bar respectively). 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. 60 bar pressure – 90 bar test pressure and pipe pressure resistance).

33.8.3. Fittings shall be calculated for the occurring service pressure. Fittings shall be suitable for deeper temperatures (approx. –50°C). In sections of pipe that are subjected to static head pressure (closed pipe work) the service pressure must not be exceeded, if need be a safety valve shall be fitted.

33.8.4. The pipe work between cylinder and area valve shall be marked by the manufacturer, so that 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. Fittings shall be marked by a red spot and the letter D. 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 approved.

33.8.5. 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.

33.8.6. 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.

33.8.7. The pipe work shall be arranged so that it cannot be damaged by its own weight, temperature fluctuations, vibration, and release of gas or other installation inherent influences.

33.8.8. 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 equipment bonding).

33.8.9. Dry air or Nitrogen will be blown inside the piping to remove any debris prior to installation of nozzles.

33.8.10. Fastening of pipe will be secured especially near nozzles to prevent pipe movement due to the high pressure during discharge

33.9. Room Integrity and Air tightness Requirements

33.9.1. Airtight rooms

36.9.1.1. Airtight rooms are the main requirement for the usage of fire prevention and gasextinguishing systems.

33.9.2. General Room tightness

36.9.2.1. For fire prevention and gas extinguishing systems the protected areas have to be sealed to become defined air tightness.

33.9.3. Room tightness - Description n50 value

36.9.3.1. The n50 value is the air change per hour (ACH) meaning the number of times each hour an amount of air equal to the volume of the area to be protected, leaks out at an over-pressure of 50 Pa

33.9.4. Measurement of n50 value

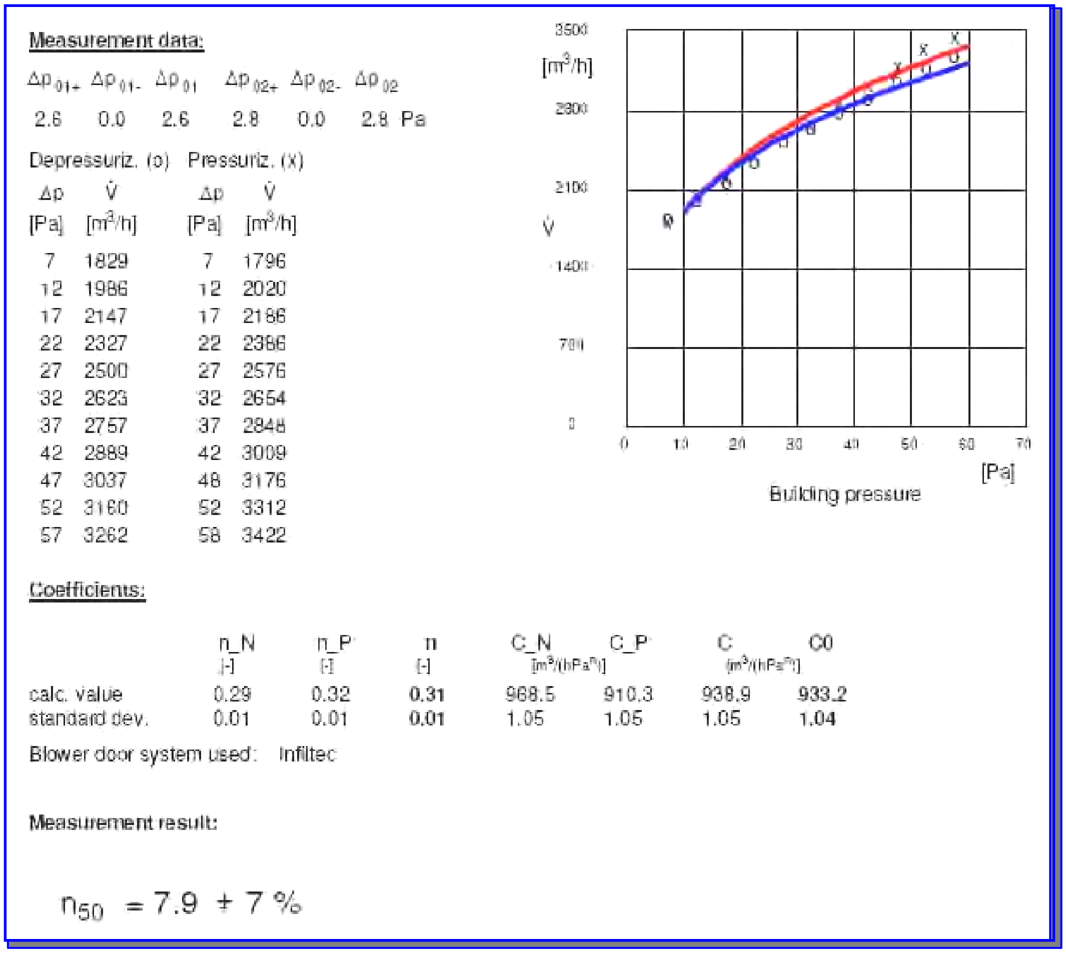
45.9.4.1. The Blower door measurement is a scientific approach to identifying and controlling Air Filtration. It is primarily used to check for any possible leakages in a given area by applying two types of pressure: over pressure and underpressure.

45.9.4.2. 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.

45.9.4.3. 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 over-pressure measurement or enters from there during under pressure measurement.

45.9.4.4. 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.

45.9.4.5. The following picture shows how the result of a blower door measurement looks like.


Measurement data:

Δp_{01+}	Δp_{01-}	Δp_{01}	Δp_{02+}	Δp_{02-}	Δp_{02}	
2.6	0.0	2.6	2.8	0.0	2.8	Pa

Depressuriz. (o) Δp [Pa]	$\dot{V}$ [m³/h]	Pressuriz. (x) Δp [Pa]	$\dot{V}$ [m³/h]
7	1829	7	1796
12	1986	12	2020
17	2147	17	2186
22	2327	22	2386
27	2500	27	2576
32	2623	32	2654
37	2757	37	2848
42	2889	42	3009
47	3037	48	3176
52	3160	52	3312
57	3262	58	3422

Coefficients:

	n_N [-]	n_P [-]	n [-]	C_N [m³/(hPa^n)]	C_P	C [m³/(hPa^n)]	C0
calc. value	0.29	0.32	0.31	968.5	910.3	938.9	933.2
standard dev.	0.01	0.01	0.01	1.05	1.05	1.05	1.04

Blower door system used: Infiltec

Measurement result:

$n_{50} = 7.9 + 7\%$

Figure 9.44:. Example for Blower door measurement report

33.9.5. Walls

36.9.5.1. The walls as well as raised floor and ceiling of the protected areas should at least comply with the fire resistance class F30 or consist of non-flammable and non melting materials. The walls should also be plastered and if this is not sufficient enough painted with a reasonable tight coating.

33.9.6. Doors and Windows

36.9.6.1. The doors and windows used for the protected areas should also comply with fire regulation and also be air tight to prevent leakage. The doors and windows need to have a mechanism for closing automatically in case of an emergency situation. For fire prevention systems the doors and windows have to be closed all times except for access.

33.9.7. Sealed Penetrations

36.9.7.1. Sealing of penetrations for pipes and cables is also a very important issue otherwise it will have a major influence due to the holding time of the gas concentration within the protected area. Please be aware that normal fire stopping material will not seal the opening in an airtight matter. On the market are professional airtight break-throughs available. Another solution is to seal withfire stopping material as first and add acrylic sealant followed by latex paint.

33.9.8. Pressure Relief

36.9.8.1. For all gas extinguishing systems pressure relief have to be calculated and implemented to prevent the rooms from over-pressure damages. Fire prevention systems do not require pressure relief.

33.9.9. Design Criteria for Applications

45.9.9.1. All gas extinguishing designs have to be made in line with one of the followinginternational approval bodies. Especially all calculation and design programs have to be approved by:

i. AFNOR (Association Française de Normalization), France
ii. FM (Factory Mutual), US
iii. LPCB (Loss Prevention Certification Board), UK
iv. NTC (National Test Center), China
v. SSL (Scientific Services Laboratory), Australia
vi. UL (Underwriters Laboratory Inc), US
vii. ULC (Underwriters Laboratory Canada), Canada
viii. VdS (Verband der Sachversicherer e.V.), Germany

33.9.10 Room tightness

45.9.9.2. The air tightness of the protected areas has to be designed according to thefollowing Table 9.46:

Table 9.46: n50 Values based on volumes

Volume in m^3	1	100	1,000	10,000	50,000	500,000

N50 – Value in 1/h	5.0	1.5	1.0	0.1	0.05	0.01

45.9.9.3. To all intermediate volumes linear interpolation should be applied.

33.9.10. Special requirements for closed cabinets

45.9.10.1. For closed cabinets (enclosed and airtight vaults, IT-cabinets, etc.) inside the protected area a separate fire detection and fire protection have to be implemented (i.e. inside fire detection and extinguishing, inside fire detectionand automatic door opening in case of fire prevention).

45.9.10.2. The following picture shows possible solutions for enclosed cabinets by usinginternal fire detection with integrated extinguishing agent.

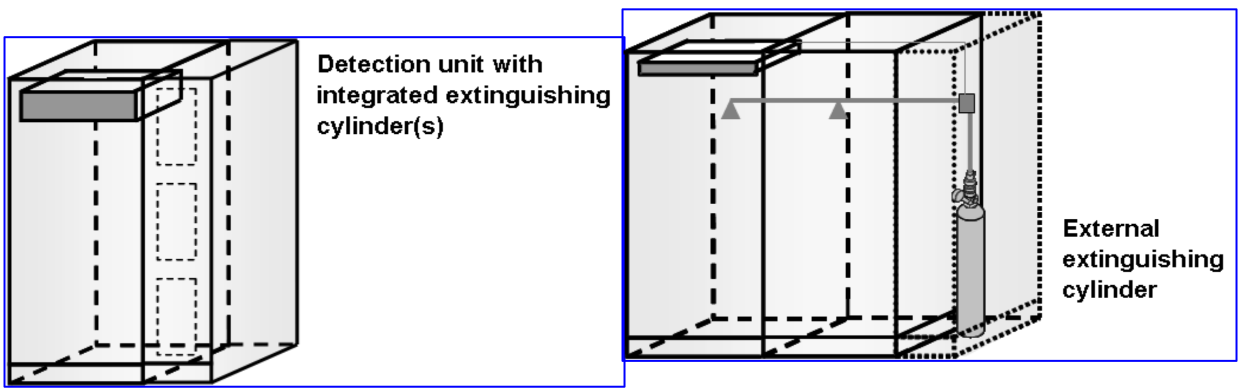


Figure 9.45: Fire Detection and extinguishing in closed cabinets (air tight).

33.10. Inert Gases

33.10.1. By introducing an inert gas, the oxygen content in the room is reduced - until the point where the oxygen concentration lies below the level at which combustion is possible. Inert gases do not generate any chemical reactions andalso leave no residue.

33.10.2. An inert gas is any gas that does not react with elements. Like the noble gases an inert gas is not necessarily elemental and is often compound gases. Like the noble gases the tendency for non-reactivity is due to the valence, the outermost electron shell, being complete in all the inert gases. This is a tendency, not a rule, as noble gases and other "inert" gases can react to formcompounds.

33.10.3. Inert gases used for fire protection are Nitrogen, Argon, Carbon Dioxide and mixtures of these three gases.

33.10.4. Carbon dioxide is not applicable to usually occupied facilities due to the toxic property. But it can be used in industrial applications.

33.10.5. Maximum discharge time for all Inert Gases shall not exceed 60 seconds.

33.10.6. The following diagram shows the principle structure of an inert gas extinguishing system.

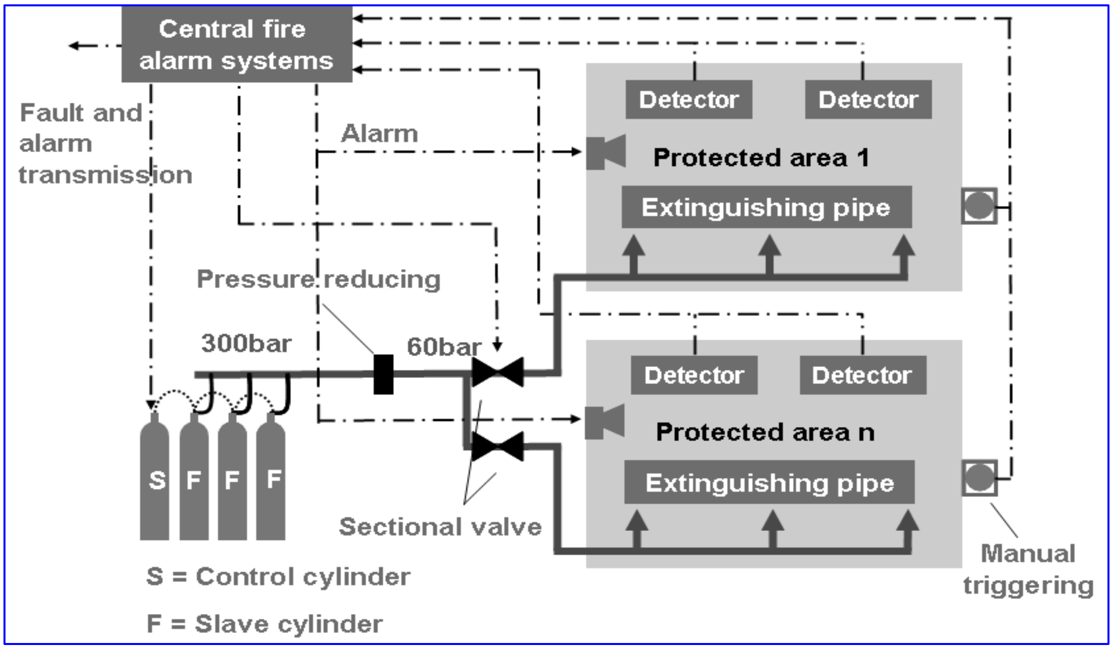


Figure 9.46: Block Diagram for inert gas extinguishing systems

Table 9.47 INERT GAS COMPARISONS

	NITROGEN	ARGON	INERGEN	ARGONITE	CARBON DIOXIDE
TRADE NAMES	IG 100, NN 100	Argon	IG 541	IG 55	Carbon Dioxide
POSITIVES	• Non Toxic • Environmen-tallyfriendly • Electrically Non-conduc-tive • Normal venting af-terflooding • Forms harmless compound whenmixed with air	• Non Toxic • Environmentally friendly • Electrically Non-con-ductive • Normal venting afterflooding • Forms harmless compound when mixedwith air	• Contains only natural gases • Non Toxic • Environmentally friendly • Electrically Non-conduc-tive • Normal venting afterflooding • Feasible to be used inoccupied spaces	• Contains only naturalgases • Non Toxic • Environmentally friendly • Electrically Non-con-ductive • Normal venting afterflooding • Forms harmless compound when mixed with air	• C02 is a natural ele-ment making up 0.03% of the air • Most effective extin-guishing properties of all inert gases • Has been used as an extinguishing agent forapproxi-mately 80 years • Ideal to extinguish open orun-enclosed sections • Electrically Non-conduc-tive
NEGATIVES	• Due to lighter density than air, not suitable for unenclosed ob-jects	• Due to heavier den-sity than air, counter acts thehyper-venti-lation effect • Not suitable for unenclosed objects	• Due to heavier den-sity than air, counter acts thehyper-venti-lation effect • Not suitable for unen-closed objects	• Not suitable for occupied spaces. • Due to heavier den-sity than air, counter acts thehyper-venti-lation effect • Not suitable for unenclosed objects	• Life endangering • Pressure relief via adja-centareas only permit-ted in certain circum-stances Due to it's density, (C02 is 1.5 times heavier than air)lower lying areas could become contam-inated through leakage • Distance between reser-voir / gas bottles and area to beflooded is limited. • Not applicable for officebuildings

EXTINGUISH-INGCHARAC-TERS	• Does not cause misting • Negligible tempera-ture reduction • Extinguishing Con-centration of 40-41% • Nominal Dis-chargetime is 60 seconds	• Does not cause misting • Negligible temper-aturereduction • Extinguishing Con-centration of 35-45% • Nominal Discharge time is60 seconds	• Does not Cause misting • Negligible temper-aturereduction • Removal from flooded areathrough normal ventilation • Extinguishing Con-centration of 33-35% • Nominal Discharge time is60 seconds	• Does not Cause misting • Negligible temper-aturereduction • Removal from floodedarea through normal ventilation • Extinguishing Con-centration of 31-37% • Nominal Discharge time is 60 seconds	• Causes misting • Considerable tempera-turereduction during flooding • Danger to neigh-boringareas through leakage • Release of room pres-sureduring extin-guishing by feeding directly into the Open only. • Removal from area af-ter flooding must be controlled. Usually carriedout by the fire Services.
TECHNICAL INFOR-MATION	• Density- 1.165 kg/m^3 • Does not mix inreservoirs • Low friction loss • Stored in Gas form at200-300 bar pres-sure	• Density- 1.662 kg/m^3 • Does not mix in reser-voirs • Low friction loss • Stored in Gas form at 200-300 bar pressure	• Density- 1.418 kg/m^3 • Does not mix in reser-voirs • Low friction loss • Stored in Gas form at 200-300 bar pressure	• Density- 1.412 kg/m^3 • Does not mix in reser-voirs • Low friction loss • Stored in Gas form at 200-300 bar pressure	• Does not mix in thereservoirs • Low friction loss • Stored in liquid form , usually requires less spacefor the reservoir/ bottles • Storage in cylin-ders inliquid form at 60 bar pressure

APPLICATION	• Electrical Equipment • Equipment Rooms • Industrial Applications • Warehouse • Cable cellars • Telecommunica-tionrooms (i.e. Mobile Switching Center) • Storages • Archives	• Partial flooding in floor voids in IT Data Centers &Communi-cation Rooms	• Electrical Rooms • Equipment Rooms • Museums • Galleries • IT Data Center • Telecommunication rooms(i.e. Mobile Switching Center) • Storages • Archives	• Partial flooding in floor voids in IT Data Centers &Communi-cation Rooms	• Electrical Switch-gear Rooms • Open apparatus such ascabinets and machinery • In particular, un-mannedareas.

33.10.7. Nitrogen, Argon, Inergen, Argonite and Carbon Dioxide are all inert extinguishing agents. Table 9.47 above briefs out the comparison between theinert gases.

33.10.8. Carbon Dioxide in detail

45.10.8.1 Location

45.10.8.1.1 The CO2 storage area shall be located outside the area put atrisk in the case of a fire, but it should be located as close as possible to the protected zone.

45.10.8.1.2 The CO2 storage area shall be a separate enclosure which is easily accessible even in the event of a fire, and protected against access by unauthorized persons. No other combustible material and no stored goods shall be available in this area.

45.10.8.1.3 The CO2 storage area shall be separated from adjacent rooms and/or areas such that the components of the CO2 system installed in this area are protected from mechanical, chemical and atmospheric exposure.

45.10.8.2 Equipment

45.10.8.2.1 The CO2 storage area shall have sufficient electrical illumination.

45.10.8.2.2 The room temperature in the CO2 storage area for high pressure systems shall not fall below 0° or exceed 35°C. Any heating, if necessary, shall be fixed. The components of the CO2 system in the CO2 storage area shall be protected against heating above ambient temperature caused by sunlight or other sources.

45.10.8.2.3 If in the case of high pressure systems room temperatures below 0°C in the CO2 storage area cannot be ruled out, the distribution pipe work shall be calculated and dimensioned as for low pressure systems.

45.10.8.2.4 The CO2 storage area shall allow easy access for maintenance and inspection of components of the CO2 system on the spot.

45.10.8.2.5 In the CO2 storage area the following shall be permanently affixed in a highly visible position resp. be available:

a. name of the installer and, if available, the company responsible for maintenance ofthe system, the year of installation of the CO2 system;

b. operation instructions with pipe work and control layout of the CO_2 system; if applicable, number of weights required for actuating the containers;
c. layout of the zone protected by the CO_2 system.

45.10.8.3 CO_2 supply containers and selector valves

45.10.8.3.1 Any legal and official requirements for pressure containers shall be fulfilled.

45.10.8.3.2 Valves and equipment for CO_2 supply containers to be assembled in a CO_2 system shall be approved by a competent authority.

45.10.8.3.3 Any valves and slide valves, even those according to DIN 3352, shall be approved.

45.10.8.3.4 In high pressure systems all CO_2 supply containers shall contain the same quantity of CO_2. The highest allowable fill level of these CO_2 supply containers is 0,75kg per liter of container volume. The container volume per container shall not exceed 67,5l.

45.10.8.3.5 The CO_2 supply quantity shall be permanently monitored by an automatic device approved by the authority.

45.10.8.3.6 This leakage monitoring shall respond at the latest when only 90% of the required CO_2 quantity are left. If the CO_2 supply quantity is stored in several supply containers, all containers shall be monitored.

45.10.8.3.7 In high pressure systems each CO_2 supply container shall be connected to the main supply pipe via a check valve, such that it may be decommissioned and replaced at all times without interfering with the other containers.

45.10.8.3.8 The automatic opening of the container valves shall be carried out by a device approved by the authority. The functional reliability of this device shall be easy to inspect on the spot without causing any discharge of CO_2.

45.10.8.3.9 If an emergency triggering device is provided, this shall be approved by the authority.

45.10.8.3.10 In low pressure systems the response pressure of the required safety valve shall not exceed 23 bar.

45.10.8.3.11 The CO_2 shall be kept at a temperature between 252K (- 21°C) and 254K (-19°C) by an automatic cooling aggregate, corresponding to an absolute pressure between 19 bar and 21 bar. If the pressure in the CO2 supply container exceeds 22 bar, a fault warning shall be released. The heat insulation of the CO2 supply container shall be at least such that during a failure of the cooling aggregate, assuming an ambient temperature of 303K (30°C), not more than 0,05% of the required CO2 supply quantity per hour are discharged via the safety valve.

45.10.8.3.12 Containers without dip tube (e.g. alarm containers) shall be permanently marked as "containers without immersion tube". For this purpose, a flange may be inserted when screwing in the container valve.

45.10.8.4 Pipes

45.10.8.4.1 All pipes of CO2 low pressure systems and the nozzle pipework of CO2 high pressure systems require a certificate according to EN 10 204. This certificate shall state that thepipes are designed according to the required operating pressure.

45.10.8.4.2 Manifolds require a factory test certificate according to EN 10 204 stating that they were designed for the required operating pressure. Additionally, all materials and components used shall be specified in the certificate.

45.10.8.4.3 After the installation the pipes between container and selector valve shall be subjected to a 60-minute water pressure test.

45.10.8.4.4 Where flange connections are used, this water pressure test may be replaced by a water pressure test of the individual components or of pipe. In these cases a gas leakage test (pabs = 3 bar) shall be carried out after installation.

45.10.8.4.5 If existing manifolds of low pressure systems are extended, no water pressure test will be required, provided that:

a. the extension is subjected to a water pressure test with 40bar;
b. the connecting welding seam (old and new part) is done
c. a leakage test with CO2 is carried out for the entire manifold, using the existing container pressure of the low pressure system.

45.10.8.4.6 Welding works at the pipe work shall be carried out only by welders holding a certificate of qualification according to local standards.

45.10.8.4.7 Fittings shall be designed according to the anticipated operating pressure and for use at low temperatures (approx.–50°C).

45.10.8.4.8 All pipe sections of CO2 high pressure systems between container and selector valve shall bear the manufacturer's mark, so that they can be identified according to the factory test certificates even after installation. Manifolds, being a physical unit, may be marked by an expert. A clear assignment of the physical unit to the factory test certificate submitted shall be possible.

45.10.8.4.9 The welder shall mark each welding seam with an individual mark, so that the seam may be clearly identified as done by this particular welder.

45.10.8.4.10 If required by the application, the outer and inner surfaces shall be sufficiently protected against corrosion.

45.10.8.4.11 Hoses used for the installation of CO2 extinguishing systems shall be approved by the authority. Hoses shall not be longer than necessary and used only where fixed pipes are unsuitable

45.10.8.5 Nozzles:

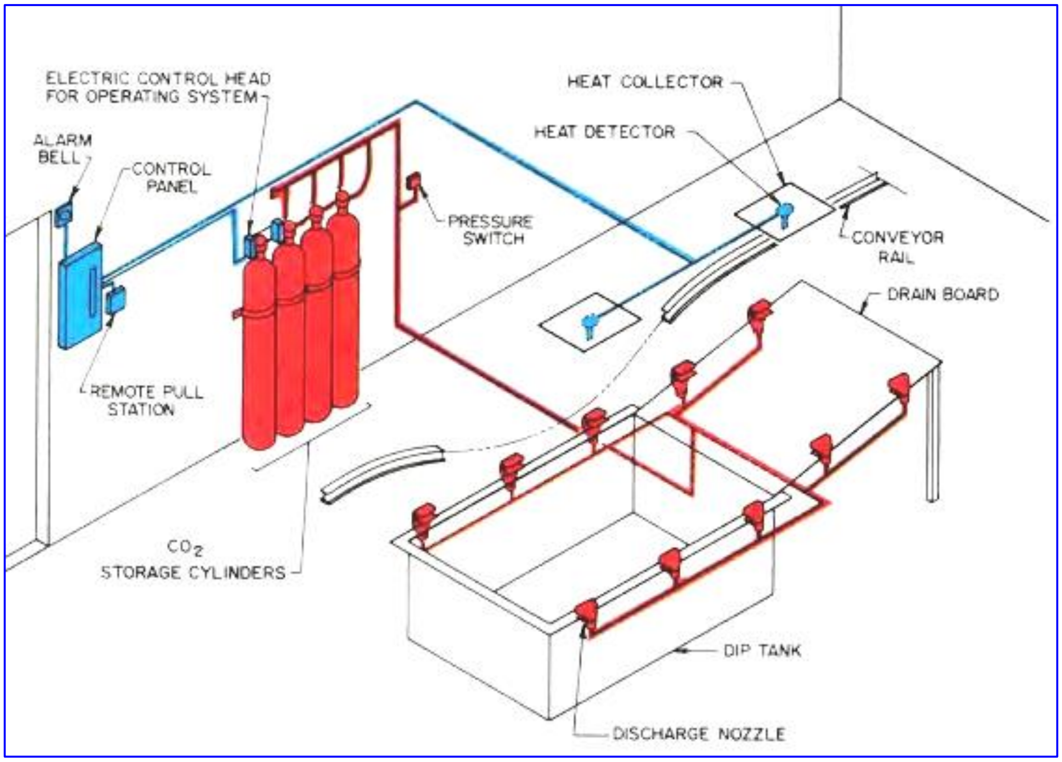
a. Nozzles shall be approved by the authority for the installation into CO2 systems.
b. Nozzle openings smaller than $7mm^2$ in diameters are not permitted.
c. Each nozzle shall be marked clearly and permanently, e.g. with the equivalent nozzle diameter.
d. Unless specified otherwise for particular applications, the nozzles of CO2systems, without extended discharge and in consideration of the CO2 storage pressure and the respective pipe work, shall be dimensioned such that the required CO2 design quantity can be discharged into the flooding zone within the discharge time.

45.10.8.5.1 Evidence shall be given via a procedure approved by the authority, that these requirements are fulfilled. The nozzle dimensioning of systems with extended discharge shall be agreed with the authority.

Table 9.48: KB factor for solid materials and facilities

		WITHIN 4 MIN		WITHIN 1 MIN	
MATERIAL	KB - factor	CO_2 vol%	O_2 vol%	CO_2 vol%	O_2 vol%
Paper	2.00	57.00	9.10	34.00	13.80
Plastic	2.25	61.00	8.20	34.00	13.80
Polystyrene	1.00			34.00	13.80
Polyurethane	1.00			34.00	13.80
Cellulose	2.25	61.00	8.20	34.00	13.80
Electrical switch anddistri-bution rooms	1.20	40.00	12.60	34.00	13.80
Data processing systems	2.25	61.00	8.20	34.00	13.80
Control room of high rackstor-age	1.50	47.00	11.20	34.00	13.80
Paint shop and drying system	1.50	47.00	11.20	34.00	13.80
Generators inl. Coolingsys-tems	2.00	57.00	9.10	34.00	13.80
Cable rooms, cable floorsand ca-ble ducts	1.50	47.00	11.20	34.00	13.80
Oil filled transformers	2.00	57.00	9.10	34.00	13.80
Textile machines	2.00	57.00	9.10	34.00	13.80

Figure 9.47: Typical Carbon Dioxide Suppression System



33.11. Chemical Gases

33.11.1. The extinguishing ability of chemical gases is based on both physical and chemical processes. In addition to the suppression of oxygen - as in the use of inert gases – chemical gases absorb heat and chemically disrupt the burning process.

33.11.2. Several chemical extinguishing agents are available on the market. The most important and common agents are HFC227 (FM200) and C6 F12 O (NOVEC 1230). Table 9.49 briefs out the comparison between Chemical Gases.

33.11.3. Maximum discharge time for all Chemical Gases shall not exceed 10 seconds.

33.11.4. All chemical gas extinguish systems should strictly adhere to manufacturer's MSDS recommendations and design parameters. Careful considerations should be exercised as some of the chemical gases produce hazardous byproducts during extinguishing process when they come in contact with burning or hot surfaces

33.11.5. Powdered Aerosol agents shall be strictly applied to unoccupied areas only.

Table 9.49 CHEMICAL Gas COMPARISONS

	HFC 227	HFC 125	C6 F12 O
TRADE NAMES	FM-200, FE-227, MH227, Solkaflam 227	NAFS 125, ECARO-25, FE-25TM	Novec 1230
POSITIVES	• Low concentration of gas required • Does not cause Ozone depletion • Feasible for use in occupied spaces	• Low concentration of gas required • Does not cause Ozone depletion	• No Flooding damage to facility and equipment • Low concentration of gas required • Does not cause Ozone depletion
NEGATIVES	• Global warming potential is very high with around 31-42 years of agent lifetime • At high temperature, agent will decompose tohydrogen fluoride which leaves pungent odor along with other decomposition products such as Carbon monoxide and carbon dioxide	• Generates hazardous reaction during fireand intense heat • Contact will cause frostbite • After flooding, atmosphere should betested before re-entry	• High temperature fires produce split products of Novec which are toxic. Refer to MSDS, TDP of the product.
EXTINGUISHINGCHARACTERS	• Effective Fire suppression at concentrations between 6.25% and 9% • Maximum discharge duration is 10 seconds	• Effective Fire suppression at concentrations between 8% and 10% • Extinguishes fire by absorbing heat at molecular level faster than heat is generated, so fire cannot sustain itself • Maximum discharge duration is 10 seconds	• Liquid at room temperature, gasifies immediatelyafter discharge • Maximum discharge duration is 10 seconds
TECHNICAL INFORMATION	• Consists of Carbon, Fluorine and Hydrogen • Super-pressurized with Nitrogen to 2482 Kpa • Colorless, Odorless and Electrically Non-conductive • Operating temperature is -12.2 °C to 65.6 °C • Stored in liquid form at 24-42 bar	• Super-pressurized with Nitrogen to 2482Kpa • Colorless, Odorless and Electrically Non-conductive • Operating temperature is -12.2 °C to 65.6 °C • Stored in liquid form at 24 bar	• Low toxicity • Boiling point of 49 °C • Stored in liquid form, Super-pressurized with Nitrogen to 25 bar

APPLICATION	• Electrical Rooms • Telecommunication Rooms • Data centers • Server Rooms • BMS rooms • High value areas • Clean rooms • Archives and record storage	• Transportation and Infrastructure • Marine Applications • Storage's • Industrial applications • Laboratories • Petrochemical industries	• Pump applications • EDP Equipment enclosures • Telecommunication equipment enclosures • Storage's • Marine Applications • Industrial Applications

Table 9.49 CHEMICAL GAS COMPARISONS

33.12. Fire Prevention System

33.12.1. Under normal circumstances a fire can start at any time. According to the valueof the goods requiring protection, measures should be in place to minimize damage for such a scenario. Measures stretch from simple hand-held extinguishers to automatic early fire detection and extinguishing systems. All these methods have one thing in common: they can only react once a fire has already started.

33.12.2. Fire prevention offers a system that can actively prevent a fire from starting and can therefore offer one hundred percent fire protection.

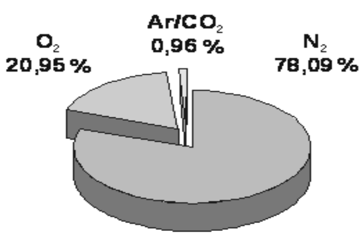
33.12.3. The advantages of a fire prevention system are:

Certainty of avoiding outbreak and spread of fire

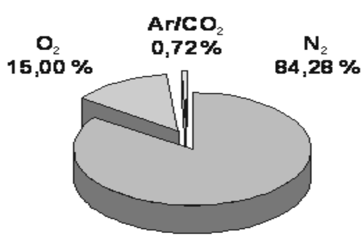
i. Permanent and preventative fire protection to secure business Processesand valuable goods
ii. Avoidance of further damage from smoke, spread of fire or fromextinguishing agents
iii. Problem-free adaptability to changes in fire risk
iv. Wide-ranging design freedom
v. Cost savings at the construction stage of fire detection measures
vi. Personnel retain access to protected areas

33.12.4. Fire prevention through extraction of oxygen

33.12.5. In order for a fire to start, heat, combustible substance and oxygen from the atmosphere are needed. If the oxygen is reduced, the flammability levels also decline. Below a certain level of oxygen concentration, fires can no longer burn. This is the principle of fire prevention through extraction of oxygen.



Natural atmosphere



Fire prevention atmosphere for a designconcentration of 15 Vol. % of oxygen

Figure 9.48: Comparison Natural and fire prevention atmosphere

45.12.4.1. Oxygen reduction facilitates a controlled reduction of oxygen levels in enclosedareas. By introducing nitrogen the oxygen content is reduced by dilation and held at a precise level. In such an atmosphere, outbreak of fire can be eliminated.

33.12.6. Accessibility of protected area

45.12.5.1. Rooms protected by fire prevention systems remain accessible to personnel, so that there is no reduction in functionality of the space.

33.12.7. Production of nitrogen on-site

45.12.6.1. The nitrogen required to reduce the oxygen concentration can be generated ina cost-effective manner on-site using an air processing system.

33.12.8. Advantages of using nitrogen to reduce oxygen content

i. In combination with air it forms the most tolerant mixture to breathe
ii. Is present at 78% of normal atmospheric air
iii. Is simple to generate on-site
iv. Is non-toxic
v. Distributes quickly and evenly

45.12.7.1. Fire prevention systems are able to protect single and multi-zone applications.The protected area is defined on base of the air condition system and the room areas that are connected by this air conditioning.

45.12.7.2. The following pictures show the system diagram for single zone and multi zone systems:

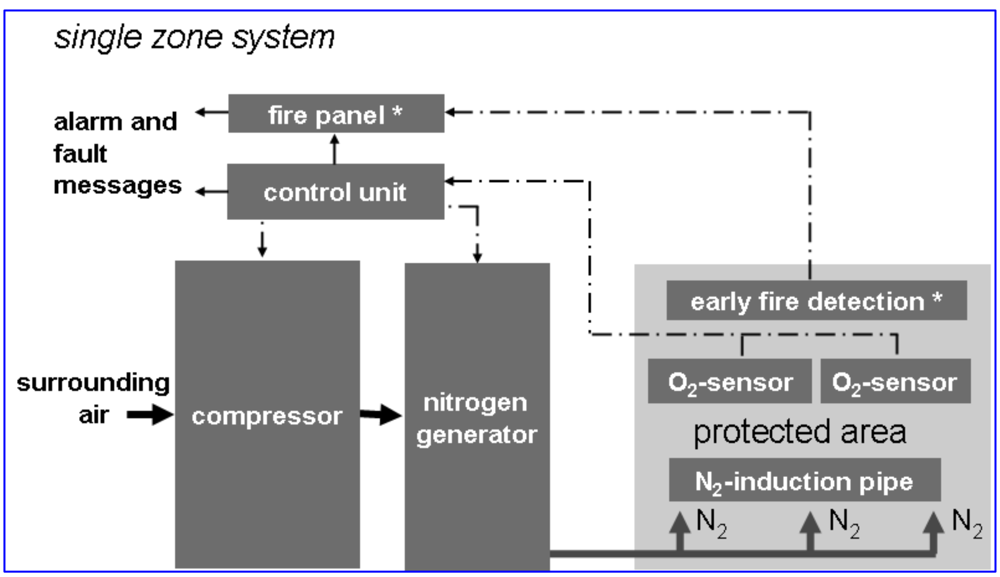


Figure 9.49:- Single Zone Oxygen Reduction System Diagram

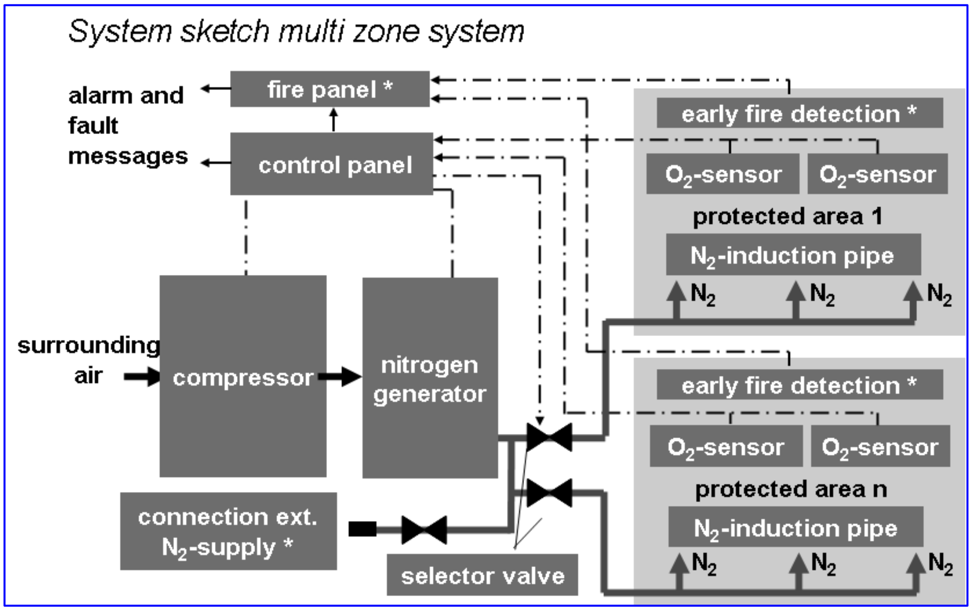


Figure 9.50: Multi Zone Oxygen Reduction System Diagram

33.12.9. Ideal Applications

45.12.8.1. Access controlled, enclosed airtight environments like:

i. IT and data centers
ii. Server rooms
iii. Telecommunication rooms (i.e. Base Transmitter Station cylinders, basetransmitter station controller rooms, mobile switching centers)
iv. Electrical rooms (i.e. Low voltage rooms, UPS rooms, Battery rooms, etc)
v. Archives
vi. Hazard warehouses
vii. Cold and cool warehouses
viii. Small loading carrier warehouses
ix. Automatic car parks
x. Storage rooms of Museums and Galleries

33.12.10. Fire prevention with fast oxygen reduction

45.12.9.1. Fire prevention systems with fast oxygen reduction may be used under thefollowing conditions:

i. The Oxygen design concentration is higher as the ignition point of thema-terial inside the protected area.
ii. The risk of fire will be solved by using a fast oxygen reduction system
iii. The fast oxygen reduction system will take care, that in case of a starting ignition the oxygen level will reduced to the designed concentration according to the materials inside the protected area.
iv. The Fire prevention system is able to hold this level for an endless periodof time.
v. Shut down of the air condition system and the power is not necessary.
vi. The business process can run without any interruption

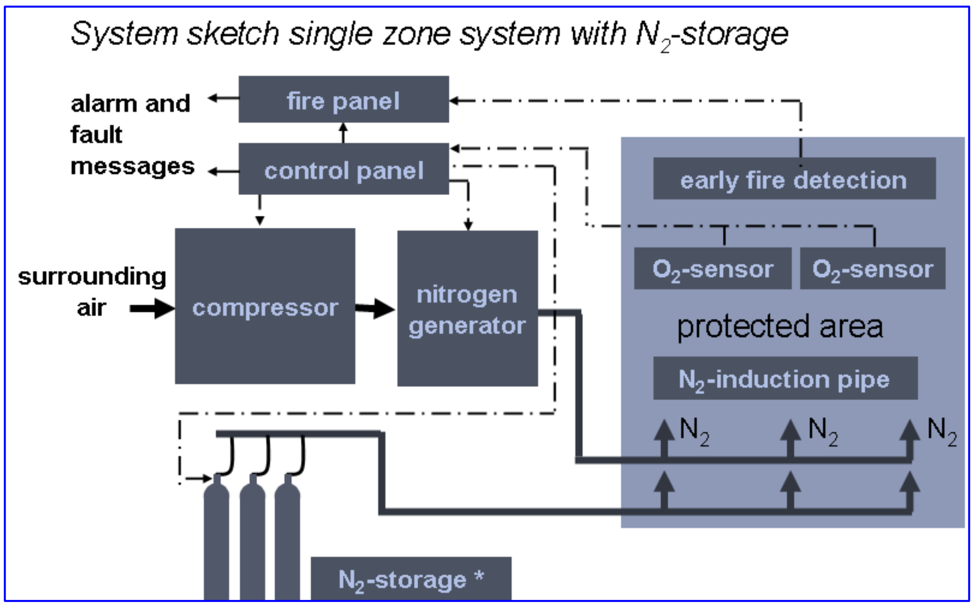


Figure 9.51: Single Zone System Diagram with fast oxygen reduction

33.12.11. Special requirements for fire prevention systems

45.12.10.1. The fire prevention system should have a dedicated and separate AirHandling Unit (AHU) system per protected area; no fresh air entry is allowed.

45.12.10.2. The objectives of having an AHU system complying with the norms of the fire prevention system will:

i. Eliminate fresh Air entry to the protected areas,
ii. Eliminate Nitrogen leakage from the protected areas to the outside
iii. Reduce the cost of power consumption

45.12.10.3. In case the AHU is located outside the protected area, you should make sure that all outside ducting are air tight to prevent fresh air entry or Nitrogen leakage.

45.12.10.4. The Air handling systems of the building should be designed in the way that no pressure differences will accrues between protected areas and neighbor areas. Pressure differences force a much higher air exchange rate so that the fire prevention system will not work efficiently. Another effect will be an uncontrolled introduction of nitrogen into unprotected areas.

33.13. Health & Safety Aspects of Gas Extinguishing Systems and Fire Prevention Systems

33.13.1. Safety for Gas Extinguishing Systems

i. For the warning of persons, hazard areas shall be provided with audible and visual alarm systems in order to alert people present in the flooding zone.
ii. The signal of the audible alarm devices shall be distinctly different from the operational noises and be at least by 5 dB (A) above the environment sound level.
iii. Visual alarm devices shall be available in addition to the audible ones. Visual alarm devices shall provide a conspicuous signal by way of flashing.
iv. As far as extinguishing systems with gaseous extinguishing agent are concerned, the extinguishing alarm shall be switched off only after it has been ensured that no unauthorized people can enter the hazard areas any more.
v. The energy supply for the alarm must in any case be sufficient for a duration of 30 minutes.
vi. Extinguishing systems that can cause harm to persons due to flooding shall be provided with delay devices. Delay devices shall ensure that flooding will be performed only after the alarm devices have been activated and the set pre- warning time has elapsed.
vii. For total flooding systems, a pre-warning time shall be effective for each automatic or manual release of the extinguishing system.
viii. There shall be a provision to disable the release of extinguishing system. The blocking shall be performed mechanically such that an extinguishing agent discharge is safely prevented.
ix. Piping must be electrically grounded.
x. Rooms that are protected with extinguishing systems shall be arranged such that extinguishing agents cannot unintentionally escape in such quantities that people in adjacent rooms or areas will be affected.
xi. Escape routes shall be available for all extinguishing and hazard areas.
xii. Rooms, whose single escape and rescue route runs through the extinguishing area, have to be treated as ‘extinguishing area’ as far as alarm and delay are concerned.
xiii. Doors shall be of self-closing construction, swing open in the escape direction and be easily openable from inside at any time and without any other tools.

xiv. If, for operational reasons, self-closing doors have to be kept open, these shall be fitted with hold-open systems that are designed such that automatic closing on activation of the extinguishing system.
xv. The owner shall develop an operating procedure based on the operating instructions provided by the manufacturer and installer, which covers, in particular, all necessary safety information.
xvi. The owner shall instruct all persons who have access to the hazard areas before they take up their activities and at least annually regarding any possible hazards of the extinguishing agent and any necessary protection measures on the basis of the operating procedures.
xvii. The instruction shall be documented.
xviii. The owner shall have rectified any faults of the extinguishing system which impair personnel protection without delay. If this is not possible, he shall shut down the system. During this time fire protection shall be ensured by other means.
xix. Flooded rooms may only be re-entered when a instruction to do so has been issued by the person authorized by the owner or by the Civil Defence after thorough investigation. If required, concentration measurements of the extinguishing gases and of the oxygen concentration need to be performed.
xx. Flooded rooms shall be ventilated prior to re-entry. In doing so, it shall be ensured that people in adjacent rooms and in the vicinity will not be jeopardized.
xxi. The venting of the flooded rooms shall only be performed by people who have been instructed accordingly.
xxii. In case the rooms have to be entered for venting, this is permissible only when using a breathing apparatus that is independent from the surrounding atmosphere.

33.13.2. Safety for Fire Prevention Systems

45.13.2.1. Fire Prevention systems function with an oxygen reduced atmosphere to prevent a fire from breaking out. The design concentration is depending on thematerials stored inside the protected area. For standard application the designconcentration will be between 17 Vol. % and 13.0 Vol. % oxygen. The human body works well with an oxygen concentration between 12 Vol. % and 20.95 Vol. % of Oxygen. Employers should provide preliminary medical examinations to all employees having access to rooms provided with Fire Prevention System with reduced oxygen levels. The medical examination should consist of the following questionnaire at minimum:

i. Is there a family history of benign blood disease, inherited blood disease, anemia or sickle-cell anemia?
ii. Did you, while in the mountains or flying, ever get pains (excluding headaches) such as stomach pains, chest or joint pains?
iii. Did you, while in the mountains or flying, get headaches, nausea, have breathing difficulties, tiredness such that you felt ill?
iv. Do you have any known heart disease?
v. Do you have any known disease of the lungs or breathing tracts?

vi. Do you have anemia of any kind?
vii. Do you have sickle-cell anemia?
viii. Have you had a stroke, a transient ischemic attack or do you know if you have a narrowing of the carotid artery?
ix. Have you been treated for irregular heartbeat?
x. Have you felt dizziness in the last 3 months which interfered with your daily activities?
xi. Have you fainted in the past year?
xii. Do you have to pause in your private or professional activities because of shortness of breath on exertion?
xiii. While climbing stairs do you have to stop to catch your breath?
xiv. Has your physical fitness deteriorated noticeably in the past 3 months?
xv. Under physical or mental stress, have you experienced pains or pressure in your chest?
xvi. Have you in the past month had pains in your chest even while at rest?
xvii. Have you in the last 3 months woken up because you couldn't breathe properly?

45.13.2.2. If all questions will be answered with no, the person could access oxygen reduced areas safely. In all other cases the person should be checked by a doctor.

45.13.2.3. The working time inside a oxygen reduced atmosphere should be limited to 4 hours. After 4 hours the people should have a break of 30 minutes with fresh air before re-entering this area.

