INSPECTION OF
FIRE FIGHTING EQUIPMENT AND SYSTEMS

OISD - STANDARD - 142

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INSPECTION OF
FIRE FIGHTING EQUIPMENT AND SYSTEMS

Prepared by:

COMMITTEE ON “INSPECTION OF FIRE FIGHTING EQUIPMENT AND SYSTEMS

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Preamble

Indian petroleum industry is the energy lifeline of the nation and its continuous performance is essential for sovereignty and prosperity of the country. As the industry essentially deals with inherently inflammable substances throughout its value chain – upstream, midstream and downstream – Safety is of paramount importance to this industry as only safe performance at all times can ensure optimum ROI of these national assets and resources including sustainability.

While statutory organizations were in place all along to oversee safety aspects of Indian petroleum industry. Oil Industry Safety Directorate (OISD) was set up in 1986 Ministry of Petroleum and Natural Gas, Government of India as a knowledge centre for formulation of constantly updated world-scale standards for design, layout and operation of various equipment, facility and activities involved in this industry. Moreover, OISD was also given responsibility of monitoring implementation status of these standards through safety audits.

In more than 25 years of its existence, OISD has developed a rigorous, multi-layer, iterative and participative process of development of standards – starting with research by in-house experts and iterating through seeking & validating inputs from all stake-holders – operators, designers, national level knowledge authorities and public at large – with a feedback loop of constant updation based on ground level experience obtained through audits, incident analysis and environment scanning.

The participative process followed in standard formulation has resulted in excellent level of compliance by the industry culminating in a safer environment in the industry. OISD – except in the Upstream Petroleum Sector – is still a regulatory (and not a statutory) body but that has not affected implementation of the OISD standards. It also goes to prove the old adage that self-regulation is the best regulation. The quality and relevance of OISD standards had been further endorsed by their adoption in various statutory rules of the land.

Petroleum industry in India is significantly globalized at present in terms of technology content requiring its operation to keep pace with the relevant world scale standards & practices. This matches the OISD philosophy of continuous improvement keeping pace with the global developments in its target environment. To this end, OISD keeps track of changes through participation as member in large number of International and national level Knowledge Organizations – both in the field of standard development and implementation & monitoring in addition to updation of internal knowledge base through continuous research and application surveillance, thereby ensuring that this OISD Standard, along with all other extant ones, remains relevant, updated and effective on a real time basis in the applicable areas.

Together we strive to achieve NIL incidents in the entire Hydrocarbon Value Chain. This, besides other issues, calls for total engagement from all levels of the stake holder organizations, which we, at OISD, fervently look forward to.

Jai Hind!!!

Executive Director

Oil Industry Safety Directorate
FOREWORD

The Oil Industry in India is 100 years old. Because of various collaboration agreements, a variety of international codes, standards and practices have been in vogue. Standardisation in design philosophies and operating and maintenance practices at a national level was hardly in existence. This, coupled with feed back from some serious accidents that occurred in the recent past in India and abroad, emphasised the need for the industry to review the existing state of art in designing, operating and maintaining oil and gas installations.

With this in view, the Ministry of Petroleum and Natural Gas in 1986 constituted a Safety Council assisted by the Oil Industry Safety Directorate (OISD) staffed from within the industry in formulating and implementing a series of self regulatory measures aimed at removing obsolescence, standardising and upgrading the existing standards to ensure safe operations. Accordingly, OISD constituted a number of functional committees of experts nominated from the industry to draw up standards and guidelines on various subjects.

The present document on “Inspection of Fire Fighting Equipment and Systems”, has been prepared by the Functional Committee on “Inspection of Static Equipment”. This document is based on the accumulated knowledge and experience of industry members and the various national and international codes and practices. This document is meant to be used as supplement and not as a replacement for existing codes and practices. It shall be borne in mind that no standard can be a substitute for the judgement of a responsible qualified Inspection Engineer. Suggestions are invited from the users after it is put into practice to improve the document further. Suggestions for amendments to this document should be addressed to

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This standard in no way supercedes the statutory requirements of bodies like IBR, CCE, Factory Inspectorate or any other Government Body which must be followed as applicable.
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Though every effort has been made to assure the accuracy and reliability of data contained in these documents, OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from their use.

These documents are intended only to supplement and not replace the prevailing statutory requirements.
Committee on
INSPECTION OF FIRE FIGHTING EQUIPMENT AND SYSTEMS

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In addition to the above, various other experts from the industry contributed in the preparation, review and finalisation of this document.
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SECTION I

INSPECTION OF FIRE FIGHTING EQUIPMENT AND SYSTEMS

1.0 INTRODUCTION

The complex nature of present day petroleum industry involving critical operating conditions and high level of product inventory call for an efficient fire fighting system. The fire fighting system should be designed, constructed, tested and maintained as per standard engineering practice for safe and efficient operation. The design of each fire fighting equipment or fire fighting system shall be carried out as described in the relevant chapters. Various fabrication and inspection stages shall be decided upon and a quality control/quality assurance programme evolved to ensure quality product.

2.0 SCOPE

This standard covers the design, construction, inspection and testing requirements of new and installed fire fighting equipment and Installations. The requirement given herein are MINIMUM. The Standard also covers performance requirements of equipment.

This Standard covers the following types of fire extinguishing systems:

1) Dry Chemical Powder
2) Carbon dioxide
3) Halon
4) Foam
5) Water Sprinkler
6) Fixed Water Spray

SECTION II

DRY CHEMICAL POWDER (DCP) FIRE EXTINGUISHING SYSTEM

1.0 DEFINITIONS AND TYPES OF DCP FIRE EXTINGUISHING SYSTEMS

1.1 DEFINITIONS

1.1.1 Extinguisher (DCP) Portable/ Trolley mounted:

DCP extinguisher consists of a cylinder containing finely powdered chemicals which are expelled by means of an inert gas contained either in a compressed gas cartridge located within the DCP cylinder as in case of portable extinguishers or stored in a separate cylinder located outside DCP cylinder as in case of trolley mounted extinguishers.

1.1.2 Mobile DCP Tender:

It consists of a cylindrical vessel containing extinguishing agent i.e. DCP, and a series of cylinders containing expelled gas i.e. compressed nitrogen, all mounted on a truck or trailer.

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1.1.3 Cylinder

For this standard, a cylinder means a cylindrical container/vessel containing DCP or expellent gas as the case may be.

1.1.4 Cartridge

For this standard, cartridge is a small cylinder containing expellent gas and located within the DCP cylinder.

1.1.5 Operating Pressure

The operating pressure is the pressure developed in the DCP container with the discharge nozzle closed, when the full designed quantity of expelling gas in a cartridge or cylinder is released into it.

1.1.6 Test Pressure

The hydrostatic pressure at which the container together with its cap assembly and discharge hose is to be tested.

1.1.7 Burst Pressure

It is the pressure at which the material fails. The burst pressure test is conducted as a proof test to ensure that the material is capable of withstanding working pressure. The burst pressure should be greater than 3 times the operating pressure.

1.2 TYPES OF DRY POWDER EXTINGUISHING EQUIPMENT & SYSTEMS

The various types of extinguishers/systems covered in this standard are:

1.2.1 Portable

Portable extinguishers have a maximum dry powder filled weight of 10 kg. and a maximum gross weight of 23 kg. The expellant gas is contained in a cartridge within the cylinder.

1.2.2 Trolley Mounted

In principle, the basic operation of Trolley Mounted DCP Fire Extinguishers and Portable DCP Extinguishers are similar. Trolley mounted extinguishers are manufactured to 25.0, 50.0, 75.0, 100.0 and 150 Kg. capacity. The expellant gas is located in a cylinder outside the DCP container.

1.2.3 Trailer Mounted

Trailer Mounted extinguishers are manufactured in the 200 kg to 500 kg capacity range. Expellant gas is located in a cylinder outside the DCP container.

1.2.4 Mobile Tender

Dry Powder Tender is of 1, 2, 3 & 4 Tons capacity on an automobile chassis. The expellant gas is contained in a series of cylinders mounted on a truck.

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2.0 DESIGN OF DCP CYLINDERS

2.1 DESIGN PRESSURE

The portable trolley mounted fire extinguishers and the DCP cylinder on mobile tenders shall be designed to withstand pressure of 22.5 kg/sq cm. The maximum operating pressure shall not exceed 15 kg/sq cm. This pressure will be adequate to achieve required performance characteristics.

2.2 MATERIAL OF DCP CYLINDER

The material of various parts of the DCP cylinder shall be as given below:

i) Shell of all portable cylinders upto 10 kg IS-513 grade capacity ‘EDD’ or “DD”

ii) Shell of all trolley mounted cylinders upto 150 kg IS-2002 grade A or IS-2041

iii) Shell of mobile tender IS-2002 gr 2A or IS-2041.

iv) Nozzle pipe IS-1239/IS-1978

v) Flanges ASTM A-105 or Equivalent

vi) Plunger and nozzle of all portable cylinders upto 10 kg capacity Type I of IS- 319

vii) Cap nozzle and drain plug of all trolley mounted extinguishers upto 150 kg capacity. Type I of IS-319/ SS

viii) Discharge nozzle on trigger for cylinder, portable and trolley mounted. IS-617

ix) Washers for all sizes of extinguishers IS-5382/IS-2171

x) Inner container IS-513/IS-2171

2.3 DESIGN THICKNESS

The thickness of plate material for the DCP cylinder shall be calculated as per the formula given below:

\[ t = \frac{PD}{200 \ fj + P} \]

Where

\[ t = \text{minimum thickness of shell plate exclusive of corrosion allowance in mm.} \]
P = Design pressure in kg/cm²
D = outside diameter of DCP cylinder in mm.
f = allowable stress value for the material used in kg/mm²
j = weld joint efficiency factor

Thickness of the shell including dished ends shall not be less than 2 mm for portable extinguishers up to 10 Kg, 3.15 mm for 25 Kg, 50 Kg & 75 Kg and 6.3 mm for 100 Kg & above trolley mounted extinguishers respectively.

2.4 CAPACITY
The capacity of portable extinguishers shall be of 1, 2, 5 and 10 Kg weight of Dry Chemical Powder and of trolley mounted extinguishers of 25, 50, 75, 100 and 150 Kg weight. The mobile tender capacity shall be of 300 Kg, 500 Kg, 1, 2, 3 & 4 Tonnes by weight.

3.0 CONSTRUCTION
3.1 WELDING
The cylinder body shall be of welded type. All ferrous fittings shall be welded to the body while all non-ferrous fittings shall be brazed.

i) All welding shall be carried out using qualified welders and agreed welding procedures.

ii) The weld joint design for the long seam as well as the circumferential seam shall be of the square edge butt type for plate thicknesses 3.0mm and less and single “V” butt for thicknesses higher than 3.0mm.

iii) All welding shall be carried out using shielded metal arc welding (SMAW) or gas tungsten arc welding (GTAW) techniques only. The electrode for welding shall conform to AWS/ASME classification. The electrode diameter shall be chosen considering plate thickness to be welded.

iv) All butt welds shall be full penetration welds.

v) All other requirements as outlined in section II of IS-2825 shall be followed.

3.2 SAFETY VALVE
All trolley mounted DCP extinguishers shall be provided with safety valve preferably on its top dished end to requirements of IS-2825. The set pressure shall be 17 Kg/sq.cm.

3.3 OPERATING PRESSURE
Suitable test shall be done to demonstrate that sufficient space is provided so that internal pressure does not exceed 15 Kg/sq.cm. and the body shall not show any sign of leakage if the discharge nozzle is closed and the extinguisher is operated at 27 + 2°C.
3.4 DRY CHEMICAL POWDER

The types of Dry Chemical Powder and requirements shall be as per IS-4308 with Sp.Gr. in the range of 0.95 to 1.0. Permanent marking of dry chemical powder filling height shall be considered to avoid over pressurisation of cylinder.

3.5 EXPPELLANT GAS

The Expellant gas used shall be carbon dioxide (CO2) or nitrogen (N2). The maximum quantity of expellant gas to be used for various capacities of Dry Chemical Powder Extinguishers shall be such that the internal pressure of the DCP cylinder shall at no point of time exceed 15 kg/sq.cm.

3.6 HOSE

The length of the discharge hose shall be as specified in IS-2171 and IS-10658. The hoses shall be designed to withstand the design pressure of the DCP cylinder.

3.7 DISCHARGE NOZZLE

The discharge nozzle shall be designed to discharge the powder as per performance characteristics outlined in 4.0.

3.8 CAP/FILLER OPENING

The size of cap/filler opening shall be as per IS-2171 (latest edition).

3.9 VENT HOLES

Necessary vent holes shall be provided as per IS-2171

3.10 SAFETY CLIP

Safety clip shall be provided to prevent accidental actuation of piercing mechanism.

3.11 COATING

The internal and external surfaces of the cylinder body shall be coated with Zinc or lead-tin alloy. Thickness of Coating for various sizes shall be as specified in standards IS-2171 and IS-10658.

3.12 PAINTING

The extinguisher shall be painted fire red conforming to shade No.536 of IS-5. The paint shall conform to IS-2932.
4.0 PERFORMANCE CHARACTERISTICS

The performance characteristics for each size of extinguisher shall be as given below:

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<th>Duration of Discharge (Sec.)</th>
<th>Throw Range (Mtrs.)</th>
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5.0 INSPECTION AND TESTING OF NEW EXTINGUISHERS DURING CONSTRUCTION

5.1 SHELL AND ATTACHMENTS

5.1.1 Material Identification

Material used for the cylinder shell shall be identified to ensure conformity with manufacturing standard. Raw material/bought out material for other components shall also be identified.

