CONSTRUCTION STANDARD

FOR

FIREPROOFING

ORIGINAL EDITION

DECEMBER 1997

This standard specification is reviewed and updated by the relevant technical committee on July 2003(1), Jan. 2005(2) and Jan. 2014(3). The approved modifications are included in the present issue of IPS.

FOREWORD

The Iranian Petroleum Standards (IPS) reflect the views of the Iranian Ministry of Petroleum and are intended for use in the oil and gas production facilities, oil refineries, chemical and petrochemical plants, gas handling and processing installations and other such facilities.

IPS is based on internationally acceptable standards and includes selections from the items stipulated in the referenced standards. They are also supplemented by additional requirements and/or modifications based on the experience acquired by the Iranian Petroleum Industry and the local market availability. The options which are not specified in the text of the standards are itemized in data sheet/s, so that, the user can select his appropriate preferences therein

The IPS standards are therefore expected to be sufficiently flexible so that the users can adapt these standards to their requirements. However, they may not cover every requirement of each project. For such cases, an addendum to IPS Standard shall be prepared by the user which elaborates the particular requirements of the user. This addendum together with the relevant IPS shall form the job specification for the specific project or work.

The IPS is reviewed and up-dated approximately every five years. Each standards are subject to amendment or withdrawal, if required, thus the latest edition of IPS shall be applicable

The users of IPS are therefore requested to send their views and comments, including any addendum prepared for particular cases to the following address. These comments and recommendations will be reviewed by the relevant technical committee and in case of approval will be incorporated in the next revision of the standard.

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GENERAL DEFINITIONS:

Throughout this Standard the following definitions shall apply.

COMPANY:

Refers to one of the related and/or affiliated companies of the Iranian Ministry of Petroleum such as National Iranian Oil Company, National Iranian Gas Company, National Petrochemical Company and National Iranian Oil Refinery And Distribution Company.

PURCHASER:

Means the “Company” where this standard is a part of direct purchaser order by the “Company”, and the “Contractor” where this Standard is a part of contract documents.

VENDOR AND SUPPLIER:

Refers to firm or person who will supply and/or fabricate the equipment or material.

CONTRACTOR:

Refers to the persons, firm or company whose tender has been accepted by the company.

EXECUTOR:

Executor is the party which carries out all or part of construction and/or commissioning for the project.

INSPECTOR:

The Inspector referred to in this Standard is a person/persons or a body appointed in writing by the company for the inspection of fabrication and installation work.

SHALL:

Is used where a provision is mandatory.

SHOULD:

Is used where a provision is advisory only.

WILL:

Is normally used in connection with the action by the “Company” rather than by a contractor, supplier or vendor.

MAY:

Is used where a provision is completely discretionary.

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1. SCOPE

1.1 This Standard is the minimum requirements and covers the methods of application of fireproofing to steel structures of process equipment, piping cable trays in fire potential areas.

1.2 However, fireproofing should never be considered as a replacement for or relaxation of the normal fire-preventive measures and the suitability of the fire-fighting equipment available.

1.3 This Standard is intended for use in manufacturing oil and gas, exploration and production and chemical manufacturing. It applies to all steel supporting structures in process areas and processing plants in land-based oil/gas/petrochemical (onshore) installations. It is not intended to apply to offshore platforms or floating installations.

Note 1:

This standard specification is reviewed and updated by the relevant technical committee on July 2003. The approved modifications by T.C. were sent to IPS users as amendment No. 1 by circular No. 201 on July 2003. These modifications are included in the present issue of IPS.

Note 2:

This standard specification is reviewed and updated by the relevant technical committee on Jan. 2005. The approved modifications by T.C. were sent to IPS users as amendment No. 2 by circular No. 265 on Jan. 2005. These modifications are included in the present issue of IPS.

Note 3:

This standard specification is reviewed and updated by the relevant technical committee on Jan. 2014. The approved modifications by T.C. were sent to IPS users as amendment No. 3 by circular No. 415 on Jan. 2014. 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.

ACI (AMERICAN CONCRETE INSTITUTE)

ACI-509-R: 2005	"Guide to Shotcrete"

API (AMERICAN PETROLEUM INSTITUTE)

API PUBLICATION 2218: 2010	"Fireproofing Practices in Petroleum and Petrochemical Processing Plants"
API 2510: 2001	"Design and Construction of Liquefied Petroleum Gas (LPG) Installation"

BSI (BRITISH STANDARDS INSTITUTION)

BS EN 934-2: 2009+A1: 2012 "Admixtures for Concrete, Mortar and Grout-Part 2: Concrete Admixtures-Definitions, Requirements, Conformity, Marking and Labeling"

NFPA (NATIONAL FIRE PROTECTION ASSOCIATION)

NFPA 58: 2013 "Liquefied Petroleum Gas Code"

UL (UNDERWRITERS LABORATORIES INC.)

UL 1709: 2011 "Rapid Rise Fire Tests of Protection Materials for Structoral Steel"

IPS (IRANIAN PETROLEUM STANDARDS)

IPS-E-GN-100 "Engineering Standard for Units"

IPS-M-CE-105 "Material Standard for Building Materials"

IPS-C-TP-101 "Construction Standard for Surface Preparation"

IPS-C-TP-102 "Construction Standard for Painting"

3. ABBREVIATIONS

AR Authorized Representative of the Owner.

4. UNITS

This Standard is based on International System of Units (SI), as per IPS-E-GN-100 except where otherwise specified.

5. GENERAL REQUIREMENTS

5.1 Fireproofing is one of the available options to limit damage caused by fire. It offers protection against the adverse thermal effects of fire for a limited period and limited degree of exposure.

5.2 The standard fireproofing material is concrete with or without admixtures. Alternative materials are available but they shall only be used if approved by the AR. Such materials may be preferred for existing structures whose strength or space limitation do not allow the use of concrete.

5.3 If fireproofing is required for inside buildings, consideration shall be given to the use of lightweight fireproofing materials subject to approval of the AR.

5.4 Where fixing of such system to surfaces necessitates the welding of fixtures to the surfaces, the fireproofing materials and procedures used shall be approved by the AR.

6. SURFACE PREPARATION AND PRIMING OF STEEL STRUCTURES

6.1 Prior to application of fireproofing, the steel shall be cleaned (degreased) to provide a surface free from grease, oil and dirt.

6.2 After degreasing, the loose rust or mill scale and other foreign matter shall be removed by wire brushing or by sandblasting.

6.3 Surface preparation process and materials and equipments to be used and also grades of cleanliness shall be in accordance with IPS-C-TP-101.

6.4 After preparation of steel surfaces, two coats of lead primer shall be applied with a nominal dry film thickness (each coat) of 40 micron in accordance with IPS-C-TP-102. Any shop primer that is present need not be removed.

7. MATERIALS

7.1 The materials for reinforcement of fireproofing are described in the following sub-clauses, and shall be as specified in IPS-M-CE-105(1) Part 2.

7.2 All materials shall be adequately protected against damage and from the weather during loading, transportation, offloading and storage. Bagged materials shall not be set directly on the ground and shall be kept under cover.

7.3 The specification of materials including cement, aggregate, gypsum, brick and tiles shall be in accordance with IPS-M-CE-105(1) part 1.

7.4 The maximum aggregate size for poured concrete shall be 10 mm (3/8 inch). The fine aggregate for gun-applied concrete shall comply with IPS-M-CE-105(1) part 1.

7.5 Normal water reducing admixtures (see IPS-M-CE-105 or BS EN 934-2) shall be added to poured in place concrete to maintain sufficient workability at the minimum water/cement ratio. The type of admixture shall be subject to the approval of the designer, and the dosage and mixing shall be strictly in accordance with the Manufacturer's instructions.

7.6 The poured or troweled in place concrete shall have minimum cement content of 350 kg/m^3 and a minimum characteristic strength of 21 N/mm^2.

7.7 Unless otherwise specified, gun-applied (shotcrete) concrete shall consist of 1 part cement to 3.5 part of fine aggregate proportioned by weight. The minimum equivalent cube compressive strength at 28 days shall be 28 N/mm^2.