34. Dry Chemical Suppression Systems

46.11. Introduction

46.11.1. Dry chemical is a powder mixture that is used as a fire-extinguishing agent. It is intended for application by means of portable extinguishers, hand hose line systems, or fixed systems.

46.11.2. The principal base chemicals used in the production of currently available dry chemical extinguishing agents are sodium bicarbonate, potassium bicarbonate, potassium chloride, urea-potassium bicarbonate, and monoammonium phosphate. Various additives are mixed with these base materials to improve their storage, flow, and water repellency characteristics. The most commonly used additives are metallic stearates, tri-calcium phosphate, or silicones, which coat the particles of dry chemical to make them free-flowing and resistant to the caking effects of moisture and vibration.

46.11.3. Multipurpose dry chemical can be used on fires in flammable liquids, fires involving energized electrical equipment, and fires in ordinary combustiblematerials.

46.12. Application

i. Flammable liquids
ii. Existing Kitchen hoods and ducts which are provided with pre- engineered dry chemical system. (Dry Chemical for new Kitchenhoods is not allowed. See next section on WET CHEMICAL SYSTEM)
iii. Deep fryers
iv. Oil filled transformers
v. Oil filled circuit breakers
vi. Textile Machinery
vii. Cotton Mills

46.12.1. Regular dry chemical has certain limited applications in extinguishment of flash surface fires with ordinary combustibles, but the chemical requires water to put out deep-seated smoldering fires.

46.13. Limitations

i. Regular dry chemical provided for use on surface-type Class A fires, it should be supplemented by water spray for extinguishing smoldering embers or in case the fire gets beneath the surface.

ii. Multipurpose dry chemical becomes sticky when heated, where removal of the residue from fine machine parts may be difficult.

iii. Dry chemical should not be used in installations where relays and delicate electrical contacts are located (e.g., in telephone exchanges and computer equipment rooms), as the insulating properties of dry chemical might render such equipment inoperative.

iv. Total flooding systems are applicable only when the hazard is totally enclosed or when all openings surrounding a hazard can be closed automatically.

46.14. Design criteria

46.14.1. Dry Chemical Systems can be total flooding, Local application type, Hand hose type or combinations. Any Dry Chemical System shall be engineered or Pre-engineered. All the system, cylinders, containers, Dry Chemical, expellant gas, piping, valves and nozzles shall be as per Manufacturer's instructions with approval and listing for particular applications.

46.14.2. Dry chemical system's application, system size, flow-rate, quantity, selection of nozzles, piping arrangement etc. shall be as per Manufacturer's recommendation.

46.14.3. See CHAPTER FIRE DETECTION AND ALARM SYSTEM for Automatic fire detection for system actuation.

46.14.4. At least one manual actuator shall be provided for the system.

46.14.5. Chemical agents are stored in pressure containers, usually of welded steel construction, either under atmospheric pressure until the system is actuated or under the pressure of the internally stored expellant gas.

46.14.6. Containers in which dry chemical is stored separately under atmospheric pressure are equipped with an expellant gas inlet, a moisture-sealed fill opening, and a dry chemical outlet. The gas inlet leads to an internal gas tube arrangement constructed so that, when it flows into the tank, it agitates and permeates the powder, making it fluid-like. The dry chemical outlet is provided with a rupture disc or valve to permit buildup of proper operating pressure in the tank before the dry chemical can start to flow.

46.14.7. The expellant gas assembly consists of a pressure storage vessel together with necessary valves, pressure regulators, and piping to deliver the expellant gas to the dry chemical storage tank at the correct pressure and rate of flow.

46.14.8. The expellant gas is usually dry nitrogen. However, dry air or other gases may be used.

46.14.9. Chemical expellant gas assemblies shall be located as near as practicable to the hazard to be protected. An area in which temperatures stay between - 40 to +120°F (- 40 to +49°C) is desirable to maintain the quality of the drychemical.

46.14.10. 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.

46.14.11. 46.14.11.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.

46.14.12. The total area of unlosable openings shall not exceed 15 percent of the total area of the sides, top, and bottom of the enclosure. Where unlosable openings exceed 15 percent of the total enclosure surface area, a local application system shall be used to protect the entire hazard

46.14.13. In Existing 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. At least one fusible link or heat detector shall be installed within each exhaust duct opening in accordance with the manufacturer's listing. A fusible link or heat detector shall be provided above each protected cooking appliance and in accordance with the system manufacturer's listing.

35. Wet Chemical Suppression Systems

47.11. Introduction

46.14.14. Wet Chemical Agent consists of organic or inorganic salts mixed with water to form an alkaline solution that is capable of being discharged through piping or tubing when under expellant gas pressure. It can be used as a fire- extinguishing agent. It is intended for application by means of portable extinguishers, hand hose line systems, or fixed systems.

46.14.15. Wet chemical extinguishing agents are typically a proprietary mixture consisting of potassium carbonate, potassium acetate, potassium citrate, or a combination, mixed in water and other additives such as phenolphthalein, phosphoric acid, and/or dyes. As they are already liquid in character, wet chemical agents do not require additives to enhance flow.

46.14.16. When wet chemicals extinguishing agents are sprayed on a grease fire, they interact immediately with the grease and saponify, forming a blanket of foam over the surface on which they are sprayed.

47.12. Limitation

47.12.1. Wet chemical extinguishing agents are not acceptable for use in areas wherefires involve energized electrical equipment.

47.13. Design criteria

47.13.1. Wet Chemical Systems can be total flooding, Local application type, Hand hose type or combinations. Any Wet Chemical System shall be engineer or Pre-engineered. All the system, cylinders, containers, Wet Chemical, expellant gas, piping, valves and nozzles shall be as per Manufacturer's instructions with approval and listing for particular applications.

47.13.2. Wet chemical system's application, system size, flowrate, quantity, selection of nozzles, piping arrangement etc shall be as per Manufacturer's recommendation.

47.13.3. See CHAPTER 8. FIRE DETECTION AND ALARM SYSTEM for Automatic fire detection for system actuation.

47.13.4. At least one manual actuator shall be provided for the system.

47.13.5. Wet chemical extinguishing agents are typically stored in plastic containers up to 5 gal (19 L) in capacity. Attention should be given to the freeze point of the particular agent. The agent storage life is approximately 12 years. System tanks containing wet chemical range in size between 1.5 gal (5.7 L) and 3 gal (11.4 L), depending on the manufacturer's design.

47.13.6. To expel the agent, most systems use pressurized cartridges of nitrogen or carbon dioxide. To ensure proper operation, the temperature ranges for wet chemical systems are between 32°F (0°C) and 130°F (54°C).

47.13.7. Shutdown of fuel, gas, electrical power to the protected equipment etc shall be achieved at the time of system discharge.

47.13.8. Piping and fittings must be of noncombustible materials and compatible with the characteristics of wet chemical. Distribution piping should be either Schedule 40 black iron, chrome-plated or stainless steel.

47.13.9. Nozzles should be provided with 'blow off cap' to prevent the clogging due to grease, dust etc.

47.13.10. 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. At least one fusible link or heat detector shall be installed within each exhaust duct opening in accordance with the manufacturer's listing. A fusible link or heat detector shall be provided above each protected cooking appliance and in accordance with the system manufacturer's listing.

47.13.11. A typical kitchen hood protection with wet chemical system is shown in Figure 9.52 below.

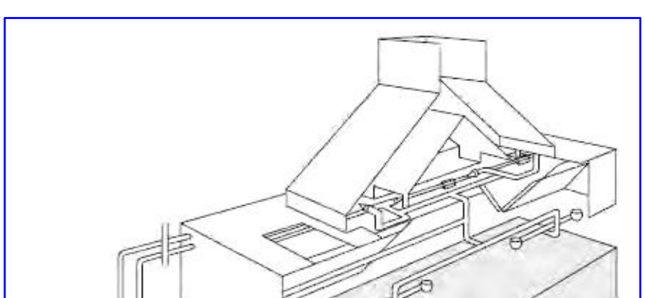


Figure 9.52: typical Kitchen hood wet chemical system

47.14. Inspection and Maintenance

47.14.1. Owners of chemical extinguishing systems should conduct monthly inspections to determine whether the system is in proper operating condition. This inspection is not intended to be a detailed, but is rather a visual check of the system to ensure the following items:

i. Clogging of nozzles, fusible links because of grease, paint or dust is cleaned
ii. The extinguishing system is in its proper location.
iii. The manual actuators are unobstructed.
iv. The tamper indicators and seals are intact.
v. The maintenance tag or certificate is in place.
vi. There is no obvious physical damage or condition exists that might preventoperation.
vii. There is no damage to, or obstruction of, fusible links or actuating devices.
viii. The pressure gauge(s), if provided, is in operable range.
ix. The nozzle blow-off caps are intact and undamaged.
x. The hood, duct, and protected cooking appliances have not been replaced,modified, or relocated.

36. *Material Approval*

48.11. All the Materials, Systems, Assemblies, equipment, Products and Accessories, referredto in this chapter with respect to Life Safety, Fire Safety and Emergency Services shall be Listed, Approved and Registered by the Civil Defence Material Approval Department.

48.12. The above requirement applies to all the products with or without international listing, registration or approval.

37. *Further References*

37.1. The following International Codes and Standards were referred, studied and consulted for this chapter. Further details where applicable can be referred to in these Codes and Standards. Also see XV. ACKNOWLEDGEMENT OF INTERNATIONALCODES AND STANDARDS.

- NFPA 11: Standard for Low-, Medium-, and High-Expansion Foam
- NFPA 12: Standard on Carbon Dioxide Extinguishing Systems
- NFPA 13: Standard for the Installation of Sprinkler Systems
- NFPA 13D: Standard for the Installation of Sprinkler Systems in One and Two- Family Dwellings and Manufactured Homes
- NFPA 13R: Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height
- NFPA 14: Standard for the Installation of Standpipes and Hose Systems
- NFPA 15: Standard for Water Spray Fixed Systems for Fire Protection
- NFPA 16: Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems
- NFPA 17: Standard for Dry Chemical Extinguishing Systems
- NFPA 17A: Standard for Wet Chemical Extinguishing Systems
- NFPA 20: Standard for the Installation of Stationary Pumps for Fire Protection
- NFPA 22: Standard for Water Tanks for Private Fire Protection
- NFPA 2001: Standard on Clean Agent Fire Extinguishing Systems
- NFPA 2010: Standard for Fixed Aerosol Fire-Extinguishing Systems
- NFPA 750: Standard on Water Mist Fire Protection System

Chapter No.: 7

Fire Hoses Recommendation

In this Chapter:

- The primary purpose of this Specification is to enhance the reliability of fire hose, nozzles, and fire hose appliances when deployed during incidents. Safety remains a paramount concern for the continued in-service use of these components

Intent of the Chapter:

- To familiarize end users of various types of Fire Hoses.
- To enable designers and owners to Choose Hose appropriately according to the hazard.
- To regulate the inspection and maintenance of Fire hose.

1. Introduction

The Egyptian Fire Code stipulates that there must be two types of faucets and hoses inside the building and administrative facilities, which are a faucet, a hose, a 2.5 inch ejector, and a permanent compressed hose made of rubber with a diameter of 1 inch.

The reason is that a 1-inch hose is easy to use by one person, while a 2.5 inch hose requires the skills of the individual and the use and the number of 2 an individual with specialized training in firefighting from a civil protection department.

Modern water hoses use a variety of natural synthetic fabrics and Elastomers in their construction. These materials allow hoses to be stored wet without rotting and resist the harmful effects of exposure to sunlight and chemicals.

Modern hoses are also lighter than older designs, and this has helped reduce the physical stress on firefighters. Many devices are becoming more common, which remove air from inside the fire hose, commonly referred to as a fire hose vacuum.

This process makes the hoses smaller and somewhat rigid, thus, allowing more fire hoses to be packed or to be loaded in the same place on firefighting equipment.

2. A 2.5" Diameter Fire Hose, Lined Inside And Out

General:

1. Supreme heavy duty lay flat hose for all firefighting operations. made by Circular woven jacket out of 100% high tenacity synthetic yarn
2. Heavy duty lay flat hose for all firefighting operations Inside and outside rubber lined fire hose to achieve rapid performance in firefighting operations.
3. These technical specifications will come into effect on the 20th 23/11/12

First: Hose:-

Technical Specifications:

1. The country of manufacture of the hose with connection must be from one of the countries of the European Union, America, and Japan.

2. The hose fabric must be from high grade synthetic rubber Lined with an inner layer of rubber lined and an outer layer using the "Through the weave extrusion process". Offers high resistance to acids, salt solutions, oil, fuel and many more chemicals. The fabric must be free of any defects.

3. The inner diameter when full should be 2.5 inches. The hose must be 30 meters long.

4. The weight of one meter of hose must not exceed 520 g.

5. The explosive pressure of the hose must not be less than 50 bar.

6. It must withstand an operating pressure of no less than 17 bar without water leaking, whether from the hose fabric or the connections trap area, and it must be subjected to a test pressure of no less than 22 bar under the same previous conditions.

7. The hose must be manufactured in accordance with one of the local or international standard specifications, and must pass the tests stated in those specifications, with the submission of a technical certificate that the entire hose with sealants conforms to the standard specifications (for hose BS 6391 type3, and for wrappers BS336:1989 or its equivalent) and it must be issued by one of the international laboratories or by the Egyptian General Authority for Standardization and Quality (for the local product).

8. The hose must be printed in an indelible manner with the trademark data - the number and date of the standard - the hose grade and inner diameter - the operating pressure - the explosive pressure - the date of production - - the accrediting body

Secondly, the Connection:

1. The hose must be fitted at both ends, one male and the other female, with a 2.5-inch Morse model.

2. The coupling must be made of gun metal, light metal alloy withstands shocks and heavy operation.

3. The fasteners must be tightly tied to ensure that the fastening can withstand high pressures, and the fasteners must be connected to the hoses by the company that produces the hose.

4. Each hose must be supplied with 5 rubber gaskets and 5 gaskets other than those installed with female lacquer and similar to it.

5. The requesting party may require the supply of a number of suitable welding parts at a separate price as needed.

General requirements:

1. A sample of the hose, 2 meters long, without coupling , will be submitted with the bid to test the explosive pressure, and a complete sample with clamps, 30 meters long, to test the operating pressure and test pressure
2. The original technical bulletins for the hose must be submitted with the bid, in either Arabic or English, showing the full specifications of the hose, provided that they are approved by the seal of the supplying company.
3. The supplying company is obligated to provide a certificate of origin for the hose, complete with labels, indicating the country of manufacture, model, and year of production 1Euro and must be accompanied by a packing list, customs release upon supply, and a certificate of conformity issued by the Export and Import Control Authority.
4. The technical inspection body has the right to conduct the necessary tests on the hoses provided at any testing body at the expense of the supplying company in order to ensure the resistance of the hoses to friction and all provisions of the specification, whether during the technical examination of the offers or upon receipt.
5. The supplying company is obligated to provide the producing company's website on the international information network and the e-mail address of the relevant department to review the data and certificates provided by the company, provided that all catalogs attached to the technical offer are identical to what is contained on the producing company's website, and in the event that the product is not available on The company's website does not match the offer technically.
6. The supplying company is committed to the technical specifications included in the tender and the catalogs provided, even if they exceed the specifications presented.
7. The supplying company undertakes to guarantee the hoses for a period of no less than one year from the date of receipt, against manufacturing defects
8. The supplying company is committed to providing after-sales services, including maintenance work and providing spare parts for coupling, gaskets, and appropriate welding parts, for a period of at least five years.
9. The production date of the hose must not exceed one year from the date of issuance of the supply order.
10. The supplying company is obligated to conduct an inspection at the headquarters before supplying.
11. The requesting party has the right to add financial and contractual conditions in accordance with applicable regulations

3. For a 2.5 Inch Diameter Fire Hose, Lined On The Inside Only:

A 2.5-inch diameter fire hose, lined from the inside only, is used in fighting fires to achieve rapid performance in firefighting operations.

These technical specifications will come into effect on the 20th 24/11/12.

First: Hose:-

Technical Specifications:

1. The country of manufacture of the hose with connection must be from one of the countries of the European Union, America, and Japan.
2. The hose fabric must be made of high grade synthetic rubber, lined inside and outside with an inner layer of rubber and an outer layer made of a material resistant to acids, alkali's, oils, and friction on the ground.
3. The fabric must be free of any defects.
4. The inner diameter when full should be 2.5 inches. The hose must be 30 meters long.
5. The weight of one meter of hose must not exceed 400 grams.
6. The explosive pressure of the hose must not be less than 50 bar.
7. It must withstand an operating pressure of no less than 16 bar without water leaking, whether from the hose fabric or the connection strap area, and it must be subjected to a test pressure of no less than 25 bar under the same previous conditions.
8. The hose must be manufactured in accordance with one of the local or international standard specifications, and must pass the tests stated in those specifications, with the submission of a technical certificate that the entire hose with sealants conforms to the standard specifications (for hose BS6391 type 1 , and for wrappers BS336:1989 or its equivalent) and it must be issued by an international laboratory or by the Egyptian General Authority for Standardization and Quality (for the local product).
9. The hose must have the trademark data printed on it in an indelible way - the number and date of the standard - the grade of the hose and the inner diameter - the operating pressure - the explosive pressure - the date of production - the accrediting body.

Secondly, the Coupling:

1. The hose must be fitted at both ends, one male and the other female, with a 2.5-inch Morse model
2. The coupling must be made of a gun metal, light metal alloy withstands shocks and heavy operation.
3. The fasteners must be tightly tied to ensure that the fastening can withstand high pressures, and the fasteners must be connected to the hoses by the company that produces the hose.

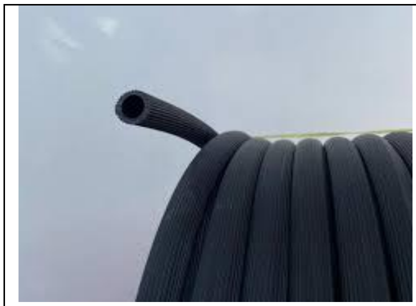
General requirements:

1. A sample of the hose, 2 meters long, without coupling, to test the explosive pressure, and a complete sample with clamps, 30 meters long, to test the operating pressure and test pressure, shall be submitted with the bid.
2. The original technical bulletins for the hose must be submitted with the bid, in either Arabic or English, showing the full specifications of the hose, provided that they are approved by the seal of the supplying company.
3. 3The supplying company is obligated to provide a certificate of origin for the hose, complete with labels, indicating the country of manufacture, model, and year of production. 1Euro and must be accompanied by a packing list, customs release upon supply, and a certificate of conformity issued by the Export and Import Control Authority.
4. The technical inspection body has the right to conduct the necessary tests on the hoses provided at any testing body at the expense of the supplying company in order to ensure the resistance of the hoses to friction and all provisions of the specification, whether during the technical examination of the offers or upon receipt.
5. The supplying company is obligated to provide the producing company’s website on the international information network and the e-mail address of the relevant department to review the data and certificates provided by the company, provided that all catalogs attached to the technical offer are identical to what is contained on the producing company’s website, and in the event that the product does not exist On the company's website, the offer is not technically identical.
6. The supplying company is obligated to adhere to the technical specifications included in the tender and the catalogs provided, even if they exceed the specifications presented.
7. The supplying company undertakes to guarantee the hoses for a period of no less than one year from the date of receipt, against manufacturing defects.
8. The supplying company is committed to providing after-sales services, including maintenance work and providing spare parts for coupling, gaskets, and appropriate welding parts, for a period of at least five years.
9. he production date of the hose must not exceed one year from the date of issuance of the supply order.
10. The supplying company is obligated to conduct an inspection at the headquarters of the General Administration of Civil Protection before supplying.
11. The requesting party has the right to add financial and contractual conditions in accordance with the applicable regulations.
12. Each hose must be supplied with 5 rubber gaskets and 5 gaskets other than those installed with female lacquer and similar to it.

4. For Fire Hose Diameter (1.5) Inch Lined Inside And Out

A 1.5-inch diameter fire hose, lined inside and out, is used in fighting fires to achieve rapid performance in firefighting operations.

These technical specifications will come into effect on the 20th24/11/12.



First: Hose:-

Technical Specifications:

1. The country of manufacture of the hose with connection must be from one of the countries of the European Union, America, and Japan.
2. The hose fabric must be made of polyester, lined inside and outside with an inner layer of rubber and an outer layer made of a material resistant to acids, alkali's, oils, and friction on the ground.
3. The fabric must be free of any defects.
4. The inner diameter when full should be 1.5 inches.
5. The hose must be 25 meters long.
6. The weight of one meter of hose must not exceed 300 grams.
7. The explosive pressure of the hose must not be less than 50 bar.
8. It must withstand an operating pressure of no less than 17 bar without water leaking, whether from the hose fabric or the connection strap area, and it must be subjected to a test pressure of no less than 22 bar under the same previous conditions.
9. The hose must be manufactured in accordance with one of the local or international standard specifications, and must pass the tests stated in those specifications, with the submission of a technical certificate that the complete hose with sealants conforms to the standard specifications for the hose BS 6391 type 3, and for wrappers BS336:1989 or its equivalent) and it must be issued by one of the international laboratories or by the Egyptian General Authority for Standardization and Quality (for the local product).

10. The hose must have the trademark data printed on it in an indelible way - the number and date of the standard - the hose grade and inner diameter - the operating pressure - the explosive pressure - the date of production - the accrediting body.

Secondly, the coupling:

1. The hose must be installed at both ends, one male and the other female, 2.5-inch Morse-style hose, and their total weight must be a maximum of 1 kg.
2. The lockers must be made of dun metal, light metal alloy withstands shocks and heavy operation.
3. The fasteners must be tightly tied to ensure that the fastening can withstand high pressures, and the fasteners must be connected to the hoses by the knowledge of the company that produces the hose.
4. 5 rubber gaskets and 5 gaskets must be provided with each hose, other than what is attached to the female lacquer and similar to it.
5. The requesting party may require the supply of a number of suitable welding parts at a separate price according to need.

General requirements:

1. A sample of the hose, 2 meters long, without clamps, to test the explosive pressure, and a complete sample with clamps, 25 meters long, to test the operating pressure and test pressure, shall be submitted with the bid.
2. The original technical bulletins for the hose must be submitted with the bid, in either Arabic or English, showing the full specifications of the hose, provided that they are approved by the seal of the supplying company.
3. The supplying company is obligated to provide a certificate of origin for the hose, complete with labels, indicating the country of manufacture, model, and year of production Euro 1 and must be accompanied by a packing list, customs release upon supply, and a certificate of conformity issued by the Export and Import Control Authority.
4. The technical inspection body has the right to conduct the necessary tests on the hoses provided at any testing body at the expense of the supplying company in order to ensure the resistance of the hoses to friction and all provisions of the specification, whether during the technical examination of the offers or upon receipt.
5. The supplying company is obligated to provide the producing company’s website on the international information network and the e-mail address of the relevant department to review the data and certificates provided by the company, taking into account that all catalogs attached to the technical offer are identical to what is contained on the producing company’s website, and in the event that the product is not available on The company's website does not technically match the offer

6. The supplying company is committed to the technical specifications included in the tender and the catalogs provided, even if they are higher the specifications presented.
7. The supplying company undertakes to guarantee the hoses for a period of no less than one year from the date of receipt, against defects Industry.
8. The supplying company is committed to providing after-sales services, including maintenance work and providing spare parts for lacquers, gaskets, and appropriate welding parts, for a period of at least five years.
9. The production date of the hose must not exceed one year from the date of issuance of the supply order.
10. The supplying company is obligated to conduct an inspection at the headquarters of the General Administration of Civil Protection before supplying.
11. The requesting party has the right to add financial and contractual conditions in accordance with the applicable regulations.

5. Technical Specifications for Fire Hose Joints 2.5”, 1.5"

A metal connection used for firefighting purposes to convert the outlets of pumps or hoses with diameters (2.5) inches into diameters (1.5) inches - to enable the use of fire hoses with a diameter of (1.5) inches when needed.

Technical Specifications:

1. The joint connection must be made of a strong, durable, lightweight metal such as a gun metal, light alloy.
2. It must be one piece without any separating welds. One end must be a male (2.5) inch, Morris style, and the other end must be a female (1.5) inch in diameter, Morris style.
3. The end of the female hose coupling must be provided with a rubber hook to securely connect it to the hose coupling, in addition to one or more zippers made of durable steel.

General requirements

1. The original technical catalog shall be submitted to the participant with the bid and shall be in one of the Arabic or English languages.
2. It may be sufficient to attach scanned copies of the catalogs to the technical offers approved by the bidder, provided that the original catalog is presented during the technical envelope opening committee for review and conformity..
3. Provide a sample for testing with the offer. Inside and that, a number of (5) rubber bands are supplied with each participant, unlike the compound with anti-lacor and similar to it.
4. The supplying company is obligated to provide the subscriber with a certificate of origin - if he is an importer, indicating the country of manufacture, model, year of production and customs release - upon supply.
5. The supplying company is committed to the technical specifications contained in the tender and the catalogs provided - if they exceed the specifications presented.
6. The supplying company undertakes to guarantee the subscriber for a period of no less than two years from the date of receipt against manufacturing defects.

6. Technical specifications rubber hose crossings

Crossings used to protect hoses while cars pass over them in accidents that require extending hoses on the road while car traffic continues.

With the following specifications:-

a) Made of reinforced rubber that can withstand heavy duty Reinforced Rubber).

b) It should accommodate two water lines with a diameter of 2.5 inches

c) The crossing must be foldable and portable, and its parts must be connected by synthetic fiber belts to prevent slipping.

d) The crossing should be provided with reflective strips and sides to distinguish it at night

General Conditions:

1. The original technical bulletins for the crossings must be submitted with the bid, and they must be in Arabic and English, approved by the supplying company and include that the crossings are produced by one of the specialized international companies.
2. The supplying company is committed to the technical specifications stated in the bid, if they exceed the specifications offered, and must submit a sample for examination with the bid.
3. The crossings must pass the load and anti-slip test and the supplying company must guarantee the crossings for one year from the date of supply.
4. The requesting party has the right to add financial and contractual conditions in accordance with applicable regulations.
5. Technical specifications of the fire hose welding machine.
6. A welding machine manufactured specifically for repairing fire hoses that are lined inside and out with rubber.
7. It includes preparing the hoses before welding, temperature, pressure, and time required for the fire hoses in order to achieve efficiency and accuracy in performance and withstand heavy service, with the following specifications:
8. First: the heating unit.
9. Heating unit (Heating Unit) operates on regular current (220 volts - 50 Hz) and is equipped with a digital temperature indicator
10. Be able to heat up to 165 degrees Celsius, and the temperature can be easily adjusted according to the type of hose.
11. It must be adjustable to the desired temperature. Adjustable (and equipped with a means of protection to ensure that the temperature does not exceed the permissible limits and is automatically disconnected to prevent exceeding.

Second: - Timer (Timer).

12. To be provided with a digital indicator (Digital) to indicate the operating time.
13. To be provided with an audio warning at the end of the period.

Third: pressure.

14. To be provided with a means of easily controlling the pressure (manual or mechanical) during welding. The operating pressure after repair is tested at 15 bar

Fourth: Accessories:

The following accessories are supplied with the machine:

i. Electric drill suitable for brush sets.

   1) A set of heating brushes consisting of at least 3 pieces, including one longitudinal Stainless steel scissors.

   2) 100 patches for hoses coated with polyurethane with the necessary powder for heating above °C (the size of the patches is not less than 6 cm for a round or 6 cm x 6 cm for a square).

General requirements

15. The original technical bulletins for the machine shall be submitted with the bid.
16. They shall be in Arabic and English and certified by the supplying company, which shall include that the machine is produced by one of the specialized international companies.
17. The supplying company is obligated to provide a certificate of origin of the machine indicating the country of manufacture, model, and year of production, Euro 1.
18. The supplying company is committed to reporting on the producing company's website on the international information network.
19. The supplying company is committed to providing after-sales services, including maintenance and the provision of spare parts, for a period of at least five years.
20. The requesting party has the right to add financial and contractual conditions in accordance with applicable regulations
21. The supplying company is committed to the technical specifications contained in the tender and the catalogs provided - if they exceed the specifications presented
22. The supplying company undertakes to guarantee the machine for a period of no less than one year from the date of receipt, against manufacturing defects and malfunctions resulting from normal use.
23. The date of production and model of the machine must not exceed one year from the date of supply.

Chapter No.: 8

Fire Hydrants, Monitor And Water Pumps Recommendation

In this Chapter:

- Recommended Practice for Water Flow Testing and Marking of Hydrants, Fire Monitor applies to both public and private hydrants and provides fire protection engineers, contractors, installers,

Intent of the Chapter:

- The capacity of the firefighting pumps depends upon the building and hazard location
- To provide guideline Technical Specifications For a Manual Fire Monitor and Hydrant

Hydrant waters extinguishing the wall 2.5

Morris-style wall fire hydrant that is installed on the purlins of vertical fire networks or external or internal networks in various locations. It is not permitted to be installed in public fire networks in streets and roads.

Technical Specifications:-

1. It must be made of rust-resistant material
2. It must conform to Egyptian and British standard specifications no. BS: 5041 or equivalent.
3. Be well finished - easy to open and close.
4. It must have a female exit hole with a diameter of (2.5) inches, a Morris model, and a Benz fitted with zipper spring at least one zipper must be made of durable metal.
5. It allows the male hose lacquer to be installed by simply pressing it, and it has leather or rubber gaskets installed to securely connect it to the male hose lacquer. Kindness
6. The tap must withstand an operating pressure of no less than (15) bar without any water leaking from the gasket or from the core of the tap. Self-suitable entry hole that can be installed with water pipes and supplies in the fire network with a diameter of at least 400 inches.
7. It must be equipped with a battery (of the same type as the material of the faucet) to control the process of opening and closing the water. The tire must be connected to a threaded shaft (the heart of the faucet) that ends with a gasket made of leather to prevent water leakage for a tight seal.
8. A number of (5) spare gaskets, other than those installed with the tap and similar to them, are supplied

General requirements

1. The original technical bulletins for the faucet must be submitted with the bid and must be in either Arabic or English, provided that they are approved by the seal of the supplying company and include that the faucet was produced by one of the specialized companies.
2. The supplying company is committed to providing a sample for virtual inspection (to verify the quality of the finishing) and testing along with the presentation
3. The supplying company is obligated to provide an industrial registry certificate for the manufacturing factory and a certificate of its conformity with Egyptian standard specifications.
4. The supplying company is obligated to provide the industrial registry certificate for the manufacturing factory and a certificate of its compliance with Egyptian standard specifications
5. The supplying company is obligated to provide a certificate of origin for the imported faucet stating the country of manufacture, year of production and customs release.
6. The supplying company is obligated to report on the producing company's website on the international information network. The supplying company is obligated to adhere to the technical specifications contained in the tender and the submitted catalog - if they exceed the specifications offered. The supplying company undertakes to guarantee the faucet for a period of not less than one year from the date of receipt, against manufacturing defects.

7. The production date of the faucet should not exceed one year from the date of supply. The requesting party has the right to add financial and contractual conditions in accordance with applicable regulations

Technical specifications for vertical fire hydrant controlled by a screw valve:

It is a fire hydrant connected to the public ground water network for use by firefighters with the following specifications:

1. **Body:**

a. It is the part of the tap that is connected to the network on the one hand and on the other hand to the outlet connection.

b. The faucet body is made of gray cast iron in accordance with the Egyptian Standard Specification (1/2001) or cast iron with spherical graphite in accordance with the Egyptian Standard Specification 1300 - so that the body can withstand a tensile stress of no less than 250 Newton's/mm^2.

2. **Director :**

a. The outlet hole of the faucet body or the elbow in the flange shall have an internal diameter of (63 mm) and an outlet shall be installed on it which is a threaded connection with a removable flange made of cannon bronze and has a cast cover that is connected to the faucet by means of a chain.

3. **Column and accessories:**

a. The shaft shall be made of forged bronze or of a turned bronze bar with a tensile stress of not less than 540 N/mm2 and an elongation of not less than 20% for a standard test piece five times the length of the diameter.

b. A cast iron cover is installed on top of the column, which is fixed to the column with a screw.

4. **Base rules and aspects of locks:**

a. The fulcrums attached to the body of the stopcock are made of cannon bronze, the hardness of which is not less than 80 Brinell.

5. **Flanges and connecting parts:**

The connecting parts flange, outlet elbow flange, and faucet body shall be completely level and conform to standard specifications

a. Connecting parts prepared for use with pipes with a head and tail shall be made of vertically cast iron or centrifuged cast in accordance with Egyptian Standard No. 1 2001. The necessary nuts and bolts are used to connect opposite flanges together from steel whose tensile strength is not less than 440 newtons/mm2.

6. **Paint:**

The paint material must be rust-proof, smooth, shiny, consistent, and of a degree of hardness that will not liquefy when exposed to a temperature of 70 degrees Celsius.

7. **The exams :-**

The faucet is tested according to the Egyptian standard

Data required to be clarified on the tap:

The following data shall be clearly stated on every tap manufactured and tested in accordance with this standard:

a. The direction of the valve opening is on the upper part of the test pressure

b. The name or brand of the manufacturer.

c. The serial number of the valve or faucet.

d. The number and date of the standard according to which it was manufactured.

e. The year of manufacture.

General requirements:

1. The offer must include the original bulletins for all components, provided that they are certified by the supplying company and include that the faucet is produced by one of the specialized companies.
2. That Egyptian Standard Specification No. 253/2003, Updated 2005, be the minimum level for acceptance, on the basis of which the supplier is obligated to submit a sample for examination with the bid.
3. The supplying company must guarantee the faucet for a period of at least one year, starting from the date of receipt, against manufacturing defects or against malfunctions resulting from normal use.
4. The supplying company must adhere to the technical specifications stated in the tender if they exceed the specifications presented.
5. The requesting party has the right to add financial and contractual conditions in accordance with applicable regulations. With it

Technical Specifications for a Manual Fire Monitor with a Diameter of 2.5” (Continuous Stream, Spray)

General

Manual fire monitor used in fighting fires (continuous stream, spray) and installed with fire hoses Diameter (2.5) to achieve speed of performance

Technical Specifications:-

1. It should be made of a light metal alloy of a type designed for firefighting that can withstand shocks and high pressures
2. It delivers water in the form of a continuous column and spray in the form of very small water droplets.
3. A discharge rate of (250) liters/minute should be given at a pressure of (7) bar
4. It must be equipped with a Morris male water entry hole (2.5 inches - 64 mm).
5. It must be provided with an operating handle (shutdown - water column - spray).
6. All components of the ejector must be produced by the original manufacturer

General requirements:-

1. Technical bulletins for the launcher shall be submitted with the bid, and they shall be in both Arabic and English, explaining the full specifications of the launcher, provided that they are approved by the seal of the supplying company and include evidence that the launcher is produced by one of the specialized companies and complies with one of the international standards.
2. The supplying company is obligated to provide a certificate of origin for the ejector stating the country of manufacture, model, year of production, and customs release upon supply.
3. The supplying company is obligated to provide information about the producing company's website on the international information network, as well as the relevant technical department.
4. A sample must be submitted for examination and testing along with the offer.
5. The supplying company is committed to the technical specifications contained in the tender and the catalogs provided - if they exceed the specifications presented
6. The supplying company undertakes to guarantee the ejector for a period of no less than one year from the date of receipt, against defects Industry
7. The ejector must pass the tests stated in the specifications according to which it is produced
8. The requesting party has the right to add financial and contractual conditions in accordance with the applicable regulations.

Technical Specifications for 1.5 Inch Diameter Manual Fire Monitor [Continuous Stream, Spray]

Manual firefighting launcher used in fighting fires [continuous stream - spray] and is installed with 1.5-inch diameter fire hoses to achieve rapid performance.

Technical Specifications:

1. It gives water in the form of a column and spray in the form of very small water droplets.

2. It should give a discharge rate of no less than (200) liters/minute at a pressure of (7) bar.

3. It should be light in weight and easy to carry - with an appropriate length to achieve speed of performance and direction. It is made of or covered with heat and electricity insulating materials and can withstand friction and collision with solid objects.

4. It has a male Morris style water inlet hole (1.5 inches) and a water exit drainage hole with a diameter of (1/2) inch, i.e. (12) mm.

5. Equipped with a means of opening and closing water and switching from continuous column to spray.

General requirements

1. The original technical catalog shall be submitted to the tenderer with the bid and shall be in one of the Arabic or English languages. It may be sufficient to attach scanned copies of the catalogs to the technical bids approved by the bidder, provided that the original catalog is presented during the technical envelope opening committee for review and conformity.

2. Submit a sample for examination with the presentation, with the name of the country of origin engraved on it. Ministry of Interior: The supplying company is obligated to provide a certificate of origin for the ejector stating the country of manufacture and model

3. The year of production and customs release upon supply.

4. The supplying company is committed to the technical specifications contained in the tender and the catalogs provided.

5. If it exceeds the specifications presented.

6. The supplying company undertakes to guarantee the ejector for a period of no less than two years from the date of receipt against manufacturing defects.

7. The date of production and model of the launcher shall not exceed one year from the date of supply. The requesting party has the right to add financial and contractual conditions in accordance with applicable regulations.

Technical specifications for an automatic ground reciprocating ejector with a discharge capacity of no less than 900 l/m

A ground reciprocating fire extinguisher installed at the end of the fire hose on the side facing the fire.

It can be fixed to the ground by a suitable means that prevents it from slipping while ensuring it against backlash.

Technical specifications:

1. It should be made of a light metal alloy of the type used for firefighting that can withstand shocks and high pressures. It gives water in the form of a column, spray, and mist using a lever to control the desired water exit form or a rotating head at the end of the ejector.
2. It must be resistant to collision with solid objects, and must withstand high temperatures resulting from use near flame sources.
3. The entry hole must be one (2.5) inch or more in diameter and equipped with a base or a set of legs by which it can be fixed to the ground without being affected by the reaction of the water coming out.
4. Possibility of self-movement in the horizontal plane, right and left, at an angle of 30 degrees in each direction, allowing for control work, provided that this movement takes place automatically due to water pressure.
5. Possibility to manually adjust the vertical shooting angle (from 35 degrees to 90 degrees).
6. It can be used to project water and foam (low and medium expansion), and it is equipped with a foam that is compatible with the device.
7. The discharge rate of the ejector shall not be less than (900) liters/minute at a pressure of (7) bar, and for a distance of at least 50 meters of water.
8. The thrower must be provided with an exit nozzle for water with variable drainage.
9. The thrower must be provided with a brake to stop the reciprocating movement.
10. The thrower must be provided with a pressure gauge
11. The total weight of the launcher and its components must not exceed 15 kilograms.
12. All components of the ejector must be produced by the original manufacturer.
13. The following data must be written on the shooter in an indelible manner
    a) The name of the manufacturer or trademark
    b) Ejector model
    c) Water injection data (operating pressure - minimum discharge - maximum discharge - nominal pressure)
    d) Opening and closing directions and locations.
    e) Directions and modes of projectile formation (rinsing mode - different modes of action)

General requirements:

1. Technical bulletins for the launcher shall be submitted with the bid. They shall be in Arabic and English, explaining the full specifications of the launcher, provided that they are approved by the seal of the supplying company and include evidence that the launcher is produced by one of the specialized companies and is compatible with one of the international specifications.

2. The supplying company is obligated to provide a certificate of origin for the ejector stating the country of manufacture, model, year of production and customs release upon supply. The supplying company is obligated to provide information about the producing company's website on the international information network, as well as the section

3. The specialized technician. The supplying company is committed to the technical specifications contained in the tender and the catalogs provided - if they exceed the specifications presented.

4. The supplying company undertakes to guarantee the ejector for a period of no less than one year from the date of receipt, against manufacturing defects

5. The thrower must pass the tests contained in the specifications produced according to them. The requesting party has the right to add financial and contractual conditions in accordance with the applicable regulations.

Technical specifications for a low diffusion foam lance 200 L\M

Foam lance provides a low-dispersing foam for use in fighting liquid fires

Technical Specifications:-

1. It must be made of stainless steel or mild steel and can withstand shocks and high pressures in accordance with the specification it complies with.

2. Black core (2.5 inch male Morris) shall be made of light metal alloy is a type used for extinguishing.

3. The ejector must be provided with a ball valve for closing and opening.

4. It should be able to achieve a discharge of 200 liters/min at a pressure of 5 bar with an expansion rate of 1:15

5. The following information must be written on the slanderer in an indelible manner:

   a) Name of the manufacturer or brand

   b) Ejector model

   c) Water injection data (operating pressure - minimum discharge - maximum discharge - nominal pressure)

General requirements:

1. Technical bulletins for the launcher shall be submitted with the bid. They shall be in Arabic and English, explaining the full specifications of the launcher, provided that they are approved with the seal of the supplying company and include evidence that the launcher is produced by one of the supplier's specialized companies.

2. The supplying company is obligated to provide a certificate of origin for the ejector indicating the country of manufacture, model, and year of production Customs release upon supply

3. The supplying company is obligated to provide information about the producing company's website on the international information network, the specialized technician.

4. A sample must be submitted for examination and testing along with the offer.

5. The supplying company shall adhere to the technical specifications contained in the tender and the catalogs provided - if they are greater Offered specifications

6. The supplying company undertakes to guarantee the ejector for a period of no less than one year from the date of receipt, against defects Industry.

7. The ejector must pass the tests stated in the specifications for which it is produced. The requesting party has the right to add financial and contractual conditions in accordance with the applicable regulations.

An automatic ground reciprocating ejector with a discharge of no less than 2000 l/min

A ground reciprocating fire extinguisher installed at the end of the fire hose on the side facing the fire. It can be fixed to the ground by a suitable means that prevents it from slipping while ensuring it against backlash.

Technical Specifications:-

1. It should be made of a light metal alloy of a type used for firefighting that can withstand shocks and high pressures. It delivers water in the form of a column, mist and mist using a lever to control the desired water output shape or a rotating head at the end of the ejector

2. It must be resistant to collision with solid objects and withstand high temperatures resulting from use near flame sources. The entry hole must be two or more inches (2.5) inches in diameter and equipped with a base or a set of legs by which it can be fixed to the ground without being affected by any reaction. Water coming out.

3. The possibility of self-movement in the horizontal plane, right and left, at an angle of 25 degrees in each direction, which allows control work, provided that this movement takes place automatically due to water pressure.

4. The ability to manually adjust the vertical firing angle (at least 50 degrees). It can be used to project water and foam (low and medium expansion) and is provided with a foam extrusion extension compatible with the device.

5. The discharge rate of the ejector shall not be less than (200) liters/minute at a pressure of (7) bar, and for a distance of at least 50 meters of water.

6. The thrower must be provided with an exit nozzle.)Nozzle (for water with variable drainage.

7. The thrower must be provided with a means of stopping the reciprocating movement.

8. The thrower must be provided with a pressure gauge

9. The total weight of the launcher and its components must not exceed 25 kilograms. All components of the ejector must be produced by the original manufacturer.
10. Ejection in an indelible manner the following data:
    a) The name of the manufacturer or brand, or the model of the ejector, must be written on it.
    b) Water injection data (operating pressure - minimum discharge - maximum discharge - nominal pressure)
    c) Opening and closing directions and locations.
    d) Directions and modes of projectile formation (rinsing mode - different modes of action)

General requirements:

1. Technical bulletins for the launcher shall be submitted with the bid, and they shall be in Arabic and English, explaining the full specifications of the launcher, provided that they are approved by the seal of the supplying company and include evidence that the launcher is from the Ministry of Production, one of the specialized companies, and is compatible with one of the international specifications.
2. The supplying company is obligated to provide a certificate of origin for the ejector stating the country of manufacture, model, year of production and customs release upon supply.
3. The supplying company is obligated to provide information about the producing company's website on the international information network, as well as the relevant technical department. The supplying company is committed to the technical specifications contained in the tender and the catalogs provided - if they exceed the specifications presented.
4. The supplying company undertakes to guarantee the ejector for a period of no less than one year from the date of receipt, against manufacturing defects
5. The thrower must pass the tests contained in the product specifications, according to which the requesting party has the right to add financial and contractual conditions in accordance with the applicable regulations.

Technical specifications for a medium dispersion foam launcher 400 liters/min

Foam lance provides medium spreading foam for use in fighting liquid fires with light water foam.

Technical Specifications:-

1. It must be made of stainless steel or mild steel and can withstand shocks and high pressures in accordance with the specification it complies with.

2. To be equipped with black core (2.5 inch male Morris) from light metal alloy.
3. The ejector shall be provided with a closed and open ball valve.
4. The thrower must be provided with a metal front net
5. The thrower must be provided with a pressure gauge with the ability to protect it against shocks.
6. The thrower must be provided with a handle made of a heat- and electrical-insulating and shock-resistant material.
7. It must be able to achieve a discharge of 400 liters/min at a pressure of 5 bar at an expansion rate of 1:50.
8. The following data must be recorded on the ejector in an indelible manner.
   a) Factory name or brand
   b) Ejector model
   c) Water injection data (operating pressure - minimum discharge - maximum discharge - nominal pressure)

General requirements:-

1. Technical bulletins for the launcher shall be submitted with the bid, and they shall be in Arabic and English, explaining the full specifications of the launcher, provided that they are approved by the seal of the supplying company and include evidence that the launcher is produced by one of the specialized companies.
2. The supplying company is obligated to provide a certificate of origin for the ejector stating the country of manufacture, model, year of production, and customs release upon supply.
3. The supplying company is obligated to provide information about the producing company's website on the international information network, as well as the relevant technical department. It is necessary to submit a sample for inspection and testing along with the offer.
4. The supplying company is committed to the technical specifications contained in the tender and the catalogs provided - if they exceed the specifications presented
5. The supplying company undertakes to guarantee the ejector for a period of no less than one year from the date of receipt, against defects Industry:
6. The thrower must pass the tests contained in the product specifications in accordance with them. The requesting party has the right to add financial and contractual conditions in accordance with the applicable regulations.

Technical specifications Water thrower in the form of a curtain

1. A thrower works to push water spray in the form of a water curtain for the purpose of providing protection for individuals from the heat of fire and gases, as well as preventing the risk of exposure to fire, with the following specifications: -
2. The launcher must be made of lightweight metal alloy and have a carrying handle and bases for ground stabilization. The entry hole must be a 2.5-inch Morris male. .
3. The discharge rate should not be less than 1000 liters/d at a pressure of 8 bar.
4. The thrower must be given water in the form of a water curtain with a height of not less than 7 meters, at a pressure of 8 bar, and with a width of not less than 20 meters.
5. The weight of the thrower must not exceed 5 kg

General requirements

1. The bidder's original technical bulletins shall be submitted with the bid and shall be in both Arabic and English and certified by
2. The supplying company, which includes that the launcher is produced by one of the specialized international companies
3. The supplying company is obligated to provide a certificate of origin for the flashlight indicating the country of manufacture, model, and year of production, or Euro 1
4. The supplying company is committed to reporting on the producing company's website on the international information network. The supplying company is committed to providing after-sales services, including maintenance and the provision of spare parts, for a period of at least five years.
5. The supplying company is committed to the technical specifications contained in the tender and the catalogs provided - if they exceed the specifications presented
6. The supplying company undertakes to guarantee the ejector for a period of no less than one year from the date of receipt, against defects Industry and malfunctions resulting from normal use..
7. The date of production and model of the launcher must not exceed one year from the date of supply.
8. The requesting party has the right to add financial and contractual conditions in accordance with applicable regulations

Technical specifications for moving water jet (water/foam)

A mobile water thrower used in firefighting and is installed with 2.5-inch diameter fire hoses In order to achieve speed of performance

Technical Specifications:-

1. It should be made of a light metal alloy of a type used for firefighting that can withstand shocks and high pressures
2. It is equipped with two 2.5-inch male Morris feed holes equipped with two non-return valves.
3. The ejector nozzle must be multi-purpose (stream- spray) with the possibility of equipping it to release foam
4. To provide complementary accessories for the multiple use of foams (low and medium expansion). The ejector discharge rate should not be less than 1600 liters/minute at a pressure of 7 bar and a throwing distance of not less than 50 meters of water and 30 meters of foam.
5. Possibility of horizontal movement of at least 180 degrees and vertical operating range of 30 degrees: 90 degrees
6. The guidance must be done manually by means of a wheel or lever, with the ability to set the direction and angle of the thrower
7. All components of the firefighter must be produced by the original manufacturer specializing in the production of international firefighting equipment
8. The following information must be recorded on the thrower:
   a) The name of the factory or brand.
   b) B launcher model.
   c) Water injection data (operating pressure - minimum discharge - maximum discharge - nominal pressure)
   d) Opening and closing directions and locations.
   e) Directions and modes of projectile formation (rinsing mode - different modes of action)

General requirements:

1. Technical bulletins for the launcher shall be submitted with the bid, and they shall be in Arabic and English, explaining the full specifications of the launcher, provided that they are approved with the seal of the supplying company and include evidence that the launcher is produced by one of the specialized companies.
2. The supplying company is obligated to provide a certificate of origin for the ejector stating the country of manufacture, model, year of production and customs release upon supply.

