STANDARD

FOR

INSTALLATION, INSPECTION

AND

TESTING OF FIRE FIGHTING FIXED SYSTEMS

ORIGINAL EDITION

MAY 1997

This standard specification is reviewed and updated by the relevant technical committee on May 2003. The approved modifications are included in the present issue of IPS.

CONTENTS : PAGE No.

PART IV

PART V

0. INTRODUCTION

In the Iranian Petroleum, Gas and Petrochemical industries various oil product and chemical units are protected against the out break of fire with special type of fire fighting fixed systems which are relevant to the nature of fire protection needed.

In this Standard the construction requirement for fire systems is discussed.

1. SCOPE

This Standard specifies the minimum requirements for the construction, installation, inspection and testing of various types of fire fighting fixed systems and is divided in five parts as follows:

Part 1 CO_2 Fire Extinguishing Systems
Part 2 Dry Chemical Powder Fire Extinguishing Systems
Part 3 Sprinkler Systems
Part 4 Water Supply Systems
Part 5 Foam Systems

Note:

This standard specification is reviewed and updated by the relevant technical committee on May 2003. The approved modifications by T.C. were sent to IPS users as amendment No. 1 by circular No 217 on May 2003. These modifications are included in the present issue of IPS.

2. REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

BSI (BRITISH STANDARD INSTITUTION)

BS 5306 Part 2 Section 5 Clause 24 (1990)

IPS (IRANIAN PETROLEUM STANDARDS)

E-SF-200 "Fire Fighting Sprinkler Systems"
E-SF-160 "Engineering Standard for CO2 Extinguishing Systems"
E-SF-180 "Engineering Standard for Dry Chemical Fire Extinguishing Systems"
E-TP-100 “Engineering Standard for Paints”
E-SF-220 “Engineering Standard for Water Distribution and Storage Facilities”
G-SF-100 “Fire Fighting Trucks & Pumps”
M-EL-290/6 "Earthing"

3. DEFINITIONS AND TERMINOLOGY

Definitions used in the following standards are applied:

IPS-E-SF-140 "Foam Generating and Proportioning Systems"
IPS-E-SF-160 "CO_2 Gas Fire Extinguishing Systems"
IPS-E-SF-180 "Dry Chemical Fire Extinguishing Systems"
IPS-E-SF-200 "Fire Fighting Sprinkler Systems"
IPS-E-SF-220 "Fire Water Distribution & Storage Facilities"

4. UNITS

This Standard is based on International Systems of Units (SI), except where otherwise specified.

5. GENERAL

5.1 This Standard is prepared for the use and guidance of those charged with the installation, commissioning, testing and approving of extinguishing systems in order that installed equipment function as expected throughout their life.

5.2 Only those skilled in the field of safety and fire are authorized to approve the installation testing and commissioning of the systems.

It is necessary for those charged to consult with fire protection engineers to be aware and experienced with design of fire extinguishing systems, which would enable them to effectively discharge their respective duties.

PART I

6. INSTALLATION, TESTING AND QUALITY CONTROL OF CO_2 EXTINGUISHING SYSTEMS

6.1 Type of Systems

System shall comply with requirements of IPS-E-SF-160.

6.2 Planning

Where a fixed carbon dioxide extinguishing system is being considered for new or existing building the following authorities shall be consulted during construction and installation of the system:

a) The plant manager.

b) The operation/production superintendent.

c) The fire protection engineer.

d) Authorities who are concerned with the project.

6.3 System Layout Drawings

6.3.1 Prior to installation of system the layout drawing with full details and dimensions shall be prepared to define clearly both the hazards and the proposed system.

Detail of hazards shall be included to show the materials involved and also the location and/or limits of the hazard and any other materials that are likely to become exposed to the hazard in the event of fire. The means of egress from the area to be protected (if it is an automatic total flooding system), for personnel who are likely to be present in that area shall be indicated together with the number of occupants.

The location and size of piping and nozzles shall be clearly indicated together with the location of carbon dioxide supply cylinder, fire detection devices, manual control locking devices, and all auxiliary equipment. Features such as dampers, means of escape, delay system and doors related to the operation of the system shall also be shown with all details of calculations used in assessing the quantity of carbon dioxide.