7.8 Mineral wool shall be approved by the AR.

7.9 Vermiculite shall be supplied as a dry premixed factory-controlled material in suitable containers. The mix shall be based on vermiculite and ordinary Portland cement plus additives to improve its theological properties.

7.10 Water shall be clean and free of oils, acids, salts or substances injurious to the concrete. Water of drinkable quality is accepted.

7.11 Reinforcing fabric for poured concrete fireproofing (see 9.2) shall be galvanized weld mesh with wire size of 100 mm × 2.5 mm. Smaller pitch may be adopted where concrete is to be applied other than by pouring (see 7.12).

7.12 The gun-applied shotcrete, (see Clause 9.3) concrete fireproofing shall be reinforced with 50 mm × 50 mm × 3 mm dia galvanized steel welded wire fabric for all large surface areas, e.g. vessel skirts. For vermiculite cement, the galvanized mesh shall be 25 mm × 25 mm × 1.6 mm.

7.13 On structural steel members material shall be 25 mm × 25 mm × 2 mm dia. galvanized steel welded wire fabric maintained at 20 mm from profile by the use of 20 mm dia. carbon steel bars suitably located to maintain this space at all locations.

7.14 Expanded metal lath (galvanized) - For large surfaces "Expamet", "Rib-lath" or equivalent may be used.

7.15 Steel pins of minimum 2.5 mm diameter shall be used to hold mesh reinforcement in place.

7.16 Galvanized mild steel bands and buckles shall be not less than 0.6 mm thick by 13 mm wide.

7.17 Tie wire for attaching reinforcing mesh shall be galvanized soft iron wire, having minimum 1.6 mm diameter.

8. INSTALLATION OF REINFORCEMENTS

8.1 Fixing of Pins to Hold Mesh

The pins shall be welded to the structural steelwork sections at a maximum spacing of 400 mm to suit the profile of the section. No welding shall be carried out on vessels without the approval of the AR.

Unless otherwise specified by the AR, vessels and vessel skirts shall be supplied complete with fixing pins. They shall be spaced at approximately 300 mm centers except at manholes etc., where closer spacing may be necessary.

8.2 Installation of Weld Mesh Fabric

8.2.1 The reinforcing mesh for concrete fireproofing shall be positioned so as to maintain a cover of not less than 25 mm and not more than 30 mm.

8.2.2 In the case of vermiculite cement fireproofing, the structural members shall be wrapped in expanded metal lath if the vermiculite cement is to be applied by hand troweling or the member is to be encased, with a void between the flanges (hollow encased member). The voids behind the metal lathing in vertical runs shall be filled with mineral wool or provided with solid baffles at 3 m centers to prevent chimney action.

8.2.3 Where the thickness of vermiculite cement exceeds 30 mm, mesh reinforcement shall be placed at the midpoint of the fireproofing in addition to the expanded metal. Additional reinforcement layers shall be used where the thickness of the concrete or vermiculite cement exceeds 80 mm.

8.2.4 The mesh shall be firmly attached to the fixing pins with galvanized tie wire shall overlap at least one square and be tied together at approximately 150 mm centers. Specific attention shall be given to ensure that the mesh is correctly positioned around the flange edges.

8.2.5 Where required by the drawings or in the specification, the mesh shall be firmly held in place around vessels and vessel skirts by galvanized mild steel bands at 450 mm to 600 mm centers. On large skirts, a ribbed expanded metal ay be required to give greater rigidity.

8.3 Bolts

Holding down bolts for vessels and vessel skirts, which do not need fireproofing, shall be coated with suitable protective grease, prior to being covered by fireproofing. In the case of vessel saddles that have provision for sliding on a bedplate, a specific check shall be made to ensure that the supports are left free to slide.

8.4 Expansion Joints

Where provision is made in the structural steelwork for expansion or contraction, the joints shall extend through the fireproofing.

9. APPLICATION METHODS

9.1 General

9.1.1 Concrete fireproofing materials shall be applied by one of the following methods:

a) Pouring and troweling.

b) Shotcreting (guniting).

9.1.2 During application special care shall be taken that all irregular areas and corners are completely filled and that voids or air pockets are precluded.

9.1.3 During cold weather the concrete and the surface to which it will be applied shall be kept at a temperature above °C both during application and curing. This shall be accomplished by providing an enclosure in which a temperature above 5°C is maintained during mixing, application and curing. The fireproofing materials containing water shall be protected against freezing; however, direct steam shall not be used for this purpose.

9.1.4 For proprietary systems, a flexible membrane coating may be required depending on local circumstances. Coating hall be subject to approval of the AR.

9.1.5 Joints between exposed steelwork and fireproofing shall be caulked to prevent water from entering the system at his point. (see 9.5).

9.1.6 The top of fireproofing shall be protected by cover plates continuously welded to the steel structure in order to prevent ingress of rainwater between the members and the fireproofing.

9.1.7 Protection from heavy rain, frost and extreme weather conditions shall be provided during the application of fireproofing.

9.1.8 Provision shall be made for adequate ventilation during and after application, until the materials are dry. In extremely dry and hot conditions, however appropriate measures shall be taken to keep vermiculite-containing systems moist until set. Measures such as screening the work area from radiant sunlight and wrapping the finished work may be required, depending on the severity of the ambient conditions.

9.1.9 Once set; the fireproofing shall be resistant to frost damage, (with or without use of admixture).

9.1.10 where fixing of such systems to surfaces necessitates the welding of fixtures to the surfaces, the AR shall approve the materials and procedures used.

9.2 Pouring and Troweling Method

9.2.1 Pouring in a horizontal position

This method is used for fireproofing of floor or other horizontal surfaces by pouring the material and troweling. This method permits easy inspection and requires neither skilled our nor any special equipment.

9.2.2 Pouring in a vertical position

9.2.2.1 The application of this method shall be restricted to minor repair and to those cases where guniting or horizontal pouring is not feasible. The method requires shuttering, which shall have a maximum height of 500 mm. The shuttering shall be made reasonably watertight and the inside surface shall be sufficiently oiled, but without excess.

Note:

Dry wooden shuttering may need a treatment to prevent the absorption of mixing water from the fresh concrete.

9.2.2.2 Fireproofing material shall be poured behind shuttering using funnels and sheet metal tubes as required, skilled lab our and close supervision shall be imperative.

9.2.2.3 The fireproofing shall be applied in a manner, which will minimize material segregation.

9.2.2.4 Each batch from the mixer shall be placed so that the full thickness of coating will be

reached, using temporary weirs (shutters) as necessary. On no account shall another layer be added later to complete the coating.

9.2.2.5 Once application has started it shall proceed without interruption until the entire coating of the part concerned has been completed. If an unavoidable interruption does occur, the wet edge of the fireproof coating shall be cutback at right angle to the surface to give an edge of full thickness. All material ahead of the cut shall be removed and discarded.

9.2.2.6 If any surface finish is required, the surface should simply be leveled off with a screed or a wood float.

9.3 Shotcreting (Guniting) Methods

9.3.1 Description

In shotcreting or gun-applied process, concrete is pneumatically projected at high velocity on to a surface. It is classified into two processes i.e. "Dry-mix" and "Wet-mix" (see also ACI-506 R-90).

9.3.2 Dry-mix equipment

Dry-mix shotcrete equipment the commonly called guns, may be divided into two distinct types: pressure vessels (batch) and or continuous-feed guns.

For more information sec ACI 506 R Section 3.2.

9.3.3 Wet-mix equipment

A concrete pump, usually trailer-mounted, pushes the concrete mixture through the delivery hose. Early applications used a squeeze- type pump because it could maintain as almost continuous flow of concrete. A peristaltic type, or squeeze pump, uses mechanical rollers to squeeze the concrete through a tube into a delivery hose. Although still available , these pumps have been largely replaced by positive displacement piston pumps with a hydraulically powered valve. Wet-mix shotcrete equipment is used where higher production rates those than available with dry-mix equipment are advantageous.