Technical specifications for a multi-purpose hand thrower (2.5 inches).

Multi-purpose fire extinguisher (2.5 inches) with high discharge and the ability to control the discharge rate. It is used in fighting fires to achieve rapid performance and withstand heavy service.

Technical Specifications:

1. It must be made of a light metal alloy of a type used for firefighting that can withstand shocks and pressures The high
2. It should be light in weight - easy to carry - and covered in the head area with a material that insulates heat and electrical current. It must be equipped with a 2.5-inch male entry hole, Morris model, made of the same material as the ejector, capable of rotating 360 degrees, and installed by the company that produces the ejector.
3. The projector should be equipped with a rotating head at the end to control the shape of the water exit (column - spray - fog), a control lever for opening and closing, and a handle for easy guidance.
4. The ejector must be equipped with a self-rinsing system (Flushing) to get rid of sediment
5. The spray amplitude angle should not be less than 100 degrees
6. It provides multiple water drainage rates of no less than (750) liters/minute at a pressure of 7 bar at the maximum discharge, and it can be adjusted by the user using a rotating ring in the dispenser with the required discharge written on it.
7. Can be used for foam extrusion (low and medium expansion).
8. The following data must be recorded on the thrower in an indelible manner, which conforms to American specifications NFPA 1964 or European 15182/2006
   a) Factory name or brand
   b) Ejector model
   c) Water injection data (operating pressure - minimum discharge - maximum discharge - nominal pressure)
9. All components of the ejector must be produced by the original manufacturer.

General requirements:

1. -Technical bulletins for the launcher shall be submitted with the bid, and they shall be in Arabic and English, explaining the full specifications of the launcher, provided that they are approved by the seal of the supplying company and include evidence that the launcher is produced by one of the international specialized companies.
2. The supplying company is obligated to provide a certificate of origin for the launcher. Indicating the country of manufacture, model, year of production, and customs release upon import.
3. The supplying company is obligated to provide information about the producing company’s website on the international information network, as well as the relevant technical department.
4. A sample must be submitted for inspection and testing with the offer within a week from the date of the technical bid opening session.
5. The supplying company must adhere to the technical specifications contained in the tender and the catalogs provided - if they exceed the specifications presented.

6. The supplying company undertakes to guarantee the ejector for a period of no less than one year from the date of receipt, against defects Industry
7. The ejector must pass the tests contained in the specifications according to which it is produced
8. The requesting party has the right to add financial and contractual conditions in accordance with applicable civil protection regulations

Technical specifications of the multi-media rapid intervention firefighting machine powered by an engine that uses liquid fuel:

1. A multi-purpose firefighting machine for rapid intervention, used to quickly combat vehicle fires on roads, bridges, and tunnels after installing it on a closed van, a small pickup truck, or any light means of transportation. It can also be installed on sliding ducts in fire trucks.
2. With the following specifications, it is a multi-purpose firefighting machine for rapid intervention, easy to operate and use by one person.
3. It is a single unit consisting of a high-pressure water pump and a liquid fuel engine mounted on a metal chassis, and is equipped with a water tank and another for foam, in addition to a carbon dioxide gas cylinder, with a hose.
4. A long, multi-purpose nozzle and launcher for various firefighting media (water in various forms, air foam, foam with carbon dioxide gas

First: the pump:

1. That It shall be of the centrifugal type and the drive shaft shall be made of stainless steel, giving a water discharge rate of no less than (20) liters/minute at operating water pressure.
2. No Less than (230) bar
3. That it is equipped with an ejection hole connected to the multi-purpose hose.
4. To be provided with a fixed mixing device for the foamy liquid.

Secondly: the engine

1. The machine's four-stroke engine runs on gasoline, and its capacity is not less than (20) horsepower, and it must be suitable to fulfill With pump requirements
2. It must be equipped with a fuel tank sufficient to operate at maximum performance rates for two hours without the need to refuel
3. That It is equipped with an electric method (Marsh), in addition to the possibility of manual management

4. That Provided with a charging circuit for the battery (dynamo/charger)..
5. That The cooling system provides the ability to operate the equipment at maximum performance rates without overheating the engine About normal rates

Third: Water tank

1. It must have a capacity of no less than (100) liters and is sufficient to operate the fire pump at full capacity for at least (4) continuous minutes.
2. To be made of stainless steel -Stainless Steel).
3. To be provided with an indicator of the water level.
4. It must have a top opening for refilling and refilling
5. The welding areas should be coated with epoxy or its equivalent
6. It is connected to a water discharge hole from inside the tank that ends with a valve.

Fourth: Foam liquid tank:

1. The capacity of the foam tank should be no less than (10%) of the capacity of the water tank. It must be made of a material that does not react with the foamy liquid, such as: stainless steel. Stainless Steel or Fiber Glass
2. It must be connected to the fixed foam liquid mixing device attached to the machine.

Fifth: Carbon dioxide gas cylinder (CO_2):.

1. The cylinder capacity must not be less than (5) liters of water capacity
2. Another cylinder similar to the vehicle must be supplied with the machine as a spare.
3. The cylinder body should be made of seamless steel or carbon fiber (Carbon fiber) has the ability to withstand an operating pressure of no less than (200) bar.
4. There should not be any welds in the cylinder body and it should be provided with a base to rest on.
5. The cylinder must be equipped with a head assembly made of durable metal, equipped with a gas exit hole for a multi-purpose hose, and a valve to control opening and closing.
6. The cylinder must be certified by one of the Egyptian Standard Accreditation Authorities No. (735) in the year 1966 from an official technical body if the device is locally manufactured.
7. The machine comes with the necessary and appropriate tools and hand tools to replace the cylinder Gas Carbon Dioxide.

Sixth: Multiple hose for firefighting media:

1. Reinforced hose for all firefighting media and divided internally into separate paths (water - foam liquid - carbon dioxide gas - electrical cable to control operation). . The length of the hose must not be less

than (80) meters and must be made for heavy duty to withstand weights and the passage of cars over it.

2. A multi-purpose launcher for various firefighting media should be installed at the end of the hose, so that the hose can be used at any length, without the need to extend the hose to its full length.
3. The hose should be fixed on a metal reel for easy unrolling, use, and rewinding the hose onto the reel after completion of use.

Seventh: Multiple firefighting media launcher.

1. A multi-purpose launcher for various firefighting media, made of strong anti-rust material, and equipped with a handle for easy control and guidance.
2. The multi-thrower has a means of controlling the speed of the engine rotation, and is equipped with a sliding link in. Ejector for use with foam liquid
3. The ejector is equipped with an easy way to switch from using one extinguishing agent to another extinguishing agent without the need to go to the machine (water, air foam, carbon dioxide foam, carbon dioxide gas (front control of the ejector).
4. The ejector has the ability to expel the extinguishing agent in different forms, namely: water (solid column - concentrated spray - diffuse spray - cone column).Yes). Foam with air bubbles (low diffusion foam - medium diffusion foam). Foam with carbon dioxide gas bubbles Low diffusion foam modem average spread).
5. Gas Carbon dioxide used in indoor fires, electrical panels and appliances control...... etc.

Eighth: General specifications of the machine

1. Possibility Operate and use the equipment in a time not exceeding (5) seconds only
2. The total weight of the machine, including the battery, metal chassis, and fully filled tanks, should not exceed on (300) kg.
3. That The machine dimensions are as follows:
4. L: Not more than (100) meters.
5. W: Not more than (0.80) meters.
6. H: Not more than (100) meters
7. The machine must be equipped with an indication panel containing a meter to measure the operating and expulsion pressure
8. Possibility the machine chassis is equipped with four wheels for easy movement on the ground, in addition to handles, provided that the wheels are installed in a way that is easy to remove.
9. To carry the special machine when Install the machine on the car requirements the public

10. The original technical bulletins for the machine must be submitted with the bid, in both Arabic and English, from the supplying company, which include that the machine is produced by one of and approved Companies Specialized global

Technical specifications for an extinguishing system (unit) that operates using the air-compressed foam release theory COMPRESSED AIR FOAM SYSTEM (CAFS)

General

1. A firefighting unit that generates foam using compressed air. The unit is designed to expel water, foam, or air-compressed foam from the exhaust outlets - with the ability to adjust the expansion ratio of the compressed air-generated foam. As needed.
2. With the following specifications
3. The system (unit) consists of a firefighting water pump, a foam tank with a capacity of no less than 30 liters, a water tank with a capacity of 600 to 1,000 liters, an air compressor, a direct foam mixing system, and a complete control panel with meters and indicators.
4. The unit frame is designed to contain all the system components and is made of high-quality steel pipes.
5. The unit is equipped with four steel supports at the corners for easy carrying.

The engine

1. Heavy-duty gasoline engine - four-stroke - capacity no less than 20 horsepower - air cooling - electric starter - 12 volt battery. The engine is able to provide the necessary power through the transmission of the water pump and air compressor for long periods of use at maximum operating rates without the temperature rising above safe degree.
2. The electrical circuit and electrical connections can withstand high temperatures and weather conditions and are equipped with a system automatic reset circuit breakers for maximum protection and in accordance with international standard specifications NFPA

Water pump

Centrifugal pump - stainless steel drive shaft.

1. The fire water pump provides a water discharge rate of no less than 300 liters/minute at a pressure of 7 bar.
2. The intake and exhaust holes are 1.5 inches in diameter, complete with valves, in addition to a discharge hole for the pump.
3. The pump is equipped with a preparation device capable of drawing water from a depth of 6 meters and it can be operated through control Board.

Water tank

The unit's water tank is made of stainless steel or fiberglass and is connected to the pump.

Foam pump:

A pump equipped to pump foam at a rate of no less than 6 liters/min and operating up to a pressure of 16 bar.

Foam mixing system:

1. The system is for self-mixing to generate the force concentrate from the exhaust nozzles.
2. The system is capable of self-adjusting the desired foam rate based on the ejection rate.
3. The device is equipped with a valve to prevent the foam center from re-fluxing.

Air compressor:

1. The compressor is capable of achieving a rate of no less than 9 cubic meters of air at a pressure of 7-8 bar (if water is not used -no flow)
2. The compressor is equipped at the exhaust nozzle with a pneumatic control valve that adjusts the amount of air exhausted.
3. The compressor is equipped with an automatic adjustment system to achieve an air pressure rate within the limits of less than or more than 5% of the water pump pressure.
4. The control panel provides an indication of the compressor status during operating modes -Automatic - Fixed unload
5. The machine is equipped with an oil cooling system that maintains the air compressor temperature at maximum operating rates.
6. The oil tank is equipped with a gauge to indicate the oil level in the pressure vessel, a discharge hole, as well as a self-limiting valve to control the oil flow to the refrigeration unit.
7. The air compressor is cooled through a copper tube connected to the water pump and is able to provide safe temperatures at maximum operating rate and up to 60 degrees Celsius.
8. The compressor is equipped with an air filter that is easy to change when needed.

Air passages:

1. Air hoses, fittings and pipes withstand pressure up to 16 bar
2. The valves are made of brass or stainless steel and prevent water back flow into the air system
3. All links are grouped into regular paths.

Control Board

1. The control and operation panel is made of smooth aluminum and coated with an anti-rust treatment.

2. It is equipped with control levers The following meters and indicators:

   a) Water pressure meter

   b) Air pressure gauge.

   c) The temperature meter for the compressor is equipped with a light alarm when the temperature increases. Tachometer - operating hours counter.

   d) Starter - speed control device (throttle control).

   e) Keys and indicators for adjusting the compressor operating modes (Auto Sync plate).

   f) The control switches and indicators for the mixing device.

   g) Control switch for the expulsion valve - Switch for operating the preparation device and special indicators.

   h) The ejection hole is 1.5 inches in diameter and is plated with insulating chrome

   i)Pressure control switch. The pump control valve connects to a connection to fill the tank.

   j)Control valve for filling the tank

   k) The 1.5-inch pump filling hole is equipped with lacquer.

   l)All control panel switches and indicators are equipped with the necessary indicators and labels in accordance with international standard specifications

General requirements:-

1. Detailed technical bulletins for the unit shall be submitted with the offer, which include all data in Arabic and English, approved with the seal of the supplying company, and produced by one of the international specialized companies.
2. The supplying company shall adhere to the technical specifications contained in the tender and the catalogs provided - if any exceeds the specifications offered.
3. The supplying company is obligated to provide information about the producing company's website on the international information network, as well as the technical department
4. The supplying company is committed to the technical specifications contained in the tender and the catalogs provided - if they exceed the specifications presented. The supplying company undertakes to guarantee the unit for a period of no less than one year from the date of receipt, against manufacturing defects.
5. The requesting party has the right to add financial and contractual conditions in accordance with the applicable regulations. The supplying company is committed to providing after-sales service (an authorized maintenance center for the car and all its equipment in the Republic of Egypt).
6. The supplying company is committed to providing a proposed list of spare parts necessary for operation and maintenance of consumable parts within ten years, within a limit of 10% of the value of the system

Technical specifications for a telescopic pole firefighting system installed on fire engines

1. Extinguishing system consisting of a pole with telescopic links MAST (equipped with a multi-purpose water/foam fire extinguisher) works through a wired electronic control panel that enables the user to control the operation of the extinguisher remotely.
2. It is equipped with at least two LED lights - and water is pumped to the system via the main fire pump in the fire truck. The system can be installed on fire and rescue vehicles.

Technical Specifications:-

1. A telescopic pole with five interlocking telescopic links and made of light aluminum alloy. It is a type designed for firefighting and can withstand shocks and high pressures. The thickness of the telescopic pole is not less than 6 mm, with an outer diameter of not more than 250 mm, and achieves a height of not less than (7) meters when the joints are fully unfolded, compared to the base of the telescopic pole.
2. The telescopic pole is equipped with an internal telescopic connection to feed the fire extinguisher with water/water and foam). . The telescopic pole consists of at least a number of telescopic links with an internal diameter of not less than 100 mm and a thickness of not less than 2 mm. . The extension of the telescopic links is controlled by valves operated by compressed air connected to a compressor of appropriate capacity or from a fire engine, ensuring the stability of the links without rebound after the completion of extending the links to the full required height.
3. Availability of a safety means to drain the extinguishing agent in the event that the pressure exceeds the permissible rate while feeding the ejector through the telescopic column.
4. The availability of switches at the base of the telescopic pole to control the opening or closing of the air pumping valve and meters to measure the air pressure inside the telescopic pole.
5. The top of the telescopic pole is provided with a base for installing a firefighting launcher. The multi-purpose launcher (foam water) is made of a light metal alloy of the type used for firefighting. It can withstand shocks, high pressures and temperatures.
6. High levels resulting from use near flame sources.
7. The ejector delivers water in the form of a column and spray at a discharge rate of (2500) liters/minute at a pressure of (7) bar and a distance of at least 50 meters of water - where it is fed through the telescopic column without being affected by the reaction of the water exit.
8. It is supplied with a foam connector that is mounted on the nozzle.
9. The possibility of the launcher moving in the horizontal plane in both directions with a non-continuous 5360 rotational movement, which allows for combat operations - with the possibility of adjusting the angle of the vertical launch at an angle of no less than 75° upwards and no less than an angle of 525° downwards, measured from the horizontal plane of the thrower. .
10. The launcher derives electrical current from the car’s electricity using an insulated internal cable that passes inside the telescopic pole to prevent it from being exposed to the continuous movement of the

telescopic pole extension during operation or from the outside, while providing it with the necessary protection during operation.

11. All components of the ejector and telescopic pole must be produced by the original manufacturer of European origin or the United States of America.
12. The following information must be written on the slanderer in an indelible manner:
    a. Factory name or brand.
    b. Launcher model.
    c. Water injection data (operating pressure - minimum discharge - maximum discharge - nominal pressure)
    d. Opening and closing directions and their locations.
    e. Directions and positions of projectile formation (rinsing mode - different disposal modes) -
13. The top of the equipment is equipped with 2 searchlights. Each LED has a power of not less than 40 watts.
14. The lighting floodlights are operated either from the operating battery of the fire engine or through an electric generator with an operating capacity suitable for operating the floodlights.
15. A proposal is presented for equipping a system with a video camera for live transmission of the event connected to a screen to see where the fire occurred and control the firefighting operations at a price. (A separate quote containing specifications for the air compressor and generator suitable for operating the system will be provided at a separate price

General requirements:

1. Technical bulletins for the launcher, telescopic pole, camera, and flashlights shall be submitted with the bid, and they shall be in Arabic and English, explaining the full specifications of the launcher, provided that they are approved with the seal of the supplying company and include a statement stating that the entire system is produced by one of the international specialized companies.
2. The supplying company is obligated to provide a certificate of origin for the launcher, telescopic pole, flashlights, and camera, indicating the country of manufacture, model, and year of production upon supply.

Chapter No.: 9

Firefighting Vehicle Recommendation

In this Chapter:

- The vehicles which are designed for firefighting are called firefighting apparatus.
- Firefighting apparatus can give firefighting services as well as the emergency medical services.

Intent of the Chapter:

- These vehicles are designed differently according to the cases will be used.
- To provide guideline Technical Specifications For a Different type Firefighting apparatus

1. Introduction :

Before doing any research into truck types, configurations and components, it is important to have a clear understanding of the immediate and long-long term goals of the fire department.

a) The main mission of the fire truck:

Will a new truck be the workhorse of the department, responding to every call, or is it meeting an existing gap in coverage? These considerations can help a fire department determine the best truck type, chassis and components to include in a truck specification.

b) Current fleet needs.

Whether you are replacing an existing apparatus in your fleet or considering a new type of truck, it's important to evaluate your current fleet of trucks and determine how a new truck fits into your fleet.

c) Service area requirements:

Each company has unique needs and the fire trucks that service the company must match these needs.

d) Geographic terrain.

There are many types of fire trucks, each designed to manage specific tasks and, in some cases, specific terrain. Will your vehicle need to go off road? The geographic region can make a big difference in vehicle weight considerations, engine size, horsepower and more.

e) Climate.

The climate in a region may have an impact on the types of components a fire department plans to use on a new fire truck. In fact, environmental factors may motivate a department to consider specific features.

2. **How Do You Choose the Right Apparatus and Chassis?**

Every detail in the purchase of a fire truck matters. Therefore, understanding the mission of the truck will help your organization make an informed decision Take considers this simple statement

- The needs of your fleet?
- The needs of your company and service area?
- The firefighters?
- The tools that are required for your mission?
- The space you have in your fire station? (height, length and width)
- Your budget?

The type of apparatus your department requires will drive the chassis you choose, which will affect your gross vehicle weight rating, which will, in turn, influence your powertrain and horsepower considerations.

Ultimately, this will determine your payload capacity and the equipment and personnel that can be onboard.

3. **Common Fire Truck Apparatus Definitions**

it can be helpful to have a basic understanding of the key terms often used to describe fire trucks in the ordering process. Here is a brief overview.

NFPA standards for National Fire Protection Association, which delivers information and knowledge through more than 300 consensus codes and standards, research, training, education, outreach and advocacy.

a) Gross Vehicle Weight Rating (GVWR) :

is defined by NFPA 1901 as “the final-stage manufacturer’s specified maximum load-carrying capacity of a single vehicle.”

b) Curb Weight :

is the total overall weight of a vehicle alone, with no equipment or personnel on board. It is defined by NFPA 1901 as ‘the total weight of the complete vehicle less the payload.”

c) Payload capacity :

is the total weight of all of the cargo, personnel and equipment on board a fire apparatus. The payload capacity is calculated by subtracting curb weight from a fire truck’s gross vehicle weight. Payload Capacity = GVWR – Curb Weight.

d) Gross Axle Weight Rating (GAWR) :

is defined by NFPA 1901 as “the final stage manufacturer’s specified maximum load-carrying capacity of an axle system, as measured at the tire-ground interfaces.”

e) Horsepower :

is the unit of measure for power and is often understood as the rate at which work can be completed.

f) Drivetrain :

is the interaction of several parts working together that when combined with the power, thrust a vehicle into motion. The drivetrain usually consists of the transmission, driveshaft, differential, axles and wheels.

Powertrain, on the other hand, can be understood as the elements of the drivetrain combined with the source of propulsion (diesel or electric engine) and the axles to put a vehicle into motion.

g) Angle of approach :

is defined by NFPA 1901as “the smallest angle made between the road surface and a line drawn from the front point of ground contact of the front tire to any projection of the apparatus in front of the front axle.”

h) Angle of departure :

is defined by NFPA 1901 as “the smallest angle made between the road surface and a line drawn from the rear point of ground contact of the rear tire to any projection of the apparatus behind the rear axle.”

i)Tip Load Capacity :

is used for aerial apparatus and refers to the maximum weight the aerial device can hold at the tip without tipping over the apparatus.

Technical specifications of a Rescue Vehicle

1. General :

An easy-to-maneuver rescue vehicle with high mechanical capacity, fully equipped, designed as a rescue vehicle and manufactured according to the technical principles of rescue vehicles and produced by one of the specialized international companies

2. Technical Specifications :

a) Chassis:

I. The chassis must be of one of the brands bearing an international trademark.

II. The maximum actual load on any of the axles should not exceed 90% of the permissible design load, provided that the supplying company provides a statement of load distribution and a certificate of suitability for the vehicle, including the design and equipment with the actual load and all accessories and equipment in accordance with the permissible loads on the chassis.

III. The rear traction machines must be only (2x4) with double tires on the rear axle.

IV. The chassis beams must be one piece without any welds or additions except within the limits permitted by the original manufacturer of the chassis.

V. The brakes must be equipped with heavy-duty dual-circuit brakes and must be equipped with a system (ABS) The transmission must be manual, and the internal turning radius must not exceed 8 m.

VI. Possibility of towing the fire truck from the front and back. The net vertical clearance between the wheels and the fire truck body when it is fully loaded must not be less than (15) cm.

VII. The ground clearance of the fully loaded fire truck should not be less than (18 cm),

VIII. the total height should not exceed (3.75) meters while the fire truck is not loaded,

IX. The total width should not be less than (2.5 meters), and the length should not be less than (9.5) meters.

X. It must be provided Suitable places in the cabin in to install respirators with all their accessories so that they can be easily worn.

XI. The fire truck must be supplied with its accessories, including a tool kit, a fire truck lift cord, and a spare tire.

XII. A suitable place must be provided for its storage.

XIII. In the event that the spare tire is installed on top of the car, a manual winch must be provided to be used to move it to or from the storage location.

b) <u>Fire Truck cabin in :</u>

I. The fire truck cabin in must be double, of the flip type, without a front protrusion, raised hydraulically, equipped with a manual means of insurance, and composed of one closed unit with four doors manufactured by the factory that produces the chassis or under its supervision, with a certificate from the factory stating that and a customs release proving that, provided that it can accommodate For at least five people other than the driver)

II. Standard Crew cabin in

- The steering wheel should be to the left of the cabin in, and operated by hydraulic power steering - hydraulic servo.
- The top of the cabin in must be equipped with an appropriate warning light in accordance with technical standards
- The cabin in shall be equipped with a multi-tone siren of the types designated for police and rescue vehicles produced by specialized international companies.

c) <u>The Engine : -</u>

I. Water cooled four stroke diesel.

- To be equipped with a turbocharger system-turbo charger or equivalent.
- The engine must have a net relative power of no less than (14) horsepower per ton of the total weight of the fully loaded fire trucks (G.V.W) and be able to achieve the required speed and acceleration of the car.
- The engine must be environmentally friendly in accordance with European specifications (Euro 3) at least

II. Speed and acceleration:

- The maximum speed of the fire truck must not be less than (80) kilometers per hour on flat ground it is fully loaded.
- The fire truck must be able to achieve a speed of no less than (60) kilometers per hour within (40) seconds, starting from stationary with its full load on flat ground.

d) <u>The structure:</u>

I. The chassis must be equipped with tightly closed wheels with sliding doors with a lockable handle with a self-lubricating key, produced by a specialized company in accordance with international specifications, to accommodate all the car's equipment, with means to install them, on both sides of the fire truck behind the cabin in, and to accommodate all accessories, including devices and equipment, and the rest of the equipment additional accessories and accessories supplied with the car.

II. The floor of the structure, cupboards and shelves are manufactured from rough aluminum panels with a thickness of no less than (4) mm.

III. The trunk of the fire truck is divided into compartments with dimensions appropriate to the equipment needed for rescue, taking into account the distribution of loads and the assembly of equipment according to type whenever possible.

IV. The chassis should be equipped with sliding drawers with a suitable slope for ease of use, which can be pulled out of the fire truck through ducts, while providing the drawers and shelves with safe means of fixing devices and equipment.

V. A ladder made of light and durable metal alloy is installed for individuals to climb onto the top of the car.

VI. The color is matte red

e) <u>Towing Winch :</u>

I. The fire truck is equipped with an electric front towing winch that runs on the car's battery, with a steel wire with a tensile strength of no less than (5) five tons, and a steel wire length of no less than (30) meter.

II. A hook with a lock is attached to the end of the wire to secure the closure. The fire truck is equipped with a system to lock the axes and prevent their movement during Clouds.

f) <u>Basic Equipment:-</u>

a) <u>Lifting Winch</u>

I. The rear of the fire truck is equipped with a hydraulic winch with the following capabilities:

- Rotatable 360 degrees.
- Maximum lifting capacity is not less than 10 tons
- The maneuvering radius is not less than 10 m
- It is equipped with hydraulic supports that ensure complete safety during operation.
- Equipped with a braided steel wire suitable for the load, with a length of no less than 60 m.

b) Generator :

I. The fire truck is equipped with a fixed electric generator of 220/380 volts, providing a power of no less than 20 KVA and derives its movement from the fire truck engine via P.T.O provided with data Necessary (220 volt outlet, 380 volt outlet, in addition to supplying the lighting pole.

II. The fire truck must be equipped with a lighting holder consisting of several sliding links, each of which rises and falls by means of an automatic method, achieving a height of no less than 8 m from the surface of the ground, with a total capacity of 4 kilowatts, with a change in the lighting angle in all directions Equipment: (optional - number and type - according to the needs of the requesting party)

III. The car's Equipment storage locker are equipped with the following equipment:

1. (2) Mechanical metal cutting saws + (20) spare weapons needed for it.
2. (1) Mechanical concrete cutting saw + (2) spare weapons needed for it.
3. (1) Mechanical wood cutting saw + (2) weapons necessary reserve.
4. (4) Respirator complete with accessories
5. High capacity hydraulic cutting and opening unit (opener, scissors and pump) with high capacity Portable hydraulic cutting and opening unit combination tool.
6. Adjustable mechanical lifting units up to a load of no less than 11 tons, complete with accessories and multilateral Tips.
7. Complete hydraulic spacer with inclusions

8. A device to search for missing persons under the rubble by vision and auscultation.
9. (10) floating water pumps

10. (3) Cylindrical pneumatic bags, graduated heights up to two meter.
11. (1) individual lowering and lifting device (triple saddle-bag)
12. (1) individual lowering device
13. (6) flashlights with dry battery charger
14. Concrete drill bits complete with accessories
15. A set of three pieces of airbags of different capacities, complete with accessories, with payloads of no less than 60, 40 and 20 tons.
16. A complete tension and lifting device with accessories
17. (6) full set of land rescue clothing with accessories)
18. (4) dust removal cork
19. (4) scissors for cutting electrical insulating cables up to (1000) volts
20. (4) Scissors for cutting iron skewers up to (3/8) inch.
21. (4) garlands (5) kg 23
22. (2) small axes
23. (4) Mobile lighting stands equipped with flashlights, each with a capacity of (1000) watts.
24. (4) Thermoplastic electric cable reels (16 mm) with a hammered end, with (3) outlets, with a length of not less than (50) meters.
25. A manual metal sliding ladder with a length of no less than (9) meters installed on top of the car
26. (4) dry battery flashlights, capacity (250) watts
27. (6) traffic cones
28. (2) Spools of cordon rope with a length of not less than (30) meters per rope.
29. Two (2) hook ladders, no less than 4 meters long, and one rope ladder, no less than 10 meters long.

30. (6) Cordon rope holders on the base.
31. (2) reciprocating levers
32. (2) Manual crowbars, 1 meter long.
33. (2) cutting chisels
34. (2) rescue man safety belts
35. (6) Dust masks.
36. (6) Goggles to protect against sparks and dust.
37. (2) Amplifiers (microphones) (handheld).
38. Two (2) folding type hand stretchers
39. Number 2Dry chemical powder extinguishing device, capacity (6) kg for each device
40. (2) carbon dioxide gas extinguishers, with a capacity of (6) kg for each device
41. A foldable rubber launch that can accommodate: individuals with paddles and an air pump on the foot.

c) <u>General Requirements:</u>

1. The date of production and model of the car must not be less than the year in which the purchase was announced.
2. Detailed technical bulletins must be submitted with the offer, which include all data on the car and equipment in Arabic and English for the equipment, showing the full specifications of the car after its preparation, including the specifications of the chassis, engine and accessories, provided that they are approved with the seal of the supplying company and are produced by one of the international specialized companies.
3. The bidder is obligated to submit an engineering drawing of the car with all its equipment, along with the technical offer
4. The vehicle components (chassis - engine - sliding doors) must be of origin in either the European Union, Japan, or the United States of America.
5. The chassis, engine and cab must be produced by one company.
6. The supplying company is obligated to provide a certificate of origin for imported components, rescue equipment, respirators, etc., indicating the country of manufacture, model, and year of production, and customs release for clothing supplies.
7. The supplying company is committed to the technical specifications contained in the tender and the catalogs provided - if they exceed the specifications presented.

8. The supplying company is committed to providing practical training on how to use the car with all its accessories and regular maintenance methods
9. Provided with the car - if the offer is accepted - complete original documents related to the operation and maintenance of the chassis, pump and respirators in printed or electronic form (CD).
10. Upon delivery, the supplier - whether the car is equipped locally or imported from abroad - is obligated to provide an inspection and test certificate of validity from the General Administration of Civil Defense stating that the car has passed the acceptance tests and containing the car's data (chassis number - engine number - rescue equipment - any other data).
11. The supplying company is committed to providing after-sales service (an authorized maintenance center for the car and all its equipment in the Arab Republic of Egypt).
12. The supplying company undertakes to guarantee the car with all its components for a period of no less than two years from the date of receipt or for twenty thousand kilometers and five years for all rescue equipment (which represents approximately 25% of the total value of the car) against manufacturing defects.
13. The supplying company is committed to providing a proposed list of spare parts needed to operate the car and maintain the consumable parts within ten years, within a limit of 10% of the car's value.
14. The supplying company is obligated to provide the producing company's website on the international information network and the e-mail number of the relevant department to review the data and certificates provided by the company.
15. The requesting party has the right to review the manufacturing stages of the local product in coordination with the General Administration of Civil Protection.
16. The requesting party has the right to add financial and contractual conditions, in accordance with applicable regulations

Heavy duty fire truck with Rear Wheel Drive 4 x 4

With fire pump operated system P.T.O

1. **General :**

A heavy fire truck that is easy to maneuver, with mechanical capacity and high firefighting capabilities, fully equipped and manufactured according to the technical principles of international fire trucks.

2. **Technical Specifications :**

a) Chassis

I. The chassis must be of one of the brands bearing an international trademark

II. The maximum actual load on any of the axles should not exceed 90% of the permissible design load, provided that the supplying company provides a statement of load distribution and a certificate of suitability for the vehicle, including the design and equipment with the actual load and all accessories and equipment in accordance with the permissible loads on the chassis.

III. Front and rear traction machines, 4×4, with double tires on the rear axle

IV. The chassis beams must be one piece, without welds or additions, except within the limits permitted by the company producing the chassis.

V. The brakes are equipped for heavy duty and equipped with a system ABS

VI. The transmission must be steptronic is installed and manufactured by the same company that produces the chassis.

VII. The internal turning radius must not exceed 8 m.

VIII. Possibility of towing the fire truck from the front and back.

IX. The net vertical clearance between the wheels and the car's body when it is fully loaded must not be less than 15 cm.

X. The ground clearance of the fully loaded fire trucks should not be less than 25 cm, the total height should not exceed 3.5 meters while the fire truck is not loaded, the total width should not exceed 2.5 meters, and the length should not exceed 8.25 meters.

XI. The fire truck must be supplied with its accessories, including a tool kit, a fire truck lift cord, and a spare tire. It is necessary to provide a suitable place for storing it. In the event that the spare tire is installed on top of the car, a manual winch is provided to be used to transport it to and from the storage location.

XII. The car must be equipped with a fixed charger Built-in for the batteries, so that it is connected through a cable to the 220-volt electricity source, and through it the batteries are recharged throughout the period of their stopping at the fire station, so that the charger automatically stops working when the car is fully charged. A suitable cable equipped with a plug (quick connector that automatically disconnects from the source) is supplied with the car. Electricity from the power source (at least 15 meters long).

b) <u>Cab:-</u>

I. The cab must be a double cab, one closed unit with four doors, manufactured by the factory that produced the chassis or under its supervision, with a certificate from the factory stating that and a customs release proving that. It must be of the flip type without a front protrusion and it must be raised hydraulically and provided with a means of insurance. Manual and can accommodate at least five people, other than the driver.

II. The steering wheel should be to the left of the cab, and operate with a hydraulic servo (POWER STEERING)

III. The top of the cab must be equipped with a warning light that is appropriate to the width of the car and operates using a system LED according to technical standards, and 2 LED flashers at the rear of the car (one on each side), as well as 2 LED flashers on each side of the car.

IV. To be provided with a multi-barrel siren of the types designated for police and fire engines, produced by specialized international companies.

V. It must be provided with an external lighting lamp that runs on the car's electricity to illuminate the accident site and can be used to move away from the car.

VI. The car dashboard should be provided with the necessary indicators and meters that indicate the operation of the equipment and equipment in the car.

VII. Suitable places must be provided in the cabin to install respirators with all their accessories, so that they can be easily worn.

VIII. To prepare an electrical connection and a wireless device to install a wireless device, along with providing a speaker and an outlet next to the fire pump to install a wireless device microphone for use by the pump operator.

c) **The Structure :**

I. It must be made of sheet or aluminum alloy, and fiberglass is allowed as an accessory to the structure

II. 2 - The chassis must be equipped with tightly sealed wheels with self-lubricating sliding doors, provided that they are produced by one of the international specialized companies, and that accommodate all the car's equipment with means to install them, and that they must accommodate all the accessories, including hoses and various launchers, and the rest of the additional equipment and accessories that are supplied with the car, with Providing each door with appropriate lighting that operates automatically when opened, as well as a phosphorescent strip to retract the door when closed.

III. The equipment must be kept with good means of preservation and fastening inside the cupboards, in accordance with what is followed for installing equipment inside fire trucks.

IV. The rear door is equipped on both sides of the fire truck behind the cabin with mat doors of the same type and equipment as the equipment storage cupboard doors, in the case of the middle pump. If the pump is rear, the rear door shall be of the hinged type that opens upwards and is equipped with two auxiliary units, with an additional means for securing the door. When opening.

V. A ladder made of a light and durable metal alloy is installed for individuals to climb onto the top of the car.

VI. The color is matte red.

VII. The sides of the fire trucks must be provided with two phosphorescent lines on each side, each with a width of no less than 30 cm. The rear of the fire truck must be completely covered with phosphorescent markings produced by one of the specialized international companies.

d) **The Engine :**

I. Four-stroke diesel, water cooled, for heavy duty within the Arab Republic of Egypt.

II. It must be equipped with a turbo charger system or equivalent

III. The engine must have a net relative power of no less than 14 horsepower per ton of the total weight of the fully loaded fire trucks (GVW) and be able to achieve the required speed and acceleration of the car.

IV. The engine cooling efficiency must be proportional to the operation of the fire truck at rest in the summer, so that the pump is operated at maximum speed for a period of no less than four continuous hours, while the engine temperature does not rise above 30 degrees Celsius.

V. It must be environmentally friendly in accordance with European specifications At least EURO 3

e) **The Speed and Acceleration:**

I. The maximum speed of the fire truck should not be less than 80 kilometers per hour on flat ground while fully loaded.

II. The fire truck must be able to achieve a speed of no less than 60 km/h within 40 seconds, starting from a complete standstill.

III. Its payload on flat ground.

f) <u>Water Tank :</u>

I. Its capacity should not be less than 6,000 liters

II. It must be made entirely of stainless steel thickness no less (4) mm, with the welding places treated with a rust-preventing method (epoxy) or its equivalent.

III. The tank must be painted from the outside with anti-corrosion paints and paints that are resistant to the effects of salt water, as well as for all connections.

IV. It must be installed on the auxiliary chassis in accordance with technical standards, including flexible housing, and in accordance with the instructions of the chassis manufacturer, so that it can be completely lifted from the chassis and any repairs or welding can be made to it.

V. It must be equipped with longitudinal and transverse partitions of the same material as the tank and with a thickness of no less than 3 mm to achieve complete safety of the vehicle's movement while driving and turning, so that the distance between the longitudinal or transverse partitions does not exceed (1.2) meters, and connects the bottom and the top of the tank with Availability of openings for free movement of water while emptying and filling the tank, as well as openings for maintenance of the tank from the inside with covers (one opening for each breaker).

VI. It must be equipped with an upper inspection and maintenance hatch with a diameter of at least 55 cm and must be equipped with a tightly closed, easy-to-open cover made of rust-resistant material.

VII. It must be provided with an electronic water level indicator, and the statement is given on the main control panel, an overflow pipe, and two water entry holes (2.5 inches) male with a valve (one hole on each side) equipped with a closing valve.

VIII. It must be connected to the pump intake hole with a pipe not less than (4) inches, according to the diameter of the pump intake hole - through a flexible connection with a butterfly valve installed on it.

IX. It must be connected to a water discharge hole from inside the tank that ends with a valve mounted with a (2.5) inch male lacquer, Morris model.

X. The tank is connected to a filling connection via a pump.

XI. All the above-mentioned slot seals must be made of a strong metal alloy (light alloy)

g) <u>Foam Liquid Tank:</u>

I. The capacity of the foam tank must be at least 10% of the capacity of the water tank and separate from it so that it can be lifted for maintenance work.

II. It must be made of stainless steel (with a thickness of no less than 3 mm).

III. The tank must be coated from the outside with anti-corrosion paints and coatings that are resistant to the effects of salt water, as well as for all connections.

IV. It must be installed on the auxiliary chassis in accordance with technical standards, including flexible housing, and in accordance with the instructions of the chassis manufacturer.

V. An electronic indicator of the foam liquid level in the tank should be provided, and the indication should be given on the main control panel and pipe.

VI. Overflow and foam liquid filling hole is equipped with a stopcock

VII. It must be connected to the fixed foam liquid mixing device attached to the fire pump.

VIII. It is connected to an opening for discharging the foamy liquid from the tank, ending with a manual valve

IX. The tank must be provided with an upper inspection and maintenance opening with a diameter of at least 45 cm and must be equipped with a tightly closed lid that is easy to open and the lid must be marked in yellow.

X. The tank must be provided with a means to confront the expansion of the volume of the foamy liquid as a result of movement or weather factors.

h) <u>Firefighting pump and equipment:</u>

I. The pump must be centrifugal and derives its movement from the car engine via the transmission system. 2 - It must be central and installed directly behind the cab or at the back

II. The pump must be given a medium pressure discharge rate of no less than 3000 liters/minute at a pressure of 10 bar.

III. The pump must be given a high-pressure discharge rate of no less than 400 liters/minute at a pressure of 40 bar.

IV. To drain the water through 4 exhaust holes with a diameter of 2.5 inches, Morris model, distributed as two holes on each side in the case of the middle pump, or 4 outlets in the back in the case of the rear pump.

V. It must be provided with a self-priming device attached to the pump capable of drawing water from a depth of 3 meters in a time not exceeding 30 seconds.

VI. Manufacturer, two control panels, ejection branches, high-pressure pump, preparation device, operation and control panels, and fixed foam liquid mixing device (direct pump mixing).Around pump) to withdraw the foam liquid from the foam tank or from an external source, while controlling the adjustment of the mixing ratio. All of them are one unit, the module, produced by the pump manufacturer, provided that the technical presentation shows the model and data of the model, along with attaching the original catalogs of the model that contain all the technical data and the committee. Follow-up work preview before installation on the chassis

VII. It must be equipped with an automatic means to protect the pump when the pressure inside it increases or the water temperature rises.

VIII. The pump must be provided with two openings for drawing from an external water source Open, with a diameter of 4 or 5 inches, or according to the diameter of the pump's intake hole, equipped with a threaded screwdriver with a hole on each side and that In the case of the middle pump and one hole for the rear pump, it is equipped with a screw thread.

IX. The pump, upper ejector, and high-pressure pumps must be produced by one company.

X. The two suction connections from the water and foam tank must be provided with a strainer and an inspection hole to prevent any impurities from passing into the pump.

XI. The pump connections must be provided with a leakage valve through which the bottom of the pump and the lower pipes can be completely emptied after the pump is finished.

XII. The pump (module) must be equipped with two operating and control panels (a panel on each side) in the case of the middle pump, and one rear panel in the case of the rear pump, which includes meters for measuring the intake and exhaust pressure, a means of controlling the number of engine revolutions, a meter for measuring the hours of operation of the pump, and an indicator of the pump engagement, temperature, and level. Water and foam in the tanks and any other indicators that can be added. In the case of the middle pump, the main panel is on the left side.

XIII. To be provided with two filtration hoses with a diameter of 1 inch and a length of 40 meters, complete with a multiple nozzle, giving a discharge rate of no less than 200 liters/minute at a pressure of 40 bar for each nozzle, and achieving an ejection distance of no less than 25 meters, with the possibility of installing a foam release connection, and the hose must be made of From reinforced rubber

XIV. It must be connected to an upper ejector on the top of the car (water-foam column) and equipped with a connection for generating foam)Foam Tube) is compatible with the ejector and the ejector is characterized by the following:

XV. A drainage rate of no less than 3000 liters/min is given at a pressure of 10 bar.

XVI. Horizontal throwing distance of no less than 50 water meters

XVII. It is equipped with a separate valve and pressure indicator, and it can rotate a full 360 revolutions on the horizontal level and up to 75 degrees.

i) Basic Accessories Supplied With The Fire Truck:-

I. Four or Five suction hoses with a diameter suitable for the pump suction hole and equipped with a screwdriver with a total length not less than 10 meters .

II. Two suction strainers for manifold hoses made of brass or light alloy with threads and a diameter suitable for manifold hoses and equipped with a non-return valve to prevent water leakage.

III. Two wrenches for the suction hoses, produced by the same company that produces the suction hoses.

IV. One joint with a matching thread with a diameter suitable for the pump entry hole on two 2.5” Morris male entry holes.

V. One manual ladder consisting of three sliding and interlocking links with a total length of no less than 9 meters, produced by a specialized company.

VI. A hand pump to fill the pasture tank.

VII. 2 foam nozzles for high-pressure nozzles.

VIII. One Assembling triangle٢ (2.5) / 1 (2.5).

IX. One Distribution triangle 1 (2.5) / 2 (2.5).

j) Conditions are general

I. The date of production and model of the fire truck must not be less than the year in which the purchase was announced.

II. The chassis must have an authorized agent in the Arab Republic of Egypt.

III. The chassis warranty must be with a certificate approved by the agent stating the numbers of the chassis under warranty.

IV. To submit with the offer the original catalogs that include all data on the vehicle, the pump, and the firefighting equipment in English for the equipment, showing the full specifications of the vehicle after its preparation, including the specifications of the chassis, engine, pump, and accessories, provided that they are approved with the seal of the supplying company and are produced by one of the specialized companies.

V. Non To support or confirm any technical statement by displaying it in technical catalogue, the committee has the right not to accept this statement.

VI. An engineering drawing of the fire trucks with all its equipment must be submitted along with the technical offer.

VII. The vehicle components (chassis - engine - fire pump - overhead ejector - fire engine hoses complete with reel and ejector - sliding doors - fire pump transmission shaft - basic accessories shown in the brochure) must be of origin in either the EU ,Japan or USA

VIII. A certificate from the company producing the chassis that it is fit to work as a fire truck (for local equipment).

IX. That the chassis, engine, and cabin in be produced by one company.

X. The company submitting the offer is obligated to provide the producing company's website on the international information network and the e-mail number of the relevant department to review the data and certificates submitted by the company, taking into account that all catalogs attached to the technical offer are identical to what is contained on the producing company's website. In the event that the product is not available on The Company's website does not match the offer technically.

XI. The supplying company is committed to providing a certificate of origin for the imported components (fire pump - breathing apparatus - high-discharge grenade launchers - firefighting uniforms... etc.), explaining with it Country of manufacture, model, year of production and customs clearance.

XII. The supplying company is committed to the technical specifications contained in the tender and the catalogs provided, even if they exceed the specifications presented.

XIII. The supplying company is committed to providing practical training on how to use the fire trucks with all its accessories and methods of regular maintenance.

XIV. In the event that the offer is accepted, complete original documents related to the operation and maintenance of the chassis, pump and respirators must be provided with the fire trucks in printed or electronic CD format.

XV. The supplying company is committed to providing after-sales service (an authorized maintenance center for the fire trucks and all its equipment in the Arab Republic of Egypt).

XVI. The supplying company undertakes to guarantee the fire trucks with all its components for a period of no less than two years from the date of receipt or for twenty thousand kilometers and five years for all fixed firefighting equipment, which represents approximately 25% of the total value of the car, against manufacturing defects.

XVII. The supplier is obligated upon delivery - whether the fire trucks is equipped locally or imported from abroad - to provide an inspection and validity test certificate from the General Administration of Civil

Protection stating that the fire truck has passed the acceptance tests and bearing the car's data (chassis number - engine number - fire pump number and any other data). .

XVIII. The administration's right to review the manufacturing stages of the local product.

XIX. This tender is subject to Law No. 89 of 1998 and its executive regulations.

Fire Fighting Vehicle Small Businesses

Firefighting, Rescue Rear Wheel Drive Machines Only

1. General :

A fire truck with mechanical and firefighting capabilities and the ability to maneuver in tight spaces, fully equipped, designed for heavy duty in residential and industrial areas and villages, equipped with a portable fire pump, and manufactured in accordance with the regulations.

2. Technical Specifications :

a) Chassis:

I. The chassis must be of an international brand name

II. The maximum actual load on any of the axles shall not exceed 90% of the permissible design load, provided that the supplying company submits a statement of load distribution and a certificate of suitability for the vehicle, including design and equipment with the actual load and all accessories and equipment in accordance with the permissible loads on the chassis.

