

ARMCO STEEL CORPORATION
MIDDLETOWN, OHIO

PIPING
CONSTRUCTION-MATERIAL

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STANDARD SPECIFICATION No. ACS-400-35 CONSTRUCTION-MATERIAL

PIPING AND EQUIPMENT INSULATION

1.0 SCOPE

This Specification covers materials, fabrication, and installation for the insulation of piping and equipment.

2.0 APPLICABLE SPECIFICATIONS

The following Armco Standard Construction Specifications form a part of this Specification:

2.1 PIPING - GENERAL - ACS-400-01

2.2 PIPING - COLOR CODE - ACS-400-37

3.0 GENERAL

3.1 Thickness - For insulation thickness refer to the particular manufacturer's insulation thickness design requirements manual.

3.2 K Factors (BTU/hr./sq. ft./°F./inch thickness) - The K Factors stated in the tables of this specification are given at various Mean Temperatures. To find the best K Factor for a particular application temperature, multiply the stated Mean Temperature by two (x 2) and add "cold face" temperature. The stated K Factors at the result of this calculation which is nearest the application temperature should be compared.

Example: Application temperature = 1000°F

"Cold Face" (Ambient temperature) = 80°F

	(1)	(2)	(3)	) From Table
(K Factor at 500°F	.52	.64	.62)	)

2 x (500°F)+80 = 1080°F Insulation (1) has the best K Factor (.52) at the Mean Temperature corresponding to the application temperature.

3.3 Layers - All insulation over two inches in thickness shall be applied in layers. Outer layer only shall have jacketing applied in the factory on all sizes commercially available.

3.4 Pipe Fittings - Pre-molded pipe fittings of the same insulation material as the rest of the line, shall be utilized wherever practicable.

3.5 Finishes - All cements, adhesives, finishes, and jackets shall be as recommended by the manufacturer of the insulation. Any required deviations shall require a statement guaranteeing the compatibility of the cements, adhesives, finishes, or jackets with the insulation.

4.0 MATERIALS

4.1 High Temperature - 500°F and Above -

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4.1.1 Type A - Diatomaceous or expanded silica, bonded with inorganic fibers.

(1) Insulation for pipe shall be molded, sectional for pipe sizes up to 14 inches; insulation for equipment shall be flat or curved blocks 3" or 6" wide by 18" or 36" long. (For some standard thicknesses insulation for pipe size up to 24" is available.) Insulation shall be as follows:

Type A - Pipe and Equipment	Carey-Temp	Superex-M	Kaylo 20
(1) K Factor at Mean Temperature of 300°F	.43	.60	.55
K Factor at Mean Temperature of 500°F	.52	.64	.62
K Factor at Mean Temperature of 800°F	.66	.69	---
(2) Acid Resistance of insulation material	High	Low Depends on Jacketing (Metal-On)	Low Depends on Jacketing
(3) Density (A.S.T.M. 303 Test)	10 lbs/ cu. ft.	21 lbs/ cu. ft.	12 lbs/ cu. ft.
(4) Water Absorption (Immersion)	4.3% by volume	400% by weight	---
Water Absorption (100% R.H.)	.1 to .2% by weight	---	---
(5) Maximum Temperature	1600°F	1600°F	1800°F
(6) Shrinkage (A.S.T.M. 356 Test)			
500°F	.22%	---	---
1000°F	.45%	---	.7% (1200°F)
1500°F	1.20%	2.0% (1600°F)	1.6% 1800°F)
(7) Soluble Chlorides (Pipe corrosion accelerators; recommended for Aluminum and Stainless Steel)	Low (Recom-mended)	Low (Recom-mended)	Low (Recom-mended)
(8) Fire Resistant	Non-com-bustible	Non-com-bustible	Non-com-bustible

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4.1.2 Type B - Calcium silicate, or expanded silica bonded by diatomaceous earth or asbestos/inorganic fibers with canvas (factory applied where commercially available).