Further information shall be given separately indicating the equipment such as length of pipe and fittings, flow rates and pressure drops throughout the system.

6.4 Tests and Approval of Installations

6.4.1 The completed system shall be inspected and tested by qualified personnel of the supplier before the approval of the owner is obtained. Only listed or approved equipment and devices shall be used in the system.

The supplier of the equipment or their agent shall arrange tests of completed installation to the satisfaction of the owner and show that it complies the standards given in IPS-E-SF-160 .

The tests shall include the following except that the discharge of CO_2 shall not be carried out in the special cases:

a) A thorough visual inspection of the installed system covering hazard area, the layout of piping and operational equipment shall be carried out. Discharge nozzles shall be inspected for proper size and location. The location of alarms and manual emergency releases shall be checked. The configuration of hazard shall be compared to the original specification. The area shall be inspected closely for unclosable openings and sources of agent loss, which may have been overlooked in the original layout. The area shall be inspected for ease of exit before system be operated.

Warning:

Co2 extinguisher system should not be tested and discharged into area, which the employees are present.

b) A check that all components of the system have been installed in a proper manner.

c) A check that all nuts, bolts, and fittings have been correctly tightened.

d) A check that all electrical connections are safe and in working order.

e) A check of labeling of devices for proper designations and instructions. Nameplate data of the storage containers shall be compared to the specifications.

f) Carbon dioxide gas tests to check the tightness of closed suction of pipe work. Separate gas discharges shall be made into each space to ensure that the piping is continuous and that nozzles have not been blocked.

Note:

A minimum of 10% of the required quantity of gas should be discharged through the system pipe work into each space. Prior to testing proper safety procedures shall be reviewed.

g) A full discharge test shall be performed on all systems except when specially waived by relevant authority.

When multiple hazards are protected from a common supply, then a full discharge test shall be performed for each hazard.

6.4.2 Local application

6.4.2.1 Full discharge of entire design quantity of carbon dioxide through system piping to ensure carbon dioxide effectively covers the hazard for the full period of time required by the design specifications and all pressure operated devices function as intended.

6.4.3 Total flooding

6.4.3.1 Full discharge of entire design quantity of carbon dioxide into the hazard area to ensure that the concentration is achieved (minimum CO_2 concentration is given in Table 2 of IPS-E-SF-160) and maintenance in the period of time required by the design specifications and all pressure operated devices function as intended.

6.4.4 Hand held hose line

6.4.4.1 Full discharge test of hand held hose line system require evidence of liquid flow from each nozzle with an adequate pattern of coverage.

Note:

A partial discharge is appropriate for most installations, but for others a total discharge with measurement of carbon dioxide concentrations achieved is desirable.

6.4.5 Checklist

6.4.5.1 The installer of equipment as supplier shall provide a checklist to enable the owner to witness that the tests are being carried out in a satisfactory manner. The list shall include the following:

a) Check that the system has been installed according to the relevant drawing and documents.

b) Check that all the following detection equipment functions correctly.

1) In fusible link systems, ensure that control cable lines are free and that operating control weights develop sufficient energy to operate container and/or direction valve control mechanisms.

2) In pneumatic rate of rise systems check with manometer to ensure correct breathing rate and leak free capillary lines. Also apply heat to detectors to ensure correct operation and subsequent activation of control mechanisms.

3) In electrical detector systems, check electrical circuitry and supply voltages for integrity. Apply heat flame and smoke to detectors to check operation of control mechanism.

c) Operate manual release devices to ensure correct functioning.

d) Check operation of all alarm devices.

e) Check correct operation of all safety devices.

f) Carry out a test of CO_2 gas discharge using an adequate percentage of the total CO_2 capacity to check:

1) That the direction valves when shut, hold leak gas;

2) that feed pipes lead to the correct protected space;

3) that no leak occur when equipment is fitted to pipe work and at pipe fillings;

4) that pressure operated devices function correctly and the items they control, such as shutters and alarms function correctly;

5) that, where possible, discharge nozzles pass gas and that non are blocked.

g) Ensure test containers are replaced and that all containers are filled with correct quantity of carbon dioxide.

h) Check that nameplate and construction plated are correctly worded and displayed. Ensure the containers have been mechanically tested.