5.1.2 Welding

The following checks shall be carried out prior to, and during welding:

a) Review and approval of the welding procedure.

b) Qualifying of the welding procedure and welders.

c) Inspection of edge preparation and joint fit-up

d) Ensuring that during welding only approved procedure and approved electrodes are being used.

5.1.3 Testing

The following tests shall be carried out after completion of welding:

i) Dye Penetrant Inspection:

Dye penetrat examination shall be carried out on the fillet welds of all nozzles and attachments.

ii) Radiography

Spot Radiography of welds on all
cylinders shall be carried out using X-rays/Gamma Rays. 10% of the weld joints shall be radiographed which shall include at least 50% of the “T” joints. Interpretation of radiographs shall be as per IS-2825.

iii) Hydraulic Test

Extinguisher shell/container and the cap assembly with the hose assembly shall be tested to an internal pressure of 30 kg/sq.cm. The test pressure shall be held for a minimum period of two and a half minutes.

iv) Bursting Test

One prototype shall be tested and certified by either of customer/third party inspector. Hydraulic burst test shall be carried out on a prototype and no failure shall occur at a pressure below 45 kg/sq.cm. Actual burst pressure shall be recorded. In case the prototype does not rupture during Bursting Test then it should be destroyed to prevent its use.

v) Coating and Painting

Internal and external coating and external painting shall be checked and coating thickness established as per 3.11. The thickness of external paint shall be 50 microns minimum.

5.2 SAFETY VALVES

Safety devices shall be tested at 17 Kg/sq.cm gas per requirements of IS-2825.

5.3 HOSE

A sample discharge hose of minimum 0.5 mt length shall be tested upto bursting which shall not be less than 45 kg/sq.cm. Actual burst pressure of the hose shall be recorded.

5.4 CARBON DIOXIDE CARTRIDGE AND CYLINDER

Requirements for CO2 cartridge and cylinder are as specified in Section III of this Standard. When carbon-dioxide cylinder is connected to trolley mounted DCP extinguisher, the valve of CO2 cylinder should be provided with safety pin & seal.

5.5 PIERCING MECHANISM

The clearance between the cartridge holder and the plunger rod tip should be sufficient to ensure clear opening in the cartridge seal when pierced.

5.6 REPAIRS

i) Any repairs to welding shall be carried out as per IS-2825 and the same offered for reradiography. In case of repairs additional radiography shall also be done as per IS-2825. Only one time repairs shall be allowed.

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ii) Any extinguisher, which fails in hydrostatic test, shall be reoffered for inspection. If the failure is in the parent metal then the extinguisher shall be rejected. Weld failures shall be suitably repaired as per IS-2825 and reinspected.

5.7 PERFORMANCE TESTS

Performance & expansion space tests etc. shall be carried out as per IS-2171/IS-10658.

6.0 PERIODIC INSPECTION OF EXTINGUISHERS/MOBILE EQUIPMENT

6.1 LIKELY LOCATIONS OF DETERIORATION

6.1.1 Corrosion

i) Internal Corrosion:

Extinguisher (DCP Vessel) is prone to internal corrosion at the interface between the dry powder top level and empty space. Corrosion may take place where the internal coating is damaged and or where there is a holiday in the coating.

ii) External Corrosion:

The external surface of the extinguisher is prone to atmospheric corrosion particularly at areas where paint has peeled off. Support ring of the fire extinguisher is prone to water, soil and coercive corrosion. Metallic tubing for the transfer of inert gas is likely to corrode due to the atmosphere.

6.1.2 Damage/Deterioration

i) Shell

Shell may be damaged due to improper handling. Dents/ deformations may occur.

ii) Neck Ring

Neck rings are prone to breakage at the weld joint.

iii) Cap/Neck joint

The thread joint between cap and neck is prone to damage/wear/ deterioration.

iv) Cartridge Holder

The cartridge holder is prone to internal corrosion. Also the port holes are prone to erosion.

v) Spring

The spring is prone to lose its stiffness.

vi) Nozzle

The nozzle may be eroded due to frequent use of extinguisher.

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vii) **Hose**

The rubber hose is prone to ageing.

### 6.2 FREQUENCY AND PROCEDURE FOR INSPECTION

The extinguisher and its components shall be inspected at frequencies specified and as per procedure given below:

#### 6.2.1 Body

**i) Visual Inspection**

The shell of the DCP extinguisher shall be visually inspected externally once a month and internally once every three months to check for any mechanical damage or corrosion.

**ii) Ultrasonic Inspection**

Ultrasonic thickness measurements of the shell shall be carried out once every three years and readings shall be recorded.

**iii) Hydrostatic Test**

A Hydrostatic test of the cylinder shell along with cap and hose assembly shall be done at 30kg/sq.cm once every three years.

**iv) Performance Test**

Check performance test as per IS-2171 & IS-10658 on 1% of the newly procured/refilled DCP extinguishers selected at random.

**v) Rejection**

A DCP extinguisher body shall be removed from service and destroyed when the following conditions exist:

a) When it is corroded or damaged to such an extent at repair is required.

b) When the shell threads are damaged.

c) When it has failed in hydotesting.

d) When the extinguisher has been exposed to high temperatures due to proximity of fire.

#### 6.2.2 Coating and Painting

The internal coating and external painting shall be checked for damage/deterioration once in three months. The coating thickness shall be checked once every three years.

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6.2.2 Other Components

The following components shall be visually inspected once every three months.

i) Cartridge Holder

The cartridge holder shall be checked for any damage due to corrosion or erosion. The port holes shall be checked for elongation.

ii) Inner container

The inner container shall be checked for physical damages like elongation of holes due to corrosion etc.

iii) Neck ring/Shell attachments

The soundness of the brazing/welding of the neck ring & attachment to the shell shall be checked.

iv) Cap

The threading of both cap and neck shall be checked. The thread engagement shall be at least 16mm. The cap washer shall be checked for deformation and cracks.

v) Plunger

The plunger shall be checked visually for any damage.

vi) Piercer

The piercing mechanism shall be checked for its proper functioning.

vii) Spring

The spring shall be inspected for its shape, size and functional aspects.

viii) Nozzle and Discharge Fittings

The nozzle and other fittings shall be checked for erosion.

ix) Cartridge and Seal

The cartridge and seal shall be checked for damage if any.

x) Dry Chemical Powder

The dry chemical powder shall be checked for signs of caking.
6.2.3 Hose

The hose condition shall be checked visually once a month. The hose on the portable extinguisher shall be replaced every three years. The hoses on the trolley mounted extinguishers and on the mobile tender shall be hydrostatically tested every three years and replaced every 6th year.

6.2.4 Safety Valve

The safety valve shall be visually inspected for corrosion or damage once every three months. The safety valve shall be bench tested at rated test pressure once every three years.

6.2.5 Gas Cartridge/Cylinder

The CO2 cartridge in the portable extinguishers and the CO2 cylinders in the trolley mounted extinguishers shall be inspected and tested as outlined in Section III of this standard.

6.2.6 Extinguisher Trolley

The lubrication of bearings/bushes and condition of wheel should be checked/serviced once in three months.

7.0 MARKING AND DOCUMENTATION:

7.1 MARKING

i) All DCP extinguishers shall have BIS certification mark/punch on the bottom ring.

ii) All DCP extinguishers shall be permanently punched at the bottom ring with Manufacturer's name, year of manufacture, Manufacturer's Sr. No. and Inspectors stamp.

iii) The date of hydrostatic test and the user's identification number shall be clearly marked.

iv) Marking of the dry chemical powder filling height.

7.2 NEW EXTINGUISHERS

The manufacturer shall have BIS certification & shall furnish test certificates giving the following information:

i) Certificate number and date.

ii) Size, type and capacity.

iii) Material used for construction.

iv) Dry powder details viz. type, apparent density, moisture retention, fire knockdown properties, free flowing characteristics etc.
v) Operating & hypostatic test pressure.
vi) Bursting test pressure.
vii) Relief Valve testing and set pressure.
viii) Internal/external coating details.
ix) Identification marking as per relevant code.
x) Type and quantity of Expellant Gas.

7.3 INSTALLED EXTINGUISHERS

In addition to the required tag or labels, a permanent file record shall be kept for each extinguisher/installation. The record shall include the following information as applicable:

i) Identification number
ii) Date of manufacture
iii) Name of manufacturer and manufacturer’s Sr. No.
iv) Capacity of the extinguisher
v) Location at which the extinguisher is installed.
vi) Date of installing the equipment.
vii) The inspection date and the name of person or agency performing the inspection.
viii) The date when last recharged and the name of the person performing the recharge.
ix) The hydrostatic test date and name of the person or agency performing the test.
x) Next hydro-test date.
xi) Inspection observations and maintenance carried out.

8.0 CONDEMNING OF CYLINDERS

DCP extinguishers shall be condemned as per the guidelines given in IS-2190.

9.0 REFERENCES

1. IS-2171-Specifications for portable fire extinguishers
2. IS-10658-Specifications for trolley mounted fire extinguishers
3. IS-4308-Specifications for dry powder for fire fighting
4. IS-2825-Code for unfired pressure vessels

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5. ASME SEC VIII DIVN I-Boiler and pressure vessel code
6. BS-5423-Specification for portable fire extinguishers
7. NFPA-10-Portable Fire Extinguishers
8. IS-513-Cold-rolled low carbon steel sheets & strips
SECTION – III

CARBON DIOXIDE FIRE EXTINGUISHING SYSTEM

1.0 DEFINITION & TYPES OF EXTINGUISHERS

1.1 DEFINITION

1.1.1 CO2 Extinguishers & Extinguishing Systems

The extinguishers & extinguishing systems which employ CO2 (conforming to IS-307) stored in pressure containers for extinguishing fires.

1.1.2 Filling Ratio

The filling ratio of CO2 shall not exceed 0.667. The filling ratio shall be determined as the ratio of mass of CO2 in container to the mass of water required to fill the container at 15 deg. C.

1.2 TYPES

1.2.1 Portable:

Portable extinguishers are ones which are small, hand operated and with all permanent fittings normally not exceeding a gross weight of 23 Kg. Portable extinguishers are manufactured in 2, 3 & 4.5 Kg. capacity.

1.2.2 Trolley Mounted:

Trolley mounted extinguishers are larger versions of the portable extinguishers. Basically the operation of trolley mounted carbon dioxide extinguishers and portable carbon dioxide extinguishers are similar. Since the weight of the cylinder becomes heavy, these cannot be transported by hand and therefore require to be put on trolleys. The 6.8, 9 & 22.5 Kg. carbon dioxide cylinders are trolley mounted.

1.2.3 Tender:

A carbon dioxide tender is one with a large quantity of carbon dioxide. The typical tender has 16 carbon dioxide cylinders of 45.0 Kg. capacity each.

1.2.4 Fixed Carbon Dioxide Fire Extinguishing Systems:

The fixed carbon dioxide fire extinguished systems are of two types:

i) Local Application Installation:

It consists of a fixed supply of carbon dioxide, normally connected to a fixed network of pipes, nozzles and discharge horns arranged to discharge the gas directly on the surface or object on which fire is anticipated.
ii) Total Flooding Installation:

It consists of fixed supply of carbon dioxide normally connected to a fixed network of pipe, nozzles and discharge horns arranged to evenly distribute sufficient quantity of the gas throughout the enclosure(s) and capable of extinguishing fire within the enclosure(s) regardless of location of fire.

2.0 DESIGN

2.1 PORTABLE & TROLLEY MOUNTED

The portable and trolley mounted carbon dioxide extinguisher cylinders shall be designed as per Code IS:7285-1988.

2.2 FIXED CARBON DIOXIDE FIRE EXTINGUISHING SYSTEM

The thickness for distribution piping for fixed carbon dioxide fire extinguishing system shall be suitably calculated. The internal storage pressure for this calculation shall not be less than the following:

For 60 Kg/cm\(^2\) charging pressure, an internal pressure of 70 Kg/cm\(^2\) at 27 deg. C.

If higher storage temperatures are approved for a given system, the internal pressure at maximum temperature.

3.0 MATERIAL OF CONSTRUCTION

3.1.1 Materials for Portable & Trolley Mounted Carbon Dioxide Extinguishers


iv. Syphon tube : IS:407 Alloy 2 for Brass
                IS: 1545 for Copper
                IS: 738 for Aluminium

v. Hose : Wire braided rubber hose.

vi. Discharge horn : Non-metallic such as fibre glass, polyethylene etc.

3.1.2 Materials for Fixed Carbon Dioxide Fire Extinguishing System


ii. Piping : Piping shall be of non combustible material having physical and chemical characteristics, such that its integrity under stress can be predicted with reliability. Special corrosion resistant materials or coatings may be required in severely corrosive atmosphere. Black or galvanised steel pipe shall be either ASTM A 106 or API 5L Cast iron and non metallic pipe shall not be used.

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iii. Fittings: Class 150 and cast iron fittings shall not be used. All fittings shall be forged conforming to ASTMA-105 and rating of fittings shall be of minimum class 1500 for a charged pressure of 60 Kg/sq.cm.

iv. Connecting hoses: Flexible hoses used shall be double wire braided rubber covered hose. However, it is preferred that all connecting hoses and its fittings shall be metallic only.

v. Copper Tubing: Copper tubing in this system shall meet the requirements of Code IS:2501 - 1972.


4.0 CONSTRUCTION

4.1 CYLINDER FABRICATION AND DIMENSIONS

Cylinders shall be made strictly as per Code IS:7285 from hot or cold drawn seamless tube, rolled or extruded.

