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Insulation and Application Methods for Heated Piping

SPECIFICATION of insulating materials and application methods is governed by the physical and operating characteristics of the particular heated equipment or surface to be insulated. In the petroleum refining industry, storage tanks, distilling towers, boilers, heat exchangers, and ducts are covered with the type of insulation, securing members, and finish that will do the most effective heat-saving job. The most common type of plant equipment requiring insulation is piping—carrying water, steam, gas, oil, chemicals, and other materials from point to point in the refinery. Pipe insulation contributes in large proportion to the efficiency of refinery operations and is, therefore, of direct concern to engineers in the field.

There are many recommended procedures for applying pipe insulation that have produced excellent results for many years with only occasional maintenance. There are four particular conditions the alert plant engineer and experienced insulation contractor first consider in specifying insulation on a given pipe line. These are (1) temperature of the pipe contents, (2) outside diameter of the pipe, (3) location of the pipe (indoors or outdoors) and (4) degree of exposure to external damage. These conditions are most common; among others are orientation of piping (horizontal, vertical, or diagonal), exposure to moisture and vibration.

Specifications based on such information may be divided into the following categories:

1. Type of primary pipe insulation —molded-type or blanket-type.
2. Dimensions of primary insulation — length, thickness, sectional or segmental.
3. Auxiliary and finishing materials.
4. Methods of installing primary insulation, auxiliary and finishing materials.

There are two common types of mineral wool pipe insulation, *blanket-type* and *molded-type*. Blanket-type pipe insulation is mineral wool reinforced on one or both sides by a suitable confining material and bound to form a nonrigid insulating section. Blanket-type mineral wool pipe insulation is designed and manufactured to have both maximum flexibility and high thermal efficiency and is produced in sizes to fit piping from 2-in. diameter and up. The most common confining materials used are either metal lath or wire netting, both of which are secured by wire or cord ties through the mineral wool itself. Blanket-type pipe insulation is commercially manufactured in 24-in.-long single-layer sections, 1-in. to 4-in. thick, for standard pipe sizes. Standard blankets are selected having dimensions that will assure a snug fit to the pipe at specified insulation thicknesses.

Molded-type mineral wool pipe insulation consists of mineral wool combined with bonding ingredients to form a rigid insulation. This type of pipe insulation combines rigidity and strength with good insulating characteristics and is shaped to be particularly easy to install. Molded-type pipe insulation is manufactured in single and double-layer thicknesses. Each section is 36-in. long, a standard length found generally most useful. To insulate small-diameter piping, molded-type mineral wool is supplied in sections (half-cylinders), which are fitted together over the pipe. For larger pipe sizes, molded-type insulation is manufactured in segments (usually four). The manufacturer maintains a tolerance of 1/6-in. for all dimensions so that it will fit tightly.

In order to facilitate specifications, standard and double-standard thicknesses of molded-type pipe insulation for standard-weight steel pipe have been set forth by the industry.* Table 1 gives these thicknesses* for nominal pipe sizes from ½-in. to 14-in. and up. Molded-type pipe insulation may also be manufactured in 1, 1½, 2, 2½, 3, and 4-in. thicknesses for all nominal pipe sizes given in the table.

"On large piping, usually 14-in. in diameter and up, it is often very satisfactory to apply mineral wool insulating cement, particularly where irregular surfaces are encountered in combination with the piping. The

*Commercial Standard CS-117-49, "Mineral Wool Insulation for Heated Industrial Equipment."

TABLE 1. Molded-type insulation—thicknesses[a] for standard-weight steel pipe sizes.

Pipe size		Standard thickness	Double standard thickness
Nominal	Actual O. D.		
in.	*in.*	*in.*	*in.*
½	0.840	¾	1¾
¾	1.050	¾	1¾
1	1.315	¾	1¾
1¼	1.660	¾	1¾
1½	1.900	¾	1¾
2	2.375	1½	2½
2½	2.875	1½	2½
3	3.500	1½	2½
3½	4.000	1½	2½
4	4.500	1½	2½
4½ [b]	5.000	1½	2½
5	5.563	1½	2½
6	6.625	1½	2½
7 [b]	7.625	1½	2½
8	8.625	1½	2½
9 [b]	9.625	1½	2½
10	10.750	1½	2½
11 [b]	11.750	1½	2½
12	12.750	1½	3
14 and up	.....	1½	3

[a]In addition to the thicknesses specified above, molded-type pipe insulation may be manufactured in thicknesses of 1, 1½, 2, 2½, 3, and 4 in. for all nominal pipe sizes.
[b]These pipe sizes are not listed as standard for steel pipe in Simplified Practice Recommendation R57-32, Wrought-iron and Wrought-steel Pipe, Valves, and Fittings.

TABLE 2. Recommended minimum insulation thicknesses—mineral wool pipe insulation.

