

SCOPE

- I 1.1 This practice covers fireproofing of vessels, including spheres, heat exchangers, structural support members, and electrical and instrumentation installations.
- I 1.2 **An asterisk (*) indicates that additional information is furnished in the Job Specification.**

SUMMARY OF ADDITIONAL REQUIREMENTS

- I 2.1 **Table 1** lists the practices, standards, and specifications, which shall be used with this practice.

TABLE 1

PRACTICES			
IP 3-2-3	Firewater Systems	IP 14-1-1	External Insulation
IP 3-2-4	Pressure Relieving Systems	IP 19-1-1	Paint and Protective Coatings
IP 4-1-1	Concrete Design and Construction	IP 19-3-1	Guniting for Linings and Fireproof Coatings
STANDARDS AND SPECIFICATIONS			
ACI Standard		NFPA Standard	
ACI 318	Building Code Requirements for Reinforced Concrete	58	Liquefied Petroleum Gas Code
ASTM Standard		251	Standard Methods of Tests of Fire Endurance of Building Construction and Materials
E 1529	Standard Test Methods for Determining Effects of Large Hydrocarbon Pool Fires on Structural Members and Assemblies	SIS Standard	
UL Standard		05 59 00	Pictorial Surface Preparation Standards
UL 1709	Rapid Rise Fire Tests of Protection Materials for Structural Steel	SSPC Specifications	
NACE Standard		PA-2	Measurement of Dry Paint Thickness with Magnetic Gages
TM01-70	Visual Standards for Preparation of New Steel, Air Blast Cleaned with Sand Abrasive	SP6	Commercial Blast Cleaning (SIS Sa2) NACE No. 3
		SP10	Near White Blast Cleaning (SIS Sa 2 1/2) NACE No. 2

DEFINITIONS

- I 3.1 **Flammable liquids.** Low-flash liquids [flash point below 100°F (38°C)] and combustible liquids when handled at temperatures above or within 15°F (8°C) of their closed cup flash points.
- I 3.2 **Flammable materials.** Flammable liquids, hydrocarbon vapors, and other vapors, such as hydrogen and carbon disulfide, that are readily ignitable when released to atmosphere.
- I 3.3 **Combustible liquids.** Liquids with a flash point that is 100°F (38°C) or higher.
- I 3.4 **Equipment with high fire potential includes any of the following:**
 - a. Pumps with a rated capacity over 200 gpm (45 m³/h) handling flammable liquids.
 - b. Gas compressors over 200 hp (150 kW) handling flammable materials.
 - c. Fired heaters handling flammable or combustible liquids in the tubes or using liquid fuels.
 - d. Vessels, heat exchangers (including air-cooled) and other equipment containing flammable liquids at or above 600°F (315°C), or above their autoignition temperature, whichever is less.
 - * e. Reactors that operate at or above 500 psig (3450 kPa) pressure or are capable of producing exothermic or runaway reactions when specified by the Owner's Engineer.
- I 3.5 **A fire hazardous area shall include any of the following:**
 - a. The area within 20 ft (6.0 m) horizontally of **equipment that has a high fire potential.**
 - b. For tanks, spheres and spheroids, containing flammable material, the fire hazardous area shall extend to the dike wall, or 20 ft (6.0 m) from the storage vessel, whichever is greater.
 - c. For rotating equipment, the 20 ft (6.0 m) distance will be taken from the expected source of leakage.
 - d. For marine docks where flammable liquids are handled, the fire hazardous area shall extend 100 ft (30 m) horizontally from the manifolds or loading connections on the pier deck.
- I 3.6 **Low temperature rated wiring insulation** is insulation suitable for a maximum rated conductor temperature below 390°F (200°C). Examples are polyvinyl chloride and polyethylene.
- I 3.7 **High temperature rated wiring insulation** is insulation suitable for a maximum rated conductor temperature of 390°F (200°C) and higher. Examples are silicone rubber and mineral insulation (MI).