6.4.5.2 When the installation has been completed and tested, a completion certificate shall be signed by the Vendor and owner's authorized personnel.

6.5 Warning Signs

Appropriate warning signs shall be affixed as specified in IPS-E-SF-160 Clause 18.11.1.

PART II

7. INSTALLATION, TESTING AND QUALITY CONTROL OF DRY CHEMICAL POWDER SYSTEMS

7.1 Planning

7.1.1 Where dry powder extinguishing system is being considered for new or existing building the authorities specified in Clause 6.2 shall be consulted.

7.2 Calculations and Design

7.2.1 As stated in IPS-E-SF-180 Clause 7.3 equations, graphs or Tables are not required for listed pre-engineered systems since the installation should be in accordance with their protested limitations described in the manufacturer's installation manual.

7.3 Drawings

7.3.1 Prior to installation of system manufacturer's layout drawings shall be prepared and studied. These should have sufficient details to define clearly the nature of hazard and proposed appropriate type of system.

Details of the hazard and materials that are likely to become exposed to the fire should also be included.

7.3.2 Considering the contents in Clause 7.2 above, the location, sizes of piping and nozzles shall be clearly indicated, together with the location of the powder supply, fire detection devices, manual control, all auxiliary equipment, doors related to the operation of the total flooding system and all details of calculation used in assessing the quantity of discharge rate of powder and the type of system shall be shown in the layout. Further information shall be given separately indicating the equivalent length of pipe and fittings; flow rates and pressure drop throughout the system.

7.4 Commissioning and Acceptance Tests

7.4.1 General

The Supplier/Vendor shall arrange tests of the completed installation to the satisfaction of the owner's relevant authorities to show that the system complies with IPS-E-SF-180 and functions as designed.

7.4.2 Discharge of powder should be done through monitor and hose reel systems when testing. Application of other means will cause spread of powder and consequent expense of cleaning the powder from contaminated areas.

Warning

Powder system should not be test discharged into areas where atmosphere is explosive. Electrostatic effects can induce sparking which may cause ignition of any flammable vapors or gases which may be present.

7.4.3 Commissioning test program

The supplier shall submit to the owner a test program, which shall include instructions to:

a) Check that all components of the system are installed according to the designed drawings and documents and in the correct manner;

b) check that all nuts, bolts and fittings are correctly tightened and that all pipework supports are correctly fitted;

c) check that all electrical connections are safe and in working order;

d) check that all pipe work and nozzles are the correct size;

e) check that all equipment functions correctly;

f) operate manual release devices to confirm correct functioning;

g) check operation of all alarm devices;

h) check correct operation of all safety devices;

i) carry-out a test discharge of propellant gas to check:

1) that distribution valves when shut hold pressure,

2) that feed pipes lead to the correct protected space,

3) that leak occur at joints of fittings,

4) that pressure operated devices function correctly and the items they control such as shutters and alarms function correctly,

5) that piping is continuous and nozzles are not blocked,

j) train all personnel who will be authorized to use monitor and hose reels systems.

7.4.4 System restoration

After completion of the commissioning and acceptance tests the system should be restored to operational condition and all containers checked for correct fill. The pipe work shall be blown down to remove any residual powder.

7.5 Completion Certificate

7.5.1 When the system has been completed, tested and restored, the owner shall be provided with 2 copies of completion certificate, a complete set of instructions and drawings showing the system as installed and the statement that the system complies with all appropriate requirements of IPS-E-SF-180 and giving details of any departure from appropriate standard.

7.5.2 Completion certificate shall be duly signed by the supplier and the owner.

PART III

8. INSTALLATION, TESTING AND QUALITY CONTROL OF FIRE FIGHTING SPRINKLER SYSTEMS

8.1 Installation Planning

8.1.1 Prior to installation system layout drawing shall be prepared and the authorities specified in Clause 6.2 shall be consulted.