For more information see ACI 506 R.

10. FIREPROOFING CONSIDERATION FOR EQUIPMENT WITHIN A FIRE –SCENARIO ENVELOPE

10.1 Fireproofing Inside Processing Areas

Unless otherwise specified by the AR, for the following steel structures, either in the open or in buildings, fireproofing shall be applied:

a) Equipment-supporting structures.

b) Pipe-supporting structures.

c) Support for fin-fan coolers.

10.1.1 Multilevel equipment structures (excluding pipe racks) within a fire-scenario envelope

10.1.1.1 When structures support equipment that has the potential to add fuel or escalate the fire, fireproofing should be considered for the vertical and horizontal steel support members from grade up to the highest level at which the equipment is supported (see Figure 1).

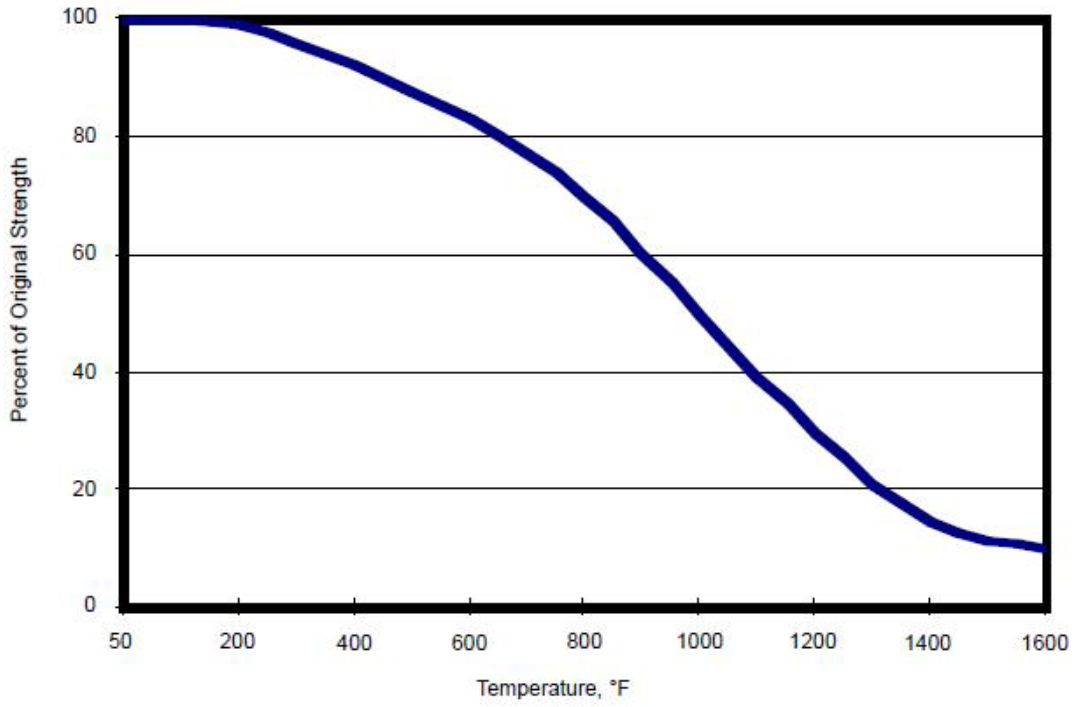
10.1.1.2 Elevated floors and platforms that could retain significant quantities of liquid hydrocarbons should be treated as though they were on the ground-floor level, for purposes of calculating vertical distances for fireproofing (see Figure 2).

10.1.1.3 Within a fire-scenario envelope, when the collapse of unprotected structures that support equipment could result in substantial damage to nearby fire-potential equipment, fireproofing should be considered for the vertical and horizontal steel members from grade level up to and including the level that is nearest to a 9.1-m (30-ft) elevation above grade (see Figure 3).

10.1.1.4 Fireproofing should be considered for knee and diagonal bracing that contributes to the support of vertical loads or to the horizontal stability of columns located within the fire-scenario envelope. Bracing that is exposed to the fire can conduct heat into the structure and negatively affect the fire rating of the fireproofing system. Fireproofing suppliers may be able to provide test-based recommendations for coverage of noncritical members. In many cases, knee and diagonal bracing that is used only for wind, earthquake, or surge loading, need not be fireproofed (see Figure 1).

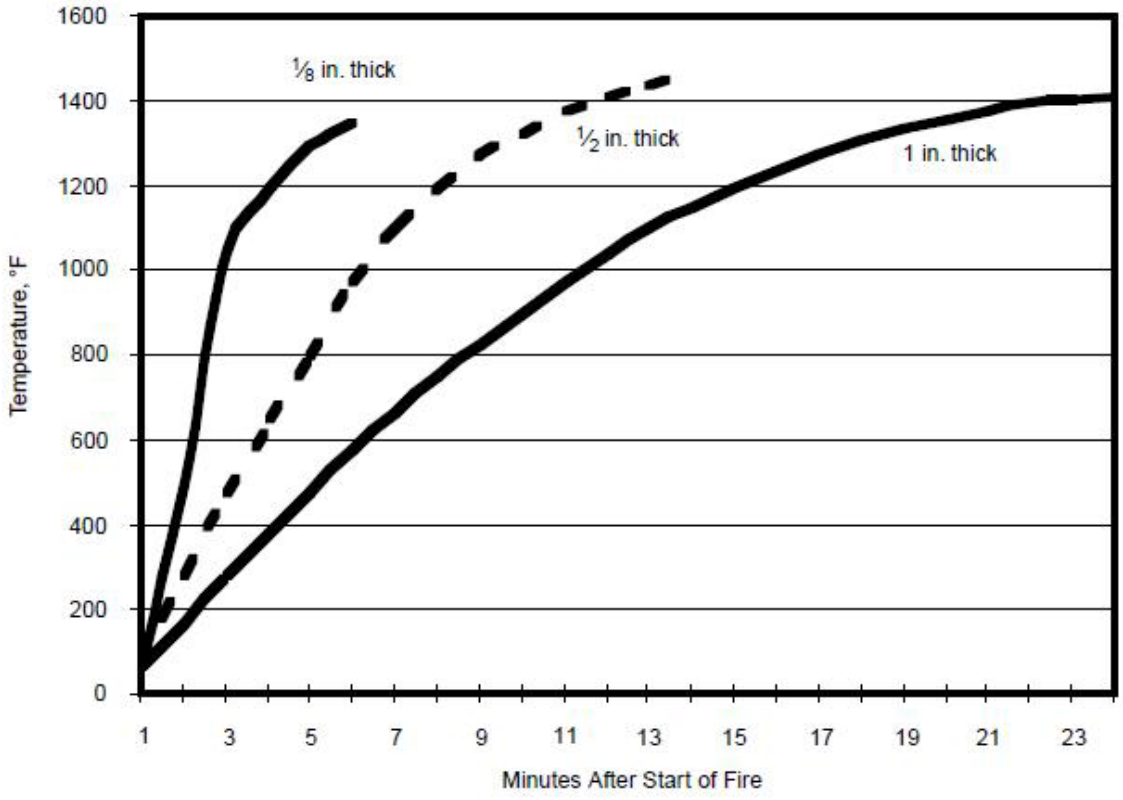
10.1.1.5 When reactors, towers, or similar vessels are installed on protected steel or reinforced concrete structures, fireproofing should be considered for equivalent protection of supporting steel brackets, lugs, or skirts (see Figure 1). To maintain the structural integrity, it is very important to consider the insulating effect of the fireproofing material in the design of supports for vessels that operate at high temperatures.

10.1.1.6 For fireproofing that is required for horizontal beams that support equipment in fire-scenario areas, the upper surface of the beam need not be fireproofed.