Blanket-type				Molded-type			
Temperature	Thickness			Temperature	Thickness		
	Pipes 2 in. to 4 in.	Pipes 4 in. to 6 in.	Pipes 6 in. and up		Pipes below 2 in.	Pipes 2 in. to 4 in.	Pipes 4 in. and up
°F	*in.*	*in.*	*in.*	°F			
150 to 250	1	1	1	Up to 275	Std.	Std.	Std.
250 to 350	1	1	1	275 to 350	do.	do.	1½".
350 to 450	1	1	1½	350 to 425	do.	1½"	2".
450 to 550	1	1½	1½	425 to 500	1½"	2"	Dbl. std.
550 to 650	1½	1½	2	500 to 600	2"	Dbl. std.	Do.
650 to 750	1½	2	2				
750 to 900	2	2	2½				
900 to 1,050	2	2½	3				
1,050 to 1,200	2½	3½	4				

insulation thickness required by pipe temperature is built up on the pipe in separate layers; it is recommended that each layer be no thicker than ¾-in. Each layer should be allowed to dry thoroughly before application of further insulating cement."

More heat will be saved on any pipe line if the thickness of the insulation is increased; however, the cost of insulation per foot of piping also increases. There is, therefore, an economic thickness of insulation which will result in maximum heat savings per dollar of cost. Table 2 gives recommended minimum insulation thickness for blanket-type pipe insulation, 150 F to 1200 F, and molded-type pipe insulation, from below 275 F to 600 F. For each type of pipe insulation, the recommended minimum thicknesses are given for three ranges of pipe diameter. Note that the data for molded-type pipe insulation refers to the standard and double-standard insulation thicknesses given in Table 1. The thicknesses tabulated in Table 2 are recommended for indoor applications. When piping is placed outdoors, as is common in the petroleum industry, it is recommended that the insulation thickness be increased not less than ½-in. Because earth is of some insulating value, thickness may be decreased ½-in. when piping is installed underground.

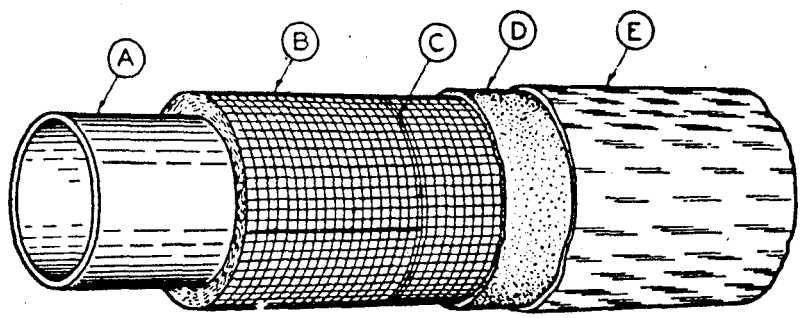
Application of Blanket-type Insulation

Usually applied on straight piping and long-radius bends of 2-in. standard pipe size or larger, blanket-type pipe insulation (Fig. 1) is first wrapped circumferentially around the bare pipe. The longitudinal edges are then secured by tying or lacing with 16-gage galvanized soft iron wire, preferably on the under side of the piping. The mineral wool blanket sections are tightly butted together on the pipe to provide an unbroken insulation covering.

The materials and method in which blanket-type insulation is finished depends upon whether it is located indoors or outdoors. There are four generally accepted materials for finishing insulation on indoor piping, (1) mineral wool insulating cement, (2) roofing-felt, (3) asphaltic mastic or emulsion and (4) canvas. Insulating cement is applied over the blanket-type pipe insulation in two ¼-in. layers. The first layer is trowelled on and allowed to dry before the second is applied. As the second alternative finish, asphalt-saturated roofing-felt is wrapped around the piping, lapped at least 2-in. and often sealed with an asphaltic compound or lap cement. Roofing-felt should be securely held over the pipe with copper wire or galvanized iron bands spaced on approximately 6-in. centers along the pipe.

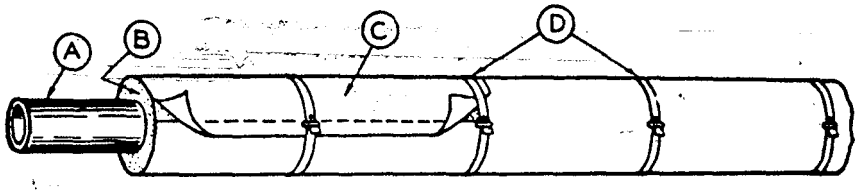
To apply an asphaltic finish to indoor piping covered with blanket-type pipe insulation, a ¼-in. layer of mineral wool insulating cement is first applied and, when dry, is covered with 1-in. galvanized-wire netting stretched over the surface and tightly wired in place. Asphaltic mastic or emulsion is then trowelled into the wire netting to provide a ⅛-in. dry thickness (or about ¼-in. when wet). As a base for a canvas pipe jacket, a layer of flameproof paper, $\frac{1}{16}$-in.-thick asbestos paper or a ¼-in. layer of insulating cement is first applied. The canvas jacket is then sewn or pasted over the base material. To insure a tight cover on a sewn canvas jacket, the stitches should be spaced at no more than 1/3-in. intervals along the pipe.