8.1.2 Drawings, information and documents

The information shall be provided to the authorities concerned in a meeting to make sure that all requirements are met. The information provided shall include the following:

a) General specification of the system and;

b) a block plan of the premises showing:

1) the type(s) of installation(s) and the hazard class(es) and the occupancy in the various buildings;

2) the extend of the system with detail of any unprotected areas;

3) the construction and acceptance of the main building and any communicating and/or neighboring buildings;

4) a cross section of the full height of the building(s) showing the height of the highest sprinkler above the stated datum level; and;

5) a statement that the installation will comply with IPS-E-SF-200(0) standard including any deviation(s) with reasons for the deviation(s).

8.2 Installation Layout Drawings

8.2.1 Layout drawing shall include the following information:

a) The class or classes of installation according to the hazard including stock category and design storage height;

b) Constructional detail of floors, ceilings, roofs, exterior walls, separating sprinklered and non-sprinklered areas;

c) sectional elevation of each floor of each building showing the distance of sprinklers from ceilings, structural features, etc. which affect the sprinkler layout of water distribution from the sprinklers;

d) indication of trunking, staging, platform, machinery, fluorescent light fittings, heaters, suspend open cell ceilings etc., which may adversely affect the sprinkler distribution;

e) the sprinkler type(s) and temperature rating(s);

f) the location and type of main control valves and location of alarm motor and gangs;

g) the location and details of any water flow and air or water pressure alarm switches;

h) the location and size of any tail-end air valves, subsidiary stop valves and drain valves;

i) the drainage slope of the pipe work;

j) the location and specification of any orifice plate;

k) a schedule listing of number of sprinklers, medium and high velocity sprayer etc. and the area of protection.

8.2.2 Precalculated pipe work

8.2.2.1 For precalculated pipe work details shall be given on or with the drawing.

a) Identification of the pressure loss between the control valve and the design point at the following design rate of flow:

1) in a high hazard installation: 225 L/min.

2) ordinary-hazard installation: 100 L/min.

8.2.3 Hydraulically calculated pipe work

8.2.3.1 For hydraulically calculated pipe work detailed calculations shall be given either on worksheet or computer printout as given in BS-5306 Part 2 Section 5 Clause 24 (1990). (See IPS-E-SF-200 Clauses 19 and 20)

8.3 Work on Site

8.3.1 Care of material on site

Components shall be properly stored on site until required for installation. Unloading, stocking and storage shall be carried-out with care to prevent damage to pipes, pipe thread, valves, sprinkler heads, gages and any pumps and power units used in the system.

8.3.2 Site locations shall be prepared in advance of delivery so that heavy items such as fire pumps, strainers and pressure tanks can be transported directly to the final locations.

8.3.3 Pipes should be protected against entry of foreign objects such as rubber cordage etc. into the bore and they shall be examined and cleaned prior to erection. Open ends of pipes should be capped as work on site proceeds.

8.3.4 Sprinklers, controls and sprayers should preferably be fitted to pipes in situ. Where fabricated ranges are used the sprinklers can be fitted immediately before erection using pipe rack to hold the racks and the ranges off the ground.

8.4 Fire Protection of Buildings Under Construction or Modification

8.4.1 General

8.4.1.1 Work on the system shall proceed with the progress of building. Installations and zones shall be made operational as soon as practical.

8.4.2 Hot work

8.4.2.1 Suitable precautions shall be taken when hot work is performed. Procedures for hot work shall be observed.

8.5 Commissioning and Acceptance Tests

8.5.1 The selected authorities of the owner shall be invited to witness the tests and inspect the system in conjunction with the supplier's engineers.

8.5.2 Commissioning tests

8.5.2.1 All installation pipe work shall be pressure tested as follows:

a) Dry pipe work, pneumatically, to not less than 2.5 bars for not less than 24 hours;

b) wet pipe work, hydraulically, to not less than 15 bars or 1.5 times the working pressure, whichever is the greater for not less than 1 hour.

Any faults disclosed such as permanent distortion, rupture or leakage shall be corrected and the test repeated.

Note:

In water sensitive areas, it is advisable to pneumatically test pipe work before any hydraulic test.