III. The traction machines must be rear only (2x4) with double tires on the rear axle.

IV. The chassis beams must be one piece without any welds or additions except within the limits permitted by the original manufacturer of the chassis.

V. The brakes must be equipped with a heavy-duty dual-circuit system.

VI. The transmission must be manual

VII. The internal turning radius must not exceed 7 meters

VIII. Possibility of towing the fire truck from the front and back

IX. The net vertical clearance between the wheels and the body of the fire truck when it is fully loaded must not be less than (15) cm

X. The ground clearance of the fully loaded fire trucks should not be less than (18) cm, the total height should not exceed 2.75 meters while the fire trucks is not loaded, the total width should not be more than (2.20) meters, and the length should not exceed (6) meters.

XI. The fire trucks must be supplied with its accessories, including a tool kit, a fire trucks lift cabin, and a spare tire. A suitable place must be provided for its storage. In the event that the spare tire is installed on top of the car, a hand winch must be provided to be used to transport it to or from the storage location.

b) cabin:

I. The cabin in must be a single cabin in with two doors and can accommodate at least three people, including the driver, and the fire trucks must be equipped behind the driver's cabin with an additional closed cabin that can accommodate four people, with a roof and stairs for boarding.

II. It is equipped with two doors. The original cabin in must be without a front protrusion and has a suitable and safe lifting device manufactured by the factory that produced the chassis without any modifications.

III. The steering wheel should be to the left of the cabin, and operate with a hydraulic servo (power steering)

IV. The top of the cabin must be equipped with a warning light that is appropriate to the width of the fire truck sand operates using a system LED according to technical standards and 2 LED flashers at the rear of the fire trucks(one on each side).

V. The cabin shall be equipped with a multi-tone siren linked to a microphone of the types designated for police and fire engines, produced by specialized international companies.

VI. It should be provided with an external lighting lamp that runs on the car's electricity to illuminate the accident site and can be used to move around

c) Body: Outside The Car

I. It must be made of sheet metal or aluminum alloy, and fiberglass is allowed as part of the structure's accessories.

II. The chassis must be equipped with tightly sealed wheels with self-lubricating sliding doors, provided that they are produced by one of the specialized companies to accommodate all the car's equipment with means of attaching them on both sides of the fire trucks behind the cabin, and to accommodate all the accessories, including hoses, various launchers, foam jars, a device for mixing foam liquids, and the rest of the equipment. Additional accessories and accessories that are supplied with the car, with Provided it with appropriate lighting that operates automatically when opened

III. A ladder made of a light and durable metal alloy is installed for individuals to climb onto the top of the car.

IV. The sides of the fire trucks must be provided with two phosphorescent lines on each side, each with a suitable width. The rear of the fire trucks must be completely covered with phosphorescent markings produced by one of the specialized international companies.

V. color: matte red

d) Engine

I. Four stroke diesel, water cooling.

II. The engine must have a net relative power of no less than 17 HP per ton of the total weight of the car with full load and to be able to achieve the required speed and acceleration of the car

e) Speed And Acceleration:

I. The maximum speed of the fire trucks must not be less than (90) kilometers per hour on flat ground while at full speed with full-load

II. The fire trucks must be able to achieve a speed of no less than (60) km/h within (40) seconds, starting from stationary with its full load on flat ground.

f) Water Tank :

I. The tank capacity should not be less than 2000 liters.

II. It must be made entirely of stainless steel with a thickness of no less than (4) mm, for the bottom and (3) mm for the sides and roof, with treatment of the welding areas.

III. Using an anti-rust method (epoxy) or equivalent.

IV. The tank must be painted from the outside with anti-corrosion paints and paints that are resistant to the effects of salt water, as well as for all connections.

V. It must be installed on the auxiliary chassis in accordance with technical standards, including flexible housing, and in accordance with the instructions of the chassis manufacturer.

VI. The tank must be fixed on the chassis well in accordance with technical standards, so that it can be completely lifted from the chassis and any repairs or welds can be made to it.

VII. It must be equipped with longitudinal and transverse partitions of the same material as the tank and with a thickness of no less than 3 mm to achieve complete safety for the movement of the fire trucks while driving and turning, so that the distance between the longitudinal or transverse partitions does not exceed (60) cm, and connects the bottom to the top of the tank, with openings available for free movement of water. Maintenance work for the tank from the inside:

VIII. It must be equipped with an upper inspection and maintenance opening with a diameter of at least 55 cm, and it must be equipped with a tight cover. Easy-to-open closure made of stainless steel.

IX. It must be provided with a water level indicator, an overflow pipe, and two water inlet 2.5“, male with a valve (one on each side), equipped with a locking valve.

X. The tank must be connected to the pump intake hole with a pipe not less than 4” through a flexible connection with a butterfly valve installed on it.

XI. The tank should be provided with an opening for emptying that ends with a valve mounted on a male 2.5” Morris valve.

XII. The tank should be provided with a pipe for filling water via pump

XIII. All the above mentioned slot seals must be made of Gun metal or strong light alloy.

g) Firefighting Machine:

One unit firefighting machine consisting of a pump and an engine mounted on a metal chassis Equipped to be installed on the fire trucks with the following specifications:-

a. Pump Specifications:-

- The pump shall be centrifugal, the drive shaft shall be made of stainless steel, and the centrifugal shaft shall be made of bronze.
- The pump preparation device is capable of achieving preparation by drawing and draining water from the pump in a time not exceeding (30) seconds from a drawing depth of 3 meters through a 6-meter hose.
- The pump must be given a water discharge rate of no less than (1600) liters/minute at an operating pressure of (7) bar.
- From a suction depth of (3) meters through a suction hose with a length of (6) meters, presenting the performance curve of the pump.
- Equip the pump with at least two discharge holes (2.5 inches) in diameter, Morris model, with its own gaskets.
- The ejection openings are provided with hoop knife valves of the type Light alloy, the intake hole is 4 inches in diameter, and the threads are equipped with a wire strainer made of copper or stainless steel to prevent the entry of impurities.
- All pump intake and exhaust openings are provided with a metal cover attached to the pump body via a chain.
- The pump is provided with a valve to empty water from the pump body.

b. **Engine specifications:**

- The four-stroke pump engine runs on gasoline
- Lubrication is forced through the engine carburetor oil pump.
- Equipped with a fuel tank sufficient to operate at maximum performance rates for two hours without the need to refuel

- Equipped with an electrical startup device (Marsh) in addition to the ability to manage manually
- Equipped with a charging circuit for the battery (dynamo/charger)
- The engine must be equipped with an electrical spark distribution system (magneto) or an electronic distributor
- The cooling system provides the ability to operate the equipment for at least two hours at maximum performance rates without high temperature.

c. **General Specifications Of The Machine:**

- The total weight of the equipment, including the battery, metal chassis, and fully filled fuel tank, does not exceed (200) kg.
- The machine shall be equipped with an indication and control panel equipped with a lighting means for reading meters and shall include the following means:
    - The speed control handle stabilizes the engine speed at the desired position.
    - Hood handle for management in cold weather.
    - Exhaust pressure gauge and intake pressure gauge.
    - Oil level indicator and high temperature indicator
    - Night lighting lamp.
    - The design ensures that the display and control panel and the battery are protected from the influence of water and the heat of the exhaust pipe.

d. **Accessories:**

- Suction hose connections with a total length of not less than (10) meters of rubber reinforced with wire size (4) inches tied by steel tied that can withstand pressure up to 20 bars, complete with tooth polish made by the manufacturer from light aluminum alloy.
- Suction joint for the pump, diameter 4” , 2 thread Morris males, diameter 2.5”, equipped with a non-return valve) and its gaskets.
- One manual ladder consisting of three sliding and interlocking links with a total length of no less than 9 meters, produced by one of the specialized companies.
- (2) manual wrench for connecting manifold hoses
- A rope for the mantle hose with a length of not less than (15) meters
- Suction strainer with non-return valve for the suction hose, diameter (4) inches, made of light aluminum alloy material
- Supplying a complete kit to maintain the engine and pump

h) General requirements

I. The date of production and model of the fire trucks must not be less than the year in which the purchase was announced.

II. Detailed technical bulletins must be submitted with the offer, which include all the vehicle and pump data in Arabic and English for the equipment, showing the full specifications of the fire trucks after its preparation, including the specifications of the chassis, engine, pump, and accessories, provided that they are approved with the seal of the supplying company and are produced by one of the international specialized companies.

III. The bidder is committed to submitting an engineering drawing of the fire trucks with all its equipment, along with the technical offer

IV. The vehicle components (chassis - engine) - fire pump - sliding doors must be of origin in either the European Union, Japan, or the United States of America.

V. The chassis, engine, and cabin must be produced by one company.

VI. The company submitting the offer is obligated to provide the website of the producing company on the international information network and the e-mail number of the relevant department to review the data and certificates submitted by the company, taking into account that all catalogs attached to the technical offer are identical to what is contained on the website of the producing company, and in the event that the product is not available on The company's website does not match the offer technically.

VII. The supplying company is obligated to provide a certificate of origin for the imported components (fire pump - breathing apparatus - high-discharge grenade launchers - firefighting uniforms... etc.) indicating the country of manufacture, model, year of production and customs release.

VIII. The supplying company is committed to the technical specifications contained in the tender and the catalogs provided if they exceed the specifications presented.

IX. The supplying company is committed to providing practical training on how to use the fire trucks with all its accessories and methods of regular maintenance (1) Complete original documents related to the operation and maintenance of the chassis, pump, and respirators, in printed or electronic form, shall be provided with the fire trucks if the offer is accepted (CD)

X. The supplying company is committed to providing after-sales service (an authorized maintenance center for the fire trucks and all its equipment in the Arab Republic of Egypt) for civility.

XI. The supplying company undertakes to guarantee the fire trucks with all its components for a period of not less than two years from the date of receipt or for twenty thousand kilometers and five years for all fixed firefighting equipment (the tank and the pump, which represent approximately 25% of the total value of the truck) against manufacturing defects.

XII. The supplying company is obligated to provide a proposed list of spare parts necessary to operate the fire trucks and maintain the consumable parts within ten years, within a limit of 10% of the car’s value.

XIII. The supplier is obligated upon delivery - whether the fire trucks is equipped locally or imported from abroad - to provide an inspection and test certificate. An authorization from the General Administration of Civil Protection stating that the fire trucks has passed the acceptance tests and containing the car's data (chassis number - engine number - fire pump number - any other data) .

XIV. The requesting party has the right to review the manufacturing stages of the local product in coordination with the General Administration of Civil Protection.

XV. The requesting party has the right to add financial and contractual conditions, in accordance with the applicable regulations.

Light Firefighting Truck with Rear Wheel Drive Only 2x4

1. General :

A light, easy-to-manoeuvre fire truck with mechanical power and high firefighting capabilities, fully equipped, designed as a fire truck, and manufactured according to the technical principles of international fire engines.

2. Technical Specifications :

a) Chassis

I. The chassis must be of one of the brands bearing an international trademark

II. The maximum actual load on any of the axles shall not exceed 90% of the permissible design load, provided that the supplying company submits a statement of load distribution and a certificate of suitability for the vehicle, including design and equipment with the actual load and all accessories and equipment in accordance with the permissible loads on the chassis.

III. Traction machines must be rear only (2x4) with double tires on the rear axle

IV. The chassis beams must be one piece, without any welds or additions, except within the limits permitted by them-the original manufacturer of the chassis

V. The brakes must be equipped for heavy duty and operate with a hydraulic system with servo

VI. The transmission must be manual

VII. The internal turning radius must not exceed 7 meters

VIII. Possibility of towing the fire trucks from the front and back

IX. The net vertical clearance between the wheels and the fire trucks body must not be less than when it is fully loaded About (15) cm

X. The ground clearance of the fully loaded fire trucks should not be less than (18) cm, the total height should not exceed 2.75 meters while the fire trucks is not loaded, the total width should not be less than (2.2) meters, and the length should not exceed (6.5 meters).

b) the structure :

I. It must be made of sheet metal or aluminum alloy, and fiberglass is allowed as an accessory to the structure.

II. The chassis must be equipped with tightly sealed wheels with self-lubricating sliding doors, provided that they are produced by one of the specialized companies to accommodate all the car's equipment with means of attaching them on both sides of the car behind the cab, and to accommodate all the accessories, including hoses, various launchers, foam jars, a device for mixing foam liquids, and the rest of the equipment. Additional accessories and accessories that are supplied with the car, along with providing it with appropriate lighting that turns on automatically when opened

III. If the pump is rear, the rear door shall be of the hinged type that opens upwards and is equipped with two auxiliary devices, along with an additional means to secure the door when opened.

IV. A light and durable metal alloy ladder is installed for individuals to climb onto the top of the car

V. The color is red the Fire extinguisher.

c) <u>The Engine :</u>

I. Four-stroke diesel, water cooling.

II. The engine must have a net relative power of no less than (17) HP/ ton of the total weight of the fully loaded vehicle, and be able to achieve the required speed and acceleration of the car.

III. The engine cooling efficiency must be proportional to the vehicle's stable operation in the summer, so that the pump is operated at maximum speed for a period of no less than four hours, while the engine temperature does not rise above Safe degree

d) <u>Speed And Acceleration:</u>

I. The maximum speed of the fire trucks should not be less than (90) kilometers per hour on flat ground while fully loaded.

II. The fire trucks must be able to achieve a speed of no less than (60) kilometers per hour within (40) seconds, starting from standing still with its full load on flat ground.

e) <u>Water Tank :</u>

I. The tank capacity should be 1000 liters Stainless steel

II. It shall be made entirely of stainless steel (stainless steel with a thickness of no less than (4) mm for the bottom and (3) mm for the sides and roof, with the welding areas treated with a rust-preventing method (epoxy) or its equivalent.

III. The tank must be painted from the outside with anti-corrosion paints and paints that are resistant to the effects of salt water, as well as for all connections.

IV. It must be installed on the auxiliary chassis in accordance with the technical standards, including the flexible housing, and in accordance with the instructions of the chassis manufacturer.

V. The tank must be fixed on the chassis well in accordance with technical standards, so that it can be completely lifted from the chassis and any repairs or welds can be made to it.

VI. It must be equipped with longitudinal and transverse partitions of the same material as the tank and with a thickness of not less than 3 mm to achieve complete safety of the vehicle's movement while driving and turning, so that the distance between the longitudinal or transverse partitions does not exceed 60 cm, connecting the bottom and the top of the tank, with openings available for freedom of movement. Water and maintenance of the tank from the inside

VII. It must be equipped with an upper inspection and maintenance hatch with a diameter of at least 55 cm, and must be equipped with a tightly closed, easy-to-open cover made of rust-resistant material.

VIII. It must be provided with a water level indicator, an overflow pipe, and two water entry holes (2.5 inches) male with a valve (one hole on each side) equipped with a closing valve.

IX. The tank must be connected to the pump intake hole with a pipe no less than (4) inches - through a flexible connection with a butterfly valve installed on it.

X. The tank must be provided with an opening to empty the water that ends with a valve mounted on a male (2.5) inch brass valve Morris style lacquer

XI. The tank should be provided with a pipe for filling water via a pump.

XII. All the above-mentioned slot seals must be made of Gun Metal or strong light alloy

f) Firefighting Pump And Equipment:

I. The pump must be centrifugal and derives its kinetic energy from the fire trucks engine via the transmission system P.T.O

II. It must be installed at the back of the fire trucks or in the center area of the fire trucks behind the cockpit

III. The pump must be given a medium pressure discharge rate of no less than (2000) liters/minute at a pressure of (8) bar from a suction depth of (3) meters.

IV. The pump must be given a high-pressure discharge rate of no less than (200) liters/minute at a pressure of 4 bar from a suction depth of (3) meters.

V. It must drain water through at least two discharge openings with a diameter of 2.5”, Morris model

VI. It must be provided with a self-preparation device to withdraw water from a depth of (3) meters in a time not exceeding (30) seconds.

VII. The pump must be provided with a suction hole from an external, exposed water source with a diameter of (4) inches, equipped with a screw thread, so that the hole is at the back of the fire trucks if the fire pump is rear, or the intake hole is on each side if the fire pump is central.

VIII. The pump must be connected to a fixed foam liquid mixing device (direct pump mixing) to withdraw the foamy liquid from an external source, while controlling the mixing ratio.

IX. The suction connection from the water tank should be provided with a strainer and an inspection hole that prevents any impurities from passing through the pump.

X. The pump connections should be provided with a leakage valve through which the bottom of the pump and the lower pipes can be completely emptied after the pump is finished.

XI. The pump must be equipped with an operating, displaying and control panel manufactured from the same country of origin of the pump, which includes meters for measuring suction and expulsion pressure (in bar), a meter for measuring the hours of operation of the pump, an indicator for engaging the pump, and a means of controlling the speed, provided that the control panel is on top of the pump if it is rear, or two control panels. (One for each side) if the fire pump is a middle

XII. To be provided with (1) filtration hose with a diameter of (1) inch and a length of (30) meters, full of water (stream /spray/fog).

XIII. The discharge rate is given (200) liters/minute at 4 bar and (25) meters to the water stream.

XIV. The hose must be made of Reinforced rubber produced by a specialized company

g) Accessories Supplied With The Fire Truck:

I. The (basic/optional) accessories must be offered in accordance with the specifications of the General Administration of Civil Protection.

II. **First**: The basic (mandatory) accessories are supplied with the car:

- Four or five suction hoses with a suitable diameter for the pump suction opening, and equipped with a screwdriver with a total length of not less than (10) meters.
- Two suction strainers for manifold hoses made of light steel with threads and a suitable diameter for manifold hoses and equipped with a non-return gasket to prevent water leakage and (2) wrenches for suction hoses.
- One joint with a fine thread with a diameter suitable for the pump entry hole, with at least two entrance holes, Morris male (2.5 inches).
- One manual ladder consisting of three interlocking sliding links with a total length of no less than (9) meters, produced by a specialized company.
- Hand pump to fill the foam tank

III. **Second**: Optional accessories for the requesting party: according to the needs of the requesting party

- (Respirators - firefighting clothing sets - ejection hoses - launchers - joints).

h) General requirements:

I. The date of production and model of the fire trucks must not be less than the year in which the purchase was announced.

II. Detailed technical bulletins must be submitted with the offer, which include all the vehicle and pump data in Arabic and English for the equipment, showing the full specifications of the fire trucks after its preparation, including the chassis, engine, pump, and accessories, provided that they are approved with the seal of the supplying company and are produced by one of the specialized companies.

III. The bidder is obligated to submit an engineering drawing of the fire trucks with all its equipment, along with the technical offer

IV. The components of the car, the chassis - engine - fire pump - fire engine hoses, complete with reel and ejector - doors (sliding) must be of origin in either the European Union, Japan, or the United States of America.

V. A certificate from the company producing the chassis that it is fit to work as a fire truck (for local equipment), and a certificate from the supplying company that the vehicle is fit to be equipped to carry out firefighting work.

VI. The chassis, engine, and cabin must be produced by one company.

VII. The company submitting the offer is obligated to provide the producing company's website on the international information network and the email number of the relevant department to review the data and certificates submitted by the company.

VIII. The supplying company is obligated to provide a certificate of origin for the imported components (fire pump - breathing apparatus - high-discharge grenade launchers - firefighting uniforms, etc.), indicating the country of manufacture, model, year of production, customs release, and item number upon supply.

IX. The supplying company is committed to the technical specifications contained in the tender and the catalogs provided - if they exceed the specifications presented

X. The supplying company is committed to providing practical training on how to use the fire trucks with all its accessories and methods of regular maintenance.

XI. Complete original documents related to the operation and maintenance of the chassis, pump, and respirators, in printed or electronic form, must be submitted with the fire trucks- if the offer is accepted (CD)

XII. The supplying company is committed to providing after-sales service (an authorized maintenance center for the fire trucks and all its equipment in the Arab Republic of Egypt).

IV. The supplying company undertakes to guarantee the fire trucks with all its components for a period of not less than two years from the date of receipt or for twenty thousand kilometers and five years for all fixed firefighting equipment (tank).

V. And the pump, which represents approximately 25% of the total value of the fire trucks (against manufacturing defects).

VI. The supplying company is obligated to provide a proposed list of spare parts needed to operate the fire trucks and maintain the consumable parts within ten years, within a limit of 10% of the car's value.

VII. The supplier is obligated upon delivery - whether the fire trucks is equipped locally or imported from abroad - to provide an inspection and test certificate of validity from the General Administration of Civil Protection stating that the fire trucks has passed the acceptance tests, with the car's data attached to it (chassis number - engine number - fire pump number - any data other).

VIII. The requesting party has the right to review the manufacturing stages of the local product in coordination with the General Administration of Civil Protection

IX. The requesting party has the right to add financial and contractual conditions, in accordance with the applicable regulations.

X. The car must be provided with its accessories, including a tool kit, a car lift cord, and a spare tire. A suitable place must be provided for its storage. In the event that the spare tire is installed on top of the car, a hand winch must be provided to be used to transport it to or from the storage place.

Medium Fire Truck with Rear Tow Vehicles Only 2x4

1. General :

An easy-to-maneuver medium-sized fire truck with high mechanical capacity and firefighting capabilities, fully equipped, designed like a car, and manufactured according to the technical principles of international fire engines.

2. Technical Specifications

a) Chassis:

I. The chassis must be of one of the brands bearing an international trademark

II. The maximum actual load on any of the axles shall not exceed 90% of the permissible design load, provided that the supplying company submits a statement of load distribution and a certificate of suitability for the vehicle, including the design and equipment with the actual load and all accessories and equipment in accordance with the permissible loads on the chassis.

III. Only rear-traction machines (2x4) must have double tires on the rear axle

IV. The chassis beams must be one piece without any welds or additions except within the limits permitted by them the original manufacturer of the chassis

V. The brakes must be equipped for heavy duty, operating with a double circuit, provided that they are equipped with a ABS system

VI. The transmission must be manual.

VII. The internal turning radius must not exceed 8 m.

VIII. The possibility of towing the fire trucks from the front and rear

IX. The ground clearance of the fully loaded fire trucks should not be less than (25) cm, the total height should not exceed (3.5) meters while the fire trucks is not loaded, the total width should not exceed (2.5) meters, and the length should not exceed (8.25) meters.

X. The fire trucks must be provided with its accessories, including a tool kit, a fire trucks lift cabin, and a spare tire. A suitable place must be provided for its storage. In the event that the spare tire is installed on top of the car, a hand winch must be provided to be used to transport it to or from the storage place.

b) Cabin in :

I. The cabin must be double, of the flip type, without a front protrusion, raised hydraulically, equipped with a manual means of insurance, and composed of one closed unit with four doors manufactured by the factory that produces the chassis or under its supervision, with a certificate from the factory stating that and a customs release proving that. It must accommodate at least five people, other than the driver Standard Crew cabin).

II. The steering wheel must be to the left of the cabin and operate with a hydraulic servo (Power Steering)

III. The top of the cabin shall be equipped with an appropriate optical warning device in accordance with technical standards

IV. The cabin shall be equipped with a multi-tone siren of the types designated for police and fire engines, produced by specialized international companies.

V. It must be provided with an external lighting lamp that runs on the car's electricity to illuminate the accident site and can be used outside the car.

VI. Suitable places must be provided in the cabin in to install the respirators, complete with their components, so that they can be easily installed wear it.

c) <u>The Structure :</u>

I. It must be made of sheet metal or aluminum alloy, and fiberglass is allowed as an accessory to the body.

II. The body must be equipped with tightly sealed wheels with self-lubricating sliding doors that accommodate all the car's equipment, with means to secure them, on both sides of the fire trucks behind the cabin, and must accommodate all accessories from various hoses, nozzles, foam Jerry cans, a foam liquid mixing device, and the rest of the additional equipment and accessories that are supplied with the car, along with providing it with appropriate lighting.

III. It works automatically when opened, provided that it is produced by one of the specialized companies

IV. If the pump is rear, the rear door shall be of the hinged type that opens upwards and is equipped with a number two assistants with an additional means to secure the stability of the door when opening

V. A ladder made of a light and durable metal alloy is installed for individuals to climb onto the top of the car.

VI. The color is matte red

d) <u>The Engine : -</u>

I. Water-cooled four-stroke diesel

II. To be equipped with a turbocharger system-turbo charger or equivalent

III. The engine must have a net relative power of no less than (14) horsepower per ton of the total weight of the fully loaded vehicle (G.V.W) and be able to achieve the required speed and acceleration of the car.

IV. The engine cooling efficiency must be proportional to the vehicle's stable operation in the summer, so that the pump is operated at maximum speed for a period of not less than four hours, while the engine temperature does not rise above the safe level.

V. The engine must be environmentally friendly in accordance with European specifications (Euro 3) at least

e) Speed And Acceleration:

I. The maximum speed of the vehicle shall not be less than (80) kilometers per hour on flat ground while at full speed at full loaded

II. The fire trucks must be able to achieve a speed of no less than (60) kilometers per hour within (40) seconds, starting from standing still with its full load on flat ground.

f) Water Tank :

I. Its capacity shall not be less than (3500) liters

II. It must be made entirely of stainless Steel (with a thickness of no less than 4 mm), with the welding areas treated with a rust-resistant method.

III. The tank should be painted from the outside with anti-corrosion paints and paints that are resistant to the effects of salt water.

IV. The same goes for all connections

V. It must be installed on the auxiliary chassis in accordance with technical standards, including flexible housing, and in accordance with the chassis manufacturer's instructions.

VI. The tank must be fixed on the chassis well in accordance with technical standards, so that it can be completely lifted from the chassis and any repairs or welds can be made to it.

VII. It must be equipped with longitudinal and transverse partitions of the same material as the tank and with a thickness of no less than "3 mm" to achieve complete safety of the vehicle's movement while driving and turning, so that the distance between the longitudinal or transverse partitions does not exceed (1.2) meters, connecting the bottom and the top of the tank with openings. Freedom of water movement and maintenance of the tank from the inside

VIII. It must be equipped with an upper inspection hole with a diameter of at least 55 cm and must be equipped with a tightly closed, easy-to-open cover made of rust-resistant material.

IX. It must be provided with a water level indicator, an overflow pipe, and two water entry holes (2.5 inches) male with a stopcock (one hole on each side) equipped with a locking stopcock.

X. It must be connected to the pump's intake hole with a pipe no less than (4) inches - through a flexible connection with a butterfly valve installed on it.

XI. The water tank shall be provided with an opening for emptying the water and ending with a stopcock mounted with a 2.5-inch male lacquer, Morris model.

XII. The tank shall be provided with a pipe for filling water via a pump.

XIII. All the above-mentioned slot seals must be made of strong aluminum alloy.

g) Foam Liquid Tank A&B

I. The capacity of the each foam tank must be at least 100 L and must be separated so that either of them can be lifted to carry out maintenance work.

II. It must be made of a material that does not react with the foamy liquid, such as: stainless steel 316 Stainless or approved industrial plastic POLYPRENE with a thickness of no less than (5) mm.

III. Each of them shall be provided with a digital indicator of the foam liquid level in the tank

IV. Each technician must connect to a complete unit for mixing the foam liquid installed in the car, through a pump to inject the foam liquid into the water line, with a mixing ratio not exceeding 10%, according to the type of foam material and in accordance with the international systems in force, provided that a certificate is submitted from the producing company to that effect, and that it is one of the specialized companies with Controlling the mixing ratio and connecting it to an air compressor to push air into the line gives rates

V. Discharge of not less than 110 cubic feet per minute at a pressure of 10 bar, automatically set by PRE-(SET) and equipped with the necessary Defense such as controlling speed increases beyond the permissible limit, which may affect the operation of the compressor.

VI. Each tank must be provided with an upper inspection and maintenance opening with a diameter of at least 45 cm and must be equipped with a tightly closed, easy-to-open lid.

VII. The tank must be provided with a means to confront the expansion of the volume of the foamy liquid as a result of movement or weather factors

h) Pump and fire equipment.

I. The pump must be centrifugal and derives its kinetic energy from the car engine via the transmission system PTO (own

II. The manifold, the ejection nozzles, the control panel, and the preparation device are all one unit produced by the company producing the pump, and this must be clarified in the original technical catalogs issued by the company producing the pump.

III. It must be installed at the back of the car or in the center area of the car behind the cockpit

IV. The pump must be given a medium pressure discharge rate of no less than (2500) liters/minute at a pressure of (8) bar. It must drain water through a number of (4) discharge openings - including (2) discharge outlets with a diameter of (2.5 inches), a Morris model designed for water ejection - as well as a number (2) outlets with a diameter of 1.5 inches, with a custom threaded lacquer. To extrude compressed foam liquid with air (American system).

V. The pump is connected to two (2) hoses with a diameter of 1 inch and a length of (100) meters. Each hose is complete with a nozzle with a diameter of 1 inch to project the compressed foam liquid (CAFS) to provide discharge rates of no less than 200 liters/min at a pressure of 40 bar.

VI. The pump must be provided with a self-priming device to withdraw water from a depth of (3) meters in a time not exceeding (30) seconds.

VII. The pump must be provided with an intake hole from an external, exposed water source with a diameter of 4 or 5 inches, equipped with a threaded screw so that the hole is at the back of the car - if the fire pump is rear, or the intake hole is on each side - if the fire pump is central.

VIII. The water and foam tank suction connections should be provided with a strainer and inspection hole to prevent any impurities from passing through the pump. The pump connections should be provided with a leakage valve through which the bottom of the pump and the lower pipes can be completely emptied after the pump is finished.

IX. The pump must be equipped with an operating, displaying and control panel that includes meters for measuring suction and expulsion pressure (in bar), a meter for measuring the hours of operation of the pump, an indicator for engaging the pump, and a means of controlling the speed.

X. The control panel should be on top of the pump if it is rear, or two control panels (one for each side) if it is Medium fire pump.

XI. To be connected to an overhead ejector on top of the car (water-foam column) and equipped with a connection for generating foam)Foam Tube) is compatible with the ejector and the ejector is characterized by the following:

a) A discharge rate of no less than (1600) liters/minute is given.

b) A horizontal throwing distance of no less than 50 water meters.

c) It is equipped with a separate valve, a means of controlling the engine speed, and a water pressure indicator, and it can rotate (+ 360) degrees on the horizontal plane and up to (+ 75) degrees.

i) Attachments are provided based on the requesting party's desire:

I. (1) of 2 manual water throwers, 2.5 inches in diameter, multi-purpose, five-stage, with the ability to control the discharge rate so as to provide a discharge of not less than 1000 liters/min at a pressure of 7 bar, which must comply with any of the European or American standard specifications.

II. (2) manual ejectors with a diameter of 2.5 inches for extruding the foam liquid, providing discharge rates of no less than 1000 liters/min at a pressure of 7 bar - they must comply with any of the European or American standard specifications and the types designated for extruding the foam liquid.

III. 2 manual ejectors with a diameter of 1.5 inches to eject the compressed foam liquid, providing discharge rates of no less than 900 liters/min at a pressure of 10 bar - they must comply with any of the European or American standard specifications and be suitable for car exits (threaded threads and any of the types designated for ejection). Compressed foam liquid (CAFS)

IV. (4) or (5) suction hoses with a suitable diameter for the pump suction opening and equipped with a screwdriver made of light alloy with a total length of no less than (10) meters.

V. (2) suction strainers for manifold hoses made of light alloy (Light Alloy) has a thread and diameter suitable for manifold hoses and is equipped with a non-return gasket to prevent water leakage.

VI. (2) wrench for suction hoses

VII. (1) joint threaded threads with a suitable diameter for the pump entry hole, with at least two entrance holes, Morris male (2.5) inches.

VIII. (1) Manual ladders consisting of three interlocking sliding links with a total length of no less than (9) meters, produced by a specialized company.

IX. Hand pump to fill the foam tank

X. (10) 2.5 inch diameter fire hoses, lined inside and out, and a 2.5 inch Morris plaster of light twist, with a length of 20 meters for each hose, will be supplied.

XI. (10) 1.5 inch diameter fire hoses lined inside and out with 1.5 inch threaded threads made of light-twist, with a length of 50 meters for each hose, will be supplied.

j) General Requirements:

I. The date of production and model of the fire trucks must not be less than the year in which the purchase was announced.

II. Detailed technical bulletins must be submitted with the offer, which include all data on the vehicle, the pump, and the firefighting equipment, in Arabic and English, for the equipment, showing the full specifications of the vehicle after its preparation, including the specifications of the chassis, engine, pump, and accessories, provided that it is approved with the company's seal.

III. Supplied and produced by one of the specialized companies

IV. The bidder is obligated to submit an engineering drawing of the fire trucks with all its equipment, along with the technical offer

V. The vehicle components (chassis - engine - fire pump - overhead ejector - fire engine hoses, complete with reels and ejector - sliding doors) must be of origin in either the European Union, Japan, or the United States of America.

VI. A certificate from the company producing the chassis confirming its suitability to work as a fire truck (for local equipment) and a certificate from the supplying company that the vehicle is fit to be prepared for firefighting work

VII. The chassis, engine and cabin in must be produced by one company

VIII. The company submitting the offer is obligated to provide information about the producing company's website on the international information network and the email number of the relevant department to review the data and certificates submitted by the company

IX. The supplying company is obligated to provide a certificate of origin for the imported components (fire pump - breathing apparatus - high-discharge grenade launchers - firefighting uniforms, etc.), indicating the country of manufacture and model and the year of production and customs release

X. The supplying company is committed to the technical specifications contained in the tender and the catalogs provided - if they exceed the specifications presented.

XI. The supplying company is committed to providing practical training on how to use the fire trucks with all its accessories and methods periodic maintenance.

XII. Complete original documents related to the operation and maintenance of the chassis, pump, and respirators, in printed or electronic form, must be provided with the fire trucks- if the offer is accepted.

XIII. The supplying company is committed to providing after-sales service (an authorized maintenance center for the fire trucks and all its equipment) in the Arab Republic of Egypt).

XIV. The supplying company undertakes to guarantee the fire trucks with all its components for a period of not less than two years from the date of receipt or for twenty thousand kilometers and five years for all fixed firefighting equipment (tank and pump).

XV. Which represents approximately 25% of the total value of the fire trucks (against manufacturing defects).

XVI. The supplying company is committed to providing a proposed list of spare parts needed to operate the fire trucks and maintain the parts.

XVII. The depreciated amount within ten years is within the limits of 10% of the car's value.

XVIII. The supplier is obligated upon delivery whether the fire trucks is equipped locally or imported from abroad to provide an inspection and test certificate of validity from the General Administration of

Civil Protection stating that the fire trucks has passed the acceptance tests, with the car's data attached to it (chassis number - engine number - fire pump number) any other data).

XIX. The requesting party has the right to review the manufacturing stages of the local product in coordination with the General Administration of Civil Protection.

XX. The requesting party has the right to add financial and contractual conditions, in accordance with applicable regulations.

Multi-Purpose Fire Truck with Front and Rear Wheel Drive (4x4)

1. **General :**

A multi-purpose fire truck, easy to maneuver, with mechanical power and high firefighting capabilities, fully equipped, designed as a fire truck, and manufactured according to the technical principles of international fire trucks.

2. Technical Specifications :

a) Chassis

I. The chassis must be of one of the brands bearing an international trademark

II. The maximum actual load on any of the axles shall not exceed 90% of the permissible design load, provided that the supplying company submits a statement of load distribution and a certificate of suitability for the vehicle, including design and equipment with the actual load and all accessories and equipment in accordance with the permissible loads on the vehicle chassis.

III. The front and rear traction machines must be (4x4) with double tires on the rear axle.

IV. The chassis beams must be one piece without any welds or additions except within the limits permitted by the company original manufacturer of chassis.

V. The brakes must be equipped with a heavy duty, double circuit system and must be equipped with a ABS system

VI. The transmission must be manual

VII. Possibility of towing the fire trucks from the front and back

VIII. The internal turning radius must not exceed 8 meters

IX. The net vertical clearance between the wheels and the body of the fire trucks when it is fully loaded must not be less than (15) cm.

X. The ground clearance of the fire trucks when fully loaded must not be less than (25) cm, and the total height must not exceed (3.75) meters with the fire trucks unladed and the total width must not be more than (3.75) meters. (2.5) meters, and the length does not exceed (8.25) meters.

XI. The fire trucks must be supplied with its accessories, including a tool kit, a fire trucks lift cord, and a spare tire.

XII. A suitable place must be provided for its storage. If the spare tire is installed on top of the car, a manual winch is used to transport it to or from the storage location.

b) Cabin :

I. The cabin shall be double, of the flip type, without a front protrusion, raised hydraulically, equipped with a manual means of insurance, and composed of one closed unit with four doors manufactured by the factory that produces the chassis or under its supervision, with a certificate from the factory stating that and a customs release proving that. It must accommodate at least five people, other than the driver (Standard Crew cabin)

II. The steering wheel must be to the left of the cabin and operate with a hydraulic steering wheel (hydraulic-power steering) With support

III. The top of the cabin shall be equipped with an appropriate optical warning device in accordance with technical standards.

IV. The cabin shall be provided with a multi-tone siren connected to a microphone of the types designated for police and fire engines and produced by specialized companies.

V. It must be provided with an external lighting lamp that runs on the car's electricity to illuminate the accident site and can be used outside the car.

VI. Suitable places must be provided in the cabin to install respirators, complete with their components, so that they can be easily installed wear it.

c) <u>The Structure</u>

I. It must be made of sheet metal or aluminum alloy, and fiberglass is allowed as an accessory.

II. The chassis must be equipped with tightly sealed wheels with self-lubricating sliding doors, provided that they are produced by one of the specialized companies.

III. They must accommodate all the car's equipment, with means for attaching them, on both sides of the fire trucks behind the cabin, and must accommodate all the accessories, including hoses, various launchers, foam jars, and a device for mixing foam liquids and the rest of the additional equipment and accessories that are supplied with the car, along with providing it with appropriate lighting that operates automatically upon opening.

IV. If the pump is rear, the rear door shall be of the type that operates hinged and opens upwards and is equipped with two auxiliary devices, with an additional means of securing the door upon opening.

V. A ladder is attached to it light and durable metal alloy for people to climb on top of the car

VI. The color is matte red.

d) <u>The Engine :</u>

I. Four-stroke diesel, water cooling

II. It must be equipped with a turbocharger system turbo charger or its equivalent

III. The engine must have a net relative power of no less than (14) horsepower per ton of the total weight of the fully loaded vehicle G.V.W, and to be able to achieve the required speed and acceleration of the car.

IV. The engine cooling efficiency must be proportional to the vehicle's stable operation in the summer, so that the pump is operated at maximum speed for a period of not less than four hours, while the engine temperature does not rise above the safe level.

V. The engine must be environmentally friendly in accordance with European specifications (Euro 3) at least

e) Speed And Acceleration:

I. The maximum speed of the fire trucks should not be less than (80) kilometers per hour on flat ground with full load

II. The fire trucks must be able to achieve a speed of no less than (60) kilometers per hour within (40) seconds, starting from standing still with its full load on flat ground.

f) Water tank :

I. Its capacity should not be less than (3500) liters. Stainless steel it must be made entirely of stainless steel with a thickness of (4) mm.

II. Treat the welding areas with an anti-rust agent (epoxy) or its equivalent.

III. The tank must be painted from the outside with anti-corrosion paints and coatings that are resistant to the effects of salt water, as well as for all connections.

IV. It must be installed on the auxiliary chassis in accordance with technical standards, including flexible housing, and in accordance with the instructions of the chassis manufacturer.

V. The tank must be fixed on the chassis well in accordance with technical standards, so that it can be completely lifted from the chassis and any repairs or welds can be made to it.

VI. It must be equipped with longitudinal and transverse partitions of the same material as the tank and with a thickness of not less than 3 mm to achieve complete safety in the movement of the vehicle while driving and turning, so that the distance between the longitudinal or transverse partitions does not exceed (1.2) meters, and connects the bottom and the top of the tank with availability of openings for free movement of water and maintenance of the tank from the inside

VII. It must be equipped with an upper inspection and maintenance hatch with a diameter of at least 55 cm, and it must be equipped with a tightly closed, easy-to-open cover made of rust-resistant material.

VIII. It must be provided with a water level indicator, an overflow pipe, and two water entry holes 2.5 inch male with one hole on each side) equipped with a closing valve.

IX. The tank must be connected to the pump intake hole with a pipe no less than (4) inches - through a flexible connection with a butterfly valve installed on it.

X. The tank must be provided with an opening to empty the water and end with a valve mounted with a (2.5) inch male lacquer, Morris model.

XI. The tank must be provided with a pipe for filling water via a pump.

XII. All the above-mentioned slot seals must be made of strong aluminum alloy

g) Foam Liquid Tank:

I. The capacity of the foam tank must be at least 10% of the capacity of the water tank and separate from it so that it can be lifted for maintenance work.

II. It must be made of a material that does not interact with the foamy liquid, such as: stainless Steel (with a thickness of no less than 3 mm), or synthetic plastics.

III. An indicator of the foam liquid level in the tank should be provided

IV. It must be connected to a fixed foam liquid mixing device attached to the fire pump

V. The tank must be provided with an upper inspection and maintenance opening with a diameter of at least 55 cm, and it must be equipped with a tightly closed, easy-to-open cover made of a rust-resistant material.

VI. The tank must be provided with a means to confront the expansion of the volume of the foaming liquid as a result of movement or air factors.

h) Firefighting pump and equipment:

I. The pump must be centrifugal and derives its kinetic energy from the fire trucks engine via the transmission PTO system

II. It must be installed at the back of the fire trucks or in the middle area of the fire trucks behind the cockpit. The pump must have a medium pressure discharge rate of no less than (2500) liters/minute at a pressure of (7) bar from a depth of intake of (3) meters.

III. The pump must be given a high-pressure discharge rate of no less than (400) liters/minute at a pressure of (40) bar from a suction depth of (3) meters.

IV. It must drain water through a number of (4) discharge holes with a diameter of (2.5 inches), Morris model. It must be provided with a self-priming device to withdraw water from a depth of (3) meters in a time not exceeding (30) second so The pump must be provided with an intake hole from an external, exposed water source with a diameter of 4 or 5 inches, equipped with a threaded screw so that the hole is at the back of the fire trucks- if the fire pump is rear, or the intake hole is on each side - if the fire pump is central.

V. The pump must be connected to a fixed foam liquid mixing device (AROUND PUMB direct mixing) to withdraw the foam liquid from the foam tank or from an external source, with control over adjusting the mixing ratio.

VI. The suction connections from the water and foam tank should be provided with a strainer and an inspection hole to prevent any impurities from passing into the pump.

VII. The pump connections must be provided with a leakage valve through which the bottom of the pump and the lower pipes can be completely emptied after the pump is finished.

VIII. The pump must be equipped with an operating, displaying and control panel that includes meters to measure suction and expulsion pressure (in bar), a meter to measure the hours of operation of the pump, an indicator for engaging the pump, and a means of controlling the speed, provided that the control panel is on top of the pump if it is rear, or two control panels (one for each side) If the fire pump is medium,

IX. It must be provided with (2) filtration hoses with a diameter of (1) inch and a length of (60) meters full of water (stream /spray/fog), and a discharge rate of no less than (200) liters/minute is given at a pressure of 40 bar bells.

X. The throwing distance is not less than (25) meters. In the case of a water column and the possibility of installing a foam release connection, the hose must be made of reinforced rubber produced by a specialized company

XI. It must be connected to an overhead ejector on the top of the fire trucks (water-foam) and equipped with a connection for generating foam) is compatible with the ejector and the ejector is characterized by the following:

- A discharge rate of no less than (1600) liters/minute is given at 7 bar
- Horizontal throwing distance of no less than 50 water meters
- It is equipped with a separate valve, a means of controlling the motor speed and a water pressure indicator, and it can rotate (+ 360) degrees on the horizontal plane and up to (+ 75) degrees and down

i) <u>Dry Chemical Powder Equipment:</u>

I. The entire dry chemical powder equipment must be produced by one of the specialized companies and conform to the Egyptian standard or one of the international specifications.

II. The capacity of the dry chemical powder tank should not be less than (500) kg filled with dry chemical powder, suitable for extinguishing all types of fires.

III. The tank must be secured with a safety valve of the self-recovery type that operates by spring pressure and must withstand test pressures in accordance with the specifications for high-pressure vessels.

IV. The powder ejection system must be using at least two external cylinders containing nitrogen gas as the propellant gas for the powder, and the maximum charging pressure of the cylinders must not be less than (120) bar.

V. The chemical powder tank must be manufactured in accordance with the technical principles for high-pressure vessels. A pressure regulator must be available between the centrifugal gas cylinders and the dry chemical powder tank so that the pressure inside the powder tank does not exceed the required centrifugal pressure.

VI. The tank is connected to (2) hoses to expel the dry powder, complete with the ejector, with a length of not less than (30) meters, coiled on a reel, and the ejector is equipped with a spring-operated locking cock.

VII. The expulsion tank is provided with a gas-propelled cleaning method

VIII. The dry chemical powder tank is provided with an internal pressure relief valve

IX. The system is equipped with all meters to measure the internal pressure of the tank and the internal pressure of the centrifugal gas cylinders on a lighted display panel that includes the meters, valves, and operating instructions.

X. The system is supplied fully packaged and ready for operation.

j) <u>Accessories Supplied With The Fire Truck:</u>

I. The (basic/optional) accessories should be offered in accordance with the specifications of the General Administration of Civil Protection

II. **<u>First:</u>** Basic accessories (mandatory) supplied with the car:

- ✓ Four or five suction hoses with a diameter suitable for the pump suction hole, and equipped with a toothpick.
- ✓ Screws from the light alloy with a total length of no less than (10) meters
- ✓ Two suction strainers for manifold hoses, made of light-twist, with threads and a diameter suitable for manifold hoses, and equipped with a non-return gasket to prevent water leakage.
- ✓ Two wrench for suction hoses
- ✓ One joints with fine threads with a suitable diameter for the pump entry hole, with at least two entrance holes, Morris male (2.5) inches.
- ✓ One of a manual ladder consisting of three interlocking sliding links, with a total length of no less than (9) meters Produced by a specialized company.
- ✓ Hand pump to fill the foam tank.

III. **<u>Second:</u>** Optional accessories for the requesting party: in number and type - according to the needs of the requesting party - respirators - firefighting clothing sets - ejection hoses - launchers - joints...)

k) <u>General requirements:</u>

I. The date of production and model of the fire trucks must not be less than the year in which the announcement of the evil operation was made

II. Detailed technical bulletins must be submitted with the offer, which include all the vehicle and pump data in Arabic and English for the equipment, showing the full specifications of the fire trucks after it has been prepared, including the characteristics of the chassis, engine, pump, and accessories, provided that it is approved with the seal of the company, including the supplier, and that it is produced by one of the specialized companies.

III. The bidder is obligated to submit an engineering drawing of the fire trucks with all its equipment, along with the technical offer

IV. The vehicle components (chassis - engine - fire pump - overhead ejector - fire engine hoses, complete with reels and ejector - sliding doors) must be of origin in either the European Union, Japan, or the United States of America.

V. A certificate from the company producing the chassis that it is fit to work as a fire truck (for local equipment), and a certificate from the supplying company that the vehicle is fit to be equipped to carry out firefighting work.

VI. The chassis, engine, and cabin must be produced by one company.

VII. The company submitting the offer is obligated to provide the producing company's website on the international information network and the email number of the relevant department to review the data and certificates submitted by it company

VIII. The supplying company is committed to providing a certificate of origin for the imported components (8) (fire pump - breathing apparatus - high-discharge grenade launchers - firefighting clothing, etc.) indicating the country of manufacture, model, year of production and customs release upon supply.

IX. The supplying company is committed to the technical specifications contained in the tender and catalogs. Introduction - if it exceeds the specifications presented.