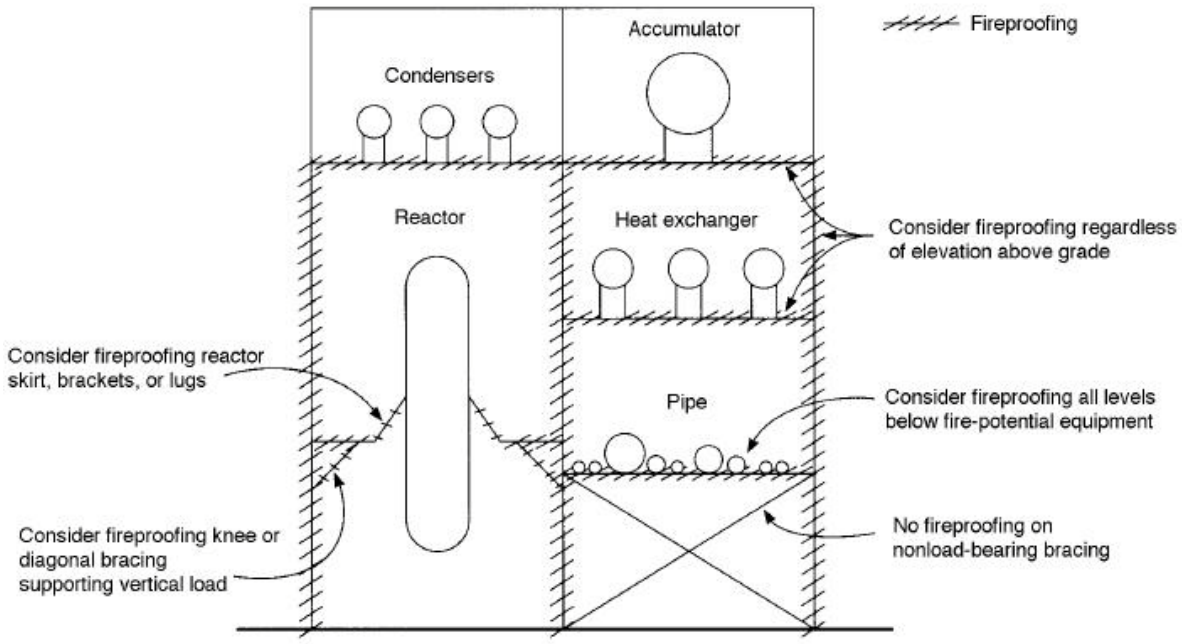
EXAMPLE OF EFFECT OF TEMPERATURE ON STRENGTH OF STRUCTURAL STEEL

Fig. 1



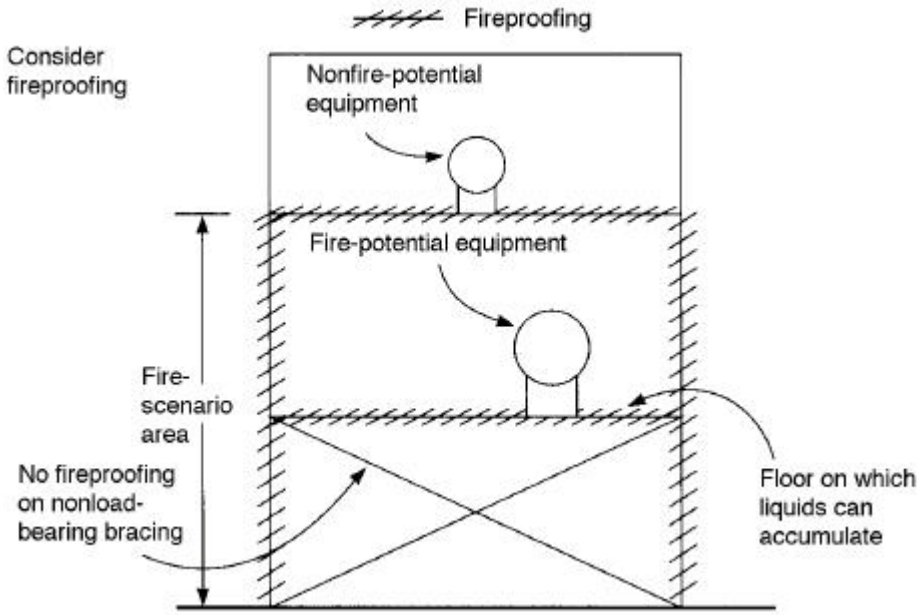
HEATING OF UNWETTED STEEL PLATES EXPOSED TO GASOLINE FIRE ON ONE SIDE

Fig. 2



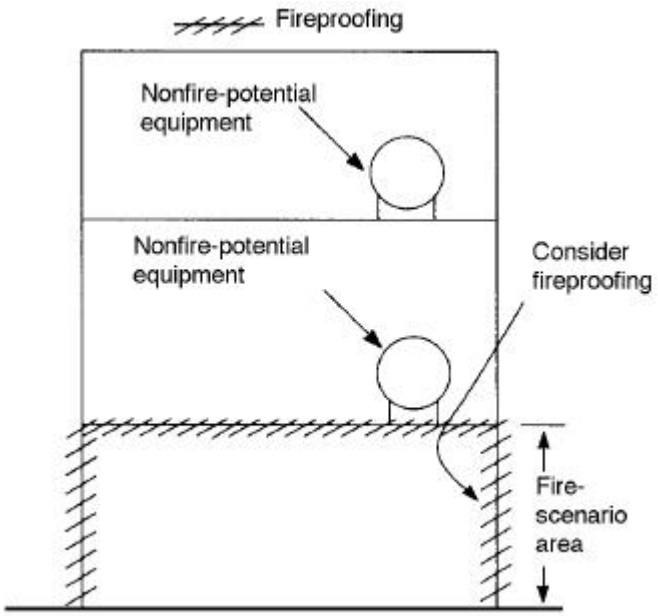
STRUCTURE SUPPORTING FIRE-POTENTIAL AND NONFIRE-POTENTIAL EQUIPMENT IN A FIRE-SCENARIO AREA

Fig. 3



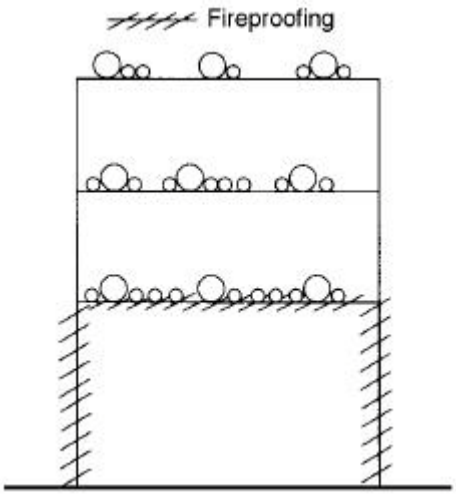
STRUCTURE SUPPORTING FIRE-POTENTIAL AND NONFIRE-POTENTIAL EQUIPMENT IN A FIRE-SCENARIO AREA