Fabrication/jointing by welding shall not be acceptable. Any attempt at welding for joining and/or rectification will call for rejection of the cylinder.

The shape of the body shall be cylindrical with the difference between maximum and minimum external dia shall not exceed 2% of the nominal internal dia.

The filling ratio of CO2 shall not exceed 0.667. The filling ratio shall be determined as the ratio of mass of CO2 in container to the mass of water required to fill the container at 15 deg. C.

4.2 PAINTING

The extinguisher shall be painted externally with suitable primer followed by synthetic enamel paint of fire red conforming to shade no. 536 of IS:5 and the paint shall conform to IS:2932.

4.3 HOSES

4.3.1 Portable & Trolley Mounted Extinguishers

Hoses for portable and trolley mounted cylinders shall be wire braided rubber hose having a minimum bursting pressure of 275 Kg/cm² in controlled discharge and 140 Kg/cm² in un-controlled discharge system.

4.3.2 Fixed Systems

Connecting hoses shall be either wire braided rubber hose or metallic hose with a minimum burst pressure of 420 Kg/cm².

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4.4 DISCHARGE FITTINGS/HEADS/ VALVES

4.4.1 Portable & Trolley Mounted Extinguishers

A discharge tube shall be provided to 2 & 3 Kg. capacity extinguishers fitted to discharge valve by swivel joints.

A hose of not less than 10 mm diameter shall be provided for 4.5, 6.8, 9 and 22.5 Kg. capacity fire extinguishers. The length of the hose shall be not less than 1 m for 4.5 & 6.8 Kg., 2 m for 9 Kg. and 5 m for 22.5 Kg capacity fire extinguishers respectively.

4.4.2 Fixed Carbon Dioxide Fire Extinguishing System

All valves under constant high pressure shall have a minimum bursting pressure of 420 Kg/cm² and those not under constant pressure shall have a minimum bursting pressure of 350 Kg/cm² g.

Design nozzle discharge pressure shall not be less than 20.6 Kg/cm² g.

All pipes and fittings, including manifold, shall have a minimum bursting pressure of 350 Kg/cm² g.

The complete distribution system shall be free from leakage when tested at a pneumatic pressure of 140 Kg/cm² g with nozzle outlets closed.

All pipe sections having dead ends shall be fitted with suitable pressure relief devices designed to operate between 168 and 210 Kg/cm².

Nozzles used in the system shall be capable of withstanding a minimum shut off pressure of 140 Kg/cm² g.

The discharge header shall be provided with suitable flushing arrangement to ensure easy elimination of foreign material, which can clog the spray nozzles.

The complete distribution system shall be generally made as per IS: 6382 - 1984.

5.0 PERFORMANCE CHARACTERISTICS

The performance characteristics for each size of the extinguisher shall be as shown below:

<table>
<thead>
<tr>
<th>Nominal size of Extinguisher (Kg.)</th>
<th>Discharge Time (Sec.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min.</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
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<tr>
<td>3</td>
<td>10</td>
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<td>4.5</td>
<td>10</td>
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<td>6.8</td>
<td>10</td>
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<td>9</td>
<td>12</td>
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<tr>
<td>22.5</td>
<td>20</td>
</tr>
</tbody>
</table>

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6.0 INSPECTION & TESTING OF NEW EXTINGUISHERS & INSTALLATIONS

6.1 PORTABLE/TROLLEY MOUNTED EXTINGUISHER

6.1.1 Shell & Attachments

i. Material Identification

Material used for the cylinder shell shall be identified and if required tested to ensure conformity with manufacturing standard. Raw material/bought out material for other components shall also be identified.

ii. Fabrication

The following checks shall be carried out:

a. Review and approval of process of manufacturing.

b. Ensuring that no welding has been carried out.

c. Inspection prior to closing in operation.

d. Inspection of surface defects and removal by grinding, if any.

e. Thickness measurements to confirm for minimum agreed finished thickness.

iii. Testing

The following tests shall be carried out after completion of extinguisher cylinder:

a. Visual

The internal and external surfaces of the cylinder shall be inspected. Surface defects of more than 5% of the shell thickness shall be ground off and the final thickness at that area shall be not less than the calculated minimum wall thickness plus corrosion allowance.

b. Dye Penetrant Inspection

Dye Penetrant examination shall be carried out on all the formed and knuckled areas.

c. Hydrostatic Stretch Test

Each finished cylinder shall be subjected to hydrostatic stretch test at a pressure of 250 Kg/cm2g. Permanent stretch suffered by the cylinder shall not exceed the following limits:

1. In case of cylinders below 20 litre water capacity - 10% of the total stretch suffered during the test, and,

2. In other cases - 10% of the total stretch suffered during the test or 1/5,000 of the original volume of the cylinder whichever is less.
d. Pneumatic Test

Cylinders, which have passed hydrostatic stretch test, shall be subjected to a pneumatic test pressure equal to 60% of the test pressure and shall show no signs of leak.

e. Leakage Test

The extinguisher without its attachment shall be shelved for 7 days after filling and shall be checked/weighed at the end of the period. There shall be no loss of mass.

f. Bursting Test of Prototype Cylinders

One cylinder of the first batch which has been earlier successfully tested hydrostatically shall be subjected to hydrostatic pressure till it bursts.

The nominal hoop stress corresponding to the pressure at which destruction occurs shall be calculated and this value shall not be less than 0.95 of the minimum specified tensile strength of the material of the cylinder. The cylinder shall burst without fragmentation.

g. Coating & Painting

The thickness of external paint shall be 100 microns minimum.

6.1.2 Hose

A sample discharge hose with length of not less than 300 mm shall be tested up to bursting which shall not be less than 275 Kg/cm² when there is controlled discharge and 140 Kg/cm² when there is no controlled discharge at nozzle. Actual burst pressure of the hose shall be recorded.

Bursting pressure of hose used in tender shall be minimum 350 Kg/cm².

6.1.3 Repairs

Any extinguisher, which fails in hydrostatic test, shall be re-offered for inspection. If the failure is in the parent metal then the extinguisher shall be rejected.

6.2 FIXED CARBON DIOXIDE FIRE EXTINGUISHER SYSTEM

6.2.1 Cylinders

Refer 6.1.1 of this section.

6.2.2 Piping & Fitting

i. Material Identification

Piping & fitting materials shall be identified and if required tested to ensure conformity with manufacturing standards.

ii. Fabrication

The following checks shall be carried out prior to and during welding:

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a. Review and approval of welding procedure.
b. Qualification of the welding procedure and welders.
c. Inspection of edge preparation and joint fit up.
d. Ensuring that during welding only approved procedure and approved electrodes are being used.

iii. Testing

a. Radiography

Spot radiography of minimum 10% of the welds of pipes shall be carried out.

b. Hydrostatic Test

The system shall be hydrostatically tested to the required test pressure.

c. Pneumatic Test

The complete distribution system shall be free from leakage when tested at a pneumatic pressure of 140 Kg/cm².

6.2.3 Safety Valves

Safety devices shall be tested at the required pressure.

6.2.4 Hose

A sample discharge hose shall be tested up to bursting pressure, which shall not be less than that specified. Actual burst pressure of the hose shall be recorded.

6.2.5 Repairs

Suitable weld repairs shall be carried out as necessary.

7.0 PERIODIC INSPECTION OF EXTINGUISHERS

7.1 LIKELY LOCATION OF DETERIORATION

7.1.1 Corrosion

The external side of the extinguishers, support, valves and discharge nozzles are prone to atmospheric corrosion.

7.1.2 Damage/Deterioration

i. Shell

Shell may be damaged due to improper handling. Dents/ deformations may occur.

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ii. Neck Joint

The thread joint between cap and neck is prone to damage/wear/deterioration.

iii. Nozzle

The nozzle may be eroded due to frequent use of extinguishers.

iv. Hose

The hose is prone to ageing.

v. Discharge Nozzle

Discharge nozzle may be clogged due to foreign material.

vi. Piping systems are prone to external corrosion/thinning.

vii. Valves used in the system may fail/get jammed.

7.2 FREQUENCY AND PROCEDURE FOR PERIODIC INSPECTION

The extinguisher and its components shall be inspected at frequencies specified and as per procedure given below:

7.2.1 Portable Extinguishers

i. Body of Cylinder

a. Visual Inspection

The shell of the extinguisher shall be visually inspected externally once a month to check for any mechanical damage or corrosion. Special attention shall be given to surface below clamping rings.

b. Hydrostatic Test

A hydrostatic test of the cylinder shell along with assembly shall be done before every refilling or once in 5 years as per IS-2190 whichever is earlier.

Ultrasonic thickness inspection of shell shall be carried out during each hydrotest.

c. Painting

The painting shall be checked for damage/deterioration once in three months. The coating thickness shall be checked once in 3 years.

d. Refilling

Loss in weight of cylinder shall be checked once in three months. Refilling shall be done if loss in weight is more than 10%.

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ii. **Other Components**

The following components shall be visually inspected once every three months.

a. **Nozzle & Discharge Fittings**

   The nozzle and other fittings shall be checked for erosion etc. during refilling.

b. **Trolley**

   Trolley shall be checked for proper functioning.

iii. **Hose**

   The hose condition shall be checked visually once in three months. The hose on the portable extinguishers shall be replaced within three years.

iv. **Gas Cylinder**

   The weight shall be checked & recorded.

v. **Safety Valve**

   The safety valve shall be overhauled & reset during refilling or after 5 years whichever is earlier.

**7.2.2 FIXED CARBON DIOXIDE FIRE EXTINGUISHER SYSTEM**

i. **Body of the Cylinder**

   a. **Visual Inspection**

   The shell shall be visually inspected externally once a month to check for any mechanical damage or corrosion.

   b. **Ultrasonic Inspection**

   Ultrasonic thickness measurements of the shell shall be carried out once every three years and readings shall be recorded.

   c. **Hydrostatic test**

   The cylinder shall be hydrotested at 210 Kg/cm² when the cylinder is sent for refilling or once in 5 years as per IS-2190 whichever is earlier.

   d. **Painting**

   The external painting shall be visually checked for damage/ deterioration once in three months. The coating thickness shall be checked once every three years.

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e. Refilling

Loss in weight of cylinders shall be checked once in three months. Refilling shall be done if loss in weight is more than 10%.

ii) Other Components

The following components shall be visually inspected once a month.

a. Piping

Piping shall be inspected for evidence of corrosion. Thickness shall be gauged every three years.

b. Pipe Hangers/Straps

Pipe hangers/straps shall be examined to check that the pipe is securely supported. Surfaces underneath pipe supports shall be checked once every three years to check for corrosion.

c. Nozzle

Nozzles shall be checked to determine that the orifices are clear and unobstructed. When nozzle seals are provided, they shall be checked for signs of deterioration and replaced if necessary. Nozzles shall be checked for proper position and alignment.

d. Container Bracketing/Supports

Bracketing/supports shall be checked to determine that their condition is satisfactory.

iii. Hose

The condition of hose shall be checked visually once in three months. The hose shall be hydrostatically tested every three years and replaced within 6 years.

iv. Safety Valve

The safety valve shall be overhauled & reset once in a year. Visual inspection shall be done once in three months.

v. Copper Tubing

Copper tubing shall be inspected visually every three months for corrosion/damage visually.

vi. All Systems

All systems shall be thoroughly inspected and tested for proper operation by competent personnel annually.

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8.0 MARKING AND DOCUMENTATION

8.1 MARKING

8.1.1 Marking On New Cylinders

All Carbon Dioxide cylinders shall be permanently punched with the following:

i. Manufacturer’s name & identification number

ii. IS-2878.

iii. Carbon Dioxide.

iv. Working pressure, test pressure and the date of hydrostatic stretch test.

v. Gross, tare and net weight in Kgs. and water capacity in litres.


All the markings (except the manufacturers marking which may be on the base) shall be punched on the neck of the cylinder.

8.1.2 Marking on the Valve

Valve fitted to the cylinder shall be clearly and durably marked in accordance with the following provision by stamping, engraving or similar process.

i. The specification of the valve.

ii. Year and quarter of manufacturing.

iii. Manufacture symbol

iv. Working pressure.

v. The name or chemical symbol of the gas for which the valve is to be used (in our case CO2)

vi. The type of screw thread on the outlet, namely left hand (LH) or right hand (RH).

vii. Inspector’s stamp.

8.2 DOCUMENTATION

8.2.1 New Extinguishers/Installation

The manufacturer shall furnish test certificates giving the following information:

i. Certificate number and date.

ii. Size, type and capacity.
iii. Materials used for construction.

iv. Hydrostatic test pressure.

v. Any other test as stipulated in Code/OISD Std

vi. Records of non-destructive tests carried out.

vii. Relief valve testing, if any.

viii. Painting details.

ix. Identification marking as per relevant Code.

8.2.2 Installed Extinguishers/ Installations

In addition to the required tag or labels a permanent tag record shall be kept for each extinguisher/ installation. The record shall include the following information as applicable.

i. Identification number.

ii. Date of manufacture.

iii. Name of manufacturer.

iv. Capacity of extinguisher.

v. Location at which the extinguisher is installed.

vi. Date of installing the equipment.

vii. The inspection date and name of the person or agency performing the inspection.

viii. The date when last recharged and name of the person or agency performing the charge.

ix. The hydrostatic test date and name of the person or agency performing the test.

x. Next hydrotest date.

xi. Inspection observations and maintenance carried out.

9.0 CONDEMNING OF CYLINDERS

Carbon Dioxide cylinder may be condemned when it leaks, or when internal or external corrosion, denting, bulging or evidence of rough usage exists to the extent that the cylinder appears to be weakened appreciably.