When blanket-type pipe insulation covers piping located either outdoors or exposed to moisture or accidental damage, it is usually finished and weatherproofed by sheet-metal jackets, roofing-felt or an asphalt compound. A sheet-metal jacket should be at least 28-gage, single or double-galvanized. The seams are lapped down-



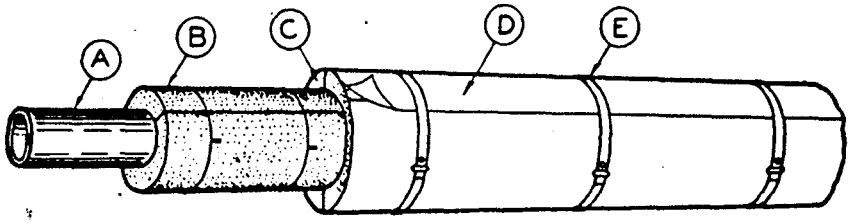
A. Bare pipe
B. Blanket-type mineral wool wrapped circumferentially around bare pipe
C. Joints secured with No. 16-gage galvanized wires
D. Insulating cement
E. Asphaltic or other specified finish.

FIG. 1. Application of blanket-type mineral wool pipe insulation on pipes.



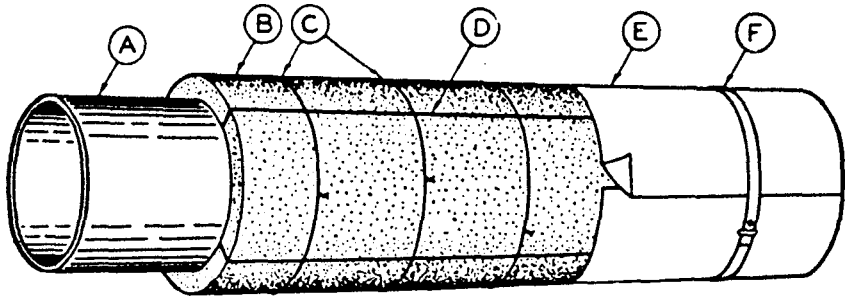
A. Bare pipe
B. Sectional mineral wool pipe insulation
C. Canvas jacket or other specified finish
D. Metal bands.

FIG. 2. Application of mineral wool sectional pipe insulation, single-layer.



A. Bare pipe
B. First layer secured with No. 16-gage galvanized wires
C. Second layer applied with all joints staggered
D. Canvas jacket or other specified finish
E. Metal bands.

FIG. 3. Application of mineral wool sectional pipe insulation, double-layer.



A. Bare pipe
B. Segmental pipe insulation
C. No. 16-gage galvanized wires
D. Insulating cement, when required
E. Canvas jacket or other specified finish
F. Metal bands.

FIG. 4. Application of mineral wool segmental pipe insulation.

ward against the weather and secured with galvanized metal bands, ½-in. wide or greater, which are machine-stretched and crimped. It is not recommended that the bands be spaced at much more than 6-in. centers along the pipe.

The roofing-felt finish is applied in the same manner outdoors as described above for indoor locations. To avoid the possibility of wetting the insulation, it is very important to lap the roofing-felt downward. An asphaltic finish is applied in the same manner outdoors as in indoors, making certain that the asphaltic coat is sufficiently thick and even at all points.

Application of Molded-type Insulation

The single and double-layer methods of applying sectional molded-type pipe insulation are illustrated in Fig. 2 and 3. In Fig. 2, single-layer sectional insulation is placed over the piping, with all sections tightly butted together, and is covered with a canvas jacket and banded in place. Double-layer application of sectional pipe insulation in Fig. 3 requires that the first layer be wired in place with loops of wires placed on approximately 8-in. centers. The second layer is tightly fitted directly over the first layer with all joints staggered to avoid aligning edges. As with single-layer application, a canvas jacket (or other finish) and metal bands follow.

Application of segmental molded-type pipe insulation in Fig. 4 is similar to the procedure followed with sectional insulation. Although Fig. 4 shows a single-layer method, double-layer segmental pipe insulation can also be obtained. On such large-diameter piping, mineral wool insulating cement is often trowelled over the installed segments before applying the canvas jacket or other finish.

A canvas jacket is the most satisfactory finish for molded-type pipe insulation located indoors and not exposed to moisture or abrasion. The canvas jacket is drawn tightly over the pipe and smoothly pasted at all lapping edges. The metal bands should be secured over the canvas at both the center and ends of each length of insulation. When factory-weight canvas is specified, insulation and canvas are supplied as a unit.

Molded-type pipe insulation installed on outdoor piping or in locations where accidental damage or wetting might occur is finished in one of the three ways recommended for blanket-type pipe insulation under similar conditions. All finishing methods are excellent; the specifier and insulation contractor select the finish most appropriate for particular conditions. ★ ★ ★