Fig. 4



STRUCTURE SUPPORTING NONFIRE-POTENTIAL EQUIPMENT IN A FIRE-SCENARIO AREA

Fig. 5



PIPE RACK WITHOUT PUMPS IN A FIRE-SCENARIO AREA

Fig. 6

10.1.2 Supports for pipe racks within a fire- scenario envelope

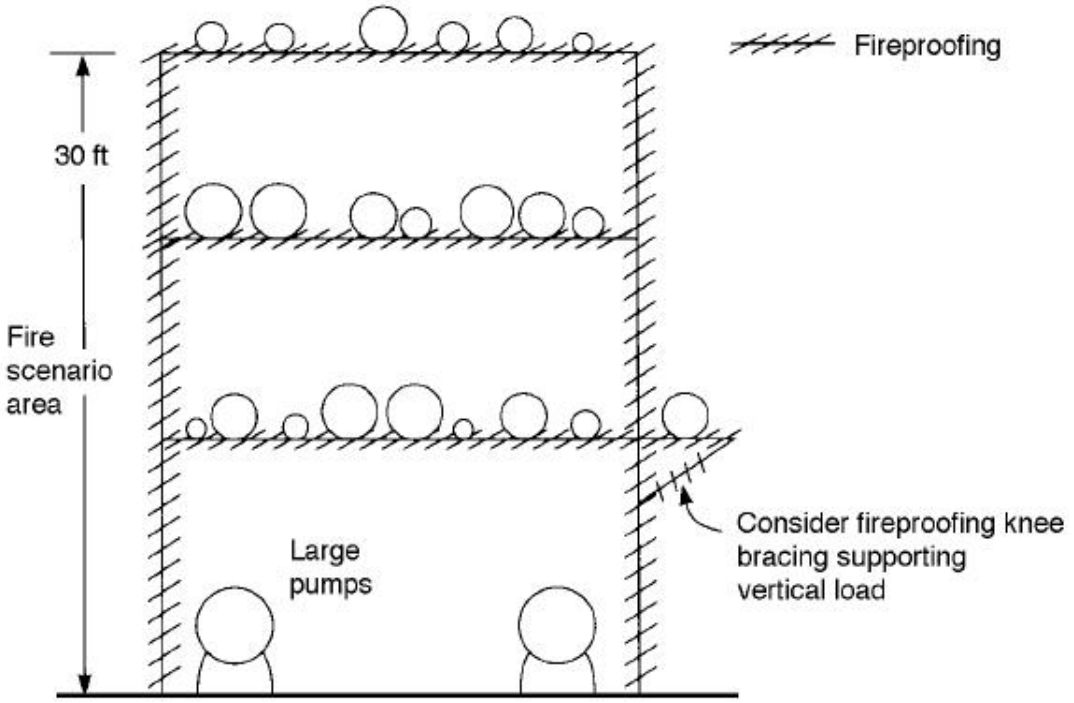
10.1.2.1 When a pipe rack is within a fire-scenario envelope, fireproofing should be considered for vertical and horizontal supports, up to and including the first level, especially if the supported piping contains flammable materials, combustible liquids or toxic materials. If a pipe rack carries piping with a diameter greater than 6 in., at levels above the first horizontal beam; or if large hydrocarbon pumps are installed beneath the rack, fireproofing should be considered up to and including the level that is nearest to a 9-m (30-ft) elevation (see Figures 6 and 7). Wind or earthquake bracing and non load- bearing stringer beams that run parallel to piping need not be fireproofed (see Figure 8).

10.1.2.2 If air fin-fan coolers are installed on top of a pipe rack within a fire-scenario envelope, fireproofing should be considered for all vertical and horizontal support members on all levels of the pipe rack, including support members for the air fin-fan coolers, regardless of their elevation above grade (see Figure 8).

10.1.2.3 Fireproofing should be considered for knee and diagonal bracing that contributes to the support of vertical loads (see Figures 7 and 9). Bracing that is exposed to the fire condition should be reviewed for potential heat conductivity effects (see 10.1.1.4). Knee or diagonal bracing used only for wind or earthquake loading need not be fireproofed.

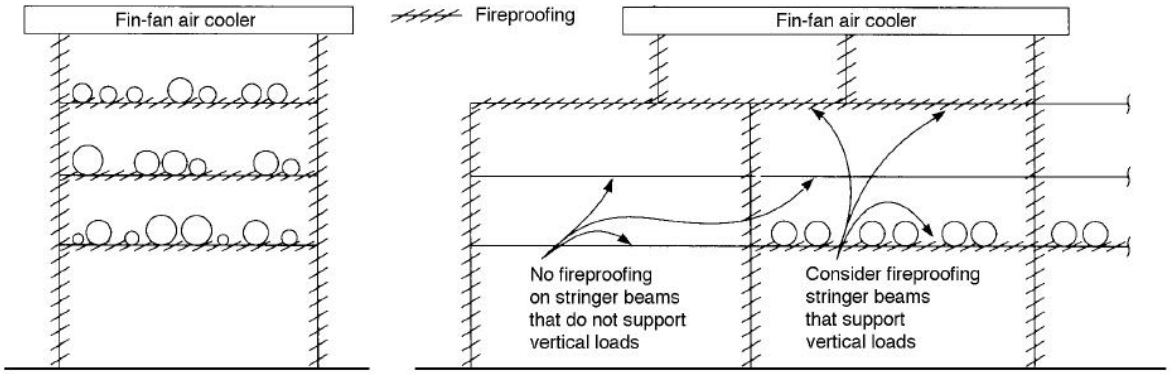
10.1.2.4 Frequently, the layout of piping requires that auxiliary pipe supports be placed outside the main pipe rack. These supports include small lateral pipe racks, independent stanchions, individual T columns, and columns with brackets. Whenever these members support piping with a diameter greater than 6 in., or important piping such as relief lines, blow down lines, or pump suction lines from accumulators or towers, fireproofing should be considered (see Figure 10).

10.1.2.5 When piping containing flammable materials, combustible liquids, or toxic materials is hung by rod- or spring-type connections from a pipe-rack support member, and the rod or spring is in a fire-scenario envelope, a “catch beam” should be provided. The catch beam and its support members should be fireproofed. If the pipe that is hung by rod- or spring-type connections is the only line on the pipe rack that contains flammable or toxic material, the pipe-rack support members should be fireproofed to the extent they support the catch beam. Sufficient clearance should be provided between the bracket or beam and the pipe to permit free movement (see Figure 9).



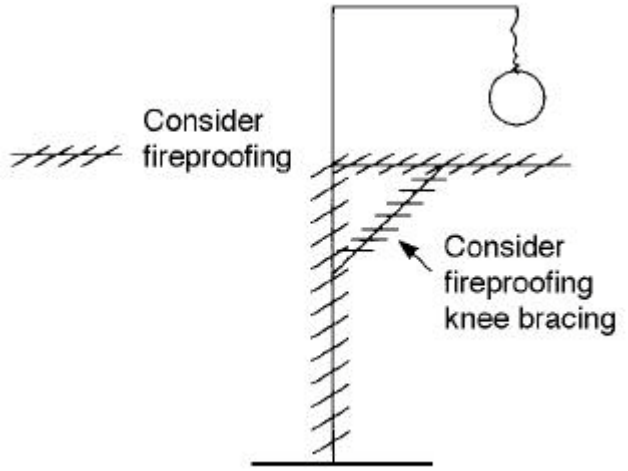
PIPE RACK WITH LARGE FIRE-POTENTIAL PUMPS INSTALLED BELOW

Fig. 7



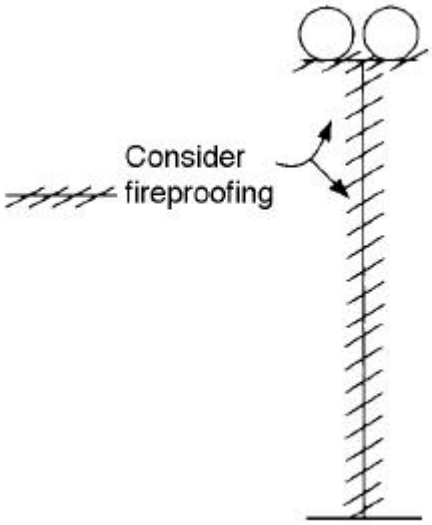
PIPE RACK SUPPORTING FIN-FAN AIR COOLERS IN A FIRE SCENARIO AREA

Fig. 8



TRANSFER LINE WITH HANGER SUPPORT AND CATCH BEAM IN A FIRE-SCENARIO AREA

Fig. 9



TRANSFER LINE SUPPORT IN A FIRE-SCENARIO AREA

Fig. 10

10.1.3 Air coolers within a fire-scenario envelope

10.1.3.1 When air fin-fan coolers in liquid hydrocarbon service are located at grade level within a fire-scenario envelope, fireproofing should be considered for their supports.

10.1.3.2 Fireproofing should be considered for the structural supports of all air-cooled exchangers handling flammable or combustible liquids at an inlet temperature above their autoignition temperature, or above 315°C (600°F), whichever is lower.

10.1.3.3 When air-cooled exchangers are located above vessels or equipment that contain flammable materials, fireproofing should be considered for the structural supports located within a 6 m–12 m (20 ft–40 ft) horizontal radius of such vessels or equipment, regardless of height (see Figure 8).