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(This practice is appropriate for attachment to Inquiry or Purchase Document)

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- I ♦ * 3.8 **Fire rated cable** is one that has successfully passed an Owner-approved fire test by maintaining conductor continuity and insulation integrity while being subjected to 2000°F (1100°C) with a heat flux of at least 50,000 Btu/hr-ft² (160 kW/m²) for at least 15 minutes under conditions equivalent to those specified in either UL 1709, ASTM E 1529, or equivalent test method.
- I ♦ * 3.9 **Steel jacket material** used to cover fireproofing shall refer to stainless steel, aluminum coated steel or galvanized coated steel, as specified by the Owner's Engineer.

FIREPROOFING MATERIALS AND METHODS

CONCRETE AND GUNITE COATINGS FOR STRUCTURAL STEEL AND VESSELS

- S ♦ * 4.1
 - a. Unless otherwise specified, concrete and gunite are the basic materials for fireproofing. Alternative fire protection coatings that meet the requirements of **Pars. 4.8 and 4.9** may be used when approved by the Owner's Engineer.
 - b. **Structural steel columns and beams to be fireproofed** shall be covered with a minimum thickness of 2 in. (50 mm) of poured in place ("solid blocked") concrete. The use of "contoured" concrete on structural steel columns and beams is considered an alternative fireproofing method and is subject to the requirements of **Pars. 4.8 and 4.9**.
 - c. **Vessel skirts and other steel support members to be fireproofed** shall be covered with a minimum thickness of 2 in. (50 mm) of gunite or concrete.
 - d. **Reinforced concrete structures**, with at least a 2 in. (50 mm) concrete covering over reinforcing steel, are adequately fire resistant, and additional fireproofing is not required.
 - e. **Steel vessels to be fireproofed** shall be covered on the outside surfaces with a minimum thickness of 1-1/2 in. (38 mm) of gunite or concrete.
- S ♦ 4.2 Concrete and gunite used for fireproofing shall be mixed to provide a minimum compressive strength of 4000 psi (27.5 MPa). The maximum water to concrete ratio shall be 0.5. Water used in preparing and applying the concrete/gunite shall be potable.
- S ♦ 4.3 Unless noted otherwise in this standard, the design, testing and application of concrete and gunite used for fireproofing shall meet the requirements of **IP 4-1-1** and **IP 19-3-1**.
- R ♦ 4.4 When concrete/gunite and light weight cementitious fire resistant coatings are used to fireproof steel, the following steps shall be taken to reduce penetration of moisture to the steel surface:
 - a. All seams and joints between the fireproofing coating and the steel surface shall be tapered and caulked with a synthetic rubber such as butyl or silicone.
 - b. When fireproofing is applied to horizontal beams that carry piping or platforms, the fireproofing shall extend up to the top flange of the beam. The exposed beam surface shall be suitably blast cleaned, primed, and topcoated. For galvanized beams, no further protection is required before fireproofing. Alternatively, the exposed beam and upper side faces of the fireproofing shall be covered with a petrolatum based fabric tape such as "Denso Steelwork Tape" or equivalent.
 - c. When required by the Owner's Engineer, the fireproofing shall be protected with a 100% acrylic latex paint system [minimum of 2 coats each 1.5 mils [40 µm] thick] or soaked with a suitable penetrating waterproofing treatment to prevent water absorption.

INSULATION USED FOR FIREPROOFING OF STEEL VESSELS

- S ♦ 4.5 **Steel vessels externally insulated for process reasons shall be considered fireproofed** if the finished insulation system meets all of the following conditions:
 - a. A minimum of two layers of insulation with joints staggered so that there are no through cracks.
 - b. Each layer is a minimum 2 in. (50 mm) of cellular glass or type II calcium silicate thermal insulation (total of 4 in. or 100 mm).
 - c. Details of the design and how each layer is secured shall follow the manufacturer's recommendation.
 - d. Covered with corrosion resistant steel jacketing.
 - e. Capable of withstanding the force of fire hose stream impingement. Fire hose-stream tests are described in NFPA 58, Appendix H. In addition to banding, the edges of the jacketing (cladding) are to be fastened with corrosion resistant steel screws or pop-rivets.
 - f. Otherwise meet all the application and installation requirements of **IP 14-1-1**.

Note: The fireproofing requirements in this paragraph are not necessarily applicable when the intent is only to take credit for thermal insulation in the reduction of fire loads. In such cases, the less restrictive requirements of **IP 3-2-4** may apply.

