HOT PIPING AND EQUIPMENT INSULATION

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1.0 SCOPE

1.1 This standard covers the basic requirements for the insulation of outdoor process piping, pressure vessels, storage tanks, heat exchangers, turbines, pumps, and other equipment operating in hot services from 100°F (38°C) to 1200°F (649°C).

2.0 REFERENCED PUBLICATIONS

2.1 Applicable sections of the latest edition of the following publications form part of this standard.

ASTM American Society for Testing and Materials

C-795-92 Specification of Thermal Insulation in contact with Austenitic Stainless Steel

E-84-91a Surface Burning Characteristics of Building Materials

C-610-94 Specification for Expanded Perlite Block and Pipe Thermal Insulation

The Aluminum Association

COMPANY Engineering Standards

Protective Coatings

COMPANY Engineering Specifications

Hot Insulation

3.0 SPECIFICATION REQUIREMENTS

3.1 When preparing insulation specifications for a CONTRACTOR, the following items, as a minimum, must be specified in the Basis of Bids or project specifications as a supplement to COMPANY Engineering Specification:

a. Insulation Materials: See paragraph 11.2 of this standard and the Insulation Material Specifications in COMPANY Engineering Specification.

b. Insulation Thickness: See COMPANY Engineering Standards.

c. Type of ultrasonic thickness inspection port to be used. See paragraph 11.2.3 of this standard and COMPANY Engineering Specification.

d. Whether flanges and valves are to be insulated. See paragraphs 6.2, 6.3, and 8.1 of this standard.

e. Whether drip rings are required around flanges. See paragraph 6.3 of this standard and COMPANY Engineering Specification.

f. Consult local and state regulations for requirements concerning material surface burning characteristics.

4.0 GENERAL

4.1 Insulation shall be applied on piping and equipment where heat conservation is beneficial to operation or economics. The insulation thickness shall be determined from COMPANY Engineering Standard. Omit insulation where it is calculated to be uneconomic. Insulation is also to be omitted where heat loss is beneficial to operation of coolers, condensers, etc. In general, insulation for heat conservation is economic to install on surfaces operating at or above 100°F (38°C).

4.2 Install insulation, guardrails, or screens for personnel protection. Insulation thickness for personnel protection shall be determined from COMPANY Engineering Standard. See Section 10 of this standard.

4.3 Insulation may be installed on tall pressure vessels in the horizontal position prior to erection provided the vessel has been inspected and approved and insulation system details have been reviewed and approved by the COMPANY.

4.4 All insulation shall be covered with metal jacketing except for special specifications such as reusable pads, etc.

4.5 Material used for insulating austenitic stainless steel shall meet ASTM C 795 and shall not contribute to stress corrosion cracking. Chlorides in contact with austenitic stainless steel can cause stress corrosion cracking at temperatures from 140°F (60°C) to 1100°F (204°C). Austenitic stainless steel equipment and piping operating in this temperature range and in areas where the insulation can get wet shall have an approved protective coating applied prior to being insulated. Refer to COMPANY Engineering Standard P-1. The insulation shall be inhibited perlite silicate per ASTM C-610-91.

4.6 Galvanized materials, such as tie wire and chicken wire mesh shall not be used on stainless steel piping and vessels. All such materials for use on stainless steel piping and vessels shall be stainless steel.

4.7 Moisture or contaminants under thermal insulation may cause accelerated corrosion if the operating temperature is less than 250°F (120°C) and where the facility may be periodically shutdown. Insulated carbon steel equipment and piping operating or cycling below 250°F (120°C) shall be coated according to COMPANY Engineering Standard.

4.8 Nameplates and code stamps shall be left uncovered and readable.

4.9 Only non-asbestos materials shall be used.

4.10 The insulation requirement code is as follows:

Code Legend	Description
(H)	Heat Conservation Insulation
(P)	Personnel Protection Insulation
(S)	Steam Tracing Insulation
(E)	Electric Tracing Insulation
(N)	No Insulation Required
(U)	Underground Piping Insulation
(J)	Jacketed Piping and Equipment Insulation
(O)	Hot Oil Tracing Insulation
(W)	Hot Water Tracing Insulation

4.10.1 Heat Conservation Insulation (H)

a. Heat conservation insulation shall be applied to piping, vessels, and equipment to conserve heat and as required for process control.

b. The following shall not normally be insulated for heat conservation:

1. Safety valves.
2. Steam condensate lines downstream of steam traps discharging to drainage system.
3. Untraced branches from traced lines downstream of the first block valve.
4. Drain and vent piping on insulated equipment downstream of the first block valve.
5. Inside of skirts on skirt-supported vessels 30 inches (0.76m) and less in diameter.

4.10.2 Personnel Protection Insulation (P) shall normally be applied to surfaces which present a hazard to personnel. See Section 10 of this standard. Isometric drawings shall indicate which sections of the line require personnel protection insulation.