Any cylinder which fails to pass the periodic examination or test or which loses in its tare weight by over 5% or which for any other defect is found to be unsafe for use shall be destroyed by flattening it as a whole or after being cut into pieces in such a manner that the pieces cannot again be joined together by welding or otherwise to form a cylinder.

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All markings on the cylinder shall be defaced before it is destroyed. History sheets of such cylinders shall be closed and kept for one year. Reports of the details of such closed history cards shall be sent to the Chief Controller or Explosives, in writing, on the 1st of January, April, July and October every year.

10.0 REFERENCES

2. IS: 1239-Specifications for mild steel tubes, tubular & other wrought steel fittings
3. IS: 6382- Code of Practice for design & installation of fixed carbon dioxide fire system.
5. IS: 3224- Specification for valve fittings for compressed gas cylinders excluding LPG.
7. IS: 2190- Code of Practice for selection, installation & maintenance of first-aid fire extinguishers
8. IS-2878- Specifications for portable fire extinguisher, carbon dioxide type.
9. IS-307 - Carbon-dioxide gas

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SECTION - IV

HALON FIRE EXTINGUISHING SYSTEM

1.0 DEFINITION AND TYPES:

1.1 DEFINITION:

1.1.1. Halon:

The extinguishers and the extinguishing system which employs Halon stored in a pressure container for extinguishing fires.

1.1.2 Normally Occupied Area:

One which is intended for occupancy.

1.2 TYPES OF HALON EXTINGUISHING SYSTEMS:

1.2.1 Portable:

Portable extinguishers have capacities of 1.25, 2.5, 4.0, 5.0, and 6.5 Kg of Halon with a max gross wt of 23 Kg. Halon 1301 is not to be filled in portable extinguishers.

1.2.2 Total Flooding System:

In this system, Halon is arranged to discharge into and fill to the proper concentration in an enclosed space or enclosure.

1.2.3 Local Application System:

In Local Application System, a supply of Halon is arranged to discharge directly on the burning material.

2.0 DESIGN:

i) Portable

The Portable Halon cylinders shall be designed as pressure vessel to Code IS 2825.

ii) Total Flooding and Local Application Systems:

The thickness for distribution piping for total Flooding and Local Application Systems shall be calculated in accordance with relevant Code. The internal storage pressure for this calculation shall not be less than the following:

For 25 kg/sq.cm (360 psig) charging pressure, an internal pressure of 43 kg/sq.cm (620 psi) at 55 deg C.

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For 42 kg/sq.cm (600 psig) charging pressure, an internal pressure of 70 kg/sq.cm (1000 psi) at 55 deg C.

If higher storage temperatures are approved for a given system, the internal pressure at maximum temp.

2.1 MATERIALS OF CONSTRUCTION:

2.1.1 Materials for Portable Halon Cylinders:

The material of various parts of Halon cylinder shall be as given below:

i. Shell : IS: 513 Grades or DD IS: 6240


iii. a. Valve Body: Leaded Tin Bronze Grade LTB-2 of IS : 318

iv. Spring : IS: 4454 (Part l) Grade l.


vi. Siphon Tube : Brass Copper, Alloy No: 2 of IS: 407 or IS: 1545.

vii. a. Sealing Nuts: Extruded Brass Section of
     b. Piercer disc: Grade I of IS : 291
     or
     c Discharge: Type I of IS : 319.
     Fitting


2.1.2 Materials for Total Flooding and Local Application Systems:

i. CYLINDERS:

Fire extinguisher manufacturers are presently using CO2 cylinders for filling Halon with the approval of Chief Controller of Explosives, India. Refer CO2 Fire Extinguishing System Section for material of Cylinders.

ii. PIPING:

Piping shall be of non-combustible material having physical and chemical characteristics, such that its integrity under stress can be predicted with reliability. Special corrosion resistant materials like Cupro-nickels or coatings may be required in

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severely corrosive atmosphere. Black or galvanised steel pipe shall be either ASTM A 53, 106, API 5L or IS 1239. Cast iron and non-metallic pipe shall not be used.

iii. **FITTINGS:**

Class 150 and Cast iron fittings shall not be used. All fittings shall be forged conforming to ASTM A 105 and rating of fittings shall be as given below

Charged Pressure Fitting Rating (Min)
25 kg/sq.cm (360 psi) Class 600
42 kg/sq.cm (600 psi) Class 1200

iv. **CONNECTING HOSES:**

All connecting hose and its fittings shall be metallic only. Non metallic hoses and fittings shall not be used.

v. **COPPER TUBING:**

Copper tubing in this system shall meet the requirements of IS-2501.

3.0 **CONSTRUCTION:**

3.1 **CYLINDER FABRICATION:**

i) The fabrication of portable cylinder body shall be by welding.

ii) All welding shall be carried out as per agreed welding procedure, using qualified welders.

iii) The weld joint design for the circumferential seam for portable cylinder shall be of square edge butt type for plate thickness 3.0 mm and less and single V butt for thickness higher than 3.0 mm.

iv) All welding shall be carried out using Shielded Metal Arc Welding or Gas Tungsten Arc Welding Process only. The electrode for welding shall conform to AWS / ASME / IS classification. The electrode diameter shall not be more than 2.5 mm for SMAW and 1.6 mm for GTAW while welding portable cylinders.

v) All welds shall be full penetration welds.

vi) There shall not be any longitudinal seam in the portable cylinders and the number of circumferential seams shall not be greater than two.

vii) Joints shall be radiographed to IS-2825

3.2 **CYLINDER DIMENSION:**

The shape of the body shall be cylindrical and filling ratio shall not be more than 75% by volume.
3.3 COATING:

On all internal and external surfaces of body of the portable cylinders, either of the following anticorrosive treatment shall be applied and thickness of coating shall be measured as given in IS: 3203.

i. Lead tin alloy (tin not less than 10%) shall be applied by hot dipping process or by electrical process, thickness not less than 0.012 mm.

ii. Copper coating by suitable process, thickness not less than 0.005 mm.

3.4 PAINTING:

The extinguisher shall be painted externally with suitable primer followed by synthetic enamel paint of fire red conforming to shade No. 536 of IS: 5 and the paint shall conform to IS: 2932.

3.5 SAFETY SYSTEM:

In a portable extinguisher with a spring loaded piercing device, the safety clip shall be provided for prevention of accidental operation of piercing mechanism and discharge of contents.

In squeeze grip valve assembly, the safety pin shall be provided for prevention of accidental operation which shall be fitted on cantilever hinged grip lever through valve body.

3.6 HOSE:

Hoses for portable cylinders of 4.0, 5.0 and 6.5 kg capacity shall be braided hose having a bursting pressure of not less than 5 MN/m2 (50 kgf/cm2). It shall have a nominal bore of 10 mm and a length of not less than 300 mm.

3.7 DISCHARGE FITTINGS:

The discharge nozzle of the portable cylinder shall be screwed to valve body/hose or it can be an integral part of valve body. The design of the nozzle and area of the orifice shall be such that it satisfies the performance requirements given in 4.0 of this Standard.

3.8 PRESSURE INDICATOR:

Pressure indicator shall be fitted to the extinguisher to indicate its internal pressure. The indicator shall be marked suitably with pressure at which the extinguisher shall be charged and also indicate when it is wholly or partially released.
4.0 PERFORMANCE CHARACTERISTIC:

The performance characteristics for each size of extinguisher shall be as given below:

<table>
<thead>
<tr>
<th>Capacity of extinguisher (kg)</th>
<th>Min period for which throw of jet will be maintained (second)</th>
<th>Max period to discharge 95% of contents (second)</th>
<th>Range of throw of jet (not less than) (meter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.25</td>
<td>8</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>2.50</td>
<td>8</td>
<td>16</td>
<td>2</td>
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<td>10</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>5.00</td>
<td>12</td>
<td>24</td>
<td>4</td>
</tr>
<tr>
<td>6.50</td>
<td>14</td>
<td>28</td>
<td>4</td>
</tr>
</tbody>
</table>

5.0 INSPECTION AND TESTING OF NEW EXTINGUISHERS AND INSTALLATIONS DURING CONSTRUCTION:

5.1 PORTABLE EXTINGUISHER:

5.1.1 Shell and Attachments:

i. Material Identification:

Material used for cylinder shell shall be identified and if required tested to ensure conformity with manufacturing standard. Raw material / bought out material for other components shall also be identified.

ii. Fabrication:

The following checks shall be carried out prior to and during welding:

a. Review and approval of welding procedure,

b. Qualification of the welding procedure and welders,

c. Inspection of edge preparation and joint fit-up,

iii. Testing:

The following tests shall be carried out after completion of welding:

a. Dye Penetrant Inspection:

Dye Penetrant examination shall be carried out on fillet welds of all nozzles and attachments.

b. Radiography:

All welds of cylinders shall be 100% radiographed. Interpretations of radiography shall be as per IS: 2825.

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C. Hydrostatic Test:

The extinguisher having 1.25 kg capacity shall be hydrostatically tested at an internal pressure of 2.5 MN/M² (25 kgf/cm²) for a period of 60 seconds. The test shall not reveal any leakage or visible distortion.

For higher capacities, it shall be tested at 3 MN/M² (30 kgf/cm²) for a period of 60 seconds.

The test shall be carried out before the extinguishers are painted and after heat treatment, if any.

d. Leakage Test:

The fire extinguisher after being covered by a inverted glass transparent jar shall be dipped in suitable water tank filled with water for 24 hours, the level of which is sufficiently higher than the height of fire extinguisher. There shall not be any collection of even a single bubble on the inside top of the inverted glass after a lapse of 24 hours. The airbubble collected in first 6 hours shall be neglected.

e. Drop Test:

This test shall be done as per IS: 11108.

f. Ultimate Failure Test:

On a prototype test, Mechanical failure shall not occur at a pressure less than 40 kgf/cm² g.

g. Coating And Painting:

The thickness of anti corrosion coating shall be 25 microns min and that of external paint shall be 75 microns minimum.

5.1.2 Hose:

A sample discharge hose with nominal bore of 10 mm and a length of not less than 300 mm shall be tested upto bursting which shall not be less than 50 kg/cm² g. Actual burst pressure of the hose shall be recorded.

5.1.3 Pressure Indicator:

Ensure that the pressure indicator as in 3.8 of this Section is fitted to the extinguisher.

5.1.4 Repairs:

i. Any repairs to welding shall be carried out as per IS: 2825. Only one time repair shall be allowed.

ii. Any extinguisher which fails in hydrostatic test shall be reoffered for inspection. If the failure is in the parent metal then the extinguisher shall be rejected.

The weld failure shall be suitably repaired as per IS: 2825 and reinspected /tested.

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5.2 TOTAL FLOODING AND LOCAL APPLICATION SYSTEMS:

5.2.1 CYLINDERS:

These are generally made using CO2 cylinders with the approval of Chief Controller of Explosives; CO2 Fire Extinguishing System Section may be referred for inspection etc. A halon cylinder of 75 kg capacity is tested to a pressure of 124 bars.

5.2.2 Piping and Fitting:

i. Material Identification:

Piping and fitting materials shall be identified and if required tested to ensure conformity with manufacturing standards.

ii. Fabrication:

The following checks shall be carried out prior to and during welding:

a. Review and approval of welding procedure.

b. Qualification of the welding procedure and welders.

c. Inspection of edge preparation and joint fit up.

d. Ensuring that during welding only approved procedure and approved electrodes are being used.

iii. Testing:

a. Radiography:

Spot radiography of the welds of pipes shall be carried out.

b. Hydrostatic Test:

The system shall be hydrostatically tested to the test pressure recommended by designer/vendor of the system.

5.2.3 Safety Valves:

Safety devices shall be tested at the required pressure.

5.2.4 Hose:

A sample discharge hose shall be tested upto bursting pressure, which shall not be less than 100 kg/cm². Actual burst pressure of the hose shall be recorded.

5.2.5 Repairs:

Any piping system, which fails in hydrostatic test, shall be reoffered for inspection. The weld failure shall be suitably repaired and reinspected /tested.

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6.0 PERIODIC INSPECTION OF EXTINGUISHERS:

6.1 LIKELY LOCATION OF DETERIORATION:

6.1.1. Corrosion:

The external side of the extinguishers, support, valves and discharge nozzles are prone to atmospheric corrosion.

6.1.2. Damage / Deterioration:

i) Shell:

Shell may be damaged due to improper handling. Dents/ deformations may occur.

ii) Neck Ring:

Neck rings are prone to breakage at weld joint.

iii) Neck Joint:

The thread joint between cap and neck is prone to damage/wear/deterioration.

iv) Nozzle:

The nozzle may be eroded due to frequent use of extinguishers.

v) Spring:

The spring is prone to lose its stiffness.

vi) Hose:

The hose is prone to ageing.

vii) Discharge Nozzle:

Discharge nozzle may be clogged due to foreign material.

6.2 FREQUENCY AND PROCEDURE FOR INSPECTION:

The extinguisher and its components shall be inspected at frequencies specified and as per procedure given below.

6.2.1 Portable Extinguishers:

i. Body of cylinder:

a. Visual Inspection:

The shell of the extinguisher shall be visually inspected externally once a month to check for any mechanical damage or corrosion.