- S ♦ *4.6 **Alternatives to cellular glass** or type II calcium silicate thermal insulation as outlined in **Par. 4.5.b** may be considered with the approval of the Owner's Engineer provided the finished insulation meets all parts of **Par. 4.5** and the following requirements:
- Capable of withstanding direct flame impingement.
 - The insulation as a composite system shall have a minimum fire resistance rating of 1-1/2 hours when tested in accordance with UL 1709 or ASTM E 1529 using a standard 10W49 beam.
 - Be asbestos free.
- S ♦ 4.7 Attention should be given to preventing corrosion under fireproofing (CUF) when fireproofing is applied to the walls of vessels operating between 25°F and 300°F (-4°C and 150°C). Proper anti-corrosion coating must be applied (refer to **IP 14-1-1** and **IP 19-1-1**).

ALTERNATIVE FIREPROOFING MATERIALS FOR STRUCTURAL STEEL AND STEEL VESSELS

- S 4.8 **Alternative fireproofing materials** that have been approved per **Par. 4.9** may be substituted for specified **gunite or concrete** fireproof coatings, for the less critical applications listed below:
- Steel vessels (excluding structural steel support members and skirts) not otherwise insulated for process reasons.
 - Support saddles for heat exchangers.
 - Stub-leg structural supports for air-cooled heat exchangers, provided the elevation of these supports is at least 25 ft (7.5 m) above grade, and the exchanger does not handle flammable materials at an inlet temperature above 600°F (315°C).
 - Pipe supports, except within diked enclosures of refrigerated storage vessels.
 - Structural supports for elevated ducts around fired heaters.
- S ♦ *4.9 **Proposals to use alternative fireproofing materials** shall be approved by the Owner's Engineer. To be considered for acceptance, data shall be submitted which demonstrates that the proposed material and installation will:
- Be suitable for the specified environmental exposure.
 - Be suitable for the equipment operating conditions and any elevated temperatures that can be encountered during steaming out, cleaning, and flushing operations.
 - Meet the fire test requirements for 2 hours protection (when the application is for structural steel), or 1-1/2 hours protection (when the application is for steel vessels) per the procedure of UL 1709 or ASTM E1529 using a standard 10W49 beam.
 - Be asbestos free.
 - Capable of withstanding the force of fire hose stream impingement. Fire hose-stream tests are described in NFPA 251 Section 4-2 for structures and NFPA 58, Appendix H for vessels.
- S *4.10 **Quality control procedures for the application of alternative fireproof coatings** shall be approved by the Owner's Engineer.

FIREPROOFING METHODS FOR LOW MELTING POINT MATERIALS

- S ♦ *4.11 **Vessels, heat exchangers, and other equipment constructed from low melting point material**, such as aluminum, and which require fireproofing shall be protected as follows:
- The fireproofing system shall prevent the shell of the equipment from reaching a temperature where the material will be stressed beyond its yield strength when exposed to a fire with temperature maintained per the UL 1709 or ASTM E 1529 test conditions for 1-1/2 hours.
 - For aluminum equipment, this shell temperature shall be considered to be 350°F (175°C). The temperature to be used for other low melting point materials will be specified by the Owner's Engineer.
- S ♦ 4.12 **Plate and frame exchangers requiring fireproofing** shall be protected as follows:
- Provide a protective enclosure designed to prevent the exchanger from exceeding its maximum operating temperature when exposed to a fire with temperature maintained per the UL 1709 or ASTM E 1529 test conditions for 1-1/2 hours.
 - The maximum operating temperature for plate and frame exchangers will be considered to be the vendor's specified maximum operating temperature or 300°F (150°C) whichever is less.
 - The fireproofing enclosure shall be able to withstand direct impingement by flames and by fire hose streams, be readily removable and replaceable for maintenance, and provide convenient access for observation.