8.5.3 Water supplies and alarms

8.5.3.1 Each water supply shall be tested with each installation in the system. The pump(s), if fitted in the supply shall start automatically and the supply pressure at the appropriate flow rate shall not be less than the appropriate value given in Clause 20 of IPS-E-SF-200 (0) and corrective action shall be taken if necessary.

Note:

Adequate facilities shall be provided for the disposal of test water. A test facility including a direct reading flow meter suitable for sprinkler service shall be provided at the pump delivery branch down stream of each outlet check valve to permit a running pressure test of the pump at the full load condition or nominal rating as appropriate.

8.5.4 Alarms

8.5.4.1 The equipment for automatic transmission of alarms to fire service or remote manned center shall be checked for:

a) Continuity of the connections and;

b) Continuity of the connection between the alarm switch and the control unit.

8.5.5 Checks

The following shall be checked and corrective actions taken if necessary:

a) All water and air pressure gage reading on trunk mains and pressure tanks and;

b) all water levels in elevated reservoir water storage and pressure tanks;

c) each water motor alarm shall be sounded for not less than 30s;

d) automatic starting of the pump; when it starts should record the starting pressure and check that this is correct. For diesel engine, run the engine for 30 min. or for the time recommended by manufacturer. Shut down the engine and use the manual start test button and check that the engine restarts;

e) the mode monitoring system for stop valve on life safety installations shall be tested;

f) the pipe work should be checked for electrical earthing connections;

g) secondary electrical supply from diesel generator shall be checked for operation;

h) all stop valves controlling the flow of water to sprinklers shall be manipulated to ensure that they are in working order;

i) dry alarm valves and any accelerators, in any dry pipe installations and tail end extensions shall be exercised;

j) test of drainage facilities shall be made.

8.6 Completion Certificate and Documents

8.6.1 The supplier shall provide to the owner the following:

a) A completion certificate stating that the system complies with all appropriate requirements of this standard and IPS-E-SF-200, and giving details of any departure from appropriate standards;

b) a copy of test reports of commissioning;

c) a complete set of operating instructions and or installed drawing including identification of all valves and instruments used for testing and operation and user program for inspection and checking;

d) a certificate giving the result of in-situ testing of pipe fasteners;

e) appropriate certificate stating that components used in the system are suitable for sprinkler service and passed quality inspections.

8.7 Sign and Notices

8.7.1 A location plate suitable for sprinkler service of weather resistant material and lettering shall be fixed on the outside of the external wall as close as practical to the entrance nearest to the

installation main control valve set(s). The plate shall bear the wording:

SPRINKLER STOP VALVE INSIDE

8.7.2 A sign shall be fitted also to the main and any subsidiary stop valves bearing the word:

SPRINKLER STOP VALVE

8.7.3 All valves and instruments used for testing and operation of the system shall be appropriately labeled.

8.7.4 Where the sprinkler system comprises more than one installation, each alarms valve shall be permanently marked with the number identifying the installation in control:

Each water motor alarm gang shall also be marked with the number of installation.

8.7.5 Where water flow into an installation initiate an automatic alarm to the fire station, notice to that effect shall be fixed adjacent to the alarm test valve(s).

8.7.6 The alarm at both the diesel engine controller and the responsibly manned location shall be marked as appropriate:

a) Diesel fire pump failure to start; and/or

b) diesel fire pump starter switched off; and pump running manually operated shut down mechanism shall be labeled "SPRINKLER PUMP SHUT-OFF".

8.7.7 Each switch in the dedicated power feed to an electric sprinkler fire pump motor shall be labeled:

"SPRINKLER PUMP MOTOR SUPPLY NOT TO BE SWITCHED OFF IN THE EVENT OF FIRE"

PART IV

9. INSTALLATION, TESTING AND QUALITY CONTROL OF WATER SUPPLY SYSTEMS

9.1 General

9.1.1 Water supply system for fire fighting include fire pumps, system of piping, control valves, hydrants and risers brought from tanks, rivers or other sources such as build reservoir or almost unlimited natural sources, to the point at which to be used for fire fighting. The magnitude of the water supply for fire fighting depend on the size and number of streams likely to be required and the length of time such streams may have to be operated. Design specification shall be in accordance with IPS-E-SF-220.