X. The supplying company is committed to providing practical training on how to use the fire trucks with all its accessories and methods of regular maintenance

XI. Complete original documents related to the operation and maintenance of the chassis, pump, and respirators, in printed or electronic form, must be submitted with the fire trucks- if the offer is accepted. (CD).

XII. The supplying company is committed to providing after-sales service (an authorized maintenance center for the fire trucks and all its equipment in the Arab Republic of Egypt).

XIII. The supplying company undertakes to guarantee the fire trucks with all its components for a period of not less than two years from the date of receipt or for twenty thousand kilometers and five years for all fixed firefighting equipment (the tank and the pump, which represent approximately 20% of the total value of the car) against manufacturing defects the supplying company is committed to providing a proposed list of spare parts needed to operate the fire trucks and maintain the consumable parts within ten years, within a limit of 10% of the car's value.

XIV. The supplier is obligated upon delivery - whether the fire trucks is equipped locally or imported from abroad - to provide an inspection and test certificate of validity from the General Administration of Civil Protection stating that the fire trucks has passed the acceptance tests and bearing the car's data (chassis number - engine number - fire pump number - any other data).).

XV. The requesting party has the right to review the manufacturing stages of the local product in coordination with the General Administration of Civil Protection

XVI. The requesting party has the right to add financial and contractual conditions, in accordance with the regulations established.

Medium Fire Truck with Rear Wheel Drive Only 4 x 2

Equipped With Air Compressed Foam System

1. **General :**

A medium-sized fire truck that is easy to maneuver, has mechanical capacity and high firefighting capabilities, fully equipped, designed like a car, and manufactured according to the technical principles of international fire engines.

2. **Technical Specifications :**

   a) **Chassis:**

      I. The chassis must be of an international brand

      II. The maximum actual load on any of the axles shall not exceed 90% of the permissible design load, provided that the supplying company submits a statement of load distribution and a certificate of suitability for the vehicle, including design and equipment with the actual load and all accessories and equipment in accordance with the permissible loads on the chassis.

      III. Only rear-traction machines (4x2) must have double tires on the rear axle.

      IV. The chassis beams must be one piece, without any welds or additions, except within the limits permitted by the company that originally produced the chassis.

      V. The brakes must be equipped for heavy duty, operating with a double circuit, provided that they are equipped with a (ABS) system.

      VI. The transmission must be automatic, and the internal turning radius must not exceed 8 m.

      VII. The possibility of towing the fire trucks from the front and rear

      VIII. The net vertical clearance between the wheels and the fire trucks body must not be less than when it is fully loaded about (15) cm

      IX. The ground clearance of the fully loaded fire trucks should not be less than (25) cm, the total height should not exceed (3.5) meters while the fire trucks is not loaded, the total width should not exceed (2.5) meters, and the length should not exceed (3.5) meters. about (8.25) meters

      X. The fire trucks must be provided with its accessories, including a tool kit, a fire trucks lift cabin and a spare tire. A suitable place must be provided to store it. In the event that the spare tire is installed on top of the car, a hand winch must be provided to be used to move it to or from the storage place.

   b) **Cabin:**

      I. The cabin must be double, of the flip type, without a front protrusion, raised hydraulically, equipped with a manual means of insurance, and composed of one locked unit with four doors manufactured by the factory that produces the chassis or under its supervision, with a certificate from the factory stating that and a customs release proving that. It must accommodate at least five people, other than the driver (Standard Crew cabin).

II. The steering wheel should be on a stand to the left of the cabin, and operate with a hydraulic servo. (Power Steering)

III. The top of the cabin must be equipped with a flasher warning light (a broad type used for police, produced by specialized international companies, American, Japanese, or European).

IV. The cabin must be equipped with a multi-tone siren of the types designated for police and fire engines, produced by specialized international companies (American, Japanese or European).

V. The fire trucks must be equipped with a (fixed) wireless device inside the fire trucks cabin in of the type that operates on the TETRA system (tetra) provided that the device is provided with a redundant receiving and transmitting unit in the pump area at the back of the fire trucks and has appropriate protection against water and heat.

VI. It must be provided with an external lighting lamp that runs on the car's electricity to illuminate the accident site and can be used outside the car

VII. Suitable places must be provided in the cabin in to install the respirators, complete with their accessories, to allow them to be easily worn.

c) <u>The Structure:</u>

I. It must be made of sheet metal or aluminum alloy, and fiberglass is allowed as an accessory to the body.

II. The body must be equipped with tightly sealed wheels with self-lubricating sliding doors that accommodate all the car's equipment, with means to secure them, on both sides of the fire trucks behind the cabin, and must accommodate all accessories from Various hoses, nozzles, foam Jerry cans, a foam liquid mixing device, and other additional equipment and the accessories that are supplied with the car, along with providing it with appropriate lighting that turns on automatically when opened

III. It must be produced by a specialized company

IV. If the pump is rear, the rear door is of the sliding type that opens upwards produced by a specialized company.

V. A ladder made of a light and durable metal alloy is installed for individuals to climb onto the top of the car.

VI. The color is matte red

d) <u>The Engine : -</u>

I. Four stroke diesel - water cooling.

II. It must be equipped with a turbo charger system or equivalent

III. The engine must have a net relative power of no less than (14) horsepower per ton of the total weight of the fully loaded vehicle G.V.W and be able to achieve the required speed and acceleration of the car.

IV. The engine cooling efficiency must be proportional to the vehicle's constant operation in the summer, such that the pump is operated at maximum speed for a period of not less than four hours, while the engine temperature does not rise above the safe one.

V. The engine must be environmentally friendly in accordance with European specifications (Euro 3).

e) The Speed And Acceleration:

I. The maximum speed of the vehicle shall not be less than (80) kilometers per hour on flat ground while at full speed with fully loaded

II. The fire trucks must be able to achieve a speed of no less than (60) kilometers per hour within (40) seconds, starting from standing still with its full load on flat ground.

f) Tank Water:

I. Its capacity shall not be less than (3500) liters

II. It must be made entirely of stainless Steel with a thickness of no less than (4) mm, with the welding areas treated with a rust-resistant method.

III. The tank must be coated from the outside with anti-corrosion paints and coatings that are resistant to the effects of salt water, as well as for all connections.

IV. It must be installed on the auxiliary chassis in accordance with technical standards, including flexible housing, and in accordance with the instructions of the chassis manufacturer.

V. The tank must be fixed on the chassis well in accordance with technical standards, so that it can be completely lifted from the chassis and make any repairs or welds with it

VI. It must be equipped with longitudinal and transverse partitions of the same material as the tank and with a thickness of no less than "3" mm to achieve complete safety of the vehicle's movement while driving and turning, so that the distance between the longitudinal or transverse partitions does not exceed (102) meters, and connects the bottom and the top of the tank with Availability of openings for free movement of water and maintenance of the tank from the inside it must be equipped with an upper inspection hole with a diameter of at least 55 cm and be equipped with a tightly closed, easy-to-open cover made of rust-resistant material.

VII. It must be provided with a digital water level indicator, an overflow pipe, and two water entry holes (2.5 inches) male with a valve (one hole on each side) equipped with a locking valve.

VIII. It must be connected to the pump's intake opening with a pipe no less than (4) inches - through a flexible connection and a compound it has a butterfly ring on it

IX. The water tank must be provided with an opening to empty the water male (2.5) inches, Morris model

X. The tank must be provided with a pipe for filling water via a pump with a valve with lacquer installed on it.

XI. All the above-mentioned slot seals must be made of strong light alloy

g) Foam Liquid Tank A&B:

I. The capacity of each foam tank must be no less than 100 liters, and must be separated so that either of them can be lifted for use maintenance work

II. It must be made of a material that does not react with the foamy liquid, such as non-removable steel Stainless or approved industrial plastics such as for rust (stainless steel 316 or polypropylene) with a thickness of no less than (5) mm

III. Each of them shall be provided with a digital indicator of the foam liquid level in the tank

IV. Each technician must connect to a complete unit for mixing the foam liquid installed in the car, through a pump for injecting the foam liquid into the water line with a mixing ratio not exceeding 10%, according to the type of foam material and in accordance with the applicable international systems, provided that a certificate is submitted from the producing company to that effect, and that it is one of the companies specialized with control to adjust the mixing ratio and connected to an air compressor to push air into the line to give rates discharge not less than 110 cubic feet per minute at a pressure of 10 bar, automatically set by pressure (SET) and equipped with the necessary protection such as controlling speed increases beyond the permissible limit, which may affect the operation of the compressor.

V. Each tank must be provided with an upper inspection and maintenance opening with a diameter of at least 45 cm and must be equipped with a tightly closed, easy-to-open lid.

VI. The tank must be provided with a means to confront the expansion of the volume of the foamy liquid as a result of movement or weather factors

h) Pump and Fire Equipment.

I. The pump must be centrifugal and derives its kinetic energy from the fire trucks engine via the transmission PTO system.

II. The manifold, the ejection nozzles, the control panel, and the preparation device are all one unit produced by the company producing the pump, and this must be clarified in the original technical catalogs issued by the company producing the pump.

III. It must be installed at the back of the fire trucks or in the center area of the fire trucks behind the cockpit

IV. The pump must be given a medium pressure discharge rate of no less than (2500) liters/minute at a pressure of (8) bar.

V. It must drain water through a number of (4) exhaust openings including (2) exhaust outlets with a diameter of (2.5) inch Morris model designed for water injection - as well as two 1.5 inch diameter outlets with threaded lacquers designed for air compressed foam liquid injection (American system). The pump is connected to two hoses with a diameter of 1 inch and a length of (100 m) (1) meter per complete hose with (1) inch diameter ejector for extruding pressurized foam liquid (CAFS) to provide discharge rates of no less than 200 liters/min at a pressure of 4 bar.

VI. The pump must be provided with a self-priming device to draw water from a depth of (3) meters in a time not exceeding (30) seconds.

VII. The pump must be provided with an intake hole from an external, exposed water source with a diameter of 4 or 5 inches, equipped with a threaded screw so that the hole is at the back of the fire trucks if the fire pump is rear, or the intake hole is on each side.

VIII. If the fire pump is central the water and foam tank suction connections should be provided with a strainer and inspection hole to prevent any impurities from passing through the pump.

IX. The pump connections should be provided with a leakage valve through which the bottom of the pump and the lower pipes can be completely emptied after the pump is finished.

X. The pump must be equipped with an operating, displaying and control panel that includes meters for measuring suction and expulsion pressure (in bar), a meter for measuring the hours of operation of the pump, an indicator for engaging the pump, and a means of controlling the speed.

i) <u>Attachments Are Provided Based On The Requesting Party's Desire:</u>

I. (2) manual water throwers, 2.5 inches in diameter, multi-purpose, five-stage, with the ability to control the discharge rate so as to provide a discharge of not less than 1000 liters/min at a pressure of 7 bar, which must comply with any of the European or American standard specifications.

II. (2) manual ejectors with a diameter of 2.5 inches for extruding the foam liquid, providing discharge rates of no less than 1000 liters/min at a pressure of 7 bar - they must comply with any of the European or American standard specifications and the types designated for extruding the foam liquid.

III. 2 manual ejectors with a diameter of 1.5 inches to eject the compressed foam liquid, providing discharge rates of no less than 900 liters/min at a pressure of 10 bar - they must comply with any of the European or American standard specifications and be suitable for fire trucks exits (threaded threads and any of the types designated for ejection). Compressed foam liquid (CAFS)

IV. (4) or (5) suction hoses with a suitable diameter for the pump suction opening and equipped with a screwdriver made of light alloy with a total length of no less than (10) meters.

V. (2) suction strainers for manifold hoses made of light alloy (Light Alloy) has a thread and diameter suitable for manifold hoses and is equipped with a non-return gasket to prevent water leakage.

VI. (2) wrench for suction hoses

VII. (1) joint threaded threads with a suitable diameter for the pump entry hole, with at least two entrance holes, Morris male (2.5) inches.

VIII. (1) Manual ladders consisting of three interlocking sliding links with a total length of no less than (9) meters, produced by a specialized company.

IX. Hand pump to fill the foam tank

X. (10) 2.5-inch diameter fire hoses, lined inside and out, and a 2.5-inch Morris plaster of light twist, with a length of 20 meters for each hose, will be supplied.

XI. (10) 1.5-inch diameter fire hoses lined inside and out with 1.5-inch threaded threads made of light-twist, with a length of 50 meters for each hose, will be supplied.

XII. The tank must be fixed on the chassis well in accordance with technical standards, so that it can be completely lifted from the chassis and make any repairs or welds with it

XIII. It must be equipped with longitudinal and transverse partitions of the same material as the tank and with a thickness of no less than “3” mm to achieve complete safety for the movement of the vehicle while driving and turning, so that the distance between the longitudinal or transverse partitions does not exceed (102) meters, and connects the bottom and the top of the tank. With the availability of openings for free movement of water and maintenance of the tank from the inside (it must be equipped with an upper inspection hole with a diameter of at least 55 cm and be equipped with a tightly closed, easy-to-open cover made of rust-resistant material).

XIV. It must be provided with a digital water level indicator, an overflow pipe, and two water entry holes (2.5 inches) male with a valve (one hole on each side) equipped with a locking valve.

XV. It must be connected to the pump’s intake opening with a pipe no less than (4) inches - through a flexible connection and a compound.

XVI. It has a butterfly ring on it

XVII. The water tank must be provided with an opening to empty the water

XVIII. Male (2.5) inches, Morris model

XIX. The tank must be provided with a pipe for filling water via a pump.

XX. With a valve with lacquer attached to it

XXI. All the above-mentioned slot seals must be made of strong aluminum alloy (light alloy)

XXII. Discharge of not less than 110 cubic feet per minute at a pressure of 10 bar, automatically set by PRE-(SET) and equipped with the necessary Defense such as controlling speed increases beyond the permissible limit, which may affect the operation of the compressor.

XXIII. Each tank must be provided with an upper inspection and maintenance opening with a diameter of at least 45 cm and must be equipped with a tightly closed, easy-to-open lid.

XXIV. The tank must be provided with a means to confront the expansion of the volume of the foamy liquid as a result of movement or weather factors

j) General requirements:

I. The date of production and model of the fire trucks must not be less than the year in which the purchase was announced.

II. Detailed technical bulletins must be submitted with the offer, which include all data of the vehicle, the pump, and the firefighting equipment in Arabic and English for the equipment, showing the full specifications of the vehicle after its preparation, including the specifications of the chassis, engine, pump, compressed air foam unit, launchers, and accessories, provided that

III. It is certified with the seal of the supplying company and is produced by one of the specialized companies.

IV. The bidder is obligated to submit an engineering drawing of the fire trucks with all its equipment, along with the technical offer 4. The vehicle components (chassis - engine - fire pump - overhead ejector - fire engine hoses complete with reel and ejector - sliding doors - air-compressed foam unit from the injection pump for the foam liquid, compressor and ejectors of all kinds) must be of origin in either the European Union or the United States American

V. A certificate from the company producing the chassis that it is fit to work as a fire truck (for local equipment), and a certificate from the supplying company that the vehicle is fit to be equipped to carry out firefighting work.

VI. The chassis, engine and cabin must be produced by one company

VII. The company submitting the offer is obligated to provide the producing company's website on the international information network and the email number of the relevant department to review the data and certificates submitted by the company.

VIII. The supplying company is committed to providing a certificate of origin for the imported components (chassis, pump, and fully compressed foam unit (foam injection pump - compressor and control switches - launchers of all kinds - .... etc.) indicating the country of manufacture, model, year of production and customs release.

IX. The supplying company is committed to the technical specifications contained in the tender and the catalogs provided - if they are higher the specifications presented.

X. The supplying company is committed to providing practical training on how to use the fire trucks with all its accessories and methods periodic maintenance.

XI. Complete original documentation for operation and maintenance must be provided with the fire trucks- if the offer is accepted

XII. For the chassis, pump and respirators in printed or electronic form (CD).

XIII. The supplying company is committed to providing after-sales service (an authorized maintenance center for the fire trucks and all its equipment in the Arab Republic of Egypt).

XIV. The supplying company undertakes to guarantee the fire trucks with all its components for a period of not less than two years from the date of receipt or for twenty thousand kilometers and five years for all fixed firefighting equipment (the tank and the pump, which represents approximately 25% of the total value of the fire trucks (against manufacturing defects).

XV. The supplying company is committed to providing a proposed list of spare parts needed to operate the fire trucks and maintain the consumable parts within ten years, within a limit of 10% of the car's value.

XVI. Upon delivery, the supplier - whether the fire trucks is equipped locally or imported from abroad - is obligated to provide an inspection and test certificate of validity from the General Administration of Civil Protection stating that the fire trucks has passed the acceptance tests and bearing the data relating to the fire trucks (chassis number - engine number - fire pump number - any other data).

XVII. The requesting party has the right to review the manufacturing stages of the relevant product with the General Administration of Civil Protection in coordination

XVIII. The requesting party has the right to add financial and contractual conditions, in accordance with applicable regulations.

Vehicle Equipped With a Hydraulic Ladder Aerial Ladder

For Rescue and Firefighting Work in High-Rise Buildings with An Operating Height Not Less Than (50) Meters

1. General

I. A vehicle equipped with a hydraulic ladder with sliding step joints (AERIAL LADDER extends in a straight line and is equipped for the purposes of firefighting, rescue and rapid evacuation from high buildings.

II. The vehicle is characterized by ease of maneuvering and has high mechanical capacity, fully equipped, designed for heavy duty and driving on various roads and manufactured according to the technical principles of international fire engines.

III. The fire trucks and the hydraulic ladder with all its components (links - basket - elevator - hydraulic pump - electricity generator - safety and control means - etc.) must be produced by one of the international companies specialized in manufacturing cars and hydraulic ladders and conform to one of the international standard specifications, in accordance with the following technical specifications.

2. **Technical Specifications**

a) Chassis:

I. The chassis must be of one of the international brands

II. The maximum actual load on any of the axes shall not exceed (90%) of the permissible design load, provided that the supplying company provides a detailed statement of the distribution of loads according to the technical catalogs provided... The chassis beams must be one piece without any additional connections, otherwise It is typically produced in the same factory that produces the fire trucks chassis

III. The brakes must be equipped for heavy duty and operate with a double-circuit system equipped with (ABS).

IV. The transmission must be manual.

V. The net vertical clearance between the wheels and the car's body when it is fully loaded must not be less than (15) cm.

VI. The total height should not exceed (400) meters, the total width should not exceed (2.5) meters, and the total length should not exceed 12 meters. Possibility of towing the fire trucks front and rear

VII. The fire trucks must be provided with its accessories, including a spare tire, tool kit, and fire trucks lift cabin, provided that a suitable place for storage is provided for the spare tire.

VIII. The color is matte red

b) Cabin:

I. The cabin should be a single cabin, of the flip-top type, without a front protrusion, and it should be raised hydraulically, provided that it can accommodate at least two people other than the driver.

II. The steering wheel should be to the left of the cabin, and the steering system should be hydraulically operated (POWER STEERING)

III. The fire trucks dashboard should be provided with the necessary indicators and meters that indicate the operation of the car's equipment and supplies (hydraulic pump - operating hours meters, etc.).

IV. The top of the cabin must be equipped with an appropriate warning light in accordance with technical standards.

V. The cabin in must be equipped with a multi-tone siren with a capacity of no less than (100) watts, connected to a microphone of the types designated for police and fire engines, produced by specialized international companies.

VI. The cabin should be equipped with an external lighting lamp that can be moved outside the fire trucks and runs on the car's electricity to illuminate the accident site

c) **The Structure :**

I. It must be made of reinforced galvanized sheet or aluminum alloy, and fiberglass is allowed within the structure

II. The chassis must be equipped with tightly closed wheels with self-lubricating sliding doors, provided that they are produced by one of the specialized companies that accommodate all the car's equipment with means to install them on both sides of the fire trucks behind the cabin, and that they must accommodate all the additional accessories and equipment that are supplied with the car, and that it be provided with appropriate lighting that It works automatically when opened.

III. The fire trucks is equipped with fixed ladder steps (25 cm per step) on both sides for individuals to climb onto the fire trucks floor, which is covered with aluminum panels with a prominent pattern with a thickness of no less than 4 millimeter.

d) **The Engine :**

I. Four-stroke diesel, water cooling.

II. To be equipped with a turbocharger system.

III. The engine must have a net relative power of no less than (14) horsepower per ton of the total weight of the entire vehicle its payload (G.V.W), and to be able to achieve the required speed and acceleration of the car.

IV. The engine cooling efficiency must be proportional to the operation of all vehicle equipment, from stability to operation in hot climates, so that the pump is operated at maximum speed for a period of not less than four hours without the engine temperature rising above the safe level.

V. The engine must be environmentally friendly in accordance with European specifications (Euro 3) at least.

e) Speed And Acceleration:

I. The maximum speed of the fire trucks must not be less than (80) kilometers per hour on flat ground while it is fully loaded.

II. The fire trucks must be able to achieve a speed of no less than (60) kilometers per hour within (30) seconds, starting from standing still with its full load on flat ground.

f) Balance:

I. The fire trucks is equipped with a set of hydraulic supports that achieve complete stability during operation and is equipped with a light warning device when operating.

II. The pillars can be extended to different dimensions in order to enable the ladder to be operated in narrow spaces, taking into account the development of a safety program for operating the ladder in each case to ensure complete stability during operation and not to deviate from the permissible limits in the every situation

III. A wooden or metal plate is provided for each pillar to increase the fulcrum in order to ensure the stability of the equipment on the soft ground. The permissible inclination of the vehicle when operating does not exceed (7) degrees.

g) Hydraulic Pump:

I. The hydraulic pump is the basic power source for all required equipment movements (lifting/straightening/rotating), even if it has the appropriate capacity to operate more than one movement at a time with the required efficiency.

h) Sliding Ladder Connections:

I. The main bearing parts of the steel link set and the staircase shall be made of light durable metal alloy

II. The weight prevents slipping and is insulated.

III. Its height should not be less than (50) meters from the surface of the ground.

IV. It consists of interlocking graduated and sliding links.

V. The operation of the ladder should be automatic (straightening the pillars and adjusting the balance level of the rotating tray through a panel).

VI. Operation and control with the possibility of manual operation.

VII. The ladder can be operated at a horizontal level from (-10) to (+70) degrees at least, and it has the ability to rotation (+360) degrees continuously in both directions.

VIII. The ability to control the speed of moving links with complete safety

IX. The electrical switches on the control panel must be waterproof and have an appropriate insulation level of no less than IP 56 and equipped with a cover of a suitable material to protect it from erosion factors.

X. The front of the ladder is provided with (2) moving spotlights with a power of no less than 200 watts to illuminate the space around the top of the ladder.

XI. The top of the ladder shall be provided with moving spotlights with a capacity of no less than 100 watts and operating on vehicle electricity.

XII. The ladder is provided with a hydraulically foldable basket at the top of the links.

XIII. The load is no less than (180) kg and is equipped with a sub-operation and control panel equipped with control levers to operate the ladder (raising/lowering) and (straightening/bending) and rotating the links.

XIV. The basket can be dismantled to install the upper ejector. The ladder is provided with a load elevator. At least (180) kg, foldable, secured with four metal sides, and equipped with appropriate safety devices.

XV. The ladder is provided with an upper launcher (water - foam) that can be installed and removed at the top of the ladder, provided that it is capable of vertical and horizontal movement to an appropriate extent, and in a way that does not conflict with the safety of the ladder. It can also change the shape of the water (column - spray) and works through a special control and operation unit next to the panel. Main operation (remote control) and a discharge rate of no less than (2000) liters/minute at 7 bar at maximum height) and a suitable place for storage should be prepared for it (on the ladder when not in operation).

XVI. The basket is provided with a multi-purpose water thrower that can be fixed and can be moved vertically and horizontally at a suitable angle. It gives a drainage rate of no less than (1200) liters/minute at a pressure of 7 bar and is equipped with a valve for opening and closing. The basket is provided with a water outlet with a diameter of (2.5) inches, female on a stopcock. It is fed with water from the inlet of the feeder pipe for the thrower attached to the basket.

i) Mechanical Motion Control Devices:

I. The control panel must be equipped with operating levers and indicators necessary for all movements of the ladder, elevator, and turntable links.

II. There must be the possibility of performing two or more stomach movements at the same time.

III. The indication and control panel must be equipped with a means of lighting for night operation.

IV. The ladder must be equipped with spotlights that allow the body of the ladder to be seen at the maximum height. The main control panel must be equipped with a seat for the operator at a level that enables him to view screens showing the operating conditions and limits of the ladder movement.

V. The ladder is equipped with a display screen installed in the main operating panel to show the movement of the ladder, the position on it, the permissible operating limits, wind speed, temperatures, and faults and their location.

j) <u>Safety Devices:</u>

I. It is provided with an audio system for communication between the top of the ladder, the basket, and the main control panel.

II. The base of the basket must be provided with an appropriate number of water sprinklers to protect it from the effects of external heat availability of a means to secure the stability of the links on the fulcrum while the fire trucks is in motion.

III. The top of the ladder is provided with a means of warning when approaching an unsafe object, with the movement of the ladder automatically stopping in the direction of the obstacle, with the possibility of canceling it manually when it is not needed.

IV. A safe emergency lowering system must be available in the event of a malfunction that includes more than one means to ensure that the ladder is returned to walking position. The ladder must be provided with a braking device that operates automatically to prevent the elevator from suddenly falling in the event of a break in the scheduled ladder cabin.

V. Stability of the ladder connections in the event of disconnecting the power sources and shutting down the fire trucks engine.

VI. The ladder is provided with an automatic stopping system for the arms and pillars in the event of excessive loads while allowing movement in the direction of return.

VII. The ladder must be equipped with a method that achieves equal distances for the stairs at any operating position.

k) <u>Auxiliary equipment:</u>

I. The ladder must be provided with an individual (RESCOMATIC) lowering device.

II. The ladder must be provided with (2) modern stretchers equipped with safety belts, with a secure means of attaching to the basket to be used in evacuating injured people from high buildings.

III. The staircase is provided with an electric generator with a capacity of no less than (8 KVA) to illuminate the overhead lights, use devices, and operate the additional electrically operated hydraulic pump in emergency situations. electrical

IV. The ladder is equipped with a digital video camera (DIGITAL) is equipped with the zoom feature, provided that it has complete protection against high temperatures, water, and shocks, while providing the ability to control the camera remotely (from the main operating base to change the shooting angle by moving the camera horizontally and vertically, while providing the necessary lighting), which ensures that The image is clear, as is an adjustable display screen that can be folded and unfolded, while providing the system with a means of recording from the camera.

V. The manual tool kit for the chassis and equipment includes (2) safety belts.

VI. Containers of hydraulic oil of the type used in the equipment, with a capacity not less than the total volume of oil filled in the equipment.

VII. Expulsion hoses lined from the inside and outside with rubber, equipped with (2.5) inch female screws and male screws of the type of Lacked mounted ejector at the top of the ladder, with a length of not less than (50) meters per hose.

VIII. Supplying (4) wireless devices that operate in a closed circle with a radius of (200) meters and are equipped with headphones and microphones that enable ladder workers to communicate directly with each other without carrying the device hindering their work on the ladder.

I) <u>Accessories Supplied With The Ladder Car:</u>

The (basic/optional) accessories should be offered in accordance with the specifications of the General Administration of Civil Protection

I. **First:** Basic accessories (mandatory) supplied with the car:

- ✓ One Four-stroke portable firefighting machine with its accessories.
- ✓ Four respirator complete with accessories.

II. **Second:** Optional accessories for the requesting party: in number and type - according to the needs of the requesting party: firefighting clothing sets - Expulsion hoses - ejectors - joints, etc.).

m) General requirements:

I. The date of production and model of the fire trucks must not be less than the year in which the purchase was announced.

II. Detailed technical bulletins must be submitted with the offer, which include all data on the vehicle, the pump, and the firefighting equipment, in both Arabic and English, for the equipment, showing the full specifications of the vehicle after its preparation, including the specifications of the chassis, engine, hydraulic pump, and accessories. The basic data in the offer must be explained in a distinctive font or phosphorescent color, provided that it is approved with a seal.

III. The supplying company is produced by one of the specialized companies and conforms to one of the international specifications, provided that proof of the conformity of the fire trucks and its components to one of the approved international specifications is presented within the technical offer.

IV. A certificate from the company producing the chassis that it is fit to work as a fire ladder equipment (for local equipment), and a certificate from the supplying company that the vehicle is fit to be equipped to carry out firefighting and rescue work.

V. The chassis, engine and cabin must be produced by one company.

VI. The supplying company is obligated to provide a certificate of origin for imported components (respirators, high-discharge grenade launchers, firefighting clothing, etc.), indicating the country of manufacture, model, year of production, and customs release upon supply.

VII. The supplying company is committed to the technical specifications contained in the tender and the catalogs provided - if they exceed the specifications presented.

VIII. The supplying company is committed to providing practical training on how to use the hydraulic ladder fire trucks with all its accessories and regular maintenance methods.

IX. Provided with the fire trucks- if the offer is accepted - complete original documents related to the operation and maintenance of the chassis and breathing devices in printed or electronic form (CD) in Arabic and English.

X. Upon delivery, the supplier - whether the fire trucks is equipped locally or imported from abroad - is obligated to provide an inspection and test certificate of validity from the General Administration of Civil Protection stating that the fire trucks has passed the acceptance tests and containing the car's data (chassis number - engine number and any other data).

XI. A video film recorded on video tape or CD that includes the following should be attached to the technical proposal:

(a) Pillar system and methods of operation.

(b) Ladder operation system for all movements.

(c) Operation control system.

(d) The electronic panel that shows the movement of the ladder and all data in accordance with what is stated in the terms and specifications booklet technical and presentation.

(e) Water drainage system from the upper ejector and how to control it.

XII. The supplying company is committed to providing after-sales service, along with providing spare parts and maintenance services through (an authorized maintenance center for the fire trucks and all its equipment in the Arab Republic of Egypt), provided that its name and address are mentioned in the art show .

XIII. The supplying company is committed to accepting inspection procedures for the equipment during the final stages of manufacturing and testing it in the country of origin by a technical committee specialized in the field consisting of at least three officers, provided that the supplying company is committed to avoiding any observations made by the technical committee within the limits of the specifications presented and the company's presentation and before shipment. The company bears all travel and accommodation expenses for the committee.

XIV. The supplying company is committed to training 2 officers on operation and maintenance work in the country of origin. 14. The supplying company is obligated to provide the producing company's website on the international information network and the e-mail number of the relevant department to review the data and certificates provided by the company.

XV. The supplier is obligated to provide a catalog on how to perform maintenance operations and repair minor malfunctions of the equipment (Manual Services)

XVI. The supplying company undertakes to guarantee the equipment with all its components for a period of not less than two years from the date of receipt or for twenty thousand kilometers for the chassis and engine and five years for all firefighting ladder equipment this is against manufacturing defects.

XVII. The requesting party has the right to add financial and contractual conditions, in accordance with the applicable regulations.

XVIII. Bids are evaluated using a points system attached to the specification.

Firefighting Truck Carrying a 15 m^3 Water Tank and Equipped With a Medium Fire Pump

1. General

A fire truck with a central pump and a transmission system It is equipped on a chassis with a water tank for the purposes of fighting fires and supplying fire engines with water, taking into account mechanical capacity and high firefighting capabilities, fully equipped, designed and manufactured according to the technical principles of international fire engines these technical specifications will come into force as of 7/1/2017.

2. Technical Specifications

a) Chassis

I. The chassis must be of one of the brands bearing an international trademark.

II. The chassis must be specially manufactured for use in firefighting purposes, provided that a certificate is submitted to that effect

III. The company that produces the chassis in the country of original origin traction machines must be 6x4, front and rear, and equipped with double tires on the axles the background.

IV. The maximum actual load on each axle of the fire trucks shall not exceed 90% of its permissible design load, provided that the supplying company submits a statement of load distribution and a certificate of suitability for the car, including the design and equipment with the actual load and all accessories and equipment in accordance with the permissible loads. It's on the chassis.

V. The chassis beams must be one piece without welds or additions.

VI. The brakes are heavy-duty and equipped with a system ABS

VII. To be a transmission Steptronic or its equivalent, installed by the same company that produces the chassis

VIII. The internal turning radius must not exceed 11 m.

IX. Providing a means in the car's body to tow it from the front and back

X. The net vertical clearance between the wheels and the car’s body must not be less than 15 cm, and the ground clearance of the fire trucks must not be less than 20 cm when it is fully loaded.

XI. The maximum height must not exceed 3.5 meters while the fire trucks is not loaded, the total width must not exceed 2.5 meters, and the length must not exceed 11 meters.

XII. The fire trucks must be supplied with its accessories, including a tool kit, a fire trucks lift cabin and a spare tire. A suitable place must be provided to store it. In the event that the spare tire is installed on top of the car, a manual winch must be provided to be used to transport it to and from the storage location.

XIII. The vehicle must be equipped with a stationary charger Built-in for batteries, so that it is connected through a cabin to a 220 volt electricity source, and through it the batteries are recharged throughout the period of their stopping at the fire station, so that the charger automatically stops working when the fire trucks is fully charged.

XIV. A suitable cabin is supplied with the fire trucks equipped with a plug (quick connector that automatically disconnects from the source energy) with a length of at least 20 meters.

b) <u>Cabin:</u>

I. The cabin must be a single unit, made up of one unit and manufactured by the factory that produces the chassis or under its supervision, with a certificate from the factory stating that. It must be of the flip type without a front protrusion, raised hydraulically, equipped with a manual insurance device, and can accommodate three people.

II. The steering wheel should be to the left of the cabin, and operate with a hydraulic servo (Power Steering)

III. The top of the cabin must be equipped with a suitable red warning light that is as wide as the fire trucks and operates using a system LED Flasher in accordance with technical standards, as well as 2 LED flashers at the rear of the fire trucks from above, at one on each side, and 2 flashers One LED on each side of the car, provided that all of them are red in color and have dimensions of no less than 15 cm.

IV. The vehicle must be equipped with a multi-barrel siren of the type designated for fire engines, produced by one of the following specialized international companies

V. The fire trucks must be equipped with an external lighting lamp that runs on the car's electricity to illuminate the accident site and can be moved away from the car.

VI. It must be equipped with 2 suitable electrical cabin reels, each with a length of not less than 30 meters, so that they can be connected together, and the lamp must have a source of electricity and a means. Installed with front the fire trucks.

VII. The fire trucks dashboard should be provided with the necessary indicators and meters that indicate the operation of the equipment and supplies.

VIII. The fire trucks cabin in should be equipped with an electrical connection and a place to install the antenna receiver for the radio device, with 2 speakers, one on each side, and one outlet next to the fire pump on the left side, next to the fire pump to install the microphone of the device. Wireless for use by the pump operator.

IX. Handles must be provided for use by the fire crew when ascending and descending from the doors fasten them to the cabin body, not the doors.

c) The Structure :

I. It must be made of sheet or aluminum alloy, and fiberglass is allowed as an accessory to the structure.

II. The chassis must be equipped with tightly sealed wheels with self-lubricating (vertical) sliding doors, provided that they are produced by one of the specialized international companies, and that accommodate all the car's equipment with means to install them and accommodate all the accessories, including hoses, launchers, and all the equipment and accessories that are supplied with the car.

III. Each cupboard is provided with appropriate lighting that operates automatically when opened, as well as a phosphorescent strip to pull the door when closed.

IV. Means must be provided for storing and fixing the equipment inside the cupboards in accordance with what is followed in installing the equipment inside fire trucks.

V. The cabinet for the intermediate pump must be equipped on both sides of the vehicle directly behind the cabin with sliding doors of the same type and fittings as the doors of the equipment storage cabinets.

VI. A ladder made of light and durable metal alloy is installed for individuals to climb onto the top of the car.

VII. The car's color is matte red.

VIII. Each side and rear of the fire trucks must be provided with two phosphorescent strips along the length of the car, each with a width of no less than 15 cm, provided that this strip is produced by one of the specialized international companies.

d) The Engine :

I. Water-cooled, heavy-duty four-stroke diesel within the Arab Republic of Egypt.

II. The engine must have a net relative power of no less than 12 horsepower per ton of the total weight of the fully loaded vehicle (GVW) and be able to achieve the required speed and acceleration of the car.

III. The engine cooling efficiency must be proportional to the operation of the fire trucks at rest in the summer, so that the pump is operated at maximum speed for a period of no less than four continuous hours, while the engine temperature does not rise above.

IV. It must be environmentally friendly in accordance with European specifications EURO 3.

e) Speed And Acceleration:

I. The maximum speed of the fire trucks must not be less than 80 km/h on flat ground while fully loaded.

II. The fire trucks must be able to achieve a speed of no less than 60 km/h within 40 seconds, starting from standing still with its full load on flat ground.

f) Water tank

I. Its capacity should not be less than 15,000 liters

II. It must be made entirely of stainless steel 316L with a minimum thickness of 4 mm, with the welds being treated with an anti-rust method (epoxy or equivalent), provided that the raw stainless steel used in manufacturing the tank and its welds are tested by one of the accredited testing laboratories at the supplier's expense, with proof of this being provided.

III. The tank must be painted from the outside, as well as all its connections, with paints that prevent corrosion and rust and are resistant to the effects of salt water.

IV. It must be installed on the auxiliary chassis in accordance with technical standards, including flexible installation, and in accordance with the instructions of the chassis manufacturer, so that it can be completely lifted from the chassis to perform any Repairs or welds to it

V. It must be equipped with longitudinal and transverse shock absorbed made of the same material from which the tank is made and with a thickness of no less than 3 mm to achieve complete safety of the vehicle's movement while driving and turning.

VI. It must be equipped with an upper inspection and maintenance hatch with a diameter of at least 55 cm, and it must be equipped with a tightly closed, easy-to-open lid made of a rust-resistant material, and the lid must be equipped with a leak-proof seal.

VII. To be provided with an electronic indicator that shows the water level and can be read on the main control panel, in addition to an indicator that is a transparent external pipe equipped with a distinctive sign showing the water level inside?

VIII. The tank must be equipped with an overflow pipe and two water feeding holes, each of which is a 2.5 inch male hose equipped with a valve, and each of them is connected to a pipe to feed the tank from the top, with one hole on each side

IX. The tank must be connected to the pump intake hole with a pipe no less than (4) inches - according to the diameter of the pump intake hole - through a flexible connection with a butterfly valve installed.

X. It should be provided with a water discharge hole from inside the tank that ends with a valve mounted with a 2.5-inch female connector.

XI. The tank must be connected to a filling connection to fill it via a pump from an open water source or from another car.

XII. All the above-mentioned slot seals must be made of light alloy or gun metal.

g) Foam Liquid Tank:

I. The capacity of the foam tank must be at least 10% of the capacity of the water tank, and it must be separate from it so that it can be lifted to carry out maintenance work.

II. It must be made entirely of stainless Steel 316L with a thickness of not less than 4 mm, with the welds being treated with a rust-resistant method (epoxy or its equivalent, provided that the raw stainless steel used in manufacturing the tank and its welds are tested by one of the approved testing laboratories at the supplier's expense, with proof provided. that

III. The tank must be painted from the outside, as well as all its connections, with paints that prevent corrosion and rust resistance to the effects of salt water

IV. It must be installed on the auxiliary chassis in accordance with technical standards, including flexible installation, and in accordance with the instructions of the chassis manufacturer, so that it can be completely lifted from the chassis to make any repairs or welds with it.

V. It should be provided with an electronic indicator that shows the level of the foaming liquid in the tank and it can be read on the main control panel, in addition to an indicator that is a transparent external pipe equipped with a distinctive mark that shows the liquid level Foam inside the tank.

VI. The tank must be equipped with an overflow pipe and a feeding hole equipped with a valve connected to a pipe to feed the tank from above.

VII. The tank must be equipped with a filling method, which is a manual pump to draw the foamy liquid from an external source, with a plug that matches the tank feed opening slot.

VIII. The tank should be connected to a fixed foam liquid mixing device attached to the fire pump.

IX. It must be provided with an opening for emptying the foamy liquid from the tank, ending with a hand valve

X. The tank must be provided with an upper inspection and maintenance opening with a diameter of at least 55 cm, and it must be equipped with a tightly closed, easy-to-open lid made of a rust-resistant material. The lid must be equipped with a leak-proof seal, and the lid must be marked in yellow.

XI. It must be equipped with longitudinal and transverse shock absorbers made of the same material the tank is made of and with a thickness of no less than 3 mm to achieve complete safety of the vehicle's movement while driving and turning.

XII. The tank must be provided with a means to confront the expansion of the volume of the foaming liquid as a result of movement or weather factors.

h) Pump and fire equipment

I. The pump must be centrifugal and derives its movement from the car engine via the transmission system PTO and be moderate.

II. In normal and safe operating conditions, the pump must be given a Nominal Pressure discharge rate

III. The average is not less than 3000 liters/minute at a pressure of 10 bar and a withdrawal depth of 3 meters.

IV. The pump must be operated under normal and safe operating conditions Nominal Pressure Rate of pressure discharge

V. The maximum level is not less than 400 liters / minute at a pressure of 40 bar.

VI. It drains the water through 4 exhaust holes equipped with 2.5-inch female Morris plugs, distributed in two holes on each side of the car.

VII. It must be provided with a self-priming device attached to the pump capable of drawing water from a depth of 3 meters in no more than a time 30 seconds.

VIII. It is necessary to provide a means to withdraw the foam from an external source other than the foam tank in the car.

IX. It is necessary to provide a means to control the mixing ratio of the foaming liquid (1%, 3%, and 6%).

X. For the manifold, the operation and control panel, the ejection branches, the high-pressure pump, the preparation device, and the constant foam liquid mixing device, direct pump mixing. Around pump to withdraw the foam liquid from the foam tank or from an external source, while controlling the adjustment of the mixing ratio.

XI. They must all be one unit, a module produced by the pump manufacturer, provided that the technical presentation shows the model and data of the module, with the original catalogs for the module containing the components attached.

XII. All technical data must be inspected by the works follow-up committee before installation on the chassis

XIII. It must be equipped with an automatic means to protect the pump when the pressure increases or the temperature of the water inside it increases

XIV. The pump must be provided with two openings for drawing water from an external water source Open, 4 or 5 inches in diameter, equipped with a black thread.

XV. The pump, upper ejector, and high-pressure pumps must be produced by one company.

XVI. The intake connections from the water and foam tanks must be provided with a strainer and an inspection hole to prevent the passage of any impurities for the pump.

XVII. The pump connections must be provided with a leakage valve through which the bottom of the pump and the lower pipes can be completely emptied after the pump is finished.

XVIII. The pump (module) must be equipped with an operating system equipped with meters to measure the intake and exhaust pressure, a means of controlling the number of revolutions (speed) of the engine, a meter to measure the hours of operation of the pump, an indicator of the pump engagement, temperature, water level, and foam material in the tanks, and any other indicators that may be added, and The main panel should be on the left side

XIX. It must be provided with two impeller hoses with a diameter of 1 inch and a length of 40 meters, equipped with a multiple nozzle that gives a discharge rate of no less than 200 liters/minute at a pressure of 40 bar for each impeller and achieves an ejection distance of no less than 25 meters, with the possibility of installing a foam release connection that is supplied with the device. The car and the hose is made of aluminum and chuck strong pain.

XX. The pump must be connected to a nozzle on top of the car to operate the water and foam liquid, and it is equipped with a connection for generating foam Tube is supplied with the vehicle and fits into the ejector, and must be distinguished

XXI. Thrower As follows:

a. Give Discharge rate of no less than 3000 liters/minute at a pressure of 10 bar.

b. Distance Horizontal water throw of no less than 50 meters.

c. It is equipped with a separate valve and a pressure indicator and is capable of rotating a full 360 revolutions on the horizontal plane, down at an angle of no less than -515, and up at an angle of no less than 750, both from the horizontal plane.

d. Providing a means of controlling the engine speed directly next to the cannon

XXII. Basic accessories supplied with the car:-

a. 4 or 5 suction hoses, equipped with a screwdriver with a diameter of thread and a thread suitable for the diameter and thread of the pump opening, with a total length of not less than 10 meters of suction.

b. 2 suction hose strainers made of brass or light alloy Light Alloy

c. It has a thread and diameter suitable for suction hoses and is equipped with a non-return valve to prevent water leakage.

d. 2 keys for attaching and disengaging the intake hoses, produced by the same company that produces the intake hoses

e. 2 joints, threads with a diameter suitable for the pump entry hole, with a male plug with a diameter of 2.5 inches Morris model.

f. One manual ladder consisting of three sliding and interlocking links, produced by a specialized company and supplied in accordance with the technical specifications for manual (portable) ladders issued by the General Administration of Civil Protection.

g. Hand pump to fill the foam tank

h. 2 foam nozzles for high pressure nozzles

i. One Assembling triangle ٢ (2.5) / 1 (2.5).

j. One Distribution triangle 1 (2.5) / 2 (2.5).

i) <u>General Conditions:</u>

I. The chassis must have an authorized agent (including sales and maintenance in the Arab Republic of Egypt).

II. The date of production and model of the car and all accessories and equipment supplied with it must not be more than one year (maximum) prior to the date of supply.

III. The chassis warranty must be provided with a certificate approved by the agent stating the chassis numbers under warranty.

IV. The original catalogs must be submitted with the offer, which include all data of the car, the pump, and the firefighting equipment, showing the full specifications of the car after its preparation, including the specifications of the chassis, engine, pump, and accessories, provided that they are approved with the seal of the supplying company and that they are produced by one of the specialized companies, and in case Do not support or confirm any technical statement in the presentation with technical catalogues, otherwise the submitted technical presentation will be considered unacceptable.

V. Must be presented an engineering drawing of the car with all its equipment, along with the technical presentation, showing the final dimensions of the car after preparation

VI. 6. The vehicle components (chassis - engine - fire pump - overhead ejector - fire engine hoses complete with reel and ejector - sliding doors - fire pump transmission shaft - basic accessories shown in the brochure must be of origin in any of the countries of the European Union, Japan, or the United States). The United States or the Russian Federation.

VII. The chassis, engine, and cab must be produced by one company, with a certificate of origin from the producing company in the country of original origin presented upon supply, as well as a customs release showing the engine number and number Chassis And its cargo

VIII. The company submitting the offer is obligated to provide the producing company's website on the international information network and the email address of the relevant department to review the data and certificates submitted by the company, provided that all catalogs attached to the technical offer shall be identical to what is stated on the website of the producing company. In the event that the product is not present on the company's website, the offer will not be technically identical.

IX. The supplying company is committed to the technical specifications contained in the catalogs submitted in the accepted bid, even if they exceed the specifications presented.

X. The supplying company is committed to providing a certificate of origin for all imported components (fire pump and its accessories - breathing apparatus - high-discharge grenade launchers - firefighting uniforms... etc.), indicating the country of manufacture, model, year of production and customs release.

XI. The supplying company is committed to providing practical training on how to use the car with all its accessories and regular maintenance methods.

XII. If the offer is accepted, complete original documents related to the operation and maintenance of the chassis, pump, and respirators, in printed and electronic format, shall be provided with the car CD

XIII. The supplying company is committed to providing after-sales service through an authorized maintenance center for the car and all its equipment in the Arab Republic of Egypt.

XIV. The supplying company undertakes to guarantee the car with all its components against manufacturing defects for a period of no less than two years from the date of receipt or twenty thousand kilometers, whichever comes first, and a period of no less than five years for all fixed firefighting equipment, which is estimated at approximately 25% of the total value of the car.

XV. Upon delivery, the supplier - whether the car is equipped locally or imported from abroad - is obligated to provide a certificate of inspection and validity testing from the General Administration of Civil Defense stating that the car has passed the acceptance tests and containing the car's data (chassis number - engine number - fire pump number and any other data).).