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FIREPROOFING MATERIALS AND METHODS FOR ABOVE GROUND WIRING

- S ♦ * **4.13** **Fire-rated cable without any fireproofing** shall be used when fire-resistance is required for aboveground wiring. For underground cables that have aboveground stub ups that require fireproofing, non fire-rated cables are acceptable (insulate the aboveground section as outlined in **Par. 4.13 a** and **b**). Otherwise, non fire-rated cable shall only be used in aboveground installations with the Owner's approval and shall require the following:
- Wiring with **low temperature rated insulation** shall be fireproofed with 2 in. (50 mm) of ceramic fiber thermal insulation, or equivalent, and a steel jacket.
 - Wiring with **high temperature rated insulation** shall be fireproofed with 1 in. (25 mm) of mineral fiber or calcium silicate thermal insulation, or equivalent, and a steel jacket.
 - Fireproofed rigid metal conduit systems** shall use only steel conduit.
 - Fireproofed cable tray** shall only be constructed of steel.
- S ♦ * **4.14** **Alternative fireproofing methods** such as **intumescent epoxy coating** may be proposed, subject to approval by the Owner's Engineer. Such proposals shall include test data documenting that the alternative fireproofing system shall allow the protected wiring to remain operable for at least 15 minutes when exposed to a 2000°F (1100°C) fire with a heat flux of at least 50,000 Btu/hr-ft² (160 kW/m²) under the test conditions of UL 1709, ASTM E 1529, or equivalent test method.
- S **4.15** **Ampacity of power wiring that is fireproofed** shall be derated to take into account the thermal insulating effect of the protective covering and jacket.

FIREPROOFING MATERIALS AND METHODS FOR EMERGENCY VALVE ACTUATORS

- S ♦ **4.16** Fireproofing for **valve actuators** shall be as follows:
- The **standard fireproofing system** shall consist of an intumescent fireproof coating, preferably a pre-cast to fit the valve similar to AAROCAS design for ROTORK actuators, or equivalent to Thermal Design Inc.'s K-Mass designed to ensure the actuator remains operable for at least 15 minutes when exposed to a 2000°F (1100°C) fire under the test conditions of UL 1709, ASTM E1529, or equivalent test method.
 - * With Owner Engineer's approval the **fireproofing system** may consist of 2 in. (50 mm) of mineral fiber or calcium silicate insulation and a steel jacket.
 - * **Alternative fireproofing methods** may be proposed, subject to approval by Owner's Engineer. Such proposals shall include test data documenting that the alternative fireproofing system shall allow the valve and actuator to remain operable for 15 minutes when exposed to a 2000°F (1100°C) fire with a heat flux of at least 50,000 Btu/hr-ft² (160 kW/m²) under the test conditions of UL 1709, ASTM E 1529, or equivalent test method. Fireproofing materials shall be of sufficient thickness to prevent internal actuator temperatures from exceeding 200°F (93°C) and vendor shall verify that the actuator will operate at that temperature.
 - Fireproofing of motor valve actuators shall include the motor and integral push-button, but exclude the handwheel and valve body.
 - * Local air receivers or surge bottles for air operated valves shall be fireproofed with the same jacketed insulation system, or with lightweight, intumescent epoxy coatings, subject to approval by the Owner's Engineer.
 - Stainless steel instrument air lines do not require fireproofing.

STEEL SURFACE PREPARATION AND PRIMER APPLICATION

- S ♦ **4.17** All metal surfaces to be fireproofed shall be prepared and primed in accordance with the procedures of **IP 19-1-1**. In summary, these procedures are:
- * **Steel** surfaces shall be cleaned by Commercial Blast Cleaning or Near White Blast Cleaning procedures, depending on environment. Two coats of either Epoxy-Phenolic with a nominal dry film thickness (each coat) of 3.0 mil (75 µm), or two coats of Coal Tar-Polyamide Mastic with a nominal dry film thickness (each coat) of 8.0 mils (200 µm) shall be applied.
Alternatively, galvanized may be used in lieu of steel that has been coated as highlighted above. Where special circumstances exist, coating a galvanized substrate may be desirable.
 - * **Alternative fireproof coatings:** Modifications to surface preparation procedures in **Par. 4.17a** shall be established by mutual agreement between the coating application contractor and the Owner's Engineer.
 - Externally insulated surfaces** shall be prepared according to **IP 19-1-1** depending on the service temperature of the equipment being insulated.