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b. Hydrostatic Test:

A hydrostatic test of the cylinder shell along with assembly shall be done before every refilling or once in 5 years whichever is earlier. Ultrasonic thickness inspection of shell shall be carried out during each hydrotest.

c. Painting:

The painting shall be checked for damage/deterioration once in three months.

d. Rejection Limit:

A Halon extinguisher shall be removed from service and destroyed when the following condition exists:

1. When the cylinder is corroded or damaged to such an extent that repairs by welding, brazing or by use of patch work is required.
2. When the cylinder or shell threads are damaged.
3. When the cylinder has been exposed to high temperature due to proximity of fire.

ii. Other Components:

The following components shall be visually inspected once every three months.

a. Neck Ring:

The soundness of the brazing/welding of the neck ring to the shell shall be checked.

b. Spring:

The spring shall be inspected for corrosion.

c. Nozzle and Discharge Fitting:

The nozzle and other fittings shall be checked for erosion.

d. Squeeze Grip Valve:

The squeeze grip valve shall be checked for damage.

iii. Hose:

The hose condition shall be checked visually once in three months. The hose on the portable extinguishers shall be replaced within three years.

iv. Pressure Indicator:

Pressure indicator shall be inspected every three months visually and calibrated at the time of recharging.
6.2.2 Total Flooding and Local Application Systems:

i. Body of the Cylinder
   a. Visual Inspection:
      The shell shall be visually inspected externally once every three months to check for any mechanical damage or corrosion.
   b. Ultrasonic Inspection:
      Ultrasonic thickness measurements of the shell shall be carried out once every three years and readings shall be recorded.
   c. Hydrostatic Test:
      The cylinder shall be hydrotested when the cylinder is sent for refilling or as per statutory requirements whichever is earlier.
   d. Painting:
      The external painting shall be checked for damage/deterioration once in three months. The coating thickness shall be checked once every three years.

ii. Other Components:
    The following components shall be visually inspected once every six months.
    a. Piping:
       Piping shall be inspected for evidence of corrosion. Thickness shall be gauged every three years.
    b. Pipe Hangers /Straps:
       Pipe hangers/straps shall be examined to check that the pipe is securely supported.
    c. Nozzle:
       Nozzles shall be checked to determine that the orifices are clear and unobstructed. Where nozzle seals are provided they shall be checked for signs of deterioration and replaced if necessary. Nozzles shall be checked for proper position and alignment.
    d. Container Bracketing /Supports:
       Bracketing/ supports shall be checked to determine that their condition is satisfactory.

iii. Hose:
    The condition of hose shall be checked visually once in three months. The hose shall be hydrostatically tested every three years and replaced within 6 years.
iv. **Safety Valve:**

The safety valve shall be visually inspected for damage once every three months and same shall be bench tested annually.

v. **Pressure Indicator:**

Pressure indicator shall be inspected visually every three months for corrosion/damage visually.

vi. **Copper Tubing:**

Copper tubing shall be inspected visually every three months for corrosion/ damage visually.

vii. **All Systems:**

All systems shall be thoroughly inspected and tested for proper operation by competent personnel annually.

7.0 **MARKING & DOCUMENTATION:**

7.1 **NEW EXTINGUISHERS / INSTALLATION:**

The manufacturer shall furnish test certificates giving the following information:

i) Certificate number and date.

ii) Size, type and capacity.

iii) Materials used for construction.

iv) Hydrostatic test pressure.

v) Relief valve testing, if any.

vi) Painting details.

vii) Identification marking as per relevant code.

7.2 **INSTALLED EXTINGUISHERS / INSTALLATIONS:**

In addition to the required tag or labels, a permanent tag record shall be kept for each extinguisher/ installation. The record shall include the following information as applicable.

i) Identification number

ii) Date of manufacture

iii) Name of manufacturer

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iv) Capacity of extinguisher

v) Location at which the extinguisher is installed

vi) Date of installing the equipment

vii) The inspection date and name of the person or agency performing the inspection

viii) The pressure test record

ix) The date when last recharged and the name of the person or agency performing the charge

x) The hydrostatic test date and the name of the person or agency performing the test

xi) Next hydrotest date

xii) Inspection observations and maintenance carried out

8.0 REFERENCE S:

1) IS: 11108 Specification for Portable Fire Extinguishers - Halon 1211 Type.

2) IS: 2825 Code for Unfired Pressure Vessels.

3) NFPA : 12 A- Halon 1301 Fire Extinguishing Systems; 12 B- Halon 1211 Fire Extinguishing Systems

4) ASTM A 53, A106- Mild steel piping specifications

5) API 5L- Mild steel piping specifications

6) IS : 1239- Specifications for mild steel tubes, tubulars and other wrought steel fittings

NOTE: Serious concern has recently been expressed regarding depletion of stratospheric ozone layer by halon. The ozone layer acts as a protective barrier shielding the earth from harmful effects of solar ultraviolet radiations. While search for an “ideal substitute” for halons is continuing, it has been decided to completely stop indigenous production of halons in India by 2010 consistent with Montreal Protocol. Steps have also been initiated to reduce release of halons to atmosphere by actions like discontinuing discharge of halons from extinguishers/systems during their maintenance & testing, arranging recovery of halons from discarded halon extinguishers etc.

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SECTION - V

FOAM FIRE EXTINGUISHING SYSTEM

1.0 DEFINITION & TYPES OF EXTINGUISHERS

1.1. DEFINITION

A system consisting of water supply, foam supply, proportionating equipment, foam makers, discharge devices and other allied equipment for the purpose of adequately distributing foam over a hazard is called a Foam Fire Extinguishing System.

1.2 TYPES

1.2.1 Portable

The type in which the foam producing equipment, materials, hose etc are transported by hand. The total liquid capacity of the inner and outer containers when filled to the specified level shall be 9 liters.

1.2.2 Foam Fire Engine/Trolley Mounted Foam Extinguisher

The capacity of a foam fire engine is more when compared to a portable fire extinguisher and it is mounted on wheels. The fire engines are of 50 lit and 150 lit capacity. The difference between a portable foam extinguisher and a fire engine is only in respect of its capacity.

1.2.3 Mobile

This includes any foam producing unit with capacity more than 150 litres which is mounted on wheels and which may be self propelled or towed by a vehicle. These units may be connected to a suitable water supply or may utilise a pre mixed foam solution.

1.2.4 Semi Fixed Systems

i. The type in which the system is equipped with fixed discharge outlets connected to piping, which terminates at a safe distance. The fixed piping installations may or may not include a foam maker. Necessary foam producing materials are transported to the location after the fire starts and are connected to the piping.

ii. The type in which foam solutions are pumped through the area from a central foam station, the solution being delivered through hose lines to portable foammakers such as monitors, foam towers etc.

1.2.5 Fixed Systems

These are complete installations piped from a central foam station, discharging through fixed delivery outlets, to the hazard to be protected. Any required pumps are permanently installed.

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2.0 DESIGN

2.1 PORTABLE

The portable foam type fire extinguishers shall be designed and constructed as per code IS: 933, 934, 10204.

2.2 FOAM FIRE ENGINE/TROLLEY MOUNTED FOAM EXTINGUISHER

The 50 lit capacity foam type fire engine shall be designed and constructed as per code IS: 5507. The 150 lit capacity foam type fire engine shall be constructed as per code IS: 10474.

2.3 MOBILE

The foam trailer with a foam tank of capacity 500 lit. and above, mounted on trailer chassis and having a water-cum-foam monitor on the trailer, the system to be made as per user’s requirements.

2.4 SEMI FIXED SYSTEM

The sizes for discharge outlets and connected piping for semi fixed foam fire extinguishing system shall be calculated in accordance with requirements specified in OISD-116.

2.5 FIXED SYSTEM

Since none of the Indian Refineries have fixed foam fire extinguishing system, it is not covered in this Standard.

3.0 MATERIAL OF CONSTRUCTION

3.1.1 Material for Portable Chemical Foam Extinguishers

i. Shell : IS : 513 Grade D.

ii. Inner Container: IS 410 - Cu Zn 37 alloy or Polyethylene to IS : 7328.

iii. Syphon Tube : IS: 513 Grade


v. Cap : —do—

vi. Seating Valve : —do—

vii. Plunger rod for Double seal : —do—

viii. Nozzle : —do—

ix. Plunger for Extruded Brass Single Seal conforming to Grade 2 of IS: 291 or Type 1 of IS : 319.

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x. Nozzle : —do—

xi. Cap Joint Washer: Natural rubber free from impurities and acid and alkaline resistant or Buffalo leather to IS: 581.

3.1.2 Materials for Portable Mechanical Foam Extinguishers

i. Shell : MS GR D, IS: 513 - 1973
iii. Neck Ring : LTB 2, IS: 318 - 1962
iv. Cap : LTB 2, IS: 318 - 1962
vi. Plunger : Brass GR 2, IS: 291 1961
vii. Washer : Rubber, Type 1A, IS: 5382 - 1969
viii. Spring : GI, IS: 4454 (Part 1) - 1975 shall be treated for corrosion resistance
ix. Piercer : 04 GR 13, IS: 6528 - 1972
x. Hose : Shall withstand Bursting PR of 50 Kg/CM2

3.1.3 Materials for Foam Fire Engines/Trolley Mounted Foam Extinguisher

i. Shell : IS: 2002/2062 or SS410S
ii. Inner Container: IS: 513 Grade O or Cu Zn alloy to IS:410.
iii. Neck Ring : Leaded Tin Bronze of Gr.2 of IS:318
iv. Cap : Extruded Brass Conforming to Grade 1 of IS : 291 or Type 1 of IS : 319.
v. Nozzle : —do—
vi. Discharge Fitting: —do—

vii. Washers : Natural rubber free from impurities. Acid and alkaline resistant.
viii. Wheels : Cast Iron conforming to FG 200 of SS 210 or of MS.
x. Cap & Nozzle for inner container : Plastics IS:7328

3.1.4 Materials for Mobile Foam Trailor

i. Foam Tank: IS : 2002/2062 or SS 410S.
ii. Piping: ASTM A 53, API 5L, IS 1239
iii. Fittings: IS: 903.

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3.1.5 Materials for semi fixed Foam Fire Extinguishing System

i. Piping : ASTM A 53, API 5L, IS-1239

ii. Fittings : ASTM A 105.

4.0 CONSTRUCTION

4.1 FABRICATION OF PORTABLE EXTINGUISHERS/FOAM FIRE TRAILOR

4.1.1 Welding

The cylinder body shall be welded. All ferrous fittings shall be welded to the body while all non-ferrous fittings shall be brazed.

i) All welding shall be carried out using qualified welders and agreed welding procedures.

ii) The weld joint design shall be of square butt type for plate thickness 3.0 mm and less and single V butt for thickness higher than 3.0 mm.

iii) All welding shall be carried out using shielded metal arc welding and gas tungsten arc welding techniques only. The electrode for welding shall conform to AWS/ASME classification. The electrode diameter shall not be more than 2.5 mm for SMAW and 1.6 mm for GTAW.

iv) All butt welds shall be full penetration welds.

v) All other requirements as outlined in Section II of IS: 2825 shall be followed.

4.1.2 Cylinder Dimensions

Cylinder dimensions shall be such that a space is provided in the body above the specified liquid levels and shall be sufficient in volume to ensure that, when the discharge nozzle is temporarily closed and the extinguisher put into operation at a temperature of 21 plus or minus 2 deg C, the pressure exerted shall not exceed 15 kgf/sq.cm. The temperature shall be the temperature of the solution and not the atmospheric temperature.

This requirement may be satisfied by providing an air space of not less than 5% of the total volume of the extinguisher.

The body of the 50 lit and 150 lit capacity foam fire engine shall be cylindrical with an outside diameter of 300 plus or minus 15 mm and 400 plus or minus 15 mm respectively.

4.1.3 Hose

The discharge hose shall have a length and bore as specified in IS : 5507. The hose shall have a minimum bursting pressure of 32 kgf/sq.cm.
4.1.4 Discharge Nozzle

The discharge nozzle shall be designed to discharge the foam as per performance characteristics outlined in para 5.0 of this Section.

4.1.5 Coating

On all surfaces of body of the inner container, sealing disc and spindle shall be coated with lead-tin alloy. The thickness of the coating shall be 0.012 mm minimum.

4.1.6 Painting

The extinguisher shall be painted fire red conforming to Shade No 536 of IS: 5. The paint shall conform to IS: 2932.

4.2 MOBILE FOAM FIRE TRAILOR AND SEMI FIXED FOAM EXTINGUISHING SYSTEM

4.2.1 Fabrication

The construction of foam tank of the mobile foam trailer and piping of the semi fixed foam extinguishing system shall be welded

i) All welding shall be carried out using qualified welders and agreed welding procedures.

ii) The weld joint design shall be of square butt type for plate thickness 3.0 mm and less and single V butt for thickness higher than 3.0 mm.

iii) All welding shall be carried out using shielded metal arc welding and gas tungsten arc welding techniques only. The electrode for welding shall conform to AWS/ASME classification. The

iii) All butt welds shall be full penetration welds

4.2.2 Painting

The foam trailer and piping shall be painted fire red conforming to Shade No 536 of IS: 5. The paint shall conform to IS: 2932.

5.0 PERFORMANCE CHARACTERISTICS

<table>
<thead>
<tr>
<th>Capacity of extinguisher/Litres</th>
<th>Min period during which the jet shall be maintained</th>
<th>Throw range</th>
<th>Maximum period for min 90% discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>30</td>
<td>6</td>
<td>90</td>
</tr>
<tr>
<td>50</td>
<td>60</td>
<td>10</td>
<td>180</td>
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</table>

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6.0 INSPECTION & TESTING OF NEW EXTINGUISHERS & INSTALLATIONS DURING CONSTRUCTION

6.1 PORTABLE EXTINGUISHERS AND FOAM FIRE ENGINES/TRAILORS

6.1.1 Shell & Attachments

i. Material Identification.