XVI. The right of the party requesting the purchase to review the various manufacturing stages of the car and its equipment

XVII. The supplying company is committed to supplying 10% of the car's value as spare parts for the car according to the statement attached to the brochure.

XVIII. All technical offers submitted will be evaluated using a points system .

Medium Fire Truck Equipped With a Medium Fire Pump

1) **General :**

Medium fire truck with a central pump and a transmission system the P.T.O is easy to maneuver, has mechanical capacity and high firefighting capabilities, fully equipped and manufactured according to the technical principles of international fire engines these technical specifications will come into force as of 7/1/2017.

2) Technical Specifications

a) Chassis:

I. The chassis must be of one of the international brands

II. The chassis must be specially manufactured for use in firefighting purposes, provided that a certificate is submitted to that effect the company producing the chassis (in the country of original origin).

III. Traction machines must be 4x4, front and rear, and equipped with dual tires on the axle-the back.

IV. The maximum actual load on each axle of the fire trucks shall not exceed 90% of its permissible design load, provided that the supplying company submits a statement of load distribution and a certificate of suitability for the car, including the design and equipment with the actual load and all accessories and equipment in accordance with the permissible Ministry of Interior loads on the chassis

V. The chassis beams must be one piece without welds or additions.

VI. The brakes are equipped for heavy duty and equipped with an ABS system.

VII. To be a transmission Steptronic or its equivalent, installed by the same company that produces the chassis

VIII. The internal turning radius must not exceed 8 m.

IX. Providing a means in the car's body to tow it from the front and back

X. The net vertical clearance between the wheels and the car's body must not be less than 15 cm, and the ground clearance of the car must not be less than 25 cm when it is fully loaded.

XI. The maximum height must not exceed 3.5 meters while the vehicle is not loaded, the total width must not exceed 2.5 meters, and the length must not exceed 8 meters.

XII. The car must be supplied with its accessories, including a tool kit, a car lift cable, and a spare tire. A suitable place must be provided to store it. In the event that the spare tire is installed on top of the car, a manual winch must be provided to be used to transport it to and from the storage location.

XIII. The vehicle must be equipped with a stationary charger Built-in for the batteries, so that it is connected through a cable to the 220 volt electricity source, and through it the batteries are recharged throughout the period of their stopping at the fire station, so that the charger automatically stops working when the car is fully charged, and a cap is supplied with the car to Suitable for a plug (quick connector that automatically disconnects from the power source) with a length of at least 20 meters

a) The Structure

I. It must be made of sheet metal or aluminum alloy, and fiberglass is allowed as an accessory for the frame.

II. The chassis must be equipped with tightly sealed wheels with self-lubricating (vertical) sliding doors, provided that they are produced by one of the international specialized companies, that accommodate all the car's equipment with the means to install them, and that they must accommodate all the accessories, including hoses, launchers, and all the equipment and accessories that are supplied. With the car, each cupboard is provided with appropriate lighting that works automatically when opened, as well as a phosphorescent strip to pull the door when closed.

III. It is necessary to provide means of storing and fixing the equipment inside the cupboards in accordance with what is followed in installing the equipment inside fire trucks.

IV. It is necessary to provide a means under the equipment storage wheels in the body of the car that allows the user to stand on them with his full foot to use it in bringing equipment located at the farthest point inside those wheels, and such that this means does not form any protrusion beyond the permitted dimensions of the car while driving.

V. The cabinet for the intermediate pump must be equipped on both sides of the vehicle directly behind the cab with sliding doors of the same type and fittings as the doors of the equipment storage cabinets.

VI. A ladder made of a light and durable metal alloy must be installed for individuals to climb onto the top of the car.

VII. The car's color is matte red

VIII. Each side and rear of the car must be provided with two phosphorescent strips along the length of the car, each with a width of no less than 15 cm. This strip must be produced by one of the specialized international companies.

IX. 9. It is necessary to provide each side of the car with two LED lights LED to illuminate the surrounding space in the car if it is parked while working at night.

b) Cabin :

I. The cabin must be double, consisting of one closed unit with four doors, manufactured by the factory that produced the chassis or under its supervision, with a certificate from the factory stating that.

II. It must be of the flip type without a front protrusion, and it must be raised hydraulically and equipped with a manual means of insurance seek For five people on at least other than the driver.

III. The steering wheel should be to the left of the cabin, and operate with a hydraulic servo Power Steering

IV. The top of the cab must be equipped with a suitable warning light of a red color (the width of the car) and operate with an LED Flasher system in accordance with technical standards, as well as 2 LED flashers at the top of the car, one on each side, and 2 LED flashers, one on each side. One side of the car, all of which must be red, with dimensions no less than 15 cm x 15 × 15 cm

V. The vehicle must be equipped with a multi-barrel siren of the types designated for fire engines, produced by one of the specialized international companies.

VI. The car must be equipped with an external lighting lamp that runs on the car's electricity to illuminate the accident site and can be moved away from the car. It must be equipped with two suitable electrical cable reels, each with a length of not less than 30 meters (so that they can be connected together), and the lamp must have a source. It has electricity and a front mounting device the car.

VII. The car dashboard should be provided with the necessary indicators and meters that indicate the operation of the equipment and supplies. . Suitable places must be provided in the cabin to install respirators with all their accessories to allow for easy wearing.

VIII. The car cabin must be equipped with an electrical connection and a place to install the antenna receiver for the wireless device, with two speakers installed (one on each side and one outlet next to the fire pump on the left side next to the fire pump to install the microphone of a wireless device for use by the pump operator).

IX. Handles must be provided for use by the fire crew when ascending and descending from all doors they are attached to the cab body, not the doors

c) **Engine:**

I. Water-cooled, heavy-duty four-stroke diesel within the Arab Republic of Egypt.

II. The engine must have a net relative power of no less than 14 hp/ ton of the total weight of the entire vehicle its payload (G.V.W) and be able to achieve the required speed and acceleration of the car.

III. The engine cooling efficiency must be proportional to the vehicle's stable operation in the summer, so that the pump is operated at maximum speed for a period of not less than four continuous hours, while the engine temperature does not rise above the safe level.

IV. It must be environmentally friendly in accordance with European standards EURO 3

d) **Speed And Acceleration**

I. The maximum speed of the fire trucks must not be less than 100 100 km/h on flat ground while fully loaded.

II. The fire trucks must be able to achieve a speed of no less than 60 km/h within 40 seconds, starting from a standstill fully loaded on flat ground.

e) Water Tank :

I. Its capacity should not be less than 4000 liters.

II. It must be made entirely of stainless Steel 316L with a thickness of not less than 4 mm, with the welds being treated with an anti-rust method, epoxy or its equivalent, provided that the raw stainless steel used in manufacturing the tank and its welds are tested by one of the approved testing laboratories at the supplier's expense, with proof of this being provided.

III. The tank must be painted from the outside, as well as all its connections, with paints that prevent corrosion and rust and are resistant to the effects of salt water.

IV. It must be installed on the auxiliary chassis in accordance with technical standards, including flexible installation, and in accordance with the instructions of the chassis manufacturer, so that it can be completely lifted from the chassis to carry out any repairs or welding with it

V. It must be equipped with longitudinal and transverse shock absorbs made of the same material from which the tank is made and with a thickness of no less than 3 mm to achieve complete safety of the vehicle's movement while driving and turning.

VI. It must be equipped with an upper inspection and maintenance hatch with a diameter of at least 55 cm, and it must be equipped with a tightly closed, easy-to-open lid made of a rust-resistant material, and the lid must be equipped with a leak-proof seal.

VII. It should be provided with an electronic indicator that shows the water level and can be read on the main control panel, in addition to an indicator that is a transparent external pipe equipped with a distinctive sign that shows the water level inside the tank. The tank must be equipped with an over-flow pipe and two water feeding holes, each of which is a 2.5" male hose equipped with a valve, and each of them is connected to a pipe to feed the tank from the top, with one hole on each side.

VIII. The tank must be connected to the pump intake hole with a pipe no less than 4" according to the diameter of the pump intake hole through a flexible connection with a butterfly valve installed.

IX. It should be provided with a water discharge hole from inside the tank that ends with a valve mounted with a 2.5" female connector.

X. The tank must be connected to a filling connection to fill it via a pump from an open water source or from another car

XI. All the above-mentioned slot seals must be made of Gun metal or light metal alloy

f) Foam Liquid Tank:

I. The capacity of the foam tank must be at least 10% of the capacity of the water tank, and it must be separate from it so that

II. It can be lifted to carry out maintenance work.

III. The model must be attached with the original catalogs for the model, which contain all the technical data, and the works follow-up committee may inspect it before installing it on the chassis.

IV. It must be equipped with an automatic means to protect the pump when the pressure increases or the water temperature increases inside it.

V. The pump must be provided with two holes for drawing water from an open external water source with a diameter of 4 or 5 inches and equipped with a threaded thread.

VI. The pump, overhead ejector, and high-pressure pumps must be produced by one company.

VII. The two suction connections from the water and foam tanks should be provided with a strainer and an inspection hole to prevent the passage of any impurities for pump

VIII. The pump connections must be provided with a leakage valve through which the bottom of the pump and the lower pipes can be completely emptied after the pump is finished.

IX. The pump (module) must be equipped with an operating system equipped with meters to measure the intake and exhaust pressure, a means of controlling the number of revolutions (speed) of the engine, a meter to measure the hours of operation of the pump, an indicator of the pump engagement, temperature, water level, and foam material in the tanks, and any other indicators that may be added the main panel must be on the left side.

X. To be provided with two filtration hoses with a diameter of 1 inch and a length of 40 meters, equipped with a multiple nozzle that gives a discharge rate of no less than 200 liters/minute at a pressure of 4 bar for each nozzle and achieves an ejection distance of no less than 30meters, with the possibility of installing a foam release connection that will be supplied with (the car) and the hose is made of reinforced rubber.

XI. It must be made entirely of stainless steel 316L with a thickness of no less than 3 mm, with the welds treated with a rust-preventing epoxy or equivalent method, provided that the raw stainless steel used in manufacturing the tank and the special welds are tested. It must be done by one of the accredited testing laboratories at the supplier's expense, with proof of this being provided

XII. . The tank must be painted from the outside, as well as all its connections, with paints that prevent corrosion and rust and are resistant to the effects of salt water.

XIII. It must be installed on the auxiliary chassis in accordance with technical standards, including flexible installation, and in accordance with the instructions of the chassis manufacturer, so that it can be completely lifted from the chassis to carry out any repairs or welding with it

XIV. It must be provided with an electronic indicator that shows the level of the foaming liquid in the tank, and it can be read on the main control panel, in addition to an indicator that is a transparent external pipe equipped with a distinctive sign that shows the liquid level foam inside the tank.

XV. The tank must be equipped with an overflow pipe and a feeding hole equipped with a valve connected to a pipe to feed the tank. The tank must be equipped with a filling means, which is a manual pump to withdraw the foamy liquid from an external source in the tank compatible with the tank feed slot.

XVI. The tank must be connected to a fixed foam liquid mixing device attached to the fire pump.

XVII. It must be provided with an opening to empty the foamy liquid from the tank, ending with a hand valve.

XVIII. The tank must be provided with an upper inspection and maintenance opening with a diameter of at least 45 cm, and it must be equipped with a tightly closed, easy-to-open lid made of a rust-resistant material. The lid must be equipped with a leak-proof seal, and the lid must be distinguished by its color yellow.

XIX. The tank must be provided with a means to confront the expansion of the volume of the foaming liquid as a result of movement or weather factors.

g) Firefighting Pump And Equipment:

I. The pump must be centrifugal and derives its movement from the fire trucks engine via the transmission system, and that be average.

II. The pump must be given under normal and safe operating conditions Nominal Pressure a medium pressure discharge rate of no less than 3,000 liters/minute at a pressure of 10 bar and a withdrawal depth of 3 meters.

III. The pump must be given under normal and safe operating conditions Nominal Pressure High pressure discharge rate of no less than 400 liters/minute at a pressure of 4 bar.

IV. To drain the water through 4 outlet openings equipped with 2.5” diameter female Morris plugs, distributed in two holes on each side of the car.

V. It must be provided with a self-priming device attached to the pump capable of drawing water from a depth of 3 meters in a time not exceeding 30 seconds.

VI. It is necessary to provide a means to withdraw the foam from an external source other than the foam tank in the car

VII. It is necessary to provide a means to control the mixing ratio of the foaming liquid (1%, 3%, and 6%).

VIII. For the manifold, the operation and control panel, the ejection branches, the high-pressure pump, the preparation device, and the constant foam liquid mixing device, direct mixing of the pump (around pump) to withdraw the foam liquid from the foam tank or from an external source, while controlling the mixing ratio. All of them must be one module, a module produced by the pump manufacturer, provided that the technical presentation shows the model.

IX. The pump must be connected to a nozzle on top of the fire trucks to operate the water and foam liquid, and it must be equipped with a connection for generating foam (Foam Tube) supplied with the fire trucks and compatible with the nozzle.

X. It must be distinguished the shooter is as follows:

- A discharge rate of no less than 3000 liters/min is given at a pressure of 10 bar.
- Horizontal water throw distance of no less than 50 meters
- It is equipped with a separate valve and a pressure indicator and is capable of rotating a full 360^{o} revolutions on the horizontal plane, down at an angle of no less than - 515^{o}, and up at an angle of no less than 750^{o}, both from the horizontal plane.

XI. Providing a means to control the engine speed directly behind the monitor.

h) Basic Accessories Supplied With The Car:-

I. Four or Five suction hoses, equipped with a screwdriver with a thread diameter and a thread suitable for the diameter and suction hole thread.

II. The pump has a total length of no less than 10 meters.

III. Two suction hose strainers made of brass or light Alloy has threads and diameters suitable for suction hoses and is equipped with a non-return valve to prevent water leakage.

IV. Two keys for attaching and disengaging the intake hoses, produced by the same company that produces the intake hoses

V. Two joints, threads with a diameter suitable for the pump entry hole, with a male screw installed, diameter 2.5” Morris model

VI. One manual ladder consisting of three sliding and interlocking links produced by a specialized company and supplied in accordance with the technical specifications for manual ladders issued by the General Administration.

VII. Hand pump to fill the foam tank.

VIII. 2 foam nozzles for high pressure nozzles

IX. 1 triangle summing 2 (2.5) /1 (2.5).

X. 1 triangle distribution 1 (2.5) /2 (2.5).

i) General conditions:

I. The date of production and model of the fire trucks and all accessories and equipment supplied with it must not be more than one year (maximum) before the date of supply

II. The chassis must have an authorized agent (including sales and maintenance in the Arab Republic of Egypt).

III. The chassis warranty must be with a certificate approved by the agent stating the numbers of the chassis under warranty

IV. The original catalogs must be presented with the offer, which include all data on the car, the pump, and the firefighting equipment, showing the full specifications of the fire trucks after its preparation, including the specifications of the chassis, engine, pump, and accessories, provided that they are approved with the seal of the supplying company and that they are produced by one of the specialized companies. In the event that any technical statement is not supported or confirmed by the presentation in technical catalogs, otherwise the submitted technical presentation will be considered unacceptable.

V. An engineering drawing of the fire trucks with all its equipment must be submitted along with the technical offer, indicating the final dimensions for the fire trucks after preparation.

VI. The vehicle components (chassis - engine - fire pump - overhead ejector - fire engine hoses complete with reel and ejector - sliding doors - fire pump transmission shaft - basic accessories shown in the brochure must be of origin in any of the countries of the European Union, Japan, or USA .

VII. The chassis, engine and cabin must be produced by one company, with a certificate of origin from the producing company in the country of original origin provided upon supply, as well as a customs release showing the engine number and number.

VIII. The company submitting the offer is obligated to provide the producing company’s website on the international information network and the e-mail address of the relevant department to review the data and certificates provided by the company, taking into account that all catalogs attached to the technical offer are identical to what is contained on the producing company’s website, and in the event that the product does not exist On the company's website, the offer is not technically identical

IX. The supplying company is committed to the technical specifications contained in the catalogs submitted in the accepted bid, even if they exceed the specifications presented.

X. The supplying company is committed to providing a certificate of origin for all imported components (fire pump and its accessories - breathing apparatus - high-discharge grenade launchers - firefighting uniforms... etc.), indicating the country of manufacture, model, year of production and customs release.

XI. The supplying company is committed to providing practical training on how to use the car with all its accessories and regular maintenance methods. 12. If the offer is accepted, complete original documents related to the operation and maintenance of the chassis, pump, and respirators, in printed and electronic format, shall be provided with the car.CD

XII. The supplying company is committed to providing after-sales service (an authorized maintenance center for the car and all its equipment in the Arab Republic of Egypt).

XIII. The supplying company undertakes to guarantee the car with all its components against manufacturing defects for a period of no less than two years from the date of receipt or twenty thousand kilometers, whichever comes first, and a period of no less than five years for all fixed firefighting equipment, which is estimated at approximately 25% of the total value of the car.

XIV. The right of the party requesting the purchase to review the various manufacturing stages of the car and its equipment.

XV. Upon delivery, the supplier - whether the car is equipped locally or imported from abroad - is obligated to provide a certificate of inspection and validity testing from the General Administration of Civil Defense stating that the car has passed the acceptance tests and containing the car's data (chassis number - engine number - fire pump number, i.e. Other data) .

XVI. The supplying company is committed to supplying 10% of the car's value as spare parts for the car, according to the list attached to the conditions document.

XVII. All technical offers submitted will be evaluated using a points system according to the attached list, provided that the minimum technical acceptance is 80 points out of a total of 1.00a point

Chapter No.: 10

Risk Assessment Methodology

In this Chapter:

- Risk assessment methodology a community decides to utilize,

- The method should be documented, reproducible, and defensible to ensure transparency and practicality for stakeholders and decision-makers.

Intent of the Chapter:

- Involves the evaluation of risks taking into consideration the potential direct
- Indirect consequences of an incident, known vulnerabilities to various potential threats or hazards, General or specific threat/hazard information.

1. Definitions:

1.1. General:

1.1.1. Listed

Approved and registered by individual EGPC, Civil Defence material department.

1.2. Risk Assessment

1.2.1. 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.

1.2.2. Acceptance Criteria

Acceptance criteria are the units and threshold values against which a fire risk assessment is judged.

1.2.3. Consequence

The outcome of an event, which may be expressed qualitatively or quantitatively.

1.2.4. Event

The occurrence of a particular set of circumstances, whether certain or uncertain and whether singular or multiple.

1.2.5. Fire Scenario

A fire scenario is a set of conditions and events that characterizes the development of fire, the spread of combustion products, the reactions of people, and the effect of combustion products.

1.2.6. Hazard

A condition that presents the potential for harm or damage to people, property, environment, mission, Or cultural heritage.

1.2.7. Frequency

The average number of times an event is repeated in a given period.

1.2.8. 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.

1.2.9. Likelihood

Frequency, probability, or their combination.

1.2.10. Risk

The paired probabilities and consequences for possible undesired events associated with a given facility or process.

1.2.11. Model

Simulation of an event.

1.2.12. Method

A process or technique to help resolve a model.

1.2.13. Probabilistic Method

A model whose outputs are probabilities or probability distributions.

1.2.14. Deterministic Model

A model whose outputs are not probabilities or probability distributions; that is, they do not quantify uncertainty.

1.2.15. 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.

1.2.16. Scenario Cluster

A group of scenarios having some, but not all, defining characteristics in common.

1.2.17. Stakeholder

Any individual, group, or organization that might affect, be affected by, or perceive itself to be affected by the risk.

1.2.18. Validation

The process of determining the correctness of the assumptions and governing equations implemented in a method.

2. Risk Assessment (RA) Studies and Reports:

2.1. Defining the problem

2.1.1. The purpose of conducting the FRA 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 facility.

2.1.2. The objectives of the FRA might be associated with the risk to life (occupants or fire fighters), the risk to property, the risk to operations (e.g., cost of business interruption), the risk to the environment, or the risk of Loss of cultural resources.

2.2. Elements of Risk

2.2.1. The elements at risk should be identified. These elements could be any or all of the following.

2.2.1.1. People (occupants, employees, general public, emergency responders).

2.2.1.2. Property (structures, systems, components of the built environment)

2.2.1.3. Environment (national parks, monuments, hazardous materials)

2.2.1.4. Mission (heritage, business continuity, information/ communication)

2.3. Guidelines for conducting Risk Assessment

2.3.1. 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 of the source or derivation of all equations that are not in common usage.

2.3.2. 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.

2.3.3. As a general guideline, **Table 17.1.** Should be followed for Risk Assessment methods.

2.3.4. **NFPA 550, NFPA 551, NFPA Handbooks** have been referred for this chapter. Consultants and House of Expertise shall refer to these documents for further details and RA methodology.

Table 17.1: Guidelines for Risk Assessment	
OCCUPANCY	**REQUIREMENTS**

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 co-ordination with Civil Defence. 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).
3. FIRE SCENARIOS	**1. GENERAL** i. The FRA should address the risk contribution from all potentially significant fire scenarios. When approximations are used (e.g., the risk contribution fro 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 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. **3. FIRE GROWTH** i. Based on all probable developments of a fire, from smoldering to flash-over 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. **4. 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. **5. 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. **6. FAILURE OF CIVIL DEFENCE EARLY RESPONSE** 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.

Table 17.1: Guidelines for Risk Assessment

OCCUPANCY	REQUIREMENTS
4. RA METHODS	i. 5 RA methodologies mentioned below are defined in Table 17.1.a. a) Qualitative method b) Semi-quantitative likelihood method c) Semi-quantitative consequence method d) Quantitative method e) Cost benefit risk methods

Table 17.1.a: RA Methodology

CATEGORY	DIVISION	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 flash-over iii. Determination of probability of fatalities in other rooms or floors of building iv. Plot of frequency versus number of fatalities v. Plot of frequency versus size of loss vi. Determination of likelihood of injuries, fatalities, property damage, and business interruption	i. FRAs to determine probability of reactor-core melt due to fire at a nuclear power plant Event tree analysis combined with fire models.

		vii. Determination of individual risk (to building occupants) and of societal risk (to entire population)	
5. **COST BENEFIT RISK METHODS**	Include determination of costs of alternative approaches to limit consequences and/or likelihoods	i. Determination of costs required to achieve various levels of risk reduction 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 17.1: Guidelines for Risk Assessment	
OCCUPANCY	**REQUIREMENTS**
5. **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

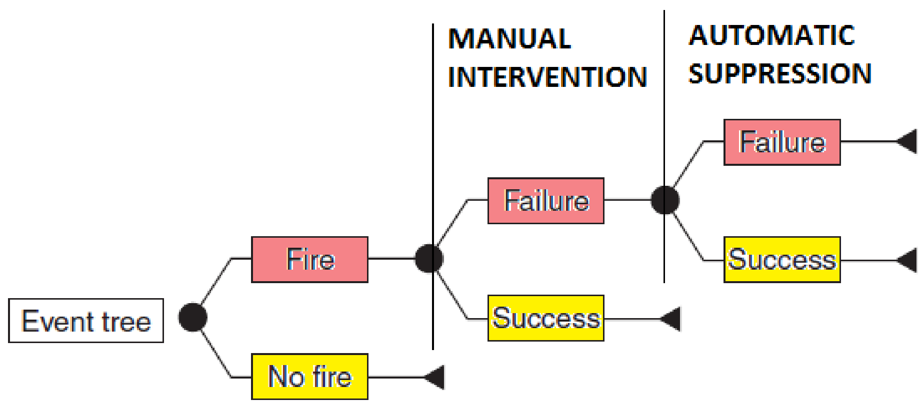
	fixed by the variables that establish the environment in which it occurs. The physical conditions that determine the progress and outcome of the fire are dependent on the fire scenarios, discussed earlier. iii. Deterministic models can incorporate our empirical knowledge of fire phenomena and the calculations 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.
5. **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. Fire alarms are random events that are, within certain constraints, uniform in nature. That is, a fire or fire alarm might occur at any time with equal probability. **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.
5. 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.
5. **FIRE MODELS**	**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, and 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 ASETB version. **4. b. CFAST** i CFAST (Consolidated Model of Fire Growth and Smoke Transport) is a multi-room 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. **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. **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 Naiver-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 pre-wetting. 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 Naiver-Stokes) MODELS** i. There are many commercially available CFD models. These general-purpose CFD models are designed to so a wide range of flow phenomena including steady and transient, laminar and turbulent and in-compressible 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 multi-phase 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. **5.c. ASCOS (Analysis of Smoke Control Systems) MODELS** i. ASCOS is a program for steady air flow analysis of smoke control systems. This pro- gram 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.
6. 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.

<table>
<tr><td></td><td>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.</td></tr>
<tr><td colspan="2">

A SIMPLE EVENT TREE FOR ILLUSTRATION</td></tr>
<tr><td>7. FAULT TREE</td><td>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.</td></tr>
</table>

	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
8. 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 17.1.b.** iii. The severity categories are mentioned in **Table 17.1.c.**

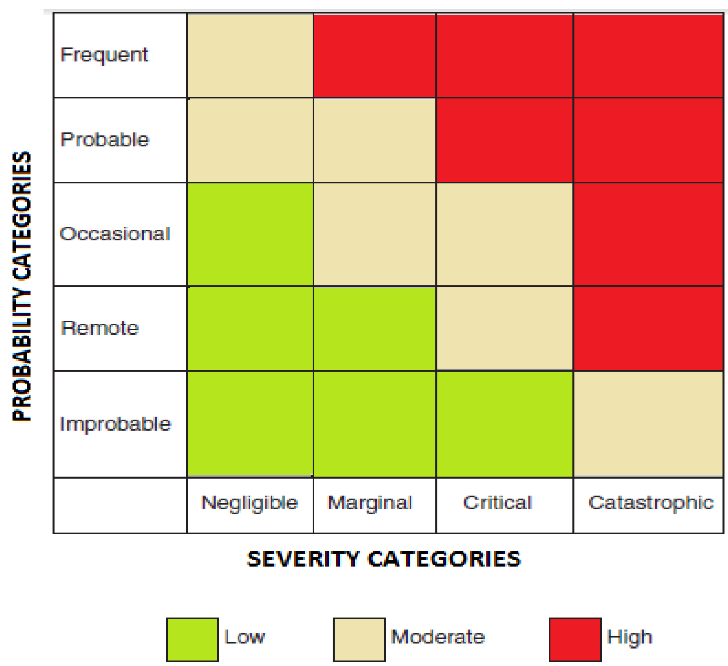
Table 17.1.b.: Probability Levels

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)

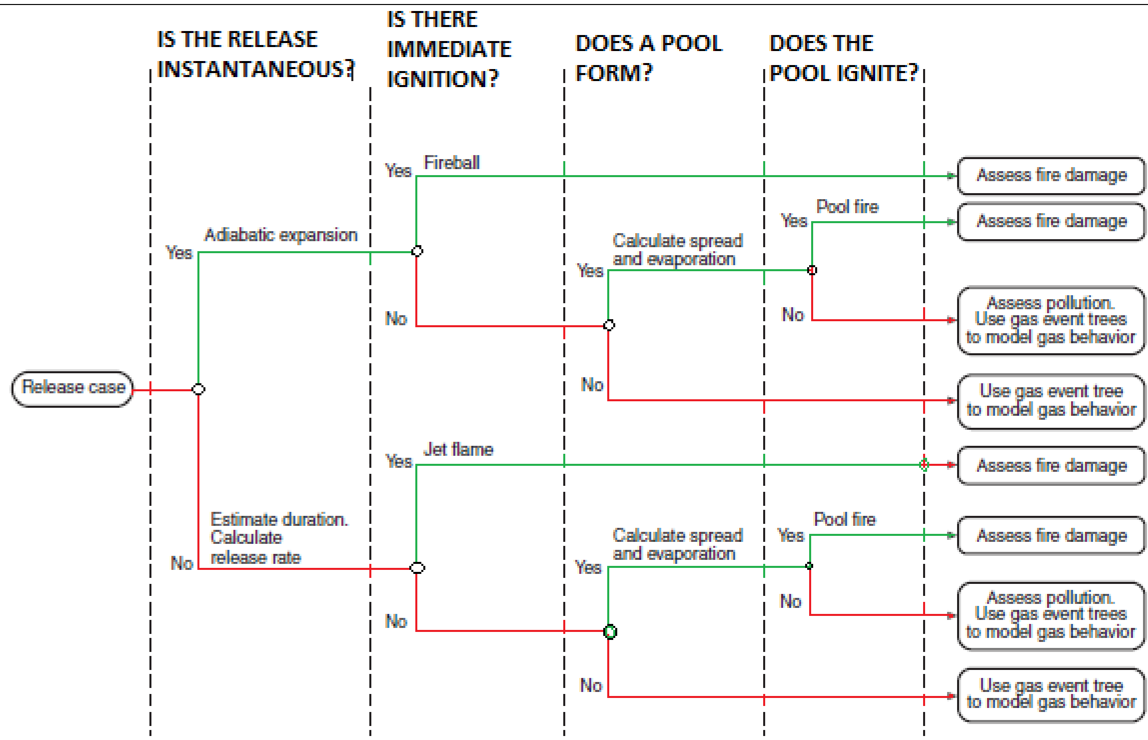
Table 17.1.c.: Severity Categories

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 17.1: Guidelines for Risk Assessment	
OCCUPANCY	**REQUIRMENTS**
9. FIRE AND EXPLOSION INDEX (F&EI) SYSTEM MATERIAL FACTOR (MF) **FOR PROCESS AND STORAGE HAZARD VALUATION**	**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 rise 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 **17.1.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 17.1.d.: Material Factor (MF) Example

Flammability	Reactivity Nr=0	Nr=1	Nr=2	Nr=3	Nr=4
Nf = 0	1	14	24	29	40
Nf = 1	4	14	24	29	40
Nf = 2	10	14	24	29	40
Nf = 3	16	16	24	29	40
Nf = 4	21	21	24	29	40

Table 17.1: Guidelines for Risk Assessment

OCCUPANCY	REQUIRMENTS
9. FIRE AND EXPLOSION INDEX (F&EI) SYSTEM MATERIAL FACTOR (MF) FOR PROCESS AND STORAGE HAZARD VALUATION	**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.**

10. FIRE AND EX-PLOSION INDEX (F&EI) SYSTEM MA-TERIAL FACTOR (MF) FOR PROCESS AND STORAGE HAZARD VALUATIO	**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 17.1.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 17.1.e.: Material Factor (MF) Example	
Nh	**Th**
0	0
1	50
2	125
3	250
4	325

Table 17.1.f.: Material Factor (MF) Example	
Threshold Limit Values (TLV)	**Penalty Factor (Ts)**
< 5	0

5 - 10	50
> 50	125

2.4. Documentation of Risk Assessment Studies

2.4.1. Risk Assessment Studies and reports shall be documented as per **Table 17.2.**

Table 17.2: Risk Assessment Reports and Documentation

ITEM	REQUIREMENTS
1. RISK ASSESSMENT RE-POR	**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, Civil Defence, 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 Civil Defence approved House of Expertise for Civil Defence approval. v. Where consultants, experienced field experts, non-registered parties prepare Risk Assessment reports, Civil Defence approved 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 Civil Defence 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 laypeople. **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. **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 the Civil Defence. 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 Pre-planning. 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.
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 out-comes 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 rankings 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. **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.

	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 scenarios used are representative of the spectrum of scenarios that could occur. **4.d. UNCERTAINTY ALANLYSIS** 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. **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.

2.5. Operation and Maintenance Manual

2.5.1. 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.

2.5.2. The operation and maintenance shall be documented as per **Table 17.3.**

Table 17.3: Risk Assessment Reports and Documentation

ITEM	REQUIREMENTS
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. **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 No.: 11

Fire Risk Assessment

(FRA)

In this Chapter:

- FRA (Fire Risk Assessment Steps.
- FRA Report requirements.
- Operation and maintenance for FRA validity.

Intent of the Chapter:

- To provide an over view of methods of conducting Fire Risk Assessment (FRA) Studies.
- To provide guideline for analysis and evaluation of Fire Risk Assessment (FRA) for a given fire safety problem.

I. purpose

The purpose of this Chapter is to provide Companies with a common standard for carrying out Fire Risk Assessment (FRA) and to ensure consistency in approach throughout the Companies. FRA is an important qualitative technique for analyzing fire potential in any location and is effective in identifying ways to enhance fire prevention and fire control.

This document is **not** intended to provide standards for engineering personnel engaged in the design and selection of fire prevention/detection/fighting facilities as required in onshore and/or offshore facilities and buildings. These topics are subject to the much more detailed standards as provided by e.g. NFPA (National Fire Protection Association) and/or British Standards (BS) documentation.

Also, this document is **not** intended to provide detailed standards for fire risk assessment as required for onshore and/or offshore facilities with fire hazards that are considered to have Major Accident Potential, such as Loss of Containment (LOC) of hydrocarbon liquids or gases. The risk analysis for such facilities are subject to standards that are much more detailed, specific and complex than those provided in this Manual.

This Manual details the general requirements for conducting and managing elementary FRA and the methods to be used. This document is aimed at supervisors and other line personnel who are responsible for operating and maintenance of facilities, buildings and workshops.

Conducting FRAs in accordance with this Chapter will assist Companies to fulfil their obligations under Egyptian Law. FRAs will help identify any areas of non-compliance so that corrective action can be taken.

II. DEFINITIONS & GLOSSARY OF TERMS

Competent Person	A person with adequate and sufficient training or experience (or a combination of both) to be capable of carrying out a task safely and efficiently.
Fire Emergency Plan	In the context of this Chapter, the Fire Emergency Plan is a document which details the actions to be taken in the event of a fire.
Fire Risk Assessment [FRA]	Qualitative technique for analyzing fire potential and identifying fire prevention and fire control measures.
Major Accident	Major accident means an "Uncontrolled Occurrence' in the operation of a site which leads to severe or catastrophic consequences to people, assets, the environment and/or company reputation (as defined in the EGPC HSE Risk Management Guidelines). The consequences may be immediate or delayed and may occur outside as well as inside the site. There will also be a high potential for escalation. The definition of 'Major accident' specifically excludes 'Occupational accidents' which have bounded, albeit possibly severe or accidents' which have bounded, albeit possibly severe or catastrophic consequences. This means that one or more pedestrian fatalities resulting from a road accident on a site (however regrettable and tragic) would not be defined as a 'Major Accident'. Similarly, one or more fatalities resulting from a fall from a scaffolding platform (again regrettable and tragic) would not be defined as a 'Major Accident'. The purpose of this definition of 'Major accident' is to identify 'Major Hazard Sites' for the purposes of this Manual. 'Major Hazard Site Operators' will be required to prepare a COMAH Report and submit it to EGPC.
Major Accident Hazard	A hazard that has the potential to result in a 'Major Accident'
Major Accident Potential	A scenario where the conditions, substances and materials on a site, and the location of the site, are such that a 'Major Accident Hazard' is present and there is therefore the possibility of a 'Major Accident'.
NFPA	National Fire Prevention Association (U.S.), the standard setting organization for fire safety in design and operation of industrial facilities, buildings and offices.
Normally Present	People normally present at a workplace are those whose normal place of work is that workplace. It includes Company employees and contractors, but not visitors.

Permit to Work [PTW] System	The system that allows central control and on-going monitoring of activities on a site and in particular to ensure that activities are authorized, carried out by qualified personnel using appropriate safety precautions and that activities with potentially hazardous interactions do not take place at the same time.
Primary Containment	Equipment that contains hazardous material such as flammable liquid or LPG and prevents it reaching the environment. (See also Secondary Containment).
Secondary Containment	Equipment or structures that prevent the spread of hazardous material such as flammable liquid or LPG in the event of spillage / leakage from primary containment.
Workplace	A location owned by a Company or a location where plant is operated by, or on behalf of, an Company.

1 INTRODUCTION

Fire Risk Assessment (FRA) is a qualitative tool for assessing fire potential and identifying ways both to prevent and to control fires. This Chapter details:

- The facilities and buildings for which Companies must carry out FRA (Section 2).
- The method which Companies must use to carry out FRAs (Section 3).
- Common fire hazards that Companies must consider in an FRA (Section 4).
- How Companies must identify people who may be at risk in a fire (Section 5).
- How Companies must evaluate the risk of fire and identify the need for additional fire prevention and control measures (Section 6).
- How Companies must record FRAs, including requirements for developing a Fire Emergency Plan to be followed in case of fire and documentation of training and exercises (Section 7).
- How and when Companies must revise FRAs and associated documentation (Section 8).
- Special requirements that Companies must take into account when preparing FRAs for workplaces where quantities of Liquefied Petroleum Gas (LPG) or other highly flammable materials are present (Section 9).

2 APPLICATION

EGPC requires all Companies to carry out a Fire Risk Assessment [FRA] for all workplaces for which they are responsible, either as owner or as occupier/operator [Ref. 1]. This Chapter explains how to carry out a FRA and how to deal with FRA follow-up and revision.

The methodology and principles described in this Chapter apply to all places where people work i.e. open areas, plant (and buildings), workshops, offices and warehouses. It also covers storage of flammable liquids and liquefied petroleum gases in fixed systems and transportable containers.

With reference to Section I. ('Purpose') this Chapter is not intended as a reference during engineering/design of new onshore or offshore facilities and/or buildings.

Also, and with reference to Section I – Purpose, this manual is not intended to cover in detail the fire hazards that are considered as having Major Accident Potential i.e. specifically Loss of Containment of hydrocarbon liquids and./or gases. When following this Manual will automatically encounter these hazards, however, the detailed risk assessment process for these is more complex. Fire risks analysis results relating to hazards with Major Accident Potential must be formally published in the COMAH Report, which must be submitted to EGPC for approval.

3 OUTLINE OF FIRE RISK ASSEMMENT

The objective of a FRA is to assess the probability of fire in the workplace occurring and it potential consequences in order to determine the risks to People, The FRA can be carried out as part of a more general risk assessment or as a specific exercise.

A FRA is not a theoretical exercise. Whilst some work can be done on paper based on knowledge of the workplace, a tour of the workplace must be undertaken to confirm, amend or add detail. There are five steps in a FRA:

Step 1:	Identify potential fire hazards and threats in the workplace (Section 4).
Step 2:	Decide who (e.g. employees, contractors, visitors.) might be in danger in the event of a fire and note their location (Section 5).
Step 3:	Evaluate the risks arising from the hazards and decide whether the existing fire precautions are adequate, or whether more should be done to prevent fires (preferable) or to reduce their potential effects (Section 6).
Step 4:	Record the findings of Steps 1-3 and details of any action taken to prevent fires, or reduce their potential effects. Ensure that employees and other affected personnel are told about the findings (Section 7).
Step 5:	Keep the assessment under review and revise it when necessary (Section 8).

The flowchart in Figure 3.1 details the FRA process and expands on the five steps.

Companies must involve in FRAs representatives of the people who work at the workplace for which the assessment is being carried out. They will have a valuable contribution to make, will help identify key issues and may have practical suggestions for improvements. The FRA must be thoroughly planned to include:

- Who will be involved?
- When it will take place?
- When the tour of the workplace will take place?
- How responsibilities for any changes will be assigned?
- How any changes will be communicated to those who need to know?
- A Remedial Action Plan to follow up FRA recommendations, including specific actions to be taken, person(s) responsible for action and close-out strategy.

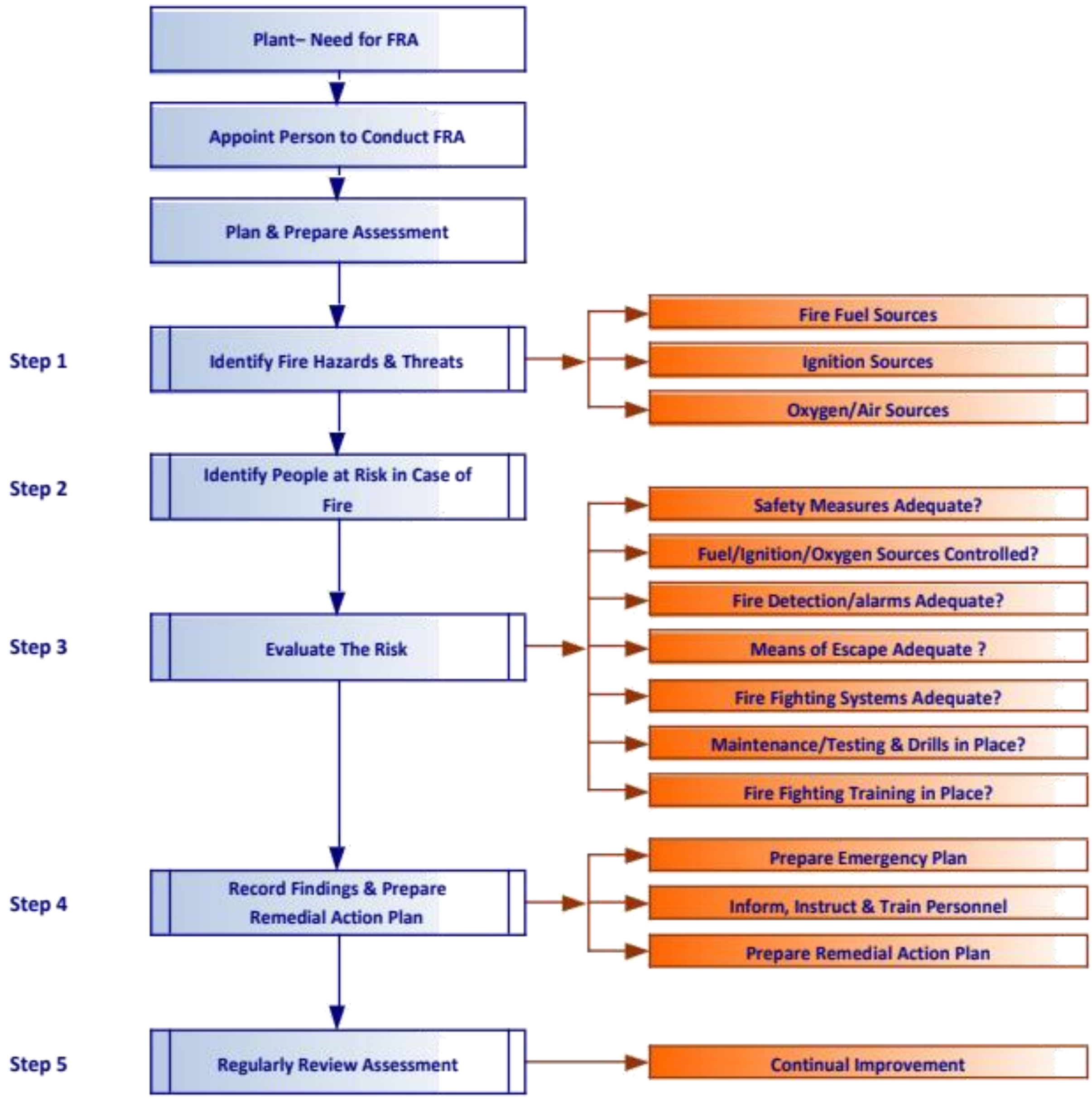


Figure 3.1: Fire Risk Assessment Process

FRA is essentially a matter of applying a systematic approach and a number of relatively simple principles. The objective is to identify those hazards and threats that could be reasonably expected to lead to a fire. It is important to concentrate on significant hazards and take immediate action to correct.

The FRA must be carried out in a practical and systematic way. It must take the whole of the workplace into account, including outdoor locations and any rooms or areas that are rarely used. If the workplace is small, it may be possible to assess it as a whole. In larger workplaces, divide the workplace into a series of assessment areas of manageable size. Natural boundaries and clear nomenclature must be used, e.g. Process Area, Office, Stores, Mechanical Workshop, South Stairwell, External Routes etc., as appropriate. Include a sketch of the division of the workplace and nomenclature in the assessment record.

If more than one Company or third party shares the workplace it will be necessary to discuss the FRA with them and coordinate activities. In such cases, it is important to ensure that the FRA adequately addresses the interface between organizations.

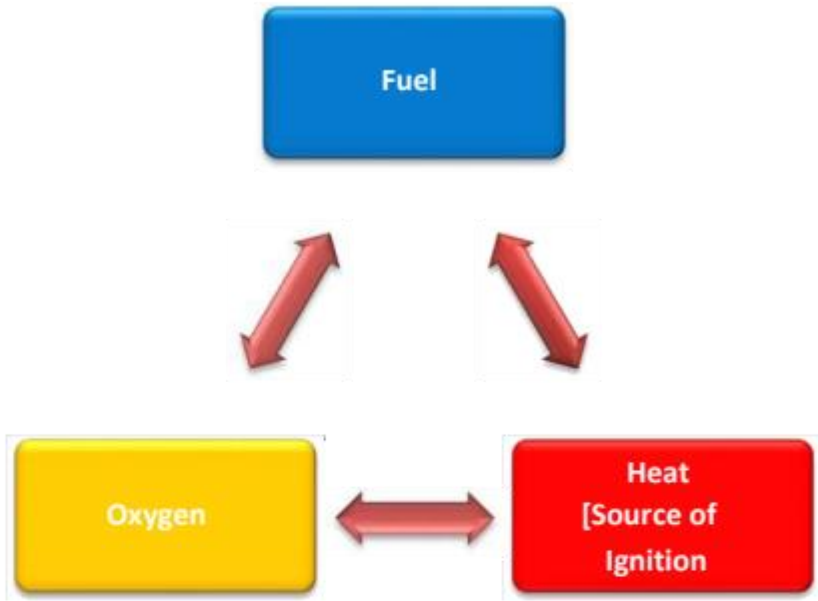
For example, does one organization have the responsibility for servicing fire extinguishers or smoke detectors in workplace areas occupied by the other organization? Who has responsibility for the scheduling and carrying out of fire warning tests and fire drills where these can affect both organizations?

If required, refer to relevant NFPA [Ref. 15], BS or other standards for further detail.

4 IDENTIFYING FIRE HAZARDS & THREATS

4.1 Fire Hazards

Three elements are needed to start a fire, as shown below:



Oxygen is always present in the air (20.8%), so identifying fire hazards primarily involves identifying fuels and ignition sources and the mechanisms that can bring the three elements together.

4.2 Sources of Fuel

Any substance that burns is fuel for a fire, and thus a hazard. When carrying out the FRA, identify substances that will burn easily and that are present in sufficient quantity to provide fuel for a fire, or which might cause a fire to spread to another fuel source.

Some of the most common fuels are:

- Flammable liquid based products such as paints, varnishes, thinners and adhesives.
- Flammable liquids and solvents such as crude oil, intermediates and refined products (e.g. petrol), white spirit, methylated spirit and paraffin. Consider that where flammable liquid has impregnated wood, textiles or other materials, it increasing the fire potential.
- Chemicals such as sulphuric acids, nitric acids and other oxidizers.
- Wood, paper and card.
- Plastics, rubber and foam such as polystyrene and polyurethane, including foams used in upholstered furniture.
- Flammable gases such as LPG, natural gas and acetylene.
- Molten metals or reactive powders such as Sodium, Magnesium, Titanium, Zirconium, metal powders

- Furniture (including fixtures and fittings) and textiles such as carpets, curtains and clothing.
- Packaging material.
- Waste materials such as wood shavings, off-cuts, dust, waste paper and textiles.

It is also necessary to consider the construction of the workplace and how this might contribute to the spread of fire. In particular, buildings must be inspected to see if they contain large amounts of:

- Hardboard, chipboard or block board in the construction of internal walls or ceilings.
- Synthetic ceiling or wall coverings such as polystyrene tiles.

If such features are present and they cannot easily be removed, then seek expert advice on the precautions necessary to reduce risks to people in the event of a fire.