10.1.3.4 Fireproofing for air-cooled exchangers located above pipe racks is covered in 10.1.2.2.

10.1.3.5 If air coolers are handling gas only, and are not exposed to a fire from other equipment at grade, fireproofing the support structure may not provide added value if, when the gas coolers fail (and if there is no liquid to spill), the fire will be above the coolers, and without the potential to jet downwards and cause flame impingement.

10.1.4 Tower and vessel skirts within a fire- scenario envelope

10.1.4.1 Fireproofing should be considered for the exterior surfaces of skirts that support tower and vertical vessels. Consideration should also be given to fireproofing interior surfaces of skirts if there are flanges or valves inside the skirt, or if there are unsealed openings exceeding 600mm (24 in) equivalent diameter in the skirt. Openings other than the single manway may be closed with removable steel plate at least 6 mm (¼ in) thick. Consideration should be given to minimizing t he effects of draft through vent openings and space that surround pipe penetrations in the skirt.

10.1.4.2 Fireproofing should be considered for brackets or lugs that are used to attach vertical reboilers or heat exchangers to towers or tower skirts. Specific requirements apply to LPG vessels (see 10.2.2 and 10.2.3).

10.1.5 Leg supports for towers and vessels within a fire-scenario envelope

If towers or vessels are elevated on exposed steel legs, fireproofing the leg supports to their full-load-bearing height should be considered.

10.1.6 Supports for horizontal exchangers, coolers, condensers, drums, receivers, and accumulators within a fire-scenario envelope

Fireproofing should be considered for steel saddles that support horizontal heat exchangers, coolers, condensers, drums, receivers, and accumulators that have diameters greater than 750 mm. (30 in), if the narrowest vertical distance between the concrete pier and the shell of the vessel exceeds 300 mm. (12 in).

10.1.7 Fired heaters within a fire-scenario envelope

10.1.7.1 Structural members supporting fired heaters above grade should be fireproofed for heaters handling flammable or combustible liquids. Structural steel members supporting fired heaters in other services should be fireproofed if located within a fire-scenario area. These include fired heaters in other-than hydrocarbon service, such as steam superheaters or catalytic cracking-unit air heaters, if a collapse would result in damage to adjacent hydrocarbon-processing equipment or piping.

10.1.7.2 If structural support is provided by horizontal steel beams beneath the firebox of an elevated heater, fireproofing should be considered for the beams, unless at least one flange face is in continuous contact with the elevated firebox.

10.1.7.3 If common chimneys or stacks handle flue gas from several heaters, fireproofing should be considered for the structural supports for ducts, or breeching between heaters and stacks.

10.1.8 Emergency valves within a fire-scenario envelope

The operation of emergency valves and valve actuators in areas exposed to fire can be important to shutting down units safely, depressurizing equipment, or isolating fuel feeding a fire. Examples of important emergency isolation valves include suction valves in piping to pumps that are fed from large towers, accumulators, or feed surge drums.

To improve the probability that emergency isolation valves will operate properly, fireproofing should be considered for both the power and signal lines that are connected to the valve.

The valve's motor operator should be sufficiently fire-protected to provide enough time for the valve to fully open or close. Valves that fail to the safe position need not be fireproofed.

Power and instrument lines can be protected according to clause 6.1.8 of API publication 2218 Motor operators may be protected by various fire-rated systems that use preformed fire-

resistant material, specially designed, lace-up fire-resistant blankets, assemblies that use mastic materials, or in tumescent epoxy coatings permanently molded to the equipment. For each of the above options, it is important to confirm that the fireproofing material is suitable for the operating temperature of the equipment being protected.

Some are limited to normal nonfire temperatures as low as 70°C (160°F), even though they can provide a 30-minute rating under UL 1709 (or functional equivalent) conditions.

The following items require special consideration:

a. Thermal-limit switches built into electric motors may cause the motors to fail before valves are fully closed or opened when exposed to fire. Deactivation of the thermallimit switches should be considered; or the equipment supplier should be consulted about possible modifications to ensure that motor operation is of sufficient duration to obtain the desired valve operation.

b. The valve's handwheel and engaging lever should not be fireproofed to the extent that the valve is made inoperable.

c. It is important to ensure that the valve's position indicator remain visible after the valve is fireproofed.

d. The solenoid on solenoid-operated valves may be fireproofed with the materials described above. Because the insulating material retains heat and blocks ventilation, the design should be investigated to ensure satisfactory operation.

e. The diaphragm housing on diaphragm-operated valves should be fireproofed with the materials described above, unless the valve is designed to fail to the safe position.

f. It is important that the fireproofing system selected is rated for use at the operating temperature of the equipment being protected and its environment.

10.1.9 Special hazard fireproofing

Process units that use radioactive sources (as are frequently used in level indicators), or have toxic gas analyzers (such as for sulfur dioxide), should ensure that these are protected, to avoid potentially harmful releases. Enclosures made of fireproof materials can be used for this purpose.

10.2 Fireproofing Outside Processing Units

10.2.1 Pipe racks within a fire-scenario envelope

10.2.1.1 If pipe-rack supports outside processing units are located within a fire-scenario envelope they should be considered for fireproofing. Bracing for earthquakes, wind or surge protection, and stringer beams that run parallel to piping need not be fireproofed.

10.2.1.2 If important pipe racks run within 6 m to 12 m (20 ft to 40 ft) of open drainage ditches or channels that may contain oil waste or receive accidental spills, either fireproofing should be considered for the pipe rack supports, as described in 10.2.1.1, or the ditch should be covered.

10.2.1.3 Similar considerations to those in 10.2.1.2 should be evaluated if the piping that carries hydrocarbons uses accordion- style expansion joints.

10.2.2 LPG storage spheres within a fire-scenario envelope

API 2510 provides specific recommendations for fireproofing of LPG vessels. For the vessel itself, fireproofing should be considered for potentially impinged portions of the vessel identified in the fire-scenario, if there is no fixed firewater protection. A fire-resistance rating of 1½ hours protection under UL 1709 conditions is cited. The fireproofing should be capable of withstanding exposure to direct fire impingement and shall be resistant to direct impact from firewater streams, as outlined in NFPA 58, Appendix H.

Structural supports should be fireproofed to the same fire resistance for all above ground portions of the structure required to support the static load of the full vessel. Fireproofing should be provided on horizontal vessel saddles where the distance between the bottom of the vessel and the top of the support structure is more than 300 mm (12 in.).

Where provided, it should extend from the support structure to the vessel, but not encase the points at which the saddles, or other structural supports, are welded to the vessel. When a vertical vessel is supported by a skirt, the exterior of the skirt should be fireproofed in accordance with 10.1.4.1. The interior should be fireproofed where there is more than one access opening in the skirt that is not covered with a plate (see API 2510A, 2001, Section 5.8.2).