Material used for the cylinder shell shall be identified and if required tested to ensure conformity with manufacturing standard. Raw material/ bought out material for other components shall also be identified.

ii. Fabrication

The following checks shall be carried out.

a. Review and approval of the welding procedure.

b. Qualification of the welding procedure and welders.

c. Inspection of edge preparation and joint fit-up.

d. Ensuring that during welding only approved procedure and approved Electrodes are being used.

e. Inspection of surface defects and removal by grinding, if any.

f. Thickness measurements to confirm for minimum agreed finished thickness.

iii. Testing

The following tests shall be carried out after completion of welding.

a. Visual

The internal and external surfaces of the cylinder shall be inspected and a surface defect of more than 5% of the shell thickness shall be ground off and the final thickness in that same area shall be not less than the calculated minimum wall thickness plus corrosion allowance.

b. Dye Penetrant Inspection

Dye Penetrant examination shall be carried out on all the formed and knuckled areas and all fillet welds of all nozzles and attachments.

c. Radiography

Spot radiography of the welds on all cylinders shall be carried out. 10% of the weld joint shall be radiographed which shall include at least 50% of the T joints. Interpretation of the radiographs shall be as per IS : 2825.
d. Hydraulic Test

Extinguisher shell/container and the cap assembly shall be tested to an internal pressure of 25 kgf / sq.cm. The test pressure shall be held for a minimum period of five minutes continuously.

e. Bursting Test

Hydraulic burst test shall be carried out on a prototype and no failure shall occur at a pressure below 60 kgf /sq.cm and 35 kgf/sq.cm for portable extinguisher and engines respectively. Actual burst pressures shall be recorded.

f. Coating and Painting

The extinguisher, after performance and hydraulic test shall be thoroughly cleaned with water free from chemical solution. The water shall then be completely drained off and the interior of the body shall be examined after 24 hours. It shall be free from all traces of rust. Superficial rust stains, which could be rubbed off with a dry cloth, may be ignored. The thickness of the coating shall be not less than 0.012 mm. The overall dry film thickness of external paint shall be 100 microns minimum.

6.1.2 Hose

A sample discharge hose of minimum 0.5 mtr length shall be tested upto bursting, which shall not be less than 32 kgf/sq.cm. Actual burst pressure of the hose shall be recorded.

6.1.3 CAP (Plastic)

For Testing Impact Resistance  A steel hammer weighing 5 kg shall be allowed to drop vertically from a height of 1 m on to the fire engine cap moulding fitted to an engine. The engine shall be held such that the direction of the hammer blow is vertically down on to the top of the moulding. Thereafter the engine should be tested for internal hydraulic pressure of 25 kgf/sq.cm for a period of 5 minutes without leakage.

6.1.4 Repairs

Any extinguisher, which fails in hydrostatic test, shall be re-offered for inspection. If the failure is in the parent metal then the extinguisher shall be rejected.

6.2 FOAM TRAILOR AND SEMI FIXED SYSTEM

6.2.1 Tank and Piping

i. Material Identification.

Material used for the tank shell shall be identified and if required tested to ensure conformity with manufacturing standard. Raw material/bought out material for other components shall also be identified.

ii. Fabrication

The following checks shall be carried out.
a. Review and approval of the welding procedure.

b. Qualification of the welding procedure and welders.

c. Inspection of edge preparation and joint fit-up.

d. Ensuring that during welding only approved procedure and approved electrodes are being used.

e. Inspection of surface defects and removal by grinding if any.

f. Thickness measurements to confirm for minimum agreed finished thickness.

iii. **Testing**

The following tests shall be carried out after completion of welding.

a. **Visual**

   The internal and external surfaces of the tank shall be inspected and a surface defect of more than 5% of the shell thickness shall be ground off and the final thickness to that same area shall be not less than the calculated minimum wall thickness plus corrosion allowance.

b. **Dye Penetrant Inspection**

   Dye Penetrant examination shall be carried out on all fillet welds of nozzles and attachments.

c. **Radiography**

   Spot radiography of the welds on all tanks and piping shall be carried out as per relevant code.

d. **Hydrostatic Test**

   The bulk tanks of the fire tender shall be hydrotested to a pressure of 0.3 bar.

   All piping except that handling expanded foam for other than subsurface application shall be subjected to a hydrostatic pressure test at 14.0 kg/sq.cm or 3.5 kg/sq.cm in excess of the maximum pressure anticipated whichever is greater. All operating devices and equipment shall be tested for proper function. All normally dry horizontal piping shall be inspected for proper drainage.

6.3 **REPAIRS**

   Suitable repairs to welding in tank shall be carried out as necessary.
7.0 PERIODIC INSPECTION OF EXTINGUISHERS

7.1 LIKELY LOCATIONS OF DETERIORATION

7.1.1 Corrosion

i. Internal Corrosion.

Extinguisher and tank internal surface is prone to corrosion. The corrosion may take place where the internal coating is damaged and or where there is a holiday in the coating.

ii. External Corrosion.

The external surface of the extinguisher is prone to atmospheric corrosion particularly at areas where paint has peeled off. Support ring of the fire extinguisher is prone to water, soil and coercive corrosion. Pipe and pipe supports are likely to corrode due to atmospheric action.

7.1.2 Damage/Deterioration

i. Shell

Shell may be damaged due to improper handling. Dents/ deformations may occur.

ii. Neck Ring

Neck ring is prone to breakage at weld joint.

iii. Cap/ Neck Joint

The threaded joint between cap and neck is prone to damage/wear/deterioration.

iv. Spring

The spring is prone to loose its stiffness.

v. Nozzle

The nozzle may be eroded due to frequent use.

vi. Hose

It may show cracks/signs of ageing.

7.2 FREQUENCY AND PROCEDURE FOR PERIODIC INSPECTION

The extinguisher and its components shall be inspected at frequencies specified and as per procedure given below:
7.2.1 Portable Extinguishers and Foam Fire Engine/Trolley Mounted Fire Extinguisher

i. Body

a. Visual Inspection

   The shell of the extinguisher shall be visually inspected once a month to check for any mechanical damage or corrosion.

b. Ultrasonic Inspection

   Ultrasonic thickness measurements of the shell shall be carried out once in three years and readings shall be recorded.

c. Hydrostatic Test

   A hydrostatic test of the cylinder shell with cap shall be done once in three years. Rusty or corroded extinguishers should be subjected to a pressure test even if they are not due for it and even if their performance is satisfactory.

d. Coating and Painting

   The internal coating and external painting shall be checked for damage/deterioration once in three months. The coating thickness shall be checked once every three years.

e. Rejection Limit

   An extinguisher shall be removed from service and destroyed when the following conditions exist:

   1) When an extinguisher is corroded or damaged to such an extent that repairs by welding, brazing or by use of patchwork is required.

   2) When the cylinder or shell threads are damaged.

   3) When the cylinder has been exposed to high temp due to proximity of fire.

ii. Other Components

   The following components shall be inspected once in three months.

   a. Inner Container

      Withdraw the inner container for checking visually the sealing system.

   b. Neck Ring

      The soundness of the brazing/welding of the neck ring to the shell shall be checked.

   c. Cap

      The threading of both cap and ring shall be checked. The cap washer shall be checked for deformation.

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d. Plunger
   The plunger shall be checked visually for any damage.

e. Piercer
   The piercer mechanism shall be checked for its proper functioning.

f. Spring
   The spring shall be inspected for its shape, size and functional aspects.

g. Nozzle and Discharge Fittings
   The nozzle and other fittings shall be checked for erosion.

h. Wheels
   Wheels shall be checked for mobility.

iii. Hose
   The hose condition shall be checked visually once in three months. The hose of the
   engine and mobile trailer shall be hydrostatically tested every three years and replaced
   every 6th year.

7.2.2. Mobile & Semi-fixed Installations

i. Foam Chambers/pourers on all storage tanks
   Visual inspection to be done once in four months and pressure testing as and when tank
   is taken out of service for M&I.

ii. Foam Tanks
   These shall be visually inspected every day for leakage etc. A thorough internal/external
   inspection, thickness survey and checking for leakage by water filling shall be done once
   in 3 years or earlier if necessary.

iii. Accessory Equipment
   Proportionating devices, foam maker, aspirator shall be visually inspected once in 4
   months.

iv. Piping
   Above ground piping shall be examined for external corrosion and proper drainage once
   in three months. Pressure testing of normally dry piping shall be done during M&I of the
   tank or earlier in case visual inspection indicate questionable strength due to corrosion or
   mechanical damage.
v. **Control Valves**

Shall be checked visually once in three years.

vi. **Vapour Seals**

Shall be checked visually once every year.

vii. **Automatic and Manual Actuating Devices**

Shall be checked visually for proper functioning once every year.

viii. **Relief Valve**

Relief valves shall be bench tested once every three years.

**8.0 MARKING & DOCUMENTATION**

**8.1 NEW ENTEINGUISHER**

The manufacturer shall submit with each order of fire fighting equipment a test certificate confirming that the fire fighting equipment have been manufactured and tested in accordance with the required Standard.

The test certificate shall clearly furnish the following information:

i. Certificate number and date,

ii. Size, type and capacity,

iii. Material used for construction,

iv. Foam properties,

v. Hydrostatic test pressure,

vi. Bursting test pressure,

vii. Internal/external coating details,

viii. Identification marking as per relevant code.

**8.2 INSTALLED SYSTEMS:**

In addition to the required tag or labels, a permanent file record shall be kept for each installation. The record shall include the following information as applicable:

i. Identification number,

ii. Date of manufacturing / commissioning,

iii. Name of manufacturer,

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iv. Capacity,

v. Location at which it is installed,

vi. Date of installation,

vii. The inspection date and the name of the person or agency performing the inspection,

viii. The date when last recharged and the name of the person performing the recharge,

ix. The hydrostatic test date and the name of the person or agency performing the test,

x. Next hydrotect date,

xi. Inspection observation and maintenance carried out.

9.0 CONDEMNING OF CYLINDERS

Foam cylinders may be condemned when it leaks or when internal or external corrosion, denting, bulging or evidence of rough usage exists to the extent that the cylinders are likely to be weakened appreciably.

Any cylinder which fails to pass periodic examination or test or which for any other defect is found to be unsafe for use shall be destroyed by flattening it as a whole or after being cut into pieces in such manner that the pieces cannot be again joined together by welding or otherwise to form a cylinder.

10.0 REFERENCE

1. IS 933 - Portable chemical fire extinguisher - foam type.
2. IS 934 - Portable chemical fire extinguisher soda acid type
3. IS 951 - Crash tender combined foam and carbon dioxide, functional requirements?
4. IS 2097 - Specification for foam making branches
5. IS 2190 - Code of practice for selection, installation & maintenance of first aid fire extinguishers
6. IS 4989 - Specifications for foam concentrate for producing mechanical foam for fire fighting.
7. IS 5490 - Refills for portable fire extinguishers & chemical fire engines
8. IS 5507 Chemical fire engine, 50 litre capacity, foam type
9. IS 8150 - Chemical foam engine, 4 litre capacity - for marine use
10. IS 10204 - Portable fire extinguishers - mechanical foam type

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11. NFPA 11A - Low expansion foam & combined agent systems
12. NFPA 11C - Mobile foam apparatus
13. NFPA 16 - Installation of deluge foam water sprinkler systems and foam water spray systems
14. NFPA 20 - Installation of centrifugal fire pumps
15. OISD 116 - Fire protection facilities for petroleum refineries and oil/gas processing plants.
SECTION VI

WATER SPRINKLER SYSTEM

1.0 DEFINITION AND TYPES:

1.1 DEFINITIONS:

1.1.1 Sprinkler System:

A sprinkler system, for fire protection purposes, is an integrated system of underground and overhead piping designed in accordance with fire protection engineering standards. The installation includes one or more water supplies. The portion of the sprinkler system above ground is a network for specially sized or hydraulically designed piping installed generally overhead and to which sprinklers are attached in a systematic pattern. The valve control in each system riser is located in the system riser or its supply piping. Each sprinkler system riser includes a device for actuating an alarm when the system is in operation. The system is usually activated by heat or smoke detector or manually and discharge water over the fire affected area.

1.1.2 Risers:

Risers are vertical pipes in a sprinkler system.

1.1.3 System Riser:

The aboveground supply pipe directly connected to the water supply.

1.1.4 Feed Mains:

Mains supplying risers or cross mains.

1.1.5 Cross Mains:

Pipes directly supplying the lines in which the sprinklers are placed.

1.1.6 Branch Line:

Lines of pipe from the point of attachment to the cross main upto the end sprinkler, in which the sprinklers are directly placed.

1.1.7 Sprinkler Alarms:

A local alarm unit is an assembly of apparatus so constructed and installed that any flow of water from a sprinkler system equal to or greater than that from a single automatic sprinkler of the smallest orifice size installed on the system will result in an audible alarm on the premises within 5 minutes after such flow begins.

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1.2 TYPES OF SPRINKER SYSTEMS:

1.2.1 Wet-Pipe Systems:

A system having automatic sprinklers attached to a piping system containing water and connected to a water supply so that water discharges immediately from sprinklers activated by fire.

1.2.2 Dry-Pipe Systems:

A system having automatic sprinklers attached to a piping system with nitrogen or air, under pressure, the release of which permits the water pressure to open a valve known as a dry pipe valve. The water then flows into the sprinkler piping system and out through the sprinklers.

1.2.3 Pre-Action System:

A system having automatic sprinklers attached to a piping system containing air that may or may not be under pressure. A supplementary fire detection system installed in the same area actuates the sprinkler system opening the valve and permitting water into the sprinkler system.