9.2 Planning for Construction

9.2.1 Drawings and documents

The information specified in design of the systems shall be provided, and mentioned in Clause 6.2 shall be consulted.

9.2.2 All drawings and documents shall carry the following information:

a) A general specification of the system, and;

b) a block plan of the area showing:

1) the type of hazards and the intend of the system,

2) particular of the water supplies including flow data and pressure,

c) a statement that the installation will comply with IPS-E-SF-220 including any deviation(s) with reasons;

d) a list of materials including pump details (manufacturer's data sheets);

e) hydraulically calculated of water flow and pressure at each ring main.

Any recommendations including planning stages of the installation shall be documented.

9.3 Installation

9.3.1 Work on site

9.3.1.1 Adequate provision shall be made by responsible authorities to protect materials and equipment on site from loss, deterioration and damage.

9.3.1.2 Unloading, stacking shall be carried out with care to prevent damages to the hydrants, couplings and other components used in the system.

9.3.2 Water pipes

9.3.2.1 General practice in tropical should be to lay down fire water mains as far as possible over ground, but in cold climate the fire water main is to be laid underground.

The depth, the type of pipe and protection required should duly be specified in design specifications. The depth of cover to provide protection against freezing will vary depending on lowest temperature. The pipe shall be properly guided in places where the pipe is subject to shock or vibration. Special care is necessary in running pipe under roads carrying heavy trucking.

In such areas pipes should be run in a covered pipe trench or be otherwise properly guarded.

9.3.3 Laying of pipe

9.3.3.1 Pipe shall be clean inside when put in trenches and open end shall be plugged when work is stopped to prevent stones or dirt from entering.

9.3.3.2 Back filling

Earth shall be well tamped under and around pipes and should contain no ashes, cinders or other corrosive materials.

9.3.3.3 Flushing

After a system has been completed and before underground pipes is permanently filled with water, the entire inside system shall be properly flushed out under pressure to move the larger obstructing materials from underground piping.

9.3.3.4 Pipes should be securely anchored before any pressure or flow tests are carried out. Steel pipes when used underground or water supplies are known to have unusual corrosive properties shall be protected against corrosion.

9.4 Initial Inspections and Acceptance Tests

9.4.1 Fire water mains and hydrants

Before final approval testing, the Supplier/Contractor shall furnish a written statement to the effect that the work has been completed in accordance with the approved specification and plans.

Inspection and, where practicable a wet test should be made by Supplier/Contractor in conjunction with fire authorities.

The test shall include flushing out the outlet and checking the outlet connections. The flow and pressure at the outlet shall also be measured and be satisfactory. The inspection should also verify that earthing requirements have been carried out satisfactorily or certified by selected electrical authorities (see IPS-M-EL-290/6 Clause 5).

9.4.2 The system should then be completely charged with water to a pressure of 10 bar measured at the inlet for a period of 15 min.

During this period an inspection of the system shall be made to check that no leakage of water is taking place.

All piping shall be tested for not less than 2 hours at a pressure of 4 bars in excess of the maximum static pressure when this is 10 bars.

9.4.3 After the initial inspection and test completed a flow test shall be carried out. For this test water shall be passed through the system under pressure and the flow gage reading recorded.

Inability to sustain an effective for fire fighting jet, or any undue pressure loss should be investigated.

9.4.4 If as a result of these tests any defects are found, these shall be remedied as necessary and a retest of the system shall be carried out. The water supply tested shall be representative of the supply that may be available at the time of a fire. All isolating valves shall be locked in open position.

PART V

10. INSTALLATION, TESTING AND QUALITY CONTROL OF FOAM SYSTEMS

10.1 General

10.1.1 Planning for construction

10.1.1.1 Drawings and documents and all the informations specified in design of the systems shall be provided and authorities mentioned in Clause 6.2 shall be consulted.