10.2.3 Horizontal pressurized storage tanks within a fire-scenario envelope

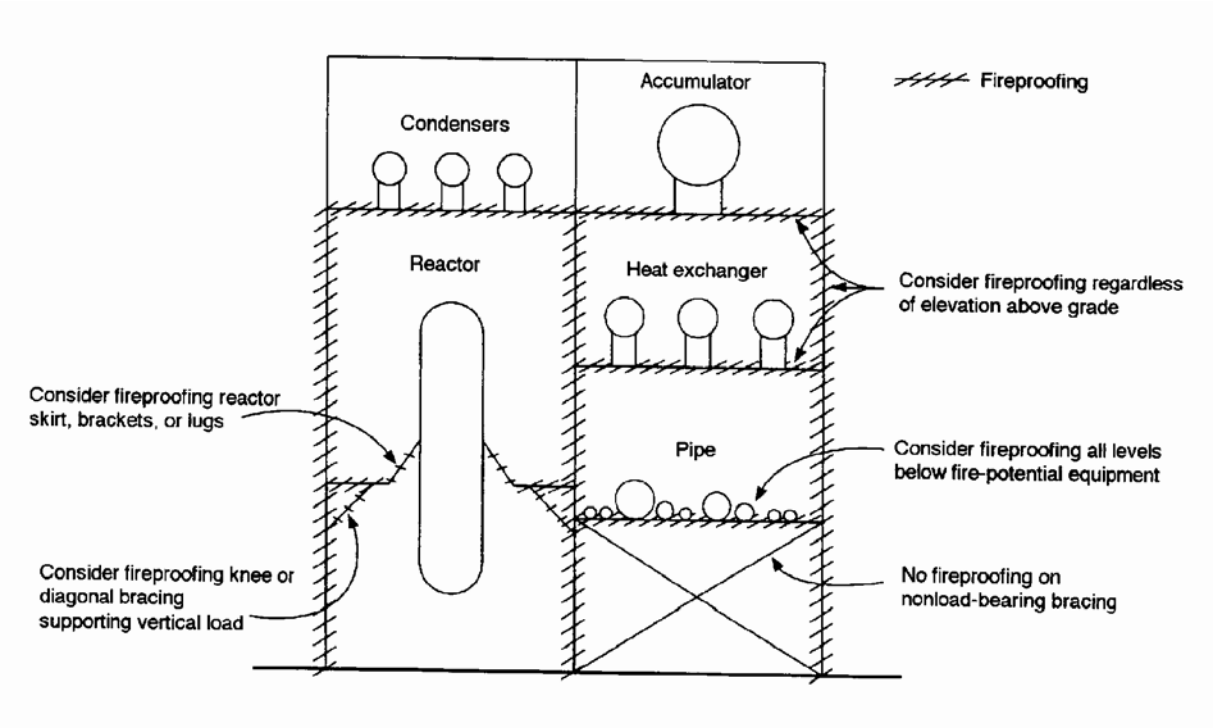
Horizontal pressurized storage tanks should preferably be installed on reinforced concrete saddles. All vessel support structures of concrete should meet the same fire-resistance rating (1½ hours in UL 1709) required for steel support fireproofing.

Fireproofing should be used for exposed steel vessel supports that exceed 300 mm (12in.) minimum distance at the narrowest point.

10.2.4 Flare lines within a fire-scenario envelope

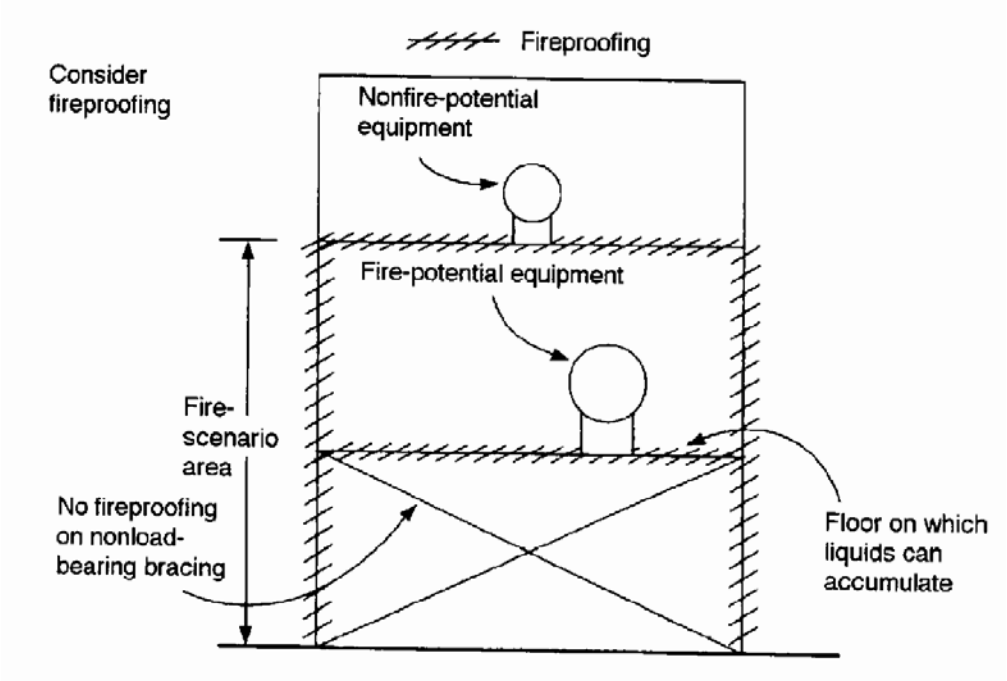
Fireproofing should be considered for supports for flare lines if they are within a fire-scenario envelope or if they are close to open ditches or drainage channels that may receive large accidental spills of hydrocarbons.

A more protective approach to the application of fireproofing is appropriate when the potential for structural failure or loss of process control from fire exposure could possibly result in the release of hazardous materials that could present a potentially serious exposure to employees and the community.



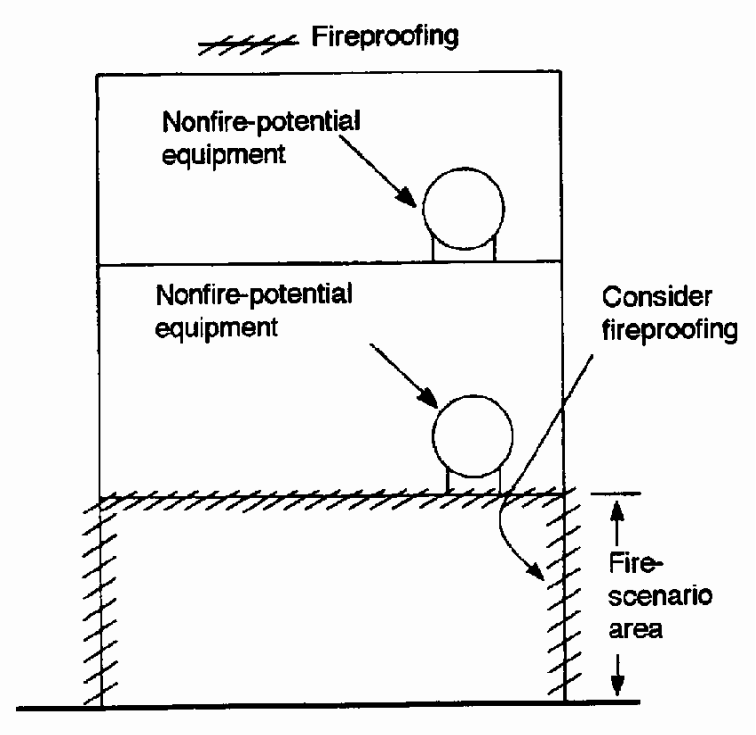
STRUCTURE SUPPORTING FIRE-POTENTIAL AND NONFIRE-POTENTIAL EQUIPMENT IN A FIRE-SCENARIO AREA

Fig. 11



STRUCTURE SUPPORTING FIRE-POTENTIAL AND NONFIRE-POTENTIAL EQUIPMENT IN A FIRE-SCENARIO AREA

Fig. 12



STRUCTURE SUPPORTING FIRE-POTENTIAL AND NONFIRE-POTENTIAL EQUIPMENT IN A FIRE-SCENARIO AREA

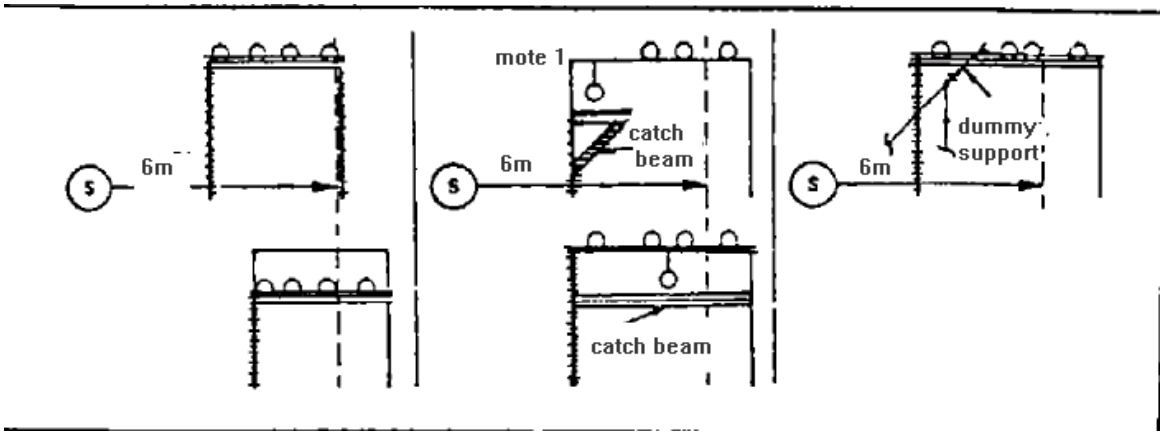
Fig. 13

10.3 Pipe Supporting Structures

10.3.1 For the pipe supporting structures, fireproofing shall be applied to the stanchions only.

10.3.2 Typical application of fireproofing for pipe supports, catch beams, and dummy pipe supports are illustrated in Fig. 13.1.