1.2.4 Deluge System:

A system having open sprinklers attached to a piping system connected to a water supply through a valve which is opened by the operation of a fire detection system installed in the same areas as the sprinklers; opening of the valve leads to water discharge from all sprinklers through the piping system.

1.2.5 Combined Dry-Pipe and Pre-Action System:

A system having automatic sprinklers attached to a piping system containing air under pressure with a supplemental fire detection system installed in the same areas as the sprinkler. Actuation of fire detection system activates tripping devices which open dry-pipe valves simultaneously and without loss of air pressure in the system. It also opens approved air exhaust valves of the system with water, which usually precedes the opening of the sprinklers. The fire detection system also serves as an automatic fire alarm system.

2.0 DESIGN:

Conventional Sprinkler systems shall be designed for a max working pressure of 12.5 kg/sq.cm. (175 psi). Sprinklers used in high voltage electrical systems, control rooms, electronic systems etc. shall be designed to relevant specifications.

2.1 FITTINGS:

Fittings used in Sprinkler system shall be designed to withstand the working pressures involved, but not less than 12.5 kg/sq.cm. (175 psi) of water.

2.2 COUPLINGS & UNIONS:

Screwed unions shall not be used on pipe larger than 1 1/2".

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2.3. **REDUCERS & BUSHINGS:**

A one piece reducer fitting shall be used wherever a change is made in the size of the pipe.

2.4 **VALVES:**

Drain valves and test valves shall be designed to withstand 12.5 kg/sq.cm (175 psi) of water. Check valves shall be installed in each connection if there is more than one source of water supply.

2.5 **HANGERS:**

The maximum distance between hangers shall not exceed 3.7 mtr. (12') for 1 1/4" size pipes and 4.6 mtr. (15') for sizes 1 1/2" and larger.

2.6 **SPRINKLERS:**

The sprinklers may be of orifice size 12.7, 15.9 & 19.1 mm. The size of orifice of the sprinkler shall be selected on the basis of level of exposure of fire. Large orifice sprinklers should be used where exposure is severe. Sprinklers shall not be used for system working pressure exceeding 12.5 kg/sq.cm. (175 psi).

2.7 **SPRINKLER ALARMS:**

All remote sprinkler water flow alarm systems shall be installed in accordance with the following applicable NFPA Standards:

i) NFPA 71, Central Station Signalling Systems

ii) NFPA 72B, Auxiliary Protective Signalling Systems

iii) NFPA 72C, Remote Station Protective Signalling.

iv) NFPA 72D, Proprietary Protective Signalling.

2.8 **RELIEF VALVES:**

A wet pipe system shall be provided with a relief valve not less than 1/4" in size set to operate at pressure not greater than 12.5kg/sq.cm (175 psi). However, when the maximum system pressure exceeds 11.8 kg/sq.cm (165 psi), the relief valve shall be set to operate at 0.6 kg/sq.cm (10 psi) in excess of the maximum system pressure.

A dry pipe system shall have an approved relief valve which shall be provided between compressor and controlling valve set to relieve at a pressure of 0.3kg/sq.cm (5 psi) in excess of maximum system air pressure.

2.9 **PRESSURE GAUGES:**

The pressure gauges shall be of approved type and shall have a maximum limit not less than twice the normal working pressure at the point installed. It shall be installed on the following locations:

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i. **Wet Pipe system**

On the sprinkler riser, above and below each alarm clock valve. (Wet Pipe System)

ii. **Dry Pipe System**

a) On the water side and air side of dry pipe valve.

b) At the pump supplying the air receiver.

c) At the air receiver.

d) In each independent pipe from air supply to dry pipe system and

e) At the exhausters and accelerators. (Dry Pipe System)

iii. **Others**

a) Above and below preaction valve and below deluge valve

b) On air supply to Preaction and Deluge valve. (Preaction & Deluge Systems.)

3.0 **MATERIALS:**

Pipe or tubes used in sprinkler systems shall be of materials given below:

3.1 **Ferrous Piping (Welded & Seamless)**

Welded and seamless steel pipe for ordinary uses, Specification for Black and

Hot dipped Zinc Coated (Galvanised) pipes ANSI/ASTM A120

Specification for Black and Hot dipped Zinc coated (Galvanised) welded and seamless
steel pipe for fire protection use ASTM A 795

Specification for welded and seamless steel pipe ANSI/ASTM A 106 Wrought steel pipe
ANSI B 36.10

Specification for Electrical resistance welded steel pipe ASTM A 135

3.2 **Copper Tube (Drawn Seamless)**

Specification for seamless copper tube ASTM B 75

Specification for seamless copper water tube ASTM B 88

Specification & general requirements for wrought seamless copper and copper alloy tube
ASTM B 251

Brazing filler metal AWS A 5.8

Solder Metal ASTM B 32

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3.3 Pipe Thickness:

All welded and seamless steel pipe shall have the minimum wall thickness for pressure upto 20.0 kg/sq.cm (300 psi) as per the following.

For sizes upto 4 inch ..Sch 40
For 6 inch to 12 inches ..Sch 30
For 14 inch and above ..Sch 20

Also refer Clause 5.8 of OISD Std 116 for guidelines on Material Specifications.

4.0 CONSTRUCTION:

4.1 THREADED PIPE AND FITTINGS:

Joining compound or tape shall be applied to the threads of the pipe and not in the fitting.

Headers shall have end flange to flushout the lines for removing the scales.

4.2 PIPE BEND:

The minimum radius of a pipe bend shall conform to the following:

Pipe size Min radius of bend
2" and less 6d
2-1/2 and above 5d

where ‘d’ is the nominal diameter of the pipe.

4.3 WELDING:

All ferrous piping and fittings shall be welded while all copper alloy piping and fittings shall be brazed.

All welding shall be carried out using qualified welders and welding procedures in compliance with the requirements of AWS D 10.9, Level Ar-3.

Welding procedure, welders and welding machine operators shall be qualified as per ASME SEC IX.

Welding shall not be performed if there is impingement of rain, snow, sleet or high wind on the weld area.

When welded outlets are formed:

i) Holes in piping shall be cut to full inside diameter of fitting or shaped/contoured nipple.

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ii) Discs shall be retrieved.

iii) Opening in piping shall be smooth.

iv) All slag and other welding residue shall be removed.

v) Fittings or shaped contoured nipples of any length shall not penetrate beyond the internal diameter of the piping.

When reducing a pipe size in the run of a main, cross main, or branch, a suitable reducing fitting designed for that purpose shall be used.

Torch cutting and welding shall not be permitted as means of modifying or repairing sprinkler systems.

Pipe joined with mechanical groove shall be joined by a listed combination of fittings, gaskets and grooves. When grooves are cut or rolled on the pipe they shall be dimensionally compatible with the fitting.

Mechanical grooved coupling including gaskets used on dry pipe shall be marked for dry pipe service.

5.0 INSPECTION & TESTING OF WET/DRY SPRINKLER SYSTEMS

5.1 SPRINKLER PIPING AND FITTINGS:

i) MATERIAL:

Pipe/fittings shall be checked / tested to ensure conformance with the required standards.

ii) FABRICATION:

Inspection of the following shall be carried out prior to and during welding:

a) Review and approval of the welding procedure,

b) Qualification of welding procedure and welders,

c) Inspection of edge preparation and joint fit up,

d) Ensuring that during welding only approved procedure and approved electrodes are being used.

iii) TESTING:

Radiography of the welds shall be carried out for 10% of the weld joints on all piping and fittings with size 2" and greater.
5.2. ACCEPTANCE TESTS:

5.2.1. Flushing of Underground Connections:

Underground mains and leading connections to system risers shall be flushed before connection is made to sprinkler piping in order to remove foreign materials which may have entered the underground piping during the course of the installation. For all systems, the flushing operations shall be continued until water is clear.

Underground lines and leading connections shall be flushed at a flow rate as given in the Table below or at hydraulically calculated water demand rate of the system, whichever is greater.

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Flow Rate (USGPM)</th>
<th>Flow Rate (L/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4&quot;</td>
<td>390</td>
<td>1476</td>
</tr>
<tr>
<td>6&quot;</td>
<td>880</td>
<td>3331</td>
</tr>
<tr>
<td>8&quot;</td>
<td>1560</td>
<td>5905</td>
</tr>
<tr>
<td>10&quot;</td>
<td>2440</td>
<td>9235</td>
</tr>
<tr>
<td>12&quot;</td>
<td>3520</td>
<td>13323</td>
</tr>
</tbody>
</table>

The above mentioned flow rates ensure a flow velocity of 3 mt/sec as required by NFPA.

Provision shall be made for the disposal of water issuing from test outlets to avoid property damage.

5.2.2. Hydrostatic Test:

All new systems including guard piping shall be hydrostatically tested for 2 hours at not less than 13.8 kg/sq.cm (200 psi) pressure or at 3.4 kg/sq.cm (50 psi) in excess of max. pressure, when the max pressure to be maintained in the system is in excess of 10.3 kg/sq.cm (150 psi). The test pressure shall be read from a gauge located at a suitable point in the individual system or portion of the system being tested.

5.2.3. Permissible Leakage:

The inside sprinkler piping shall be installed in such a manner that there will be no visible leakage when the system is subjected to the hydrostatic test pressure.

5.2.4 Test Blanks:

Whenever a test blank is used, it shall be of the self-indicating type. Test blanks shall have red painted lugs protruding beyond the flange in such a way as to clearly indicate their presence. The installer shall have all test blanks numbered so as to keep track of their use and assure their removal after the work is completed.

5.2.5 Specific Test for Dry- Pipe Systems

i. Differential dry-pipe valves:

The clapper of the differential type dry-pipe valve shall be held off its seat during any test in excess of 3.4kg/sq.cm (50 psi) to prevent damaging the valve.

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ii. **Air test:**

The pneumatic system is subjected to an air pressure of 2.8 kg/sq.cm (40 psi) and allowed to stand for 24 hours. All leaks which allow a loss of pressure by 0.1 kg/sq.cm (1.5 psi) in 24 hours shall be rectified.

iii. **Operating test of Dry-Pipe valve:**

A working test of the dry-pipe valve alone and with quick opening device, if installed, shall be made before acceptance by opening the system test pipe. Trip and water delivery times shall be measured from the time inspector's test pipe is opened and shall be recorded.

5.2.6 **Performance Test**

Frequency of performance tests shall be as per OISD-116.

5.2.7 **Test of Drainage Facility:**

Test for drainage facilities shall be made while the control valve is wide open. The main drain valve shall be opened and remains open until the system pressure stabilizes.

5.3 **LIKELY LOCATIONS OF DETERIORATION:**

5.3.1 **External Corrosion**

System components installed outdoors or in the presence of a corrosive atmosphere are prone to atmospheric corrosion.

5.3.2 **Internal Corrosion**

This will vary depending upon the water chemistry.

5.4 **FREQUENCY AND PROCEDURE FOR INSPECTION:**

During weekly, or other scheduled plant inspection, equipment shall be checked for obvious defects such as broken or missing parts, nozzle loading, or other evidence of impaired protection.

Strainers, except individual nozzle strainers shall be thoroughly inspected after each operation, or flow test and cleaned, if necessary. Routine inspection and cleaning shall be performed at intervals of not more than 12 months or more frequently based on experience.

All piping & its components shall be examined to determine condition and proper drainage at intervals of not more than one year as per OISD Standard 116.

Threaded portion of the lines connecting the deluge release valve, block valve, diaphram unit spring and water alarm turbine shaft shall be checked more critically.

6.0 **DOCUMENTATION:**

The manufacturer shall furnish test certificates giving the following information:

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i. Certificate Number & Date,

ii. Hydraulic Calculations,

iii. Materials used for Construction,

iv. Hydrostatic test pressure,

v. Coating details, if any,

vi. Location at which it is installed,

vii. Date of installation,

viii. The inspection date and name of the person or agency performing the inspection,

ix. The acceptance test date and the name of the person or agency performing the tests,

x. Next test date,

xi. Inspection observations and maintenance carried out.

7.0 REFERENCE:

1. NFPA 13 - Installation of Sprinkler systems

2. ASTM Material specifications - A 120/ A 795/ A 135/ A 106/ B 36.10/ B 75/ B 88/B 32/B 251

3. OISD 116 - Fire protection facilities for petroleum refineries and oil/gas processing plants
SECTION - VII

FIXED WATER SPRAY SYSTEM FOR FIRE PROTECTION

Fixed water spray system, also called procto-sprays or drenchers, are meant to protect an equipment from exposure to extraneous heat.

1.0 DEFINITION AND APPLICABILITY

1.1 DEFINITION:

1.1.1 Water Spray:

Water in a form having a predetermined pattern, particle size, velocity and density discharged from specially designed nozzles or devices is termed as water spray.

1.1.2 Water Spray Nozzles:

A special discharge device, which will distribute the water in special, directional pattern, peculiar to it, when supplied with water under pressure.

1.1.3 Water Spray System:

A special fixed pipe system connected to a reliable source of fire protection water supply, 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 the water supply through an automatically or manually actuated valve, which initiates the flow of water. An automatic valve is actuated by operation of automatic detection equipment installed in the same area as the water spray nozzles. In certain cases, the automatic detection equipment may also be located in another area.

The water spray system could be of high velocity or medium velocity. High velocity water spray systems are installed to extinguish oil fires involving liquids with flash point of 65°C or higher. Medium velocity water spray systems are installed to control the burning and to provide cooling and/or exposure protection.