10.1.1.2 Prior to installation of systems full consideration shall be given to the following:

a) The purpose and function of the system;

b) the application rate and the duration of discharge of the system, and the appropriate minimum values given in this Standard;

c) hydraulic calculation;

d) the pipework including support details;

e) the detection system layout (if specified) and method of operation;

f) the type, location and spacing of foam discharge devices;

g) the type and location of foam proportioning devices;

h) the source of water and quantity needed;

i) the quantity and type of foam concentrate, its design concentration, the method of storage and the quantity to be held in reserve.

10.1.2 Extensions and alterations

10.1.2.1 Any extension or alteration to an existing system shall comply with the appropriate requirements of this Standard.

Any extension or alteration to the foam system should be carried out by the installer or his agent. The organization that services the system and the relevant authorities should be notified promptly of any alteration.

The effect on available water supply and minimum required quantity of foam concentrate should be considered at the design stage of extension or alteration to a system, and full hydraulic calculations should be carried out on the new system layout prior to commissioning.

10.2 System Description

10.2.1 A system consists of an adequate water supply, a supply of foam concentrate, suitable proportioning equipment, a proper piping system, foam makers, and discharge devices designed to adequately distribute the foam over the hazard. Some systems may include detection devices.

10.2.2 These systems are of the open outlet type in which foam discharges from all outlets at the same time, covering the entire hazard within the confines of the system.

10.2.3 Self-Contained systems are those in which all components and ingredients, including water, are contained within the system. Such systems usually have a water supply or premix solution supply tank pressurized by air or inert gas. The release of this pressure places the system into operation.

10.2.4 There are four basic types of systems:

a) Fixed.

b) Semi fixed.

c) Mobile.

d) Portable.

10.2.4.1 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.

10.2.4.2 Semi fixed systems

a) The type in which the hazard is equipped with fixed discharge outlets connected to piping that terminates at a safe distance. The fixed piping installation may or may not include a foam maker. Necessary foam-producing materials are transported to the scene after the fire starts and are connected to the piping.

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

10.2.4.3 Mobile systems

This includes any foam-producing unit that is mounted on wheels, and that may be self-propelled or towed by a vehicle. These units may be connected to a suitable water supply or may utilize a premixed foam solution. For mobile systems, refer to IPS-G-SF-100.

10.2.4.4 Portable systems

These systems produce foam by equipment that can be hand carried and connected to pressurized water or premixed solution by fire hose. Generally the foam containers shall be kept in proper place to protect against sun radiation.

10.3 Commissioning and Acceptance Tests

10.3.1 General

10.3.1.1 The supplier of the system or his supervising engineers shall arrange for the completed system to be inspected and tested to determine that it is properly installed and that it will function as designed to the satisfaction of the user and the relevant authorities. A commissioning test program shall be submitted by the installer to the user, and the test shall be carried-out by competent persons.

10.3.2 Inspection

10.3.2.1 A visual inspection shall be conducted to ensure that the system has been installed correctly. All normally dry horizontal pipework shall be inspected for drainage pitch.

Inspector should check for conformity with design drawings and specifications, continuity of pipework, removal of temporary blinds. accessibility of valves, controls and gages and proper installation of foam makers, vapor seals and proportioning devices. All equipment should be checked for correct identification and operating instructions.

10.3.2.2 Water supply pipework, both underground and above ground should be flushed thoroughly at the maximum practicable rate of flow before connection is made to system piping in order to remove foreign materials which may have entered during installation or which may have accumulated in the mains systems at lower rates of flow. The minimum rate of flow for flushing

should not be less than the water demand rate of the system.

10.3.2.3 Foam concentrates have a lower surface tension than water, and they may cause internal pipe scale or sediment to loosen with the risk of blockage of sprayers, proportioning equipment, etc. Pipes and fittings should be carefully cleaned before assembly and any loose jointing material should be removed.

10.4 Flushing after Installation

10.4.1 In order to remove foreign materials that may have entered during installation, water supply mains, both underground and aboveground, shall be flushed thoroughly at the maximum practicable rate of flow before connection is made to system piping. The minimum rate of flow for flushing shall not be less than the water demand rate of the system, as determined by the system design. The flow shall be continued for a sufficient time to ensure thorough cleaning.