4.3 Sources of Ignition

Sources of ignition are threats i.e. without these the fire hazards will never result in a fire. Common types of ignition sources found in workplaces include hot surfaces, electrical equipment and static electricity, naked flames/smoking, welding and oxyacetylene torches.

Companies must identify potential sources in the workplace by assessing the probabilities for sources of ignitions. Some common examples are

- Smokers materials such as cigarettes/cigars and especially unextinguished discarded cigarette buds.
- Naked flames e.g. cigarette lighters, matches, pilot flames.
- Electrical, gas or oil fired heaters (fixed or portable).
- Work processes that generate heat such as welding or grinding.
- Kitchen and cooking equipment e.g. kettles, water heaters.
- Electrical extension cords and/or adaptor e.g. excessive number of plugs connected into one socket, under-rated extension sockets or adaptor.
- Engines or boilers.
- Machinery.
- Faulty or misused electrical equipment e.g. photocopiers, computers, paper shredders, window and /or split AC units.
- Lighting equipment such as halogen lamps.
- Hot surfaces on equipment.
- Equipment with obstructed ventilation.
- Faulty cooling systems.
- Friction e.g. from bearings, bushes or drive belts.
- Static electricity.
- Metal impact e.g. metal hammer striking a tool or object.
- Uncontrolled chemical reaction (pyrophoric or exothermic).
- Arson.

Indications of "Near Misses" such as scorch marks on furniture or fittings, dis-colored or charred electric plugs and sockets, and cigarette burns, can help identify potential hazards.

4.4 Sources of Oxygen

Oxygen is also a threat i.e. without oxygen, and even with the hazard and ignition sources present, there will be no fire. The main source of oxygen for fires is the air and in an enclosed building air is supplied in two ways, and it is important that both these types of air supply are considered:

- Natural inflow through doors, windows and other openings; and
- Mechanical air conditioning and air handling systems.

Additional sources of oxygen may also be present at workplaces, such as:

Some chemicals (oxidizing agents) can provide fire with additional oxygen to assist burning. These chemicals will be identified as oxidizing agents by the appropriate HAZCHEM symbol and other information on the container they were delivered in. The manufacturer or supplier will be able to advise on safe storage and use and this must be available in the material safety data sheet (MSDS), which the supplier is obliged to provide.

Oxygen supplies from cylinder storage or piped systems, such as used in welding processes or for health care.

Vents from some types of inert gas generator can have higher oxygen content than ambient air.

Dry cell batteries e.g. commonplace Manganese Dioxide based dry cell batteries are a frequently overlooked oxygen source and can accelerate fires in the workplace environment.

5 IDENTIFYING PEOPLE AT RISK

If there is a fire, the main priority is to ensure that everybody is evacuated to a place of safety as quickly as possible. Putting the fire out is a secondary concern. Until people evacuate the workplace, they are vulnerable to the spread of fire, heat and smoke through the workplace. If the workplace does not have adequate means of detecting fires, giving warning or allowing escape, the fire may trap people or they may be overcome by heat or smoke, before they can evacuate. Companies must identify the people who are at risk from fire at all workplaces. This means consideration of where people are working, whether at permanent workstations and normally attended areas or in places that are rarely attended. Companies must also consider where people reside when not working but still on the premises, including places such as prayer rooms, canteens, rest/comfort rooms and toilet blocks. It is necessary to consider not only employees, but also other people who might be at risk including:

- Visitors.
- Contractors.
- Customers.
- Members of the public.

In considering above categories, special consideration must be given to disabled people (physically and/or visually) who may be at risk from fire and who may require special and/or assisted means of evacuation.

Consider also the potential effects on people outside the building or beyond the boundary fence.

6 EVALUATION OF RISK

6.1 Outline of Risk Evaluation

Step 3 of an FRA involves evaluating the risk to see whether further barriers or precautions are necessary to prevent fire or to minimize its affects. The basis for such evaluation must always be prioritization e.g. as per the EGPC Manual on HSE Risk Management [Ref. 2], in which risks are classified as High, Medium or Low. This means that:

Level 1 - High Risk (Red / Intolerable Risk Region)

The risk level is not acceptable and risk control measures are required to move the risk figure to be tolerable and in the ALARP region.. **Action must be Taken Immediately to Lower the Risk.**

Level 2 - Risk reduction measure (Amber / Medium–High-Risk Region):

The risk level shall be mandatory reduced applying suitable and sufficient corrective measures, provided that the implementation of such measures is ALARP.. **Risk Reduction Measures Must be Planned and Documented.**

Level 3 - Risk reduction measure (Yellow / Medium-Risk Region)

The risk level requires control measures, provided that the implementation of such measures is ALARP. **Risk Reduction Measures Must be Planned and Documented.**

Continuous improvement (Green / Low-Risk Region):

The risk level requires continuous monitoring to prevent deterioration or deviation from performance standards.

In developing the measures to reduce the risk, one must consider:

Whether it is practicable to eliminate sources of ignition.

Whether fuel sources can be eliminated or reduced in size.

The type and size of fires that are likely to occur, given the remaining fuel and ignition sources.

Whether the fire precautions in place are sufficient and appropriate for this remaining risk.

The alarm and warning system in place

Whether everyone will be warned in case of a fire.

Whether people will be able to make their escape safely.

The methods available of fighting the fire if it is safe to do so.

Whilst carrying out Step 3, it is important to appreciate that a FRA is an on-going process and is a means of reducing risks from fire, but is not an end in itself.

Where the risk evaluation shows that fire prevention or risk reduction measures are required, i.e. additional to those present, it is important to ensure that actions related to high risk issues are implemented at the earliest (immediately) and that all concerned personnel are informed.

All remedial actions or recommendations must be recorded (Section 7) in a Remedial Action Plan and the plan must determine for each remedial action or recommendation:

Who is responsible for implementing these?

Date by which these must be completed.

Who is responsible for communicating the nature of these actions to concerned personnel (i.e. those who needs to know).

When and how this communication will take place.

How completion of actions is to be verified and reviewed to confirm that they have the desired effect.

6.2 How Fire Spreads Through Buildings

In order to assess whether people will be at risk in the event of fire, it is important to have an understanding of the way a fire in a building can develop. Most people will be familiar with an outdoor fire, such as a bonfire, and will know that they can move back from it as it grows. If the wind is blowing smoke towards them, they can move right away from the fire to a safe place because they have a choice of escape routes, not affected by heat or smoke.

Fires in buildings or other enclosed spaces behave differently to fires in the open air. The smoke rising from the fire gets trapped by the ceiling and then spreads in all directions to form an ever-deepening layer over the entire room or space. During this process, the smoke will pass through any holes or gaps in the walls, ceiling or floor and will eventually reach other parts of the building. The heat from the fire also gets trapped in the building, greatly increasing temperature. Also, as much of the smoke is retained within the building, there is a much greater risk to people from the toxic substances in the smoke. People are therefore at greater risk from a fire indoors than one outdoors. It is essential that everyone can make their escape to a safe place, before the fire and its effects can trap them in the building.

Figure 6.1 is an illustration of how the effects of a fire can spread through a building.

It is important that the start of any fire is detected as quickly as possible, by fire detection or other means, and certainly before it can make means of escape unusable. People must have enough time to escape safely.

Typically this means that the fire must be detected within minutes of it starting, but specific detection time criteria must be determined depending on specific circumstances, especially the proximity of people and escape routes to the origin of the fire.

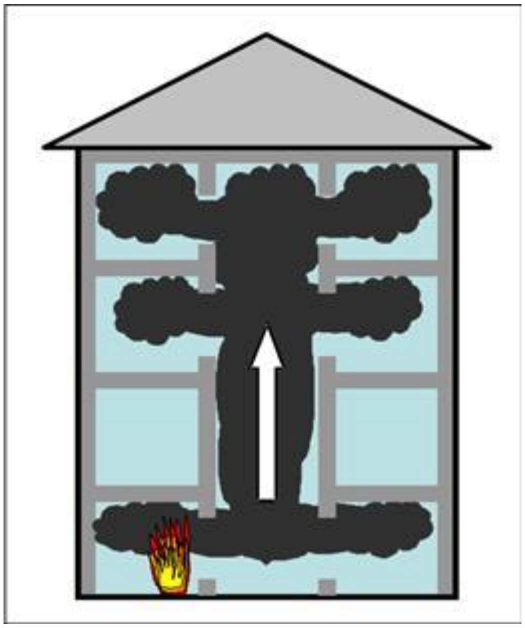


Figure 6.1: How Fire Spreads through a Building

Where quantities of highly flammable liquids and gases are involved, it may be necessary to detect the fire much faster (i.e. in seconds, rather than minutes), if people are to escape safely. Companies must review their detection systems and ensure they are appropriate for the level of risk identified in the FRA. If required, refer to the relevant detailed standards and codes for fire safety as provided in a variety of documents by Egyptian Code, HSE executive (U.K) and NFPA (U.S). Once a fire has been detected, all people must be signaled to evacuate the building by a suitable warning.

Particular attention must be given to:

Any areas, including normally occupied areas, where there could be a delay in detecting the start of a fire.

Any areas where the fire warning may go unnoticed e.g. because of high background noise levels.

People who may be unable to react quickly.

6.3 Reducing Sources of Ignition

Companies must seek to reduce the hazard from potential ignition sources by such actions as: Remove unnecessary sources of heat or replace them with safer alternatives and ensure that heat-producing equipment is used in accordance with the manufacturer's instructions and is properly maintained.

Installing machinery and equipment that has been specifically designed to minimize the risk of fire or explosion, rather than machinery and equipment that has not.

Ensure that all electrical fuses, circuit breakers and similar protective devices are of the correct rating and fit for purpose.

Ensure that sources of heat do not arise from faulty or overloaded electrical or mechanical equipment including overheated bearings.

Keep ducts and flue stacks clean.

If appropriate, use a Permit-To-Work system [Ref. 1] to control work that may result in a fire hazard, such as welding or flame cutting.

Operate a safe smoking policy by designating smoking areas and prohibiting smoking elsewhere.

Enforcing a prohibition on matches, lighters and other potential naked flame sources in areas with a high fire risk.

Ensure that all equipment that could provide a source of ignition when unattended or not in use is left in a safe condition i.e. turned off or isolated.

Making sure that any smoldering material (including smokers' material) is properly extinguished.

Taking precautions to avoid the risk of arson.

6.4 Minimizing Fuel Sources

Inventories of potential fuel for a fire must be reduced to a practical minimum, subject to operational requirements. Some ways to reduce the potential fuel for a fire include:

Remove flammable materials and substances, or reduce quantities to the minimum required for business operation.

Replace flammable materials and substances with less hazardous alternatives. Ensure flammable materials, liquids (and vapours) and gases are handled, transported, stored and used properly.

Ensure adequate separation distances between flammable materials, especially in storage areas.

Store highly flammable substances in fire-resisting stores.

Where it is necessary to keep highly flammable materials in work areas, make certain that only the minimum quantity is present and that the material is kept in a fire-resistant cabinet.

Remove or alternatively, cover or treat large areas of flammable wall and ceiling linings with fire resistant material/coating.

Ensure that flammable waste materials and rubbish are not allowed to build up and are carefully stored prior to disposal.

Take action to avoid storage areas being vulnerable to arson or vandalism.

Ensure good housekeeping.

Improve the fire resistance of the construction of the work place.

6.5 Reducing Sources of Oxygen

Ways to reduce the amount of oxygen available to a fire include:

Closing all doors, windows and other openings that are not required for ventilation, especially out of working hours.

Shutting down ventilation systems that are not essential to the function of the workplace. Not storing oxidizing materials near or with any other heat source or flammable materials. Controlling the use and storage of oxygen cylinders, ensuring that they are not leaking and their location is adequately ventilated.

Ensuring oxygen-enriched vents from inert gas generators or similar are located outside the building and away from fuel sources and ignition sources.

6.6 Fire Detection and Fire Warning Systems

In workplaces where a fire is unlikely to cut off the means of escape, for example open areas and single-storey buildings, where all exits are visible and the distances to be travelled are small, it is likely that any fire will be quickly detected by the people present. A shout of "Fire" may be all that is needed.

In larger workplaces, particularly multi-storey buildings, an electrical fire warning system with manually operated initiation points is likely to be the minimum facility needed. Automatic fire detection will be necessary in normally unoccupied areas, where a fire could start and develop to the extent that escape routes may become affected, before it is discovered.

Points that must be checked in the FRA are as follows:

Can the existing means of detection discover a fire quickly enough to raise an alarm in time for all the occupants to escape to a safe place?

Can the means for giving warning be clearly heard and understood throughout the whole premises when initiated from any single point?

If the fire detection and warning system is electrically powered, does it have an uninterrupted back up power supply?

Does everybody at the workplace know about the fire warning system? Do they know how to operate it and respond to it?

Are there instructions posted to remind people how to operate the fire warning system? Are there instructions posted to remind people how to respond when the fire warning activates?

Are the fire detection and fire warning arrangements in the Fire Emergency Plan?

If required, refer to the relevant detailed standards and codes for fire safety as provided in a variety of documents by HSE executive (U.K) and NFPA (U.S).

6.7 Means of Escape

Once a fire is detected and a warning given, everyone in the workplace must be able to evacuate without undue risk.

Companies must assess the means of escape by considering whether people can escape to a safe place, before being cut off and exposed to risk of injury.

In buildings, most deaths by fire are due to the inhalation of smoke. It is also true that many people are unwilling to travel more than a few meters through smoke to make their escape. Therefore, and with view to the possibilities of escape routes being blocked by smoke, it is important to provide alternative escape routes for people to escape safely from the building.

In small single-story premises, where travel distances are short, the time taken to escape once the warning has been given can often be measured in seconds rather than minutes. In such cases, it is likely that the normal exits will be sufficient in a fire emergency. In larger premises, where travel distances are greater and where it is possible for a single escape route to be affected by fire, heat or smoke, then two means of escape from each area may be necessary.

Points which must be checked in the FRA are:

How long will it take for people to escape to a safe place once a fire has been detected?

Is the escape time reasonable, or is it too long in view of the risk of fire and smoke spreading?

Are there enough exits and are they in the right place?

Are the type and size of exits suitable and of sufficient number for the people likely to need them?

Are there any special requirements to preserve the modesty of women, who may be present?

Are there special needs that must be catered for such as wheel chair users, the visually impaired and the hearing impaired?

Could a fire affect all exits? At least one route from any part of the building should remain available until everybody has escaped.

Are all escape routes easily identifiable, free from obstruction and adequately illuminated? Are people trained in using the means of escape?

Are there instructions posted about the means of escape?

Are the arrangements for escape included in the Fire Emergency Plan?

Is a smoke control system required (e.g. smoke duct or extractor)?

If required, refer to the relevant detailed standards and codes for fire safety as provided in a variety of documents by HSE executive (U.K) and NFPA (U.S).

6.8 Means of Fighting Fire

It is essential to provide sufficient firefighting equipment so that those who are trained in its use can extinguish a fire in its early stages, provided this does not place them in danger. The equipment provided must be suitable for the fire hazards and risks present.

Large buildings and premises that are more complex will need strategically sited portable extinguishers. Hose reels, fire blankets, sprinklers or fixed extinguishing systems may also be required, depending on the extent and the type of fire hazard.

Hose reels should be located where they are conspicuous and always accessible, such as in corridors.

Fire blankets should be located in the vicinity of the fire hazard they are to be used on and should be conspicuous.

The design of firefighting facilities must conform to good international practice (e.g. BS 5306 [Ref. 5] and BS EN 3 -7:2004+A1:2007 [Ref. 6]) and be fit for purpose. Equipment must be maintained in a condition ready for use according to the manufacturer's instructions.

Points to check during the FRA are as follows:

Are the extinguishers suitable for purpose and of sufficient capacity?

Are there sufficient extinguishers visibly sited throughout the workplace?

Are the right types of extinguishers located close to the fire hazards and can users gain access to them without exposing themselves to risk?

Are the locations of extinguishers obvious or does attention need to be drawn to them in some way?

Have the people likely to use the extinguishers been given adequate training and instruction?

Is use of firefighting equipment included in the Fire Emergency Plan?

Note:

New types of extinguishers comply with European Standard BS EN 3- 7:2004+A1:2007 [Ref. 5]. They have all red bodies and optional zones of color, up to 5% of the total surface area, to indicate extinguisher contents.

Extinguishers, which comply with the previous standard, BS 5423:1987 have all red bodies (water), all (dry power), all (carbon dioxide) and all (foam).

6.9 Maintenance and Testing

The fire safety measures and equipment must be kept in effective working order. This includes all fixtures and fittings such as fire doors, fire detection and alarm systems, fire-fighting equipment, notices and emergency lighting. Formal checks, periodic servicing and maintenance must be carried out regularly and systematically. Maintenance and testing of fire detection and fire protection facilities and equipment must be in accordance with acceptable standards (e.g. NFPA, BS or HSE Executive requirements). Any defects must be remedied as quickly as possible.

Companies must ensure that the responsibility for carrying out checks and periodic servicing and maintenance is clearly documented. To ensure safe and reliable operation, checks, periodic servicing, maintenance and repairs of fire-fighting equipment and installed systems such as fire- alarms and emergency lighting, must be carried out by competent persons. A record of the work carried out on such equipment and systems will help demonstrate compliance with both Federal Law Number 8 and this Manual.

Points to check during the FRA are as follows:

Is there a system in place for regular checking of all fire doors and escape routes and associated lighting and signs?

Is there a system in place for regular checking of firefighting equipment?

Is there a system in place for regular checking of fire detection and alarm equipment?

Is there a system in place for regular checking of other equipment provided to assist escape or escape arrangements?

Are there instructions about testing of equipment, which are accessible for those who carry out the testing?

Are those who test and maintain equipment properly trained to do so?

As a general rule, maintenance intervals must consider vendor recommendations, with practical intervals. Table 1 summarizes good practice for routine maintenance and testing of fire safety equipment. Other fixtures and fittings relevant to fire safety, such as fire doors, escape routes through corridors, staircases and notices to direct to safe escape routes, must also be checked regularly.

Table 6.1: Fire Safety Equipment Maintenance

Equipment	Period	Activity
Fire detection and fire	Weekly	Check all systems for state of repair and

warning systems including self-contained smoke alarms and manually operated devices		Operation. Repair or replace defective units. Test operation of systems, self-contained alarms and manually operated devices
	Annually	Full check and test of system by competent service engineer. Clean self-contained smoke-alarms and change batteries.
Emergency lighting equipment including self-contained units and torches	Weekly	Operate torches and replace batteries as required. Repair or replace any defective unit.
	Monthly	Check all systems, units and torches for state of repair and apparent working order.
	Annually	Full check and test of systems and units by competent person. Replace batteries in torches.
Fire-fighting equipment including hose reels	Weekly	Check all equipment for correct installation and Apparent working order.
	Annually	Full check and test by a competent person.

6.10 Fire Procedures and Training

In the event of a fire, all people at the workplace must know what to do. Adequate Pre-planning procedures must be in place in the Fire Emergency Plan, which must be integrated in the Facility Incident Response Plan

All personnel who are normally working at the workplace that is covered by the Fire Emergency Plan, must be trained in the implementation of the plan. Personnel visiting the workplace must receive an appropriate level of induction in the fire safety procedures, unless they are to be accompanied at all times by a trained person. Training levels and frequency will depend on the role of the person during a fire. If required, refer to relevant NFPA, BS or other detailed guidelines for further detail.

The Fire Emergency Plan must be tested regularly by fire drills and other appropriate activities.

The Fire Emergency Plan for small premises is likely to be relatively simple, but for larger premises the procedures must be more comprehensive and may need to assign specific responsibilities, such as for confirming that all people have evacuated to a safe place, or for liaison with the emergency services. The Fire Emergency Plan will need to take account of all people who could be on the premises at any time.

Points to check are as follows:

- Is there a Fire Emergency Plan?
- Does the Fire Emergency Plan take account of all reasonably foreseeable circumstances?
- Are EGPC Company personnel and other relevant people trained in the use of the Emergency Plan and involved in testing it?
- Is the Fire Emergency Plan accessible to all who need to know its contents?
- Are the procedures to be followed in a fire clearly displayed throughout the workplace?
- Are all people considered who may be present when there is a fire, i.e. including those who may share the same buildings or facilities?

6.11 Ensure Safety is provided for all Persons in the Workplace

Ensure there is adequate provision for the safety of all persons who may be present in the workplace, some of whom may have special needs. Consider employees, contractors and visitors. Where relevant, make provision to preserve the modesty of women. Also give attention to those who may have special difficulties in case of fire, not only those with restricted mobility, but also to those who have poor hearing and eyesight or other form of disability.

All special facilities and procedures must be developed in conjunction with the affected people.

6.12 Practical Measures

In addition to basic fire precautions, there are other things that can be done to ensure a quick and safe evacuation of the workplace. These include:

- Maintain good housekeeping.
- Ensure escape routes are kept clear at all times.
- Ensure that suitable security measures are in place to reduce the risk of arson.
- Carrying out regular fire safety checks.

Do not store objects, even temporarily, in escape corridors, stairways or lobbies, which may cause obstruction or hinder safe escape. Ensure there are no flammable materials, including waste materials in these areas since they could support the spread of fire and make the escape route unsafe.

6.13 Security

Reduce the risk of arson by providing an appropriate level of security. Make certain that flammable materials stored outside buildings do not put the workplace at risk

6.14 Fire Safety Checks

Whilst the main goal of a FRA is to protect people from the risk of fire, the findings of the assessment may also help to protect the workplace whilst it is unoccupied. In addition, a full fire safety check carried out prior to vacating the workplace to ensure it is left in a safe condition will further this secondary goal. The check must include that:

- All windows and doors are closed, including doors that can be held open by automatic release devices.
- Electrical equipment not in use is switched off and, where appropriate, unplugged.
- Smokers' materials are not left smouldering.
- All naked flames are extinguished or left in a safe condition.
- All flammable rubbish and waste is removed to a safe place.
- All highly flammable materials are safely stored and, where relevant, secured.
- The workplace is secured against unauthorized entry.

7 RECORDING

7.1 Recording the Assessment

The significant findings of the FRA must be documented, together with details of any people identified as being at particular risk. It is recommended that entries be made in the written record as the tour of the workplace progresses. This will facilitate planning of actions necessary in light of the assessment's findings.

The significant findings of the FRA must be recorded on worksheets as per the example in Table 7.1. A suitably annotated plot plan of the Workplace must be included to clearly identify the scope of the assessment and areas mentioned in the worksheets. A good record of the assessment will also assist future review and revision of the assessment.

When the assessment is completed and fire precautions are in place, Companies must record details of maintenance and testing work related to the fire precautions. They must also record details of instruction and training given to people and when these activities took place. This will help demonstrate compliance with both EGYPT Law and with this Manual. Table 7.2 is an example training record.

Table 7.1: FRA Recording – Example

Table 7.2: Training Record – Example

Date of the training or drill	
Duration of training	
Fire drill evacuation times	
Name of instructor	
Names of people receiving training	
The nature of the training or drill	
Any observations / remedial action	

7.2 Fire Emergency Plan

The Fire Emergency Plan must detail the actions that persons in the workplace should take in the event of fire. It must be kept at the work place and must be available for perusal by all concerned personnel.

The Fire Emergency Plan must be made available for inspection by independent auditors and assessors, or by auditors/inspectors.

The Fire Emergency Plan must form the basis of the training and instruction for Company employees and others regarding fire safety in the workplace.

The purpose of the Fire Emergency Plan is to ensure that:

- People in the workplace know what to do if there is a fire.
- That the workplace can be safely evacuated in the event of a fire.

The Fire Emergency Plan must be developed, taking into account the results of the FRA.

For small workplaces, the Fire Emergency Plan may comprise simple instructions covering the above points in a Fire Action Notice. In large or complex workplaces, the Fire Emergency Plan should be more detailed. The Fire Emergency Plan must provide clear instructions for:

- The action people should take if they discover a fire.
- How people will be warned if there is a fire.
- Evacuation of the workplace.
- Where people should assemble after they have left the workplace
- Procedures for checking that the workplace has been evacuated and/or searching for missing persons.
- Identification of key escape routes, how people gain access to them and escape to a safe location.
- The fire-fighting equipment provided.
- The identity and duties of people who have designated responsibilities in the event of a fire.
- Arrangements for the safe evacuation of people identified as having special requirements or who may be especially at risk including, people who may be less familiar with fire safety procedures (e.g. contractors, visitors and children), people with disabilities and arrangements to preserve the modesty of women.
- Arrangements to stop machines, processes or power supplies that need to be stopped, shut off or isolated in the event of a fire.
- Specific arrangements for any areas of the workplace with high fire risk.
- Who is responsible for alerting emergency services (incl. Civil Defence Authorities for COMAH sites) and how this is to be done?
- Procedures for liaison with emergency services on arrival, especially notifying them of any special risks, e.g. location of highly flammable materials.
- Training to be given to Company employees and others who are normally present at the workplace.
- Arrangements for ensuring that training is given.

In larger or more complex workplaces, a plan of the workplace must be included in the Fire Emergency Plan. The plan must clearly identify:

- Essential features such as layout drawings of the workplace, escape routes, doorways, walls, partitions, corridors and stairways.
- Fire resistant structures and self-closing doors provided to secure the means of escape.
- Details of the number, type and location of fire-fighting equipment.
- The locations of manually operated fire alarm call points and control equipment for the fire alarm.
- The locations of emergency lighting units and any exit route signs.
- The location of any automatic or remotely actuated fire-fighting system and associated release equipment.
- The location of key shutoff devices for isolation of utilities such electrical supply, gas supply, oil supply, water supply, etc.

Where ownership, occupation or operation of workplaces is shared between Companies or third parties then the Fire Emergency Plan must be drawn up in consultation with the other organization or organizations.

7.3 Provision of Information and Instruction

Company employees and other persons normally present at the workplace must be given information about the fire precautions in the workplace and what to do in the event of a fire. Provision of this information must include people working at the workplace outside normal hours, such as workers on overtime or cleaners.

Ensure training and instruction, including the provision of written information, is given in a way that people can understand. Training and information provision must take into account levels of education and languages commonly spoken by workers at the site.

On their first day at the workplace, all people must be instructed on:

- The location and use of escape routes from where they are working.
- The location, operation and meaning of the fire warning system.

Fire action notices similar to the example given in Figure 7.1 complement this information and must be prominently posted in key locations throughout the workplace.

Note that Fire Action Notices must also incorporate a simple plan indicating routes to safe locations. The language of Fire action notices must be in Arabic and English. Further translation into other languages must also be included where appropriate.

If required, refer to relevant NFPA, British Standards or other detailed guidelines for further detail.

Example

Figure 7.1: Fire Action Notice - Example

7.4 Training Employees

The type of training required must be based on the particular features of the workplace and must:

- Explain the emergency procedures.
- Take into account the work activity, the duties and responsibilities of employees.
- Take account of the findings of the risk assessment.
- Be easy to understand – provision of training in employees' mother language must be considered.

All employees and other persons normally present, must be told about the evacuation arrangements and be shown the means of escape as soon as possible after first attending the premises.

Training must be conducted as often as necessary so that people remain familiar with the fire precautions in the workplace and are reminded about what to do in a fire emergency. Training once or twice a year should be sufficient. Those who work outside normal hours, such as cleaners, must be included. It is also important that all affected people are told about changes to the emergency procedures before the changes are implemented.

Training must include practical exercises, e.g. fire drills, to check people's understanding of the Fire Emergency Plan and to make them familiar with its operation. Observations noted during drills and/or post-drill meetings and corrective actions must be recorded and followed-up to close-out.

The training must include:

- The importance of general fire prevention and good housekeeping.
- The action to be taken on discovering a fire.
- How to raise the alarm and what action to be taken.
- The required response upon hearing the fire warning.
- The procedures for alerting those not normally present such as visitors and directing them to exits.
- The arrangements for alerting the emergency services.
- The evacuation procedures for everyone in the workplace.
- Location of and routes to assembly points in safe locations.
- Where appropriate, the location and use of fire-fighting equipment.
- The location of escape routes, especially those that are not in regular use.
- How to open any escape doors including the use of any emergency latches.
- The importance of keeping fire doors closed to prevent the spread of fire, heat and smoke.
- Where appropriate how to stop machines and processes and isolate power or other utilities.
- The reason for not using lifts (except for those specifically designed or adapted for use in evacuating people with impaired mobility).

In addition to the above training in general fire precautions and response, all persons normally present must be informed of the risks from flammable materials used or stored on the premises. They must also be trained in the precautions in place to control the risks, particularly their role in reducing and controlling sources of ignition and fuel. Those working in high-risk areas must receive specific training in safe operating procedures and emergency responses. Such training must cover:

- Standards and work practices for safe operation of plant and equipment, and safe handling of flammable materials (especially flammable liquids).
- Housekeeping in process areas.
- Reporting of faults and incidents, including leaks and spills of flammable liquids.
- Emergency procedures for plant or processes in the event of fire, spills or leaks.
- Relevant EGYPT law and EGPC and Company requirements.

All those identified as having a supervisory role in the Fire Emergency Plan or other specific duties associated with fire prevention and response must be given additional training so that they can fulfil their role. They must also be provided with the details of the FRA.

8 REVIEW & REVISION

The FRA must be reviewed and updated whenever:

- There is a change that might affect fire risks and precautions.

- After fires or high potential near misses.
- At least once every three years.

Examples of changes that might affect fire risks and precautions include, but are not necessarily limited to, changes in:

- Work processes.
- Furniture.
- Plant machinery.
- Electrical appliances
- Substances used.
- Buildings.
- Numbers of people present.

Any of these could lead to new fire hazards or increased risk. If there is any significant change, then Companies must review and update the FRA.

It is not necessary to amend the FRA for every trivial change, but if a change introduces significant new hazards and/or threats, it is important to consider them and to introduce whatever measures are required to control risks.

If a fire or a high potential near miss occurs, then the FRA must be reviewed, giving due consideration to the causes of the fire or near miss and to those safety systems and procedures that did not work as intended.

The emergency procedures and Fire Emergency Plan must be updated whenever required as a result of changes to the FRA. Companies must ensure appropriate people are informed of the update and its implications and carry out relevant training.

9 USE & STORAGE OF FLAMMABLE LIQUIDS & LPG

This section covers additional considerations when carrying out a FRA at a workplace where highly flammable liquids, including liquefied petroleum gases (LPG), are used or stored.

With a view to the inherent risks of Loss of Containment (LOC), flammable liquids and/or LPG will invariably be classified as Major Hazards with Major Accident Potential. Therefore, all projects for new facilities or modification of existing facilities that involve use and storage of flammable liquids and LPG will be invariably be required to prepare a site COMAH report . As part of the COMAH report, a detailed formal Fire Risk Assessment must be carried out for which detailed guidance is provided in the COMAH Manual .

The purpose of this section is *NOT* to duplicate the COMAH requirements but to provide elementary guidance to personnel involved in conducting FRAs in facilities and/or buildings for which a previous COMAH report is not yet available. In conducting a FRA in accordance with this Manual , one may encounter the use and storage of flammable liquids, which could lead to the conclusion that a COMAH report is required, if not already planned. Also the guidance below will assist, until such time that more detailed directions may become available via the COMAH analysis, in providing adequate barriers to manage the risk at ALARP level.

9.1 Fire Risk Assessment involving Flammable Liquid & LPG

Where there are flammable liquids or LPGs, the five-step process for FRA (see Section 3) also applies, however, the FRA must give special attention to the much larger potential consequences of fires associated with such materials. The main focus of the FRA must be to ensure that people are able to escape to a safe place, and the FRA must specifically address the measures to:

- Minimize the risk of spillage of flammable liquid.
- Minimize leakage of flammable gas.
- Minimize the risk of fire or explosion within storage tanks, containers or pressurized systems.
- Protect storage tanks, containers or pressurized systems from external fires external (i.e. fires that have started elsewhere and could not be contained).
- Minimize the consequences of a spill of flammable liquid or leak of flammable gas, particularly with regard to people and the environment.

Special factors that must also be considered include:

- Type of storage, storage capacity and inventories.
- Location of storage and process facilities in relation to site boundaries, buildings, process areas and fixed sources of ignition.
- Design standards.
- Quantities and locations of other combustible materials.
- Quantities and locations of other hazardous substances.
- Activities on adjacent premises.
- Training and supervision of site operatives.
- Frequency of deliveries of flammable liquids or LPG.
- Loading and unloading operations.
- Inspection and maintenance.
- Proximity of public buildings, residential areas, hospitals, schools and other buildings housing members of the public.

9.2 Containment

Systems that contain Flammable liquid and LPG must be designed and constructed to international standards to ensure their strength and integrity, which must be verified and monitored according to the company Integrity Assurance Framework Chapter.

Means to contain liquid spillage, including spillage during maintenance, must be provided to prevent the liquid spreading to other parts of the premises. In the FRA the following factors must be considered:

- The capacity of secondary containment compared to the likely spill size.
- The consequences of storage tank or vessel over filling (where does the material go?).
- The prevention of ignition of the material held in secondary containment.
- Disposal of collected material.

9.3 Site Layout and Separation of Hazards

Storage areas and other areas where with large inventories of flammable liquids or LPG (including storage of gas cylinders) must be separated from each other, from other fire hazards and from areas where people may congregate. This has the advantage of both protecting people and property from the effects of a fire in storage tanks, containers or vessels, and also of protecting the large flammable inventories from events that might happen elsewhere on the site.

It is recommended that separation distances be such as to provide sufficient time for people to evacuate to a safe place before involvement of additional storage inventories in the fire. Safe separation distance must be determined on a case-by-case basis, depending on stored inventories and area layouts.

9.4 Ventilation

Good ventilation ensures that any flammable vapor’s given off from a spill, leak or release will disperse rapidly. This can be achieved by locating items such as storage tanks, storage vessels, storage containers, transfer facilities (including loading/unloading) and vent pipes in the open air in a well-ventilated location.

The FRA must consider any factors which might reduce the ventilation, such as the temporary storage of equipment, containers or other large items.

9.5 Substitution

Consideration must be given to the elimination of use of flammable liquids and LPG and substitution by alternatives that have a higher flashpoint or that are essentially non-flammable.

Also consideration must be given to reducing the inventory of flammable liquids and LPG by better planning and stock control.

Companies must remove from the workplace any flammable materials that are no longer required.

9.6 Control of Ignition Sources

Flammable atmospheres can occur in certain areas, either during normal operation (vents) or due to accidental spillage or releases. Areas with the potential for flammable atmospheres are known as hazardous areas. Hazardous areas may be classified into three distinct zones, each with a different likelihood of a flammable atmosphere occurring. These zones are defined in Figure 9.1, below.

Zone 0

- A place in which an explosive atmosphere consisting of a mixture with air of dangerous substances in the form of gas vapour or mist is present **continuously or for long periods or frequently**.

Zone 1

- A place in which an explosive atmosphere consisting of a mixture with air of dangerous substances in the form of gas, vapour or mist is likely to occur **in normal operation [see notes below] occasionally**.

Zone 2

- A place in which an explosive atmosphere consisting of a mixture with air of dangerous substances in the form of gas, vapour or mist is not likely to occur in **normal operation but, if it does occur, will persist for a short period only.**

Figure 9.1: Definition of Hazardous Zones

These definitions are taken from British Standard BS EN 60079-10 (British Standards Institute, Electrical Apparatus for Explosive Atmospheres, Part 10: Classification of Hazardous Areas, [Ref. 8]), and are broadly consistent with the IP Code on Area Classification (Institute Of Petroleum, Area Classification Code for Petroleum Installations: Model Code of Safe Practice in the Petroleum Industry, [Ref. 9).

The extent of these zones is dependent on:

- Ventilation.

- Design of the tank, vessel or other primary containment system.
- The source of the release including pressure and temperature.
- The flashpoint of the material.
- The vapor density of the material.

The above International Standards on hazardous area classification quantify the extent of the zones, primarily for the selection of fixed electrical equipment in order to reduce the risk of coincidence of a hazardous atmosphere and an electrical ignition source to an acceptable level. The area classifications provided by these codes can also provide a basis for controlling other potential ignition sources, e.g. portable electrical equipment, hot surfaces and vehicles.

Where reasonably practicable, electrical equipment should be installed in non-classified areas rather than hazardous zones. Where this cannot be done, electrical equipment must be certified for the zone in which it is located, and installed and maintained accordingly.

Where a hazardous area classification has been carried out, the location of the zones must be recorded on a plan of the site. The three-dimensional nature of the hazardous area classification must be reflected on the plan. The plan can then be used to help prevent sources of ignition entering hazardous areas. The hazardous area plan and its implications must be considered in the FRA.

A system, usually the site Permit-To-Work System [Ref. 1], must be put in place to prevent the introduction of potential ignition sources to hazardous zones without appropriate precautions. The FRA must consider the potential for introduction of ignition sources such as those listed in Section 4.3.

9.7 Specific Risk Control Measures

Detailed guidance on specific control measures that may be effective in reducing risks from the storage and use of flammable liquids and LPG can be found in publications such as:

- The Storage of Flammable Liquids In Tanks [Ref. 10],
- The Storage of Flammable Liquids In Containers [Ref. 11],
- The Safe Use of Handling of Flammable Liquids [Ref. 12],
- Small Scale Use of LPG in Cylinders [Ref. 13]
- Use of LPG in Small Bulk Tanks [Ref. 14].

10 REFERENCES

1. EGPC Manual & Technical Guidance : EGPC-GEN-GL-008_HSE Risk Management
2. EGPC Manual & Technical Guidance : EGPC-PSM-ST-001-Risk-Management-Standard
3. Control of Substances Hazardous to Health Regulations 2002 Approved Chapter (L5), Health and Safety Executive (UK), HSE Books, 2002.

4. Fire Safety - An Employer's Guide, Health and Safety Executive (UK), HSE Books, 1999, ISBN 0 11 341229 0.

5. BS 5306-0:2011, Fire protection installations and equipment on premises. Guide for selection of installed systems and other fire equipment

6. BS EN 3-7:2004+A1:2007, Portable fire extinguishers. Characteristics, performance requirements and test methods

7. EGPC Chapter& Technical Guidance : EGPC-PSM-ST-002-Safety-Case-Standard

8. Electrical Apparatus for Explosive Atmospheres Part 10, Classification of Hazardous Areas BS EN 60079-10: 1996, British Standards Institute, 1996.

9. Area Classification Code for Petroleum Installations: Model Code of Safe Practice Part 15, Institute of Petroleum, 1990, ISBN 0 47 192160 2.

10. The Storage of Flammable Liquids in Tanks, Health and Safety Executive (UK), HSE Books, 1998, ISBN 0 7176 1470 0.

11. The Storage of Flammable Liquids in Containers, Health and Safety Executive (UK), HSE Books, Second Edition, 1998, ISBN 0 7176 1471 9.

12. The Safe Use And Handling Of Flammable Liquids HSG 140, HSE Book 1999 ISBN 716 09677, Health and Safety Executive (UK).

13. HSE Information Sheet, Small Scale Use of LPG in Cylinders, Chemical Sheet No. 5, Health and Safety Executive (UK).

14. HSE Information Sheet: Use of LPG in Small Bulk Tanks, Chemical Sheet No. 4, Health and Safety Executive (UK).

15. Relevant NFPA Guidelines and Codes e.g.:
   - Standard Design for the Identification of the Fire Hazards of Materials, NFPA 704
   - Code for Safety to Life from Fire in Buildings and Structures, NFPA 101
   - Flammable and Combustible Liquids code, NFPA 30

16. EGPC Manual & Technical Guidance: EGPC-GEN-GL-002_DEFINITION and Abbreviations.

Chapter No.: 12

Firefighting Helicopters on Offshore Platforms Recommendation

In this Chapter:

- Helicopter operations of the aerial work category are processes that contain high risks due to the operating conditions.
- The purpose of these guidelines is to support the oil & gas offshore industry in managing fire and safety risks related to helicopter operations.

Intent of the Chapter:

- How To Deal With Aircraft Fires
- To enable designers and owners to Choose extinguishers appropriately according to the hazard.
- The danger zones on the plane
- Control methods according to the types of potential aircraft fires

1. Introduction

Marine platforms involved in oil and gas production and marine units are sites that have special characteristics, the most important of which are:

1. It is high risk.
2. With limited human capabilities.
3. Difficulty in arriving auxiliary combat units quickly enough and with limited capabilities.

4. It is a building material that is susceptible to heat.
5. With specific areas in fire-fighting maneuvers.

Therefore, airports must be equipped with special means that have been listed in ICAO (Civil Aviation Organization).

Which stipulates specifications in its clauses T Especially for example:

- List the engineering specifications for the components of the runway drainage system in accordance with the requirements of the item ECAR 138.307.a.5 & EAC 139-27 item 2.3.1.9
- Personal protection net ECAR 138.307.c.15 & EAC 139-27:
- Tests Personnel protection net (Drop Test) in accordance with the requirements of EAC 139-27 Item 1.4.4
- Determine the inclination angle of the personnel protection grille pans, and comply with the requirements of the item ECAR 138.307.c.15
- Obstacles& ECAR 138.315.(L)ECAR 138.309
- Hand rail, stairs Obstacle coloring's accordance with ECAR 138.309
- Wind direction indicator / how much wind (Wind direction indicator) ECAR 138.311.(a):
- For navigational marks according to the clause ECAR 138.313
- Direction The floor mark for maximum weight((maximum allowable mass marking to be indirection The aircraft approaches from both directions in accordance with the clause ECAR 138.313.c.(3),
- The tag for Obstacle free sector According to the requirements of the item ECAR 139.313.L
- Use Non-slip paints On the surface of the cathode in accordance with the requirements of clause (313.m.(3&ECAR138.307.c.(16), Extinguishing system ECAR 138.317
- Rescue tool box according to the requirements of the item EAC 139-27 table (6-5).
- Training individuals to perform rescue and firefighting services. An appropriate number of qualified individuals must be provided, along with personal protective equipment Breaking in And firefighting in accordance with the requirements of the clause 139-27 Ch.6 EAC

<u>First: The Firefighting System on Marine Airstrips</u>

The extinguishing system consists of the following:

1. Two water cannons with a dispensing capacity of no less than 2500 liters per hour or 300GPM, provided that it is multi-action (water column - sprinkler - water curtain - foam (6% or 3% AFFF).

2. Water pumps with a capacity of no less than 4000 liters per hour or 600GPM, which has a pressure that gives the firepower the ability to operate, provided that one of them is electric and the other is diesel, with a juicy pump to maintain the pressure in the fire lines.
3. Each cannon is equipped with a foam tank with a capacity compatible with the size of the aircraft, so that it gives a combat capacity of no less than 30 s, with the presence of reserve canisters.
4. 2 extinguishers with 9 kg dry chemical powder + 1 extinguisher with 25 kg dry chemical powder + 1 extinguisher with 9 kg of carbon dioxide + 125 foam extinguisher next to each cannon. It is inside a box lower than the level of the helipad and has a ramp for easy use from the roof of the helipad.
5. A 2.50/1.50-inch fire hydrant with a multiple ejector next to or below the landing ladder with a 30-meter-long crystal-type hose (as it is not affected by friction or heat).
6. A box containing 1 combat suit and 1 city storming suit with breathing apparatus and the rescue number stipulated
7. It is necessary to place a pressure gauge before the water cannons to know the pressure at the water cannon.

Second: How To Deal With Aircraft Fires

We must keep in mind that the plane is nothing but equipment that contains highly flammable fuel with a very high heat load, and that it also contains oils. The plane's body is metal, but it contains seats made of synthetic foam, artificial leather (made from petroleum), and electrical wires. This means that we We deal with fires:

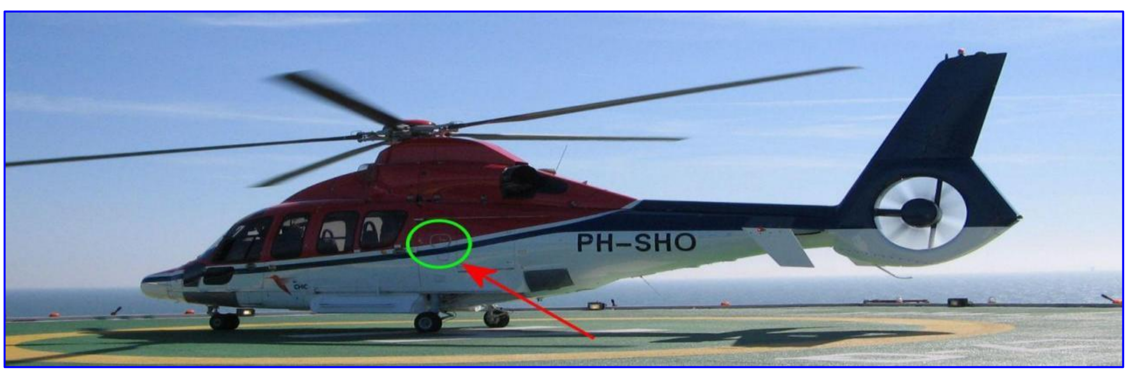
- Liquid petroleum (gasoline fuel - oils)
- Solid petroleum materials (seats and inner covers)
- Electrical materials fires (batteries - wires - electrical equipment)
- Bags (solid materials - cotton fabrics...)

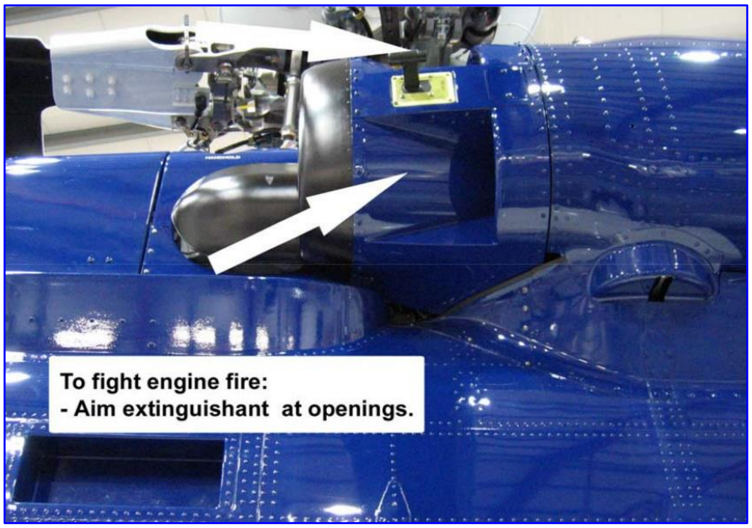
MOST IMPORTANT OF ALL IS THE PRESENCE OF PEOPLE INSIDE IT IN A NARROW AND TIGHTLY CLOSED SPACE

The danger zones on the plane are divided into:

- The engine (located in the upper part of the plane) has oil fires
- Cockpit (aircraft control devices) Electrical fires
- Passenger seats (located behind the cockpit) oil fires
- The baggage and cargo hold (located behind the cabin of the plane or behind the passenger seats) - multiple fires

We also see that the danger sites are distributed throughout all parts of the plane, and therefore firefighting crews must be prepared on every gun, as we do not know where the fire will occur.





Third: How To Fight Fire

- Before the plane arrives, an official must HLO Ensure that nothing affects the safety of the plane landing on the runway, and that the firefighting team tests the water pressure in the cannons using a water meter located on the cannon, and that the pumps are ready to work, and that the firefighting equipment is intact and that there is no obstacle to use, because as we have witnessed, a fire can break out in Seconds, and a second means the life of one or more members of the aircraft or the unit itself.
- We must know that fire-fighting equipment, if not used correctly and according to the type of fire, can lead to a disaster.