1.1.4 Automatic Fire Detection Equipment:

Equipment which will automatically detect heat, flame, smoke, flammable gases, or other conditions likely to produce fire or explosion and cause automatic actuation of alarm and protection equipment. The detector rating shall be at least 30°C above the highest ambient temperature. The detection piping and equipment shall be supported independently as far as possible. The system should actuate the deluge valve within 20 seconds.

1.1.5 Exposure Protection:

Application of fixed water spray on to the equipment to limit absorption of heat to a level which will minimize damage and prevent failure irrespective of internal or external heat.

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1.2. **APPLICABILITY:**

Fixed water spray is applicable for protection of specific hazards and equipment and may be installed independently of or supplementary to other form of fire protection system or equipment.

High velocity water spray system are installed for protection of the following:

i. Transformers, oil filled equipment of power stations

ii. Turbo-alternators

iv. Oil fired boiler rooms, oil quenching tanks etc.

Medium velocity water spray systems are used for:

i) General area protection

ii) Horizontal storage vessels (LPG bullets etc.)

iii) Vertical storage tanks

iv) Spheres

v) Protection of specific spots/areas in an equipment.

2.0 **DESIGN:**

Before a fixed water spray system is installed or existing equipment is modified, complete specifications, hydraulic calculations and working plans shall be prepared.

The practical location of on 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 effective, is determined largely by the physical arrangement and the protection needs of the installation requiring protection. Once the criteria are established, the size of nozzles to be used, the angle of the nozzle discharge cone and the water pressure needed can be determined.

The first factor to determine is the water quantity required absorbing the expected release of heat from exposure or heat of combustion. When this is determined, a nozzle may be selected that will provide that quantity at a velocity adequate to overcome air currents and to carry the spray to the equipment to be protected. Each nozzle selected must also have the proper angle of discharge to cover the area to be protected by the nozzle.

Also refer para on Water Spray Application Rate in OISD Standard 116.

There are limitations to the use of water spray, which shall be recognised. Such limitations involve the nature of the equipment to be protected, the physical and chemical properties of the materials involved and the environment of the hazard like electrical clearance, frothing etc.
Both medium and high velocity water spray systems are designed at a minimum flow rate as stipulated in relevant OISD Standard. The density of water application depends upon the flash point of the liquids handled and also the ceiling height distance of sprayers from the risk. There shall be at least one sprayer to each 9 Sq.m. area of the floor of risk. The distance between adjoining sprayers shall not exceed 3 metres. In case of vessels like spheres/bullets, the number and distance of sprayers shall be selected based on the sprayers density, angle of discharge and the diameter of the vessel.

2.1 SIZE OF WATER SPRAY SYSTEMS:

Many factors govern the size of a water spray system, including the nature of hazard or combustibles involved, amount and type of equipment to be protected, adequacy of other protection, and the size of the area, which could be involved in a single fire. The size of the system needed may be minimized by taking advantage of possible subdivision by fire walls, by limiting the potential spread of flammable liquids by dikes, curbs, or special drainage; by water curtains or heat curtains; or by combination of these features.

Because most water spray system must perform as deluge type systems with all nozzles or devices open, and because a high density of water discharge is often needed, there is a heavy water demand.

The size of a single water spray system be limited only by the available water supply so that the designed discharge rate will be calculated at the minimum pressures for which the nozzles are effective. Experience has shown that in most installations, a design discharge rate of 3,000 gpm (11,356 lt/min) should not be exceeded for a single system. Separate fire areas should be protected by separate systems.

2.2 WATER SUPPLIES:

Fixed spray systems are usually supplied from one or more of the following:

i) Connection from a reliable waterworks system of adequate capacity and pressure.

ii) Automatic fire pumps having reliable power and a water supply of adequate capacity and reliability.

iii) An elevated (gravity) tank of adequate capacity and elevation.

In some situations where the water supply is extremely limited, a cycle system, which collects and reuses water, may be acceptable. It is imperative, however, that foreign material and fuel be separated from the water before it is returned to the water spray system.

2.3 WATER DEMAND RATE:

The water supply must be adequate to supply at the effective pressure all of the spray nozzles that may be expected to operate in a fire in the protected area. Additional water may be required for hose streams and should be considered when the system is designed. The duration of the discharge required will vary according to the nature of the hazard, the purpose for which the system is designed, and other factors which can be evaluated only for each installation.

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Water demand is specified in terms of density of a uniformly distributed spray measured in lt/min/sq.mtr (gpm/sq.ft) of area protected. The discharge rate per unit of area depends on whether the spray system is installed for extinguishment of fire, control of fire, exposure protection, or prevention of fire, and upon the characteristics of the materials involved.

Also refer Annexure 1 of OISD Standard 116 for Typical Water Demand Rate Calculations.

2.4 PIPE SIZES:

Pipe sizes must be calculated for each system in order that the water at the spray nozzles will have adequate pressure. In medium velocity water spray systems, water pressure at nozzle outlet shall be 1.4 to 3.5 kg/cm2.

2.5 SELECTION AND USE OF SPRAY NOZZLES:

The selection of spray nozzles takes into consideration such factors as the character of the hazard to be protected, the purpose of the system, and possible severe wind or draft conditions.

High velocity spray nozzles, generally used in piped installations, discharge in the form of a spray filled cone, while low velocity spray nozzles usually deliver a much finer spray in the form of either a spray filled spheroid or cone. Due to difference in size of orifices in the various nozzles and the range of water particle sizes produced by each type, nozzles of one type should not be substituted. In general, higher the velocity and the coarse the size of water droplets, the greater the effective reach or range of spray.

Some open (nonautomatic) spray nozzles produce spray by giving the water high rotary motion in spiral passages inside the nozzle body.

The sprayers shall not be less than 6 mm in orifice size and shall normally have cone angles between 60° to 125°. Sprayers with cone angles below 60° are permissible for local protections only. Sprayers shall be installed normal to the exposed area of the vessel and positioned at distance as calculated from vessel diameter, spray cone angles, density etc. Minimum clear distance between water spray nozzles and live uninsulated electrical components shall conform to the guidelines given in NFPA-13.

2.6 STRAINERS:

Strainers are ordinarily required in the supply lines of fixed piping systems to prevent clogging of the nozzles. They should be selected with baskets having holes small enough to protect the smaller water passages in the nozzles used.

Water spray nozzles having very small water passage may have their own internal strainer as well as a supply line strainer to remove larger foreign material.

2.7 DRAINAGE:

Fixed pipe open nozzle water spray systems discharge large quantities of water. To limit the spread of flammable liquids, special drainage and disposal facilities including fire traps should be provided. Pitched floors, curbs, dikes, sumps or trenches etc. designed

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for safe disposal may be required alone or in combination as best adapted for specific situation.

The drainage system shall be adequate for:

a) Water discharged from fixed fire protection systems at maximum flow conditions
b) Water likely to be discharged by hose streams
c) Surface water
d) Cooling water normally discharged to the system.

2.8 MATERIALS:

Only approved materials and devices shall be employed in the installation of systems as described below:

2.8.1 Corrosion Protection:

System components installed outdoors, or in the presence of a corrosive atmosphere, shall be constructed of materials, which will resist corrosion, or be covered with protective coatings. The threaded ends of galvanized pipe, after installation, shall be protected against corrosion.

2.8.2 Spray Nozzles:

Care shall be taken in the selection of nozzle types. Distance of ‘throw’ or location of nozzle from surface shall be limited by the nozzle’s discharge characteristics.

Care shall also be taken in the selection of nozzles to waterways, which are easily obstructed by debris, sediment, etc., in the water.

2.8.3 Piping:

Pipes used in water spray systems shall conform to ASTM A-53, A 106,API 5L or IS 1239. Piping shall be designed to withstand a working pressure of not less than 12.2 bars (175 psi).

2.8.4 Fittings:

All fittings shall be of a type specifically approved for fire protection systems and of a design suitable for working pressures involved, but not less than 12.2 bars (175 psi) cold water pressures. Ferrous fittings shall be of carbon steel.

Galvanized fittings shall be used where galvanized pipe is required.

2.8.5 Hangers:

Hangers shall be of approved type for use with the piping involved. Hangers used out doors or in locations where corrosive conditions exist shall be galvanized or suitably coated for protection against the corrosive condition of the location.

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2.8.6 **Pressure Gauges:**

Pressure gauges shall be of approved type and shall have a maximum limit not less than twice the normal working pressure when installed.

2.8.7 **Strainers:**

Pipeline strainers shall be specifically approved for use in water supply connections. Strainer shall be capable of removing from the water all solids of sufficient size, which can obstruct the spray nozzle. In addition, the strainer shall be capable of continued operation without serious increase in head loss, for a period estimated to be ample when considering the type of protection provided, the condition of the water and similar local circumstances. Pipe strainer designs shall incorporate a flush out connection. Individual strainers for spray nozzles where required, shall be of approved type.

2.2.8 **Control Equipment:**

Automatic valves shall be special system water control valves approved for the use intended.

Automatic detection equipment shall be of a type listed by a testing laboratory for the intended usage such as with special systems water control valves. When used, electrical type detection equipment shall meet the area electrical area classification requirements.

3.0 **CONSTRUCTION:**

3.1 **HEADERS:**


Weld Procedure and Welder qualification shall be done as per relevant code before commissioning the job.

Stage wise inspection with visual and other NDE methods shall be carried out as required. Repairs shall be carried out as per approved procedure and shall be reinspected prior to final acceptance.

3.2 **THREADED PIPES & FITTINGS:**

Steel pipe with wall thickness less than schedule 30 (in sizes 8" and larger) or schedule 40 (in sizes less than 8") shall not be joined by threaded fittings.

All threaded fittings and pipes shall have threads cut to ANSI B2.1, Pipe Threads (except dry seal).

Joint compound or tape shall be applied to threads of the pipe and not in the fittings.

Sprinkler headers shall have end flange to flushout the lines to remove the scales.

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4.0 ACCEPTANCE TESTS:

4.1 FLUSHING OF PIPING:

Underground mains and lead-in connections to the system risers shall be flushed thoroughly before connection is made to the system piping in order to remove foreign materials which may have entered the underground piping during the course of installation or which may have been present in the existing piping. All system piping shall be flushed where practicable; otherwise, cleanliness shall be determined by visual examination.

4.2 HYDROSTATIC PRESSURE TEST:

All new system piping shall be hydrostatically tested in accordance with the specifications.

4.3 WATER DISCHARGE TEST:

When practicable, full flow tests with water shall be made in system piping as a means of checking the nozzle lay-out, discharge pattern, any obstructions and determination of relation between design criteria and actual performance and to ensure against clogging of the smaller piping and the discharge devices by foreign matter carried by the water.

When practicable, the maximum number of systems that may be expected to operate in case of fire shall be in full operation simultaneously in order to check the adequacy and condition of the water supply.

The discharge pressure at the highest, most remote nozzle shall be at least that for which the system was designed.

4.4 OPERATING TESTS:

All operating parts of the system shall be fully tested to ensure that they are in operating condition. The operating tests shall also include a test of automatic detection equipment.

5.0 PERIODIC INSPECTION AND TESTING:

5.1 LIKELY LOCATIONS OF DETERIORATION (CORROSION):

i. External Corrosion:

System components installed outdoors or in a corrosive atmosphere shall be constructed of materials, which will resist corrosion, or be covered with protective coatings. The threaded ends of galvanized pipe, after installation shall be protected against corrosion.

ii. Internal Corrosion:

This will vary depending upon the water chemistry and the system should be checked for thickness at a pre-determined frequency. Threaded portion of the lines connecting the deluge release valve, Clock valve diaphragm unit spring, water alarm turbine shaft shall be inspected more critically.

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5.2 FREQUENCY AND PROCEDURE FOR INSPECTION:

During monthly, or other scheduled plant inspections, equipment shall be checked for obvious defects such as broken or missing parts, nozzle loading, or other evidence of impaired protection.

Strainers, except individual nozzle strainers shall be thoroughly inspected after each operation, or flow test and cleaned, if necessary. Routine inspection and cleaning shall be performed at intervals as per OISD Standard 116.

5.2.1 Piping System:

At intervals of not more than one year, all piping shall be examined to determine condition and proper drainage.

Flow test on open head spray systems shall be made yearly or more frequently as determined by experience.

5.2.2 Control Valves and Automatic Detection Devices

Control valves and automatic detection equipment shall be tested annually by qualified personnel.

Where normally opened valves are closed following system operation or test, suitable procedures shall be instituted to ensure that they are reopened and that the system is promptly and properly restored to full normal operating condition. Main drain flow test shall be made after valves are reopened.

5.2.3 Spray Nozzles:

All spray nozzles shall be inspected for proper positioning, external loading, and corrosion and cleaned if necessary, at intervals of not more than 12 months or more frequently if necessary based on experience.

5.2.4 Performance Test

Frequency of performance tests shall be as per OISD-116.

5.2.5 Flushing:

Lead-in connections to system risers shall be flushed at least annually.

6.0 DOCUMENTATION:

The manufacturer shall furnish test certificates giving the following information:

i) Certificate Number & Date,

ii) Hydraulic Calculations,

iii) Materials used for construction,
iv) Hydrostatic test pressure,
v) Coating details if any,
vi) Location at which it is installed,
vii) Date of installation,
viii) The inspection date and name of the person or agency performing the inspection,
ix) The acceptance test date and the name of the person or agency performing the tests,
x) Next test dates,
xi) Inspection observations and maintenance carried out.

7.0 REFERENCE:

1. NFPA 15 - Water spray fixed systems
2. ASTM A 120
3. ASTM A 106 & API 5L - Specifications for seamless/ERW mild steel pipes
4. OISD 116 - Fire protection facilities for petroleum refineries and oil/gas processing plants.