4.10.3 Steam Traced (S), Electric Traced (E), Hot Water Traced (W), Jacketed (J), or Hot Oil Traced (O) piping and equipment shall be insulated to prevent heat loss.

4.10.4 No Insulation (N) is required unless the scope limitations in paragraphs 4.1 or 4.2 of this standard are applicable.

4.10.5 Insulation for Underground Piping (U) shall be considered on an individual basis. Consult the Technical Services Department.

4.11 Insulation cement shall not be used as a substitute for insulation. Where voids exist in the insulation, the insulation shall be replaced.

5.0 STEAM PIPING

5.1 All steam lines shall be insulated except lines which are in infrequent service and are normally cold, such as snuffing lines and steam-out branches to vessels. Such lines shall be insulated from the main header through the first block valve.

5.2 Valves and flanges in steam service shall be insulated reusable pad type insulation covers.

5.3 Steam line bleeders shall be insulated to and including the first block valve for freeze protection.

5.4 Steam condensate headers and condensate lines shall be insulated except for condensate lines that are vented to the atmosphere.

6.0 PROCESS PIPING

6.1 Process lines shall be insulated except where heat conservation is not desirable or economical.

6.2 Valves and flanges at temperatures above 600°F (316°C) can be prone to leakage where they are insulated. The use of insulation on bolted connections increases the temperature of the bolts which may cause them to relax and allow the joint to leak. The necessity of insulating valves and flanges shall be individually considered for each project. Reusable pad type insulation covers shall normally be used, however, rigid reusable type covers may be required on systems where water tight covers are necessary.

6.3 If flange leakage and leak detection are a concern and it is necessary to insulate the flange, a sheet steel flashing may be installed around the flange set with an NPS drip tube extending downward from the flashing through a drain grommet in the insulation cover.

6.4 Insulation expansion joints shall be provided to allow for the difference in expansion between the insulation and the piping or vessel.

7.0 TURBINES AND PUMPS

7.1 Reusable pad type insulation covers shall be used.

8.0 VESSELS AND HEAT EXCHANGERS

8.1 Flanges of removable heads and channels can be prone to leakage where they are insulated. See paragraph 6.2 of this standard. The necessity of insulating flanges shall be individually considered for each vessel. Reusable pad type covers shall be used where flanges are insulated.

8.2 Vertical and horizontal vessels whose diameters are within the range of pipe insulation sizes shall be covered with premolded pipe covering. Generally all fixed vessel heads shall be insulated with block or blanket insulation. Engineered vessel head segments of block insulation are preferred to assure total closure of the joints.

8.3 Vessels with diameters larger than the range of preformed pipe insulation shall be insulated with blanket or block-type insulation.

8.4 Blanket insulation shall be securely attached with stud pins or metal bands. The edges of metal mesh reinforced blankets shall be laced together with wire.

9.0 STORAGE TANKS

9.1 Prefabricated insulation panel systems are preferred for insulating storage tanks and shall be used wherever possible.

9.2 Type and thickness of insulation shall be selected for each storage tank on an individual basis. Polyisocyanurate foam may be used for temperatures up to 290°F (143°C). Wire mesh reinforced fiberglass insulation may be used on tanks up to 450°F (230°C). Above 450°F (230°C), insulation shall be wire mesh reinforced mineral fiber. Block-type insulation may also be used. The insulation shall be covered with a suitable protective coating or jacket. The most economic thickness shall be determined by calculating the minimum annual cost of the insulation and heat loss.

9.3 Insulation on tank tops shall be designed to withstand foot traffic, a corrosive environment and high winds where necessary.

9.4 Cellular glass insulation applied with a proper sealant shall be used as the bottom tier in potential splash wash-down or flood areas where water absorption and wicking may occur.

10.0 PERSONNEL PROTECTION

10.1 Where the operating temperature of piping or equipment is 140°F (60°C) or above and the conservation of heat is not advantageous those portions of equipment or piping which present a hazard to personnel shall be insulated or isolated by the use of screens, guards or handrails. A method of personnel protection other than by insulation is preferred.

10.2 Vessels, equipment and piping that are internally insulated or refractory lined generally should not be externally insulated for any purpose. The use of external insulation will raise the metal temperature, possibly to an unacceptably high level. Vessels equipment and piping that are internally insulated or refractory lined and require personnel protection should be isolated by the use of screens, guards, or handrails rather than insulated.

10.3 Personnel protection insulation shall be applied on piping or equipment as follows:

a. At grade level, which may present a safety hazard because of its location in a normally accessed area.
b. On portions within 7 feet 0 inches (2.0m) vertically above and 3 feet 0 inch (0.9m) horizontally from the floor surface of platforms, walkways, and stairs.