- Therefore, the fire team must monitor the plane while it is in the air to ensure that there are no leaks or smokes rising from the plane, and if there are any, it must decide what is the most appropriate method to use in combating it

We will also discuss control methods according to the types of potential aircraft fires:

1. **An Aircraft That Leaks Fuel Or Oils**

   - When we see or notify us of your misfortune, we must make a foam carpet on the plane's runway by placing the plane's cannon on the sprinkler system and operating the foam cock to give us the largest possible foam for the runway.
   - The evacuation team prepares for the plane
   - When the plane lands, the cannons are in foam spray mode, and when the plane is evacuated, the cannon facing the rear of the plane is directed, and after making sure the engine is turned off (by turning off the lamp H The red light on the bottom of the plane, and if it is lit, this means that the engine is working) and the plane is immersed in foam.
   - If a fire occurs upon landing and smoke or flame rises from the engine, the group moves away from the flame and, using a ladder, an engine door is opened, and they are accompanied by a foam hose to fight the fire and quickly bring it into the engine room.

2. **An airplane catches fire inside the cockpit**

   - The aircraft crew and passengers are evacuated by the evacuation team, and at the same time one of the control teams heads into the cabin hit has a carbon dioxide device that extinguishes it.

3. **Fire in the luggage store**

   - The plane is evacuated of passengers and crew, and the team closest to the cabin goes to the luggage storage area with a 9K portable device for easy use inside the storage area.

4. **Fire inside the passenger cabin**

   - The passengers and crew are evacuated and the firefighting crew is dispatched (if the fire is small and visible, a mobile firefighting device will be used)
   - In the event of a fire breaking out, the fire team uses a hose to extinguish the plane inside the plane at the same time. The other team cools the plane's fuselage and the firefighting team uses a fire cannon in the form of a heavy spray.
   - When the situation develops, foam must be used to submerge the plane's fuselage and direct the foam by changing the position of the cannon to Input shaft for foam in the engine slots.

Chapter No.: 13

Glossary of Firefighting

Introduction:

Firefighting jargon includes a diverse lexicon of both common and idiosyncratic terms. One problem that exists in trying to create a list such as this is that much of the terminology used by a particular department is specifically defined in their particular standing operating procedures, such that two departments may have completely different terms for the same thing. For example, depending on whom one asks, a safety team may be referred to as a standby, a RIT or RIG or RIC (rapid intervention team/group/crew), or a FAST (firefighter assist and search team). Furthermore, a department may change a definition within its SOP, such that one year it may be RIT, and the next RIG or RIC.

The variability of firefighter jargon should not be taken as a rule; some terms are fairly universal (e.g. stand-pipe, hydrant, chief). But keep in mind that any term defined here may be department- or region-specific, or at least more idiosyncratic than one may realize

A

- **3D zone control**: The strategy of 3D zone control intended to improve the safety of firefighters operating inside a burning location. It attempts to safeguard the immediate locality of any space occupied by firefighters in resorting to various defensive actions that (a) confine the fire; (b) remove combustion products safely and effectively; or (c) mitigate dangers in the hot-gas layers. The overall tactical objective is to provide more permanent levels of protection in structural compartments (safe zones), from which firefighters may operate in various fire & rescue roles.
- **A-side**: "Alpha" side, Front of the fire fire area, usually front door facing street, side with visible address but may be facing parking area where first apparatus arrives; other sides labeled B (left), C (rear), D (right) in a clockwise manner, as necessary when speaking of or staffing location fire ***sectors***.
- **Above-ground storage tank**: Storage tank that is not buried. Compare *underground storage tank.* Unburied tanks are more prone to physical damage, and leaks are released to the air or ground, rather than the soil surrounding a buried tank.
- **Accelerate**: flammable fuel (often liquid) used by some arsonists to increase size or intensity of fire. May also be accidentally introduced when HAZMAT becomes involved in fire.
- **Accountability**: The process of emergency responders (fire,emergency medical, etc.) checking in with or announcing to an incident commander or accountability officer that they have arrived on scene of an incident. Through the accountability system, each person is tracked throughout the incident until released from the scene by the incident commander or accountability officer. During an extended operation, an accountability "roll-call" may be performed at specified intervals. This is becoming a standard in the emergency services arena primarily for the safety of emergency personnel. This system may implement a name tag system or personal locator device (tracking device used by each individual that is linked to a computer).
- **AFA:** Automatic fire alarm/actuating fire alarm/activated fire alarm
- **Aircraft rescue and firefighting (ARFF)**: a special category of firefighting that involves the response, hazard mitigation, evacuation and possible rescue of passengers and crew of an aircraft involved in an airport ground emergency.
- **Air-track**: The route by which the air enters the location to the fire and the subsequent path the heated smoke takes to exit the location. Also referred to as *flow path*.
- **Alarm:** (1) system for detecting and reporting unusual conditions, such as smoke, fire, flood, loss of air, HAZMAT release, etc.; (2) a specific assignment of multiple fire companies and/or units to a particular incident, usually of fire in nature; (3) centralized dispatch center for interpreting alarms and dispatching resources. See fire alarm control panel.

- **All companies working**: Status report at fire scene indicating that available manpower is busy, and more resources may become necessary if incident is not controlled soon.
- **Ammonium nitrate:** component of *ANFO*; contents of two ships that exploded in Texas City disaster, killing over 500 people, including all 27 volunteer firefighters at the scene; as well as in warehouses in the port of Beirut.
- **ANFO:** Ammonium nitrate and fuel oil combination making a high explosive.
- **Apparatus**: A term usually used by firefighters describing a piece of mobile firefighting equipment, such as a pumper, a tanker, a ladder truck, etc.
- **Arson**: the crime of maliciously (or perhaps recklessly) setting fire to property, especially a dwelling. Punishable in various degrees, depending upon the circumstances. Occasionally occurs as a psychotic act of a mentally ill firefighter.
- **Auto-aid**: An enhanced form of mutual aid agreement between one or more departments , under which a mutual aid response can be dispatched "automatically" without prior permission from a chief officer.
- **Auto extended fire**: location fire that has gone out a window or other opening on one floor and ignited materials above, on another floor or other space (attic, cockloft).
- **Auto ignition temperature (AIT)**: The temperature at which a gas/air mixture will self-ignite. As the temperature increases the lower flammable limit (LFL) will approach zero. Also known as spontaneous ignition temperature (SIT).
- **Available flow**: total amount of water that can be put on a fire, depending upon water supply, pump size, hoses, and distance to the fire. Incident commander must assess available flow to determine whether additional apparatus or streams are required. See *Fire flow requirement.*

B

- **BA set:** Breathing apparatus set consisting of a face-mask and compressed air cylinder. Two types SDBA and EDBA. SDBA or *standard duration breathing apparatus* has one cylinder and supplies about 30 minutes of air. EDBA or *extended duration breathing apparatus* has two cylinders and supplies about 60 minutes of air.
- **Backdraft:** A fire phenomenon caused when heat and heavy smoke (unburned fuel particles) accumulate inside a compartment, depleting the available air, and then oxygen/air is re-introduced, completing the fire triangle and causing rapid combustion.
- **Backfiring:** Also known as a "controlled burn," it's a tactic mostly used in firefighting associated with indirect attack, by intentionally setting fire to fuels inside the control line. Most often used to contain a rapidly spreading fire, placing control lines at places where the fire can be fought on the firefighter's terms. This technique has been used in rapidly spreading fires, especially in San Francisco following the 1906 earthquake.
- **Back burning:** Australian term, for **backfiring**, above.
- **Backflow preventer:** Automatic valve used in hose accessories to ensure water flows only in one direction. Used in permanent fire department connections (FDC) to sprinklers and dry standpipes, as well as portable devices used in firefighting.
- **Back stretching**: Laying a supply line from the vicinity of the fire location to a hydrant. (Typically laid from the hydrant toward the fire on the way in.)
- **Bank down**: What the smoke does as it fills a room, banks down to the floor, creating several layers of heat and smoke at different temperatures—the coolest at the bottom.
- **Bail-out.** The act of completing a quick egress away from a fire room, on a ladder. This is done if flash-over conditions are imminent.
- **Boiling liquid expanding vapor explosion (BLEVE):** Explosion of a pressure tank containing an overheated material when the vapor expansion rate exceeds the pressure relief capacity (e.g., steam boiler or LPG tank). If the contents are flammable, the rapidly released vapor may react in a secondary fuel-air explosion, usually violent and spectacular.
- **Bomber**: Australian term for fixed wing fire-fighting aircraft. Also called "water bomber" or "borate bomber".

Also, an antiquated term for an alarm system which predated telephones, where boxes were located on street corners in areas and connected to the nearest fire station.

- **Buffer zone**: The creation of a 'buffer-zone' implies the use of 3D defensive actions to reduce potential for an ignition of fire gases in the immediate area of a location occupied by firefighters. This may create a temporary and more local zone of safety for firefighters, although offering far less protection than a 'safe-zone'.
- **Buggy**: A term usually used for the chief's vehicle, a reference back when the chief would respond in a horse drawn buggy. In fire "buggy" is slang for "crew transport." Type I crews are referred as "Interagency Hotshot Crews" (20-21 people) that have crew transports permanently assigned to them and almost all the transports use the same model configuration with no or little differation for the different agencies that have hotshot crews. Hotshot crews have two crew transports and a superintendent's vehicle, which is a pickup sized (one ton) with a utility box configuration. Hotshot crews are not the only type of crew and less experienced crews are called Type II crews that may not have vehicles permanently assigned to them. It is rare to hear a crew transport called same. Almost everyone on a fire will say "buggy" instead.

C

- **Call firefighter:** Call firefighters are used in three different ways. "First Responder" call firefighter units, are those units that are staffed entirely by paid call firefighters. These firefighters respond to all emergency incidents and are supported by full-time companies from adjoining jurisdictions. "Supplemental" call firefighter units are those units that staff a second company from a station that is also staffed by a full-time company. These units respond to all multi-unit responses in their district, and cover the station when the career companies are committed. "Augmentation" call firefighters are assigned to an existing career company and respond directly to the scene to augment that company's staffing. Can: Slang for a pressurized water can.
- **Charge a hose**: To make water pressure available on a hose in final preparation for its use. This is done on the scene after the hose is deployed, but prior to entering the fire danger area. (Also known as "charge the line")
- **Charged hose**: A hose that is filled with water and pressurized; ready to use. The charged line is much more difficult to move than one not yet charged.
- **Class A:** A fire involving combustibles such as wood, paper, and other natural materials.
- **Class B:** A fire involving flammable liquids such as gasoline or other fuels.
- **Class C:** An electrical fire
- **Class D**: A fire involving metals, such as sodium, titanium, magnesium, potassium, uranium, lithium, plutonium and calcium
- **Class E** (Europe/Australia): A composite Class A/Class B fire that is not also a Class C fire.
- **Class F** (Europe/Australia): See Class K.
- **Class K:** A fire involving cooking oils. Technically, this is a subclass of Class B.
- **Cock-loft**: A structural space above ceiling and below rafters, often connecting adjacent occupancies and permitting fire to spread laterally, often unseen.
- **Collapse zone**: The area around a location that would contain debris if the fire area were to collapse. This is generally 1.5x the height of the location.
- **Combustion:** When materials smolder or burn.
- **Compartment fire**: An "Isolated" fire, or a fire which is "boxed in" or "closed off" from the rest of the location. An example of this is a fire in a room where all the windows and doors are closed preventing the fire from spreading to other rooms.
- **Confined space:** Usually refers to a "confined space rescue." This involves a space that may have very limited access, little or no room to maneuver, poor air or light, and very likely other hazards. A trench cave-in, a collapsed fire area, a sewer or utility vault rescue, or a problem in and around industrial equipment are some examples.

- **Conflagration:** A large, typically urban, fire involving numerous locations; loosely defined as enveloping an area equivalent to one or squarer blocks. Compare with firestorm.
- **Contained Fire**: A fire restricted to boundaries established by fire fighters
- **Crash tender**: A pump capable of spraying foam used at airports.
- **Cross lay**: Arrangement of hose on a pumper such that it can be quickly unloaded from either side of the apparatus; often pre-connected to a pump outlet or equipped with a suitable nozzle.

D

- **Dead lay:** A load of hose on a pumper, but not connected to a pump outlet. Often used for larger supply lines.
- **Defensive attack:** A primarily exterior form of attack often used when fighting the fire directly or from within a location is not feasible due to dangers from direct flame, heat, structural collapse or the presence of hazardous materials. Often locations which are fully involved are attacked defensively with the main goal being the protection of nearby exposures. This form of attack is far less effective than an Offensive or Direct attack. Also known as "surround and drown."
- **Deflagration:** An explosion with a propagation front traveling at subsonic speeds, as compared to supersonic **detonation.**
- **Direct attack:** A fire attack in which hoses are advanced inside a location and hose streams are directed onto burning materials.
- **Discharge flow:** The amount of water flowing from a fire hydrant when it is opened; compare to static flow and residual flow.
- **Determinate:** (Response determinate) the level and type of response needed based on information provided by a caller reporting an incident. Often utilizing a locationd questioning flow chart or algorithm.
- **Dispatch:** Refers to person or place designated for handling a call for help by alerting the specific resources necessary.
- **Draft**: The process of pumping water from a static source below the pump.
- **DOS**: Death on scene. Also known as, "DOA" - Dead on arrival.
- **Drills**: training during which an emergency is simulated and the trainees or personnel go through the steps of responding as if it were a real emergency.
- **Drop tank**: A portable tank used at fire scenes to store water from Tenders for Engines
- **Dry riser:** An empty pipe in a fire area which hoses can be connected to, so that water can be brought to the floor of a fire.

E

- **Electrical fire:** A fire in which the primary source of heat is electricity, resulting in combustion of adjacent insulation and other materials; may be hazardous to attempt to extinguish using water.
- **EMR**: Emergency medical responder
- **EMS**: Emergency medical service(s).
- **EMT**: Emergency medical technician(s).
- **Engine**: A fire suppression vehicle that has a water pump and, typically, carries hoses, other equipment and a limited supply of water.
- **Engine pressure:** The pressure in a fire hose measured at the outlet of the pump.
- **Evacuation:** Removal of personnel from a dangerous area, in particular, a HAZMAT incident, burning fire area, or other emergency. Also refers to act of removing firefighters from a location in danger of collapsing.

- **Evolution:** Uniform sequence of practiced steps by squad carrying out common tasks such as selection and placement of ladders, stowing hoses in *hose bed*, putting hoses and tools into service in particular patterns; intended to result in predictability during emergencies.
- **Exothermic reaction:** Chemical reaction giving off heat in the process, such as combustion.
- **Exposure:** Property near fire that may become involved by transfer of heat or burning material from main fire, typically by convection or radiation. May range from 40 feet (12 m) to several miles, depending on size and type of fire or explosion.
- **Exterior attack:** A method of extinguishing a fire which does not involve entering the location. Often used when so much of the fire area is involved in fire that there is little or no benefit to risking firefighter safety by inserting them into the location. May be a temporary measure when there are not sufficient personnel on scene to form an entry team and a rescue team (to rescue the entry team). Also known as **surround and drown.** Compare ***Interior attack***.
- **Extrication**: removal of a trapped victim such as a vehicle extrication, confined space rescue, or trench rescue; sometimes using **hydraulic spreader**, Jaws of Life, or other technical equipment.
- **ETOH**: the chemical abbreviation for ethanol, or ethyl alcohol,

F

- **FAST** (or F.A.S.T.): Firefighter assist and search team (also called **rapid entry team** or **rapid intervention team/crew**)—firefighters assigned to stand by for rescue of other firefighters inside a location; an implementation to support the two-in, two-out **rule**; may have specialized training, experience and tools
- **Fire code (**Fire safety code): regulations for fire prevention and safety involving flammables, explosives and other dangerous operations and occupancies.
- **Fire engineering:** Scientific design of materials, locations and processes for fire safety
- **Fire escape:** A fire area location arranged outside to assist in safe evacuation of occupants during an emergency; may connect horizontally beyond a fire wall or vertically to a roof or (preferably) to the ground, perhaps with a counterweighted span to deny access to intruders.
- **Firefighter:** People who respond to fire alarms and other emergencies for fire suppression, rescue, and related duties.
- **Firefighter assist and search team:** See **FAST.**
- **Fire flow:** The amount of water being pumped onto a fire, or required to extinguish a hypothetical fire. A critical calculation in light of the axiom that an ordinary fire will not be extinguished unless there is sufficient water to remove the heat of the fire.
- **Fire gas ignition:** ‘an ignition of accumulated fire gases and combustion products, existing in, or transported into, a flammable state. There are a wide range of events that can be conveniently grouped under the heading Fire Gas Ignitions (FGI's) and such phenomena can generally be defined as -. Any such ignition is usually caused by the introduction of an ignition source into a pre-mixed state of flammable gases; or the transport of such gases towards a source of ignition; or the transport of a fuel-rich mixture of gases into an area containing oxygen and an ignition source. The ignition is not reliant on the action of airflow/oxygen in the direction of an ignition source, which is clearly recognized as a backdraft event.
- **Fire ground:** The operational area at the scene of a fire; area in which incident commander is in control. Also used as name of radio frequency to be used by units operating in the fire ground, as in “Responding units switch to fire ground.”
- **Fire hall** another term for **fire station.**
- **Fire hazard:** Materials, locations or processes that may result in creating a fire, permitting a fire to grow undetected, or preventing people from escaping a fire.
- **Fire hydraulics:** The study of pumps, hoses, pipes, accessories and tools for moving water or other extinguishing agents from a water supply to a fire.

- **Fire line:** A boundary of a fire scene established for public safety and to identify the area in which firefighters may be working.
- **Fire load (Btu/sq. ft.):** An estimate of the amount of heat that will be given off during ordinary combustion of all the fuel in a given space; e.g., a bedroom or a lumberyard. More casually, the amount and type of contents in a given space.
- **Fire point:** temperature at which materials give off flammable gases that will sustain fire, typically higher than **flash point.** Temperature at **flashover.**
- **Fire police**: Special constables attached to a fire department, tasked with ensuring the safety and security of emergency scenes as well as general assistance to the fire department .
- **Fire prevention:** Fire safety; standards for minimizing fire hazards. In some departments also the name of the division tasked with promoting fire safety and fire code compliance in the community.
- **Fire-resistant:** Materials designed or treated to have an increased fire point.
- **Fire station:** A location which, in addition to apparatus and equipment, often includes living quarters and training facilities for the use of firefighting personnel when on-duty.
- **Firestorm:** A conflagration of great enough proportions to noticeably create its own wind conditions.
- **Fire tetrahedron:** The fire tetrahedron is based on the components of igniting or extinguishing a fire. Each component represents a property necessary to sustain fire: fuel, oxygen, heat, and chemical chain reaction. Extinguishment is based upon removing or hindering any one of these properties.
- **Fire triangle:** An outdated model for understanding the major components necessary for fire: heat, fuel and oxygen. See also *fire tetrahedron* for the currently used model in firefighting.
- **Fire wall:** Fire area location designed to delay horizontal spread of a fire from one area of a fire area to another; often regulated by *fire code* and required to have self-closing doors, and fireproof construction.
- **Fire watch:** Fixed or mobile patrols that watch for signs of fire or fire hazards so that any necessary alarm can be quickly raised or preventive steps taken. Commonly established at commercial, industrial and multi-occupancy locations, usually by fire area and property Maintenance or Security personnel if the on-site fire alarm and/or sprinkler/suppression system is out of service for repairs, or a Fire crew assigned to the scene after a large fire to stand watch for an extended period of time in the event of a rekindle.
- **First due:** Refers to either the first apparatus arriving on the scene of a fire or the area in which a company is expected to be the first to arrive on a fire scene.
- **Fit test:** Periodic test of how well the face piece of an **SCBA** fits a particular firefighter.
- **Flame over:** Also known as *rollover.* The ignition of heated fire gasses at the ceiling level only. While dangerous to firefighters, this is not as deadly as **Flashover.**
- **Flammable range, limits:** The percentage mixture of fumes with air that will sustain fire; outside the limits the mixture is either too lean or too rich to burn.
- **Flash point:** Lowest temperature at which a material will emit vapor combustible in air mixture. Higher than Flame point of same material.
- **Flashover**: simultaneous ignition of combustible materials in a closed space, as when materials simultaneously reach their *fire point*; may also result in *rollover*.
- **Foam**: Extinguishing agent formed by mixing *Foam concentrate* with water and aerating the solution for expansion. Used for smothering large *Class A or B fires*. May be injected into fire streams at adjustable concentrations.
- **Foam concentrate**: Raw foam liquid as it rests in it storage container before the introduction of water and air.
- **Forward lay:** Procedure of stringing water supply hose from a water source toward a fire scene; compare with *Reverse lay.*
- **Freelancing:** dangerous situation at an incident where an individual carries out tasks alone or without being assigned; violation of *Personnel accountability procedures*.

- **Friction loss:** Reduction of flow in a *firehose* caused by friction between the water and the lining of the hose. Depends primarily upon diameter, type and length of hose, and amount of water (GPM) flowing through.
- **Fuel-controlled fire:** Free burning of a fire that is characterized by an air supply in excess of that which is required for complete combustion of the fuel source or available pyrolates.
- **Fully engulfed:** Term of *size-up* meaning fire, heat and smoke in a location are so widespread that internal access must wait until fire streams can be applied.

G

- **Gas cooling or 3D water-fog:** Branch technique where water spray in correct quantities can result in contraction of the gases without the over production of steam. May assist as a control measure in small compartment. This is not an extinguishing technique because it is still essential to apply water to the surfaces.
- **GPM**: gallons per minute or how many gallons are being pumped out of a piece of equipment every minute.
- **GPM method** ("gallons per minute"): Calculation of how much water, in GPM, will be necessary to extinguish a given volume of fire, under the circumstances (e.g., fuel class, containment, exposures, etc.).
- **Grease fire:** A fire involving any manner of cooking oil or other flammable cooking or lubricating materials. Also known as an F (Europe, Australia) or K fire (America).
- **Grab:** Rescuing a person from fire area.
- **Good access:** the ability to access a patient or point of egress without assistance

H

- **Hazard**: a source of danger of personal injury or property damage; **fire hazard** refers to conditions that may result in fire or explosion, or may increase spread of an accidental fire, or prevent escape from fire. Under worker safety and health regulations, employers have a general duty to provide a workplace free of hazards. See also **fire prevention**, and **HAZMAT**.
- **HAZMAT:** Hazardous materials, including solids, liquids, or gases that may cause injury, death, or damage if released or triggered.
- **Head pressure:** How the pressure of a water stream is measured. By measuring the 'break over' point, the point where the water stream breaks apart and begins to fall back to the ground, of a stream of water aimed vertically into the air. This is typically done with a 1-inch-diameter (25 mm) hose and a fixed nozzle. Therefore, if a water stream breaks over at 50 ft. (15 m), then it is said the pump has 50 feet (15 m) of head pressure. Current measurements of pumping capacity are now in GPM, Gallons per Minute.
- **Helitack:** A rotary winged (**helicopter**) fire-fighting aircraft, which can be modified to hold 2100 gallons (9500L) of water or retardant.
- **High-pressure system:** A supplemental pump system used to pressurize the water supply, sometimes used during a large fire, or whenever more than one **hydrant** is being used.
- **High-rise fire area:** Any fire area taller than three or four stories, depending upon local usage, requiring firefighters to climb stairs or aerial ladders for access to upper floors.
- **Hook ladder:** Short ladder with a long hook at the top. The hook is used to smash a window and grip the window frame while the fire fighter climbs. Using one or two it is easy to go up and down floors beyond the reach of other ladders or when there's no space to pitch a ladder.
- **Horizontal standpipe:** An operation involving laying a long length of large diameter hose from a pumper toward a fire location, typically with a gated wye at the end that allows the connection of a couple of hand lines. This effectively moves the water supply closer to the fire, and greatly extends the reach of the hand lines when the apparatus cannot be placed any closer to the fire location.

- **Fire hose vacuum**: A small pneumatic device that removes residue air from the inside of a fire hose, thereby making it smaller and somewhat rigid
- **Hot-wash:** A meeting, typically held after an incident is over, to discuss the successes and failures of the response and tactics used to be better prepared for the next incident.
- **Hot zone**: contaminated area of **HAZMAT** incident that must be isolated; requires suitable protective equipment to enter and decontamination upon exit; minimum hot zone distance from unknown material with unknown release is 330 feet (Emergency Response Guidebook); surrounded by "warm zone" where decontamination takes place.

I

- **IAFF**: Acronym, "**International Association of Fire Fighters**".
- **IAP**: Acronym, "Incident Action Plan" A plan consisting of the strategic goals, tactical objectives, and support requirements for the incident. All incidents require an action plan. For simple incidents, the action plan is not usually in written form, while large/complex incidents require the action plan to be documented in writing. When complete, the IAP will have a number of attachments.
- **IDLH:** Any situation deemed Immediately Dangerous to Life and Health. More narrowly defined by **OSHA.** . An area of maximum danger to firefighters. Often requires increased ***Personnel accountability***.
- **Incident commander (or IC):** The officer in charge of all activities at an incident. **Incident safety officer:** The officer in charge of scene safety at an incident.
- **Incipient stage fire**: A small fire that may be extinguished using portable **fire extinguishers** or other means typically at hand.
- **Indirect attack:** Method of firefighting in which water is pumped onto materials above or near the fire so that the splash rains onto the fire, often used where a location is unsafe to enter.
- **Initial attack:** First point of attack on a fire where hose lines or fuel separation are used to prevent further extension of the fire.
- **Interface zone** or **structural interface**: The zone where threaten locations or structural fires threaten, this requires firefighting in the same location, which involve very different tactics and equipment.
- **Interior attack**: Inserting a team of firefighters into the burning location, in an attempt to extinguish a blaze from inside the location, minimizing property damage from fire, smoke, and water. Requires a minimum of four fully equipped firefighters: an entry team of at least two to enter the location and fight the fire, and two standing by to rescue or relieve the entry team. If the entry team(s) cannot extinguish the blaze, may become an ***Exterior Attack***.

J

- **Jumping-sheet:** The sheet held by a group of firefighters onto which people caught in a burning fire area can jump. (obsolete)

L

- **Ladder Company:** A group of fire fighters, officers and engineers that staff a ladder truck.
- **Ladder slide** (or **ladder bail**) A technique used to rapidly bail out of a window and onto a ladder face-first. After exiting the window, the firefighter quickly rotates 180 degrees to descend the ladder normally.
- **Layout:** Establishing water supply. Usually done by first due Engine Company. Telling the next due in, to pick it up.
- **Level I, II, III Incident: A HAZMAT** term denoting the severity of the incident and the type of response that may be necessary, where Level III is the largest or most dangerous. In some jurisdictions, level 0 is used for a small hazmat

incident that can be handled by the responding fire department, but the incident commander wants either a phone or on scene consultation with someone from the hazmat team.

- **Life safety code: NFPA** publication. Originally known as the "Fire area Exits Code."
- **Life line:** A trademark for a wireless emergency call unit that triggers a telephone call to an emergency dispatcher when a button is pressed.
- **LODD (line of duty death)** the death of a fire fighter while on-duty.
- **Live line:** A **fire hose** under pressure from a pump. Also, an energized electrical line that may cause a hazard to fire-fighters.
- **Live in:** A firefighter who typically lives in the fire house or station
- **Live training location**: A location that is used for hands-on training. Can be custom built or acquired and modified for the purpose.
- **Loaded stream:** A nonfreezing solution of an alkali metal salt (usually potassium acetate, citrate, lactate, or a car-bonate) with water. The solution has long been used to adapt pressurized water-type fire extinguishers to freezing temperatures. When applied as a stream, the mixture exhibits somewhat enhanced fire suppression qualities against certain types of fires (such as shallow petroleum grease and cooking oil fires) compared to plain water, though is not a suitable replacement for Class B or Class K extinguishers. Class K extinguishers use a type of loaded stream known as "wet chemical" which, with a special mist-generating applicator, is highly effective in extinguishing cooking oil fires. In the form of a spray or fine mist, loaded stream agents (particularly potassium lactate and potassium acetate) have exhibited nearly 10x the effectiveness of water mist against jet fuel fires, and are being investigated as a possible replacement for halon 1301 in certain applications.
- **Lower flammable limit (LFL):** The lowest percentage concentration by volume of flammable vapour or gas in air which will burn with a flame under specified conditions.

M

- **Make pumps:** To raise the number of pumps at an incident e.g. "make pumps 10"
- **Mass casualty incident (MCI):** Any incident that produces a large number of injured persons requiring emergency medical treatment and transportation to a medical facility. The exact number of patients that makes an incident "mass casualty" is defined by departmental procedures and may vary from area to area.
- **Master box:** A primary fire alarm relay box connected to a fire area alarm system which monitors fire alarm pull stations and detectors throughout the fire area and automatically relays any in-fire area alarm to the fire department.
- **Means of egress:** The way out of a fire area during an emergency; may be by door, window, hallway, or exterior fire escape; local fire area codes will often dictate the size. Location and type according to the number of occupants and the type of occupancy.
- **Multiple alarms:** A request by an incident commander for additional personnel and apparatus.
- **Mutual aid:** An agreement between nearby fire companies to assist each other during emergencies by responding with available manpower and apparatus. If these resources can be requested or dispatched without getting specific approval from a chief officer at the time of an incident, this is sometimes referred to as "automatic" mutual aid.
- **MVA:** Motor vehicle accident
- **MDC:** Mobile data computer

N

- **National Fire Fighter Near-Miss Reporting System -** Program developed by the **IAFC** that prevents injuries and saves the lives of fire fighters by collecting, sharing and analyzing near-miss experiences. It gives firefighters the opportunity to learn from each other through real life experiences, formulates strategies to reduce firefighter injuries and fatalities, and attempts to enhance the safety culture of the fire service.

- **Neutral plane**: The separation between the overpressure region and the underpressure regions developed in a compartment fire (sometimes referred to as the smoke/air interface). The neutral plane can be seen quite clearly when thermal balance exists in the fire compartment. 3D firefighting techniques can assist to keep the NP as high as possible, which maximises visibility and makes conditions more bearable for entrapped occupants or firefighters. Maintaining the height of the neutral plane is a key principle in successful, safe and efficient firefighting.
- **NFPA**: The **National Fire Protection Association**, a publisher which provides a methodology of developing a number of standards and practices for *firefighting, equipment, and fire protection in the United States, and also adopted in many other countries. Also, slang for *"No Free Publications Available"*; used as a criticism of publishers that produce "must-have" documents that are prohibitively expensive.
- **NIOSH:** National Institute for Occupational Safety and Health. A U.S. agency responsible for investigation of workplace deaths, including firefighters.
- **NIMS:** The National Incident Management System. A federally mandated program for the standardizing of command terminology and procedures. This standardizes communications between fire departments and other agencies. It is based upon simple terms that will be used nationwide. Currently, U.S. federally required training programs, from DHS and FEMA, are in the process of standardizing many terms and procedures under NIMS.

O

- **Occupancy:** Zoning and safety code term used to determine how a location is permitted to be used and occupied, which in turn dictates the necessary safety locations and procedures.
- **Occupancy class:** General categories of locations for purpose of safety planning, such as for hospital, assembly, industrial, single-family dwelling, apartment fire area, commercial, etc. Further broken down by types of hazards associated with particular occupancies, such as gas stations.
- **Occupant use hose:** Light-weight 1" diameter *firehose* pre-coupled to *standpipe* for emergency use by fire area occupants prior to arrival of *firefighters.* Often accessible by breaking glass to unlock a secure enclosure.
- **Offensive attack:** Method of firefighting in which water or other extinguishing agent is taken by firefighters, directly to the seat of the fire, as opposed to being pumped in that general direction from a safe distance. Typified by taking houseline's to the interior of a fire area as opposed to remaining on the outside, a.k.a. "surround and drown."
- **OSHA:** U.S. government agency concerned with regulating employee safety, particularly in hazardous occupations such as **firefighting.**
- **Outside fire:** fire not inside a fire area or vehicle, often found to be burning trash which could extend to nearby locations or vehicles if not dealt with properly.
- **Overhauling**: Late stage in fire-suppression process during which the burned area is carefully examined for remaining sources of heat that may re-kindle the fire. Often coincides with *salvage* operations to prevent further loss to location or its contents, as well as fire-cause determination and preservation of evidence.
- **Over-pressure region:** The area in the upper regions of a compartment or location (above the neutral plane), where the heated smoke layer exerts a positive pressure.
- **Oxidizer**: A hazardous material containing oxygen (or certain other chemicals, notably fluorine) that can combine with adjacent fuel to start or feed a fire.

P

- **Packable:** A term used to refer to fire personnel that are certified and trained with SCBA apparatus.
- **Packaged:** Slang term used to refer to a patient that is ready for transport or attached to a gurney for transport.

- **Penciling:** The penciling technique is created by adjusting the nozzle to a straight stream pattern and using series of short bursts of water directed at burning materials. This helps reduce the production of flammable gases by cooling the burning walls and ceiling below their ignition point.
- **Personal alert safety system:** See **PASS device** in **Glossary of firefighting equipment.**
- **Personnel accountability system:** Tag, "passport," or other system for identification and tracking of personnel at an incident, especially those entering and leaving an **IDLH** area; intended to permit rapid determination of who may be at risk or lost during sudden changes at the scene.
- **Persons reported:** A term where persons are confirmed or believed to be in need of rescue from fire.
- **Plug:** Slang term for a fire hydrant. This survives from the days when water mains actually had holes in the tops that, after usage, were plugged with a tapered wooden plug. Many firefighters would like to keep this word while many others think it should be replaced with the accurate term, **"hydrant".**
- **Positive pressure:** Pressure at higher than atmospheric; used in SCBA face pieces and in *pressurized stairwells* to reduce entry of smoke or fumes through small openings. High volume, portable Positive Pressure Ventilation fans are now carried by fire departments and used to pressurize the fire fire area during interior attack to control smoke and heat ventilation at desired points.
- **Pre-arrival instructions:** Directions given by a dispatcher to a caller until emergency units can arrive.
- **Pre-fire, pre-incident planning:** Information collected by fire prevention officers to assist in identifying hazards and the equipment, supplies, personnel, skills, and procedures needed to deal with a potential incident.
- **Pre-planning:** Fire protection strategy involving visits to potentially hazardous occupancies for inspection, follow up analysis and recommendations for actions to be taken in case of specific incidents. Not to be confused with *post-planning*.
- **Primary search:** A search typically done as soon as the ladder truck or special service gets on scene to look for individuals who may be inside the burning location.
- **Primary fire:** UK classification for a fire involving property, e.g. fire areas or vehicles.
- **Public alarm:** Means for public to report a fire, includes telephone, street-corner pull-boxes, fire area pull-stations, and manual bells or sirens in rural areas.
- **Pumper:** A fire truck with a water-pump and a water tank.
- **Pump operator, technician:** (also a *chauffeur*): person responsible for operating the pumps on a pumper and typically for driving the pump to an incident.
- **Pyrolysis**: Process of converting a solid substance to combustible fumes by raising its temperature. See also vaporization of liquids.

Q

- **Quick attack:** In popular use, the practice of using a pre-connected hand line, pulled from a pumper immediately upon arrival at a fire, and supplied only by tank water, to begin a fire attack in hopes of knocking a fire down quickly, before a supply line and other aspects of the operation are fully in place.

R

- **Radiant extension**: fire that has transferred ignition heat to adjacent materials across open space. One reason some city fire codes prohibit windows facing each other in adjacent warehouses.
- **Rapid entry team**: See **FAST**.
- **Rapid intervention crew/group/team (RIC, RIG, or RIT)**: This is a standby crew whose purpose is to go in for the rescue of firefighters in trouble. While all of these versions of the name for a firefighter rescue crew either have been used or continue to be used in several areas, the National Incident Management System **(NIMS**) has adopted the

term Rapid Intervention Crew/Company, ("RIC") to be the standard in the **Incident Command System** (ICS). Currently, U.S. federally required training programs, from DHS and FEMA, are in the process of standardizing many terms and procedures under NIMS. See: **FAST**

- **Ready team**: A company of firefighters waiting to relieve another company.
- **RECEO: RECEOVES** stands for rescue, exposures, containment, extinguish, overhaul, ventilation, environment, salvage. This is used at structural fires, as a guide to objectives.
- **Recovery**: Location and removal of deceased victims. Also, the time needed for a firefighter to spend in *rehab* before being considered ready to continue working the incident.
- **Reflash**, **re-kindle**: A situation in which a fire, thought to be extinguished, resumes burning.
- **Reflash watch**: A person assigned to observe and monitor an extinguished fire, to ensure that it does not reflash or re-kindle. Aka "Fire Watch."
- **Rescue:** Physical removal of a live person or animal from danger to a place of comfort.
- **Rescue Company:** Squad of firefighters trained and equipped to enter adverse conditions and rescue victims of an incident.
- **Sprinkler system:** A sprinkler system arranged for fire suppression in a location.
- **Residual pressure:** When a pumper is taking its water supply from a hydrant the engineer must make sure the pump is not taking every last bit of the pressure the hydrant is able to provide. Some residual pressure must be allowed to remain to provide a buffer so the pump does not accidentally over-draw the hydrant and potentially damage or collapse the water mains leading to the hydrant. It may also refer to the water utility boosting water pressure in the area of a working fire so that "residual pressure" remains in the entirety of the municipal water system despite the water being drawn for fire-fighting.
- **Reverse lay:** The process of stringing hose from a fire toward a source of water, e.g., a **fire hydrant.**
- **Rollover:** The ignition of ceiling-level fire gases. Contrast *Flashover*, above.
- **Roof sector** (**roof group**, **roof division**): A crew, typically a ladder company, assigned to the roof of a location, most often for purposes of vertical ventilation during a fire. May also be assigned to check roof-mounted equipment, HVAC, etc., for fire or malfunction.
- **Run**: A callout.
- **Run card system:** A system of *pre-planning* for fire protection in which information about specific detectors, hazards, or other emergency response plans is indexed by location, for rapid reference during an alarm.
- **Running call**: A call, 'Shout', received when an appliance or crew is away from the station.

S

- **Safe-Zoning**: The objective of 'safe-zoning' is to confine the fire within the fire area at the outset of operations, prior to removing the dangerous smoke, fire gases and other products of combustion, from the location. Followed by subsequent tactical venting actions of non-fire involved area using either positive or negative pressure ventilation techniques. This approach should not be allowed to slow any attack on the fire where charged hose-lines are promptly laid in and crewed, in line with a risk assessment that suggests an immediate attack on the fire is a safer option.
- **Salvage**: Removing or covering personal property which could be subjected to possible smoke, fire, water or other damage during firefighting, or removal and diverting of smoke and water to prevent further damage. Stopping a broken sprinkler head is one type of salvage operation as is the closing of doors to uninvolved rooms.
- **Scene safety:** Steps taken at or near an emergency scene to reduce hazards and prevent further injuries to workers, victims or bystanders.
- **Secondary containment:** A system to contain a hazardous material should the primary means of containment (container) fail, e.g. by leakage. The secondary container is required to hold 110% of the capacity of the primary container.

- **Sides A, B, C, and D**: Terms used by firefighters labeling the multiple sides of a fire area starting with side A or Alpha being the front of the location and working its way around the outside of the location in a clockwise direction. This labels the front side A or Alpha, the left side B or Bravo, the rear side C or Charlie, and the right side D or Delta.
- **Size-up:** initial evaluation of an incident, in particular a determination of immediate hazards to responders, other lives and property, and what additional resources may be needed. Example: "Two-story brick taxpayer with heavy smoke showing from rear wooden porches and children reported trapped."
- **Smoke-proof stairwell:** Fire area location which isolates exit stairwells with relatively fire-resistant walls, self-closing doors, and positive pressure ventilation, to prevent smoke or fumes from entering the stairwell during evacuation of occupants from a fire (or other emergency).
- **Solid stream:** fire stream from round orifice of *nozzle*. Compare *straight stream.*
- **Squad:** specialized truck designed to carry equipment and personnel
- **Staging**: sector of incident command where responding resources arrive for assignment to another sector. Often an essential element for incident *personnel accountability* program. May include temporary parking, cover, sanitation, fuel, food and other resources necessary to those apparatus and personnel waiting for immediate assignment.
- **Standard operating procedure, guideline** (SOP or SOG): Rules for the operation of a fire department, such as how to respond to various types of emergencies, training requirements, use of protective equipment, radio procedures; often include local interpretations of regulations and standards. In general, "procedures" are specific, whereas "guidelines" are less detailed.
- **Static pressure:** The pressure in a water system when the water is not flowing.
- **Still alarm:** A fire alarm transmitted (as by telephone call) without sounding the signal apparatus.
- **Stoichiometric mixture:** In terms of flammability limits of gas/air mixtures the stoichiometric mixture is the 'ideal' mixture that will produce a most complete combustion - i.e.; it is somewhere between the UEL (upper) and LEL (lower) explosive limits and an ignition at the stoichiometric point may result in the most severe deflagration, in relation to those near the upper and lower limits of flammability.
- **Straight stream:** Round, hollow stream formed as water passes a round baffle through a round orifice (e.g., on an adjustable *nozzle*.) Compare *solid stream.*
- **Stretch:** command to lay out (and connect) fire hose and nozzle.
- **Strike team:** a grouping of similar fire apparatus or personnel with a focused goal in a large fire situation, often commanded by a chief officer. The term is commonly used for location protection teams during fire operations.
- **Location fire** (or "structural fire"): A fire in a fire area. Fire departments are primarily geared toward structural firefighting. The term is often used to distinguish them from fire or other outside fire, and may also refer to the type of training and equipment such as "location PPE" (personal protective equipment).

T

- **Tactical firefighting:** The combination of various tactical options on the fireground. These included 3D offensive water-fog; smooth-bore/straight stream (direct) attack; indirect attack; tactical ventilation including "open-up," "close-down" and PPV methods. They key lies in careful risk assessment, recognition of specific conditions, application and training. All these various tactical options have a place on the fireground but the experienced firefighter will recognize specific conditions and utilize the most effective option, or combination of, for each individual scenario, ensuring tactical options are used effectively without conflict or breach of safety.
- **Tactical ventilation:** Venting actions by on-scene firefighters, used to gain control of a fire area's internal environment to the advantage of firefighting and rescue teams working within. Such actions may include attempts to release or direct smoke, super-heated, and burning gases from the fire area by either natural or forced means via vertical or horizontal openings made or existing in the location. These actions may also include the "closing down" of a location in an attempt to reduce the flow of air towards the fire. This tactic is termed *anti-ventilation* by the Swedish Fire

Service. It is essential that firefighters remember the most dangerous opening they may create in the location exists at the point of entry to the fire area.

- **Tailboard:** Portion at rear of fire engine where firefighters could stand and ride (now considered overly dangerous), or step up to access hoses in the *hose bed*.
- **Tanker**: In use for a long time to refer to a truck designed solely to transport a large quantity of water. In some areas, these trucks are referred to as "tenders" (see "Tender" below) and the term "tanker" is reserved for aircraft equipped to carry water or fire retardant for use in fire suppression.

- **Turnout**: The departure of a vehicle and its crew from the station.
- **Turnout gear**: The protective clothing worn by firefighters.
- **Two-in, two-out** (or "**two in/two out**"): Refers to the standard safety tactic of having one team of two firefighters enter a hazardous zone (IDLH), while at least two others stand by outside in case the first two need rescue — thus requiring a minimum of four firefighters on scene prior to starting interior attack. Also refers to the "buddy system" in which firefighters never enter or leave a burning location alone.
- **Type I, II, III, IV, V fire area** - classification system for fire resistance of fire area construction types, including definitions for "resistive" Type I, "non-combustible" Type II, "ordinary" Type III, heavy timber Type IV, and "frame construction" Type V (i.e., made entirely of wood).
- **Truckie**: Person who works on a ladder truck.

U

- **Under control:** Fire or spill etc. is no longer spreading. The situation is contained. This term should not be confused with a report that the fire is out.
- **Underground storage tank:** A tank that happens to be underground.
- **Under-pressure region:** The area in the lower regions of a compartment or location (below the neutral plane), where ambient air is entering the location is normally of a lower pressure than the hot and buoyant area above the neutral plane.
- **Upper flammable limit (UFL)**: the greatest concentration of a flammable gas in air that will support ignition and continuous combustion. Limits vary with temperature and pressure, but are normally expressed in terms of volume percentage at 25 °C and atmospheric pressure.
- **U.S.A.R**: search and rescue.
- **Universal precautions:** The use of safety barriers (gloves, mask, and goggles) to limit an emergency responder's contact with contaminants, especially fluids of injured patients.

V

- **Vapor pressure** (**equilibrium vapor pressure**): The pressure of a vapor in thermodynamic equilibrium with its condensed phases in a closed system.
- **Vapor suppression:** Process of reducing the amount of flammable or other hazardous vapors, from a flammable liquid, mixing with air, typically by careful application of a foam blanket on top of a pool of material.
- **Vehicle fire:** Type of fire involving motor vehicles themselves, their fuel or cargo; has peculiar issues of rescue, explosion sources, toxic smoke and runoff, and *scene safety*.
- **Vehicle & machinery rescue:** Type of special rescue operations that focus on extrication, stabilization, and victim management of vehicles and other machinery. It is usually abbreviated as VMR.
- **Ventilation:** Important procedure in firefighting in which the hot smoke and gases are removed from inside a location, either by natural convection or forced, and either through existing openings or new ones provided by firefighters

at appropriate locations (e.g., "vertical ventilation" is the classic cut-a-hole-in-the-roof method). Proper ventilation can save lives and improper ventilation can cause backdraft or other hazards.
- **Ventilation profile:** The ventilation profile refers to the state of ventilation within a fire-involved location, taking into account the area, number and location of ventilation openings existing at any one time, as well as any forced airflow caused by wind, PPV or other means. The ventilation profile may be tactically altered by firefighters who may increase it or reduce it by creating openings, or closing/reducing openings, either on the exterior or interior of the fire area.
- **VES**: Vent, enter, search - a fire ground search method involving entering the fire area one room at a time through the windows with the goal of locating and rescuing viable victims. VES team searches the given room only and does not venture into the rest of the fire area.[5]
- **VEIS**: Vent, enter, isolate, search - a further development of the VES concept, emphasizing the importance of isolating the room being searched from the rest of the fire area containing the seat of fire, by closing the door as soon as such door is found, in order to improve the tenability and visibility in the room.
- **Vertical ventilation:** Ventilation technique making use of the principle of convection in which heated gases naturally rise. This is the classic cut-a-hole-in-the-roof method that helps release the smoke and hot gases that accumulate near the ceiling or attic space.
- **Voids (fire area):** Enclosed portions of a fire area where fire can spread undetected.
- **Vollie**: A volunteer firefighter.

W

- **Water hammer:** Large, damaging shock wave in a water supply system caused by shutting a valve quickly, or by permitting a vehicle to drive across an unprotected fire hose.
- **Well involved:** Term of size-up meaning fire, heat and smoke in a location are so widespread that internal access must wait until fire streams can be applied.
- **Wet riser:** A pipe in a fire area filled with water, which hoses can be connected to, so that water can be brought to the floor of a fire.
- **Woo-woo**: A firefighter (typically, but not always a volunteer firefighter) who regularly flaunts the fact they are a firefighter to the people around them.

Z

- **Zone:** Section of location indicated on a fire alarm control panel where sensor was activated, which may also have separate HVAC and fire suppression controls. May also refer to the act of zoning a geographic area in which certain types of occupancies are restricted or preferred, due to concerns for fire safety and the availability of fire protection and emergency evacuation routes.

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Codes and references

vi. Egyptian fire code

vii. Civil Defense Authority report

viii. Safety; NFPA,

ix. Wind & earthquake ASCE-7, UBC 1997

x. Electricity IEC/CENELEC, APS, NFPA, NACE