10.3.3 If pipe supporting structures are combined with structures supporting fin-fan coolers, the stanchions, cooler supporting beams and all members which reduce the effective buckling length of stanchions shall be fire proofed from grade level up to and including the supports of the tube bundle(s) (see Figs 14 and 15).



TYPICAL APPLICATION OF FIREPROOFING FOR PIPE SUPPORTS,

CATCH BEAMS AND DUMMY PIPE

Fig. 13.1

Legend: c Fire source

Fireproofed structural members

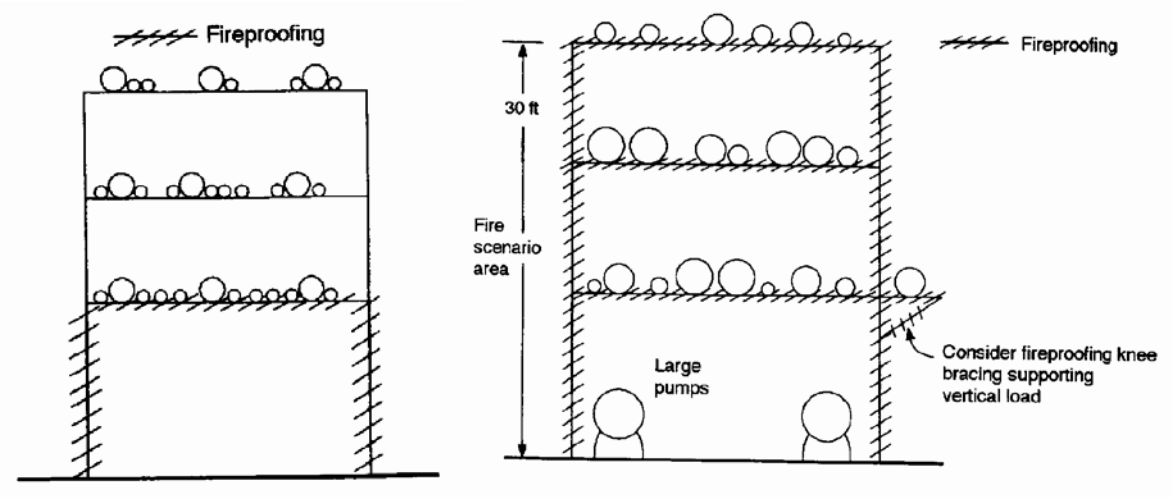
Notes:

1) If the pipe which is hung by rod or spring type support is the only line on the pipe support which contains flammable materials, then only the "Catch Beam" and its support (to the extent indicated) shall be fireproofed.

2) Fireproofing of horizontal beams shall be carried to, but not including, the next supporting column.

3) Exposed cross beams are to be fireproofed, bottom and two sides.

4) 6m is the horizontal distance measured from the nearest point of source of sustained fire.



PIPE-SUPPORTING STRUCTURES

Fig. 14

10.4 Support for Fin-Fan Coolers

10.4.1 Steel structures supporting fin-fan coolers, shall be fireproofed from grade or elevated level up to and including the supports to the tube bundle(s) (see Fig. 15).

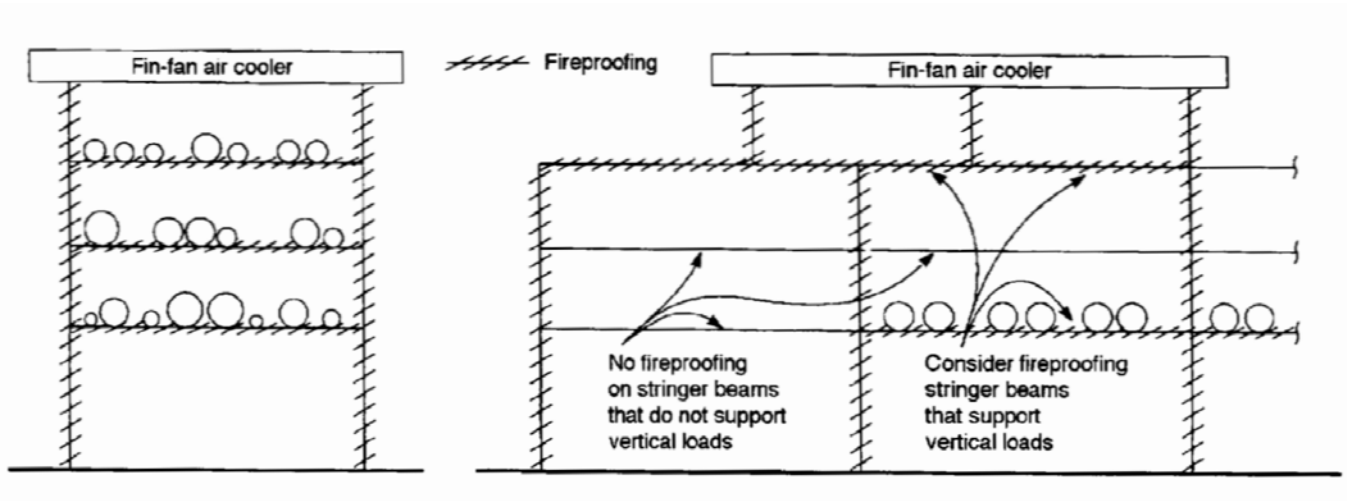
10.4.2 Air-cooler supporting structures shall be fireproofed when either of the following criteria applies:

a) The air cooler contains a total of more than 1 ton of flammable product.

b) When one or more air coolers are installed in one structure and the total mass of the coolers and their contents exceed 2500 kg.

10.4.3 All stanchions and beams (including other structural members designed for the purpose reducing the effective buckling length of stanchions) shall be fireproofed.

10.4.4 If fin-fan coolers with "flammable" liquids are located above pumps handling "flammable" liquids, a reinforced concrete floor shall be made underneath the fin-fan cooler.



b) FIN-FAN COOLER SUPPORTING STRUCTURE

c) FIN-FAN COOLER SUPPORTING STRUCTURE ON TOP OF OVERHEAD PIPE TRACK

Fig. 15

11. INSPECTION AND TESTING

11.1 The preparation for, and the placing of, fireproofing material shall be supervised and inspected at all stages of the application by competent personnel having the appropriate knowledge and experience.

11.2 Surface preparation shall be checked using the standard IPS-C-TP-101.

11.3 Protective priming of steel substrate shall be checked using the standard IPS-C-TP-102.

11.4 Dry-film thickness measurement of total fire proofing system shall be done in accordance with IPS-C-TP-102.

11.5 Work shall not proceed to the next step in the system sequence (i.e. surface preparation, priming, fireproof coating) until the previous work has been inspected and approved.

11.6 He should continuously inspect the work, paying attention to materials, forms Reinforcement, Equipment, Placement, finishing, Curing and Protection of the finished product.

11.7 Once the fire exposure time period has been Estimated, the task of specifying the fire proofing fire-resistance rating can proceed for the various equipment and support systems within the fire-scenario envelope.

For more information see subclause 5.2.5.2 of API publ.2218: R 2010 (1999).