10.4 Insulation thickness for personnel protection can, in some cases, exceed that required for heat conservation. In these cases, the larger thickness shall govern. personnel protection insulation thicknesses shall be determined from COMPANY Engineering Standard.

11.0 MATERIALS

11.1 Insulation Material Specifications

11.1.1 Specific material requirements are found in the Insulation Material Specifications of COMPANY Engineering Specification. The key to the Insulation Material Specification designations is as follows:

Insulation Type:	H - Hot Insulation C - Cold Insulation
Insulation Material:	A - Calcium Silicate C - Cellular Glass G - Glass Fiber M - Mineral Fiber
Jacketing Materials:	A - Aluminum G - "Galvalume" S - Stainless Steel P - Perlite Silicate

11.2 Material Selection

11.2.1 Insulation Materials

11.2.1.1 The following material descriptions are intended to aid in the selection of an insulation material for a particular application unless another

material is required by paragraphs 11.2.1.2 or 11.2.1.3 of this standard:

a. Calcium Silicate - Calcium Silicate has good resistance to mechanical abuse and a relatively high compressive strength. It should be used on piping and vessels in areas where mechanical abuse can be expected. Calcium silicate readily absorbs water. It is manufactured in preformed pipe covering and block forms and is suitable for use at temperatures up to 1200°F (649°C).

b. Mineral and Glass Fiber - Mineral and Glass Fiber generally provide the most economical insulation systems available but may be used only in areas where mechanical abuses is not expected. Both are manufactured in preformed pipe covering block and blanket forms. Mineral fiber is available for service temperatures up to 1200°F (649°C). The recommended temperature limit for Glass Fiber insulation is 650°F (343°C).

c. Cellular Glass - Cellular Glass has a relatively high compressive strength and good resistance to mechanical abuse and water absorption, however it is more expensive and a less efficient insulator than the other materials available for most hot service applications. In hot service applications, it is generally used only where its non-wicking and non-absorptive properties are required. It is limited to a service temperature of 800°F (427°C). Cellular Glass is subject to cracking when exposed to sudden temperature changes.

d. Perlite silicate has good resistance to mechanical abuse and moderate compression strength. It should be used on stainless steel piping and vessels where the insulation can get wet and operating above 140°F (60°C). Perlite silicate is water resistant up to 600°F (316°C) and contains a high concentration of leachable sodium silicate which will inhibit (neutralize) chlorides in moisture. Its water resistance makes this material suitable for traced piping where wet insulation can have an adverse affect on temperature control. It is manufactured in preformed pipe covering and block forms and is suitable for temperatures up to 1200°F (649°C).

e. Polyisocyanurate and Phenolic Foam has more than twice the thermal efficiency of other insulations. This insulation does not readily absorb moisture like glass fiber and mineral wool. It is easy to install and is cost effective within its allowable temperature range. Insulation can be used for freeze protection, low pressure steam and process systems on pipe and equipment. It is manufactured in preformed pipe covering, sheet and block forms. This insulation is suitable for service temperatures up to 250°F (121°C).

11.2.1.2 Hot oil and other hydrocarbon systems of piping and equipment shall be insulated with either cellular glass, calcium silicate or perlite silicate. The use of one length of cellular glass next to flanged connections should be considered to prevent absorption of the heat transfer fluid by the insulation if leakage occurs.

11.2.1.3 If the insulation is to provide fire protection for the item on which it is applied or if credit for the insulation is taken in the fire sizing of a pressure relieving device or system the insulation material used shall be calcium silicate mineral fiber, perlite silicate or cellular glass.

11.2.2 Jacketing Materials

11.2.2.1 Stainless steel or Galvalume jacketing shall be used on piping and pressure vessels larger than 10 inches (254mm) in diameter. Where fire exposure is the dominant condition for sizing a pressure relieving device or system Galvalume is recommended for all piping and vessels inside battery limits.

11.2.2.2 Galvalume jacketing shall not be used on stainless steel piping and vessels.

11.2.2.3 Aluminum jacketing may be used in areas where other materials are not required by this standard.

a. Aluminum melts at 1000°F (538°C). In a gasoline fire with a combustion temperature of 2300°F (1260°C), the aluminum jacket melting and falling will add to the incendiary conditions. The melting aluminum jacket will also expose the insulation itself to the fire and to firewater streams which may dislodge the insulation and expose the underlying pipe or vessel to the fire.

11.2.3 Ultrasonic Thickness Inspection Ports

11.2.3.1 Ultrasonic thickness and external corrosion inspection ports shall be installed in accordance with COMPANY Engineering Specification.

a. "Speedcheck" inspection port plugs do not form a watertight seal against the jacketing, whereas "V.I.P." inspection ports do. "V.I.P" inspection ports are therefore recommended for all piping and vessels, particularly those operating at less than 250°F (121°C).