Disposal of flushing water must be suitably arranged. All foam system piping shall be flushed after installation, using its normal water supply with foam-forming materials shut off, unless the hazard cannot be subjected to water flow. Where flushing cannot be accomplished, pipe interiors shall be carefully visually examined for cleanliness during installation.

10.5 Acceptance Tests

The completed system shall be tested by supplier's qualified personnel to meet the approval of the company's authority. These tests shall be adequate to determine that the system has been properly installed, and will function as intend.

10.5.1 Inspection and visual examination

Foam systems shall be examined visually to determine that they have been properly installed. They shall be inspected for such items as conformity with installation plans, continuity of piping, removal of temporary blinds, accessibility of valves, controls, and gages, and proper installation of vapor seals, where applicable. Devices shall be checked for proper identification and operating instructions.

10.5.2 Pressure tests

All piping, except that handling expanded foam for other than subsurface application, shall be subjected to a 2 hours hydrostatic pressure test at 13.80 bars (200 psi) gage or 3.45 bars (50 psi) in excess of the maximum pressure anticipated, whichever is greater. There shall be no permanent distortion or rupture and no substantial leakage during this test.

A full scale discharge test shall be conducted to ensure that the system discharge at the design rate, function in accordance with all other design requirements and produces and maintains an even foam blanket over the surfaces to be protected.

10.5.3 Operating tests

Before acceptance, all operating devices and equipment shall be tested for proper function.

10.5.4 Where conditions permit, flow tests shall be conducted to ensure that the hazard is fully protected in conformance with the design specification.

Static water pressure, residual water pressure at the control valve and at a remote reference point in the system, actual discharge rate, consumption rate of foam-producing material, and the concentration of the foam solution shall be considered. The foam discharged shall be visually inspected to ensure that it is satisfactory for the purpose intended.

Particular checks should be made during the discharge tests to ensure that these factors have been taken properly into account.

Water may be used instead of foam solution for some tests to avoid the need of extensive cleaning of the system after tests.

The inspections and tests should cover:

a) Rate of application of foam solution;

b) foam properties;

c) foam distribution;

d) running pressures;

e) concentration of the foam solution;

f) manpower requirements.

10.6 System Restoration

After completion of the acceptance test, the pipework shall be flushed, strainers inspected and cleaned and the system restored to operational condition.

10.7 Completion Certificate

The installer shall provide to the user a completion certificate stating that the system complies with all the appropriate requirements of this Standard, and giving details of any departure from appropriate recommendations.

10.8 Operation

10.8.1 Method

All operating devices whether manual or automatic should be suitable for the service conditions they will encounter. They shall not be readily rendered inoperative, nor be susceptible to inadvertent operation, as a result of relevant environmental factors such as high or low temperature, atmospheric pollution, humidity or marine environments.

The choice of method of operation will be governed by the potential rate of fire development, the likelihood of spread to other risks, and the degree of life hazard.

10.8.2 Operating instructions and training

Operating instructions for the system shall be provided at the control equipment and also at the plant or fire control center.

Persons who are authorized to operate the system should be thoroughly trained in its function and method of operation.

10.8.3 Manual controls

The location and purposes of the controls shall be plainly indicated and shall be related to the operating instructions.

Manual controls for systems shall be located in an accessible place sufficiently removed from the hazard to permit them to be safely operated in emergency, yet close enough for the operator to be aware of conditions at the hazard.

10.8.4 Color coding of pipework

The pipes shall be color coded in accordance with any scheme for pipework (see IPS-E-TP-100).

10.9 Emergency Plans and Operation Training

10.9.1 Planning

Fire and emergency plan shall be prepared and approved by responsible authorities. The plan shall consist of the following items:

a) Classification of emergencies;

b) designated of responsibilities;

c) alarms and communications;

d) outside sources and helps.

The emergency plans and instructions shall be posted at the prominent positions.

10.9.2 Instructions

Operating and maintenance instructions and layouts shall be posted at control equipment with a second copy on file. All persons who are expected to inspect, test, carry-out maintenance or operate foam generating apparatus shall be thoroughly trained and kept thoroughly trained in the functions they are assigned to perform.