(1) Pipe Insulation - Molded, sectional for pipes 1/2" to 10", segmental or sectional for pipes sizes 12" and larger, and blocks of 6", 9", 12" and 18" widths by 36" length for equipment. Insulation shall be as follows:

Type B (Pipe & Equipment	Carey-Temp	Thermobestos	Kaylo
(1) K Factor at Mean Temperature of 300°F	.43	.41	.42
K Factor at Mean Temperature of 500°F	.52	.50	.52
K Factor at Mean Temperature of 700°F	.62	.60	.62
(2) Acid Resistance of Insulating Material	High	Low (Depends on Jacketing)	Low (Depends on Jacketing)
(3) Density (A.S.T.M. 303 Test)	10-15 lbs/ cu. ft.	11 lbs/ cu. ft.	11 lbs/ cu. ft.
(4) Water Absorption (Immersion)	400% by weight	400% by weight	480% by weight
(5) Maximum Temperature °F	1600°F	1200°F	1200°F
(6) Shrinkage (A.S.T.M. 356 Test)			
500°F	.22%		.5%
1000°F	.45%		.9%
1200°F	1.20%	1.5%	1.4%
(7) Soluble Chlorides (Pipe corrosion accelerators: recommended for aluminum and stainless steel)	50 to 150 ppm chlorides (Recommended)	250 ppm chlorides	200 ppm chlorides (Recommended)
(8) Fire Resistant	Incombu-stible	Incombu-stible	Incombu-stible

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4.1.3 Type C - Diatomaceous, expanded silica, or calcium silicate bonded with inorganic fibers covered with factory applied metal jacket.

(1) Pipe Insulation - Shall be in sections 36 inches long in a complete range of pipe sizes up to 24 inches I.P.S. Jackets shall not exceed .016 inches in metal thickness and shall be galvanized or stainless steel. Insulation shall be as follows:

Type C Pipe	Philip Carey Careytemp Metal Jacketed	Johns-Manville Thermobestos Metal-On	Owens-Corning Kaylo Klad
(1) K Factor at Mean Temperature of 300°F	.43	.41	.42
K Factor at Mean Temperature of 500°F	.52	.50	.52
K Factor at Mean Temperature of 700°F	.62	.60	.62
(2) Acid Resistance of Insulating Material	High	Low Depends on Jacketing	Low Depends on Jacketing
(3) Density (A.S.T.M. 303 Test)	10 lbs/ cu. ft.	11 lbs./ cu. ft.	11 lbs/ cu. ft.
(4) Water Absorption (Immersion)	N. A.	N. A.	N. A.
(5) Maximum Temperature	1600°F	1200°F	1200°F
(6) Water Soluble Chlorides (Pipe corrosion accelerators; recommended for aluminum or stainless steel)	50 to 150 ppm chlorides (Recommended)	250 ppm	Very low chlorides (Recommended)
(7) Fire Resistance	Incombustible	Incombustible	Incombustible
(8) Shrinkage (A.S.T.M. 356 Test)			
500°F	.22%	---	.5%
1000°F	.45%	---	.9%
1200°F	1.20%	1.5%	1.4%

4.1.4 Type D - Mineral Wool or Fiberglass Blankets with Metal Fabric -

(1) Pipe Insulation - Pipe insulation shall be 24 inches long sections cut to correct width for single layer installation. Shall be light weight, uniform density, felted, and secured between inner metal lath and outer galvanized metal fabric, with suitable fastening devices to achieve snug installation.

Type D (Pipe)	Owens-Corning Fiberglass Blankets	Philip Carey Mineral Wool	Eagle-Picher Tab-Lok (Mineral Wool)
(1) K Factor at Mean Temperature of 300°F	.39	.42	.42
K Factor at Mean Temperature of 400°F	.49		
K Factor at Mean Temperature of 500°F		.57	.57
(2) Maximum Temperature	1000°F	1200°F	1200°F
(3) Density	2.4 lbs/ cu. ft.	8 lbs/ cu. ft.	---
(4) Acid Resistance of Insulating Material	---	---	---
(5) Water Soluble Chlorides (Pipe corrosion accelerators; recommended for aluminum and stainless steel)	None (Recommended)	High Chlorides (Not recommended for stainless or aluminum	Low Chlorides (Recommended)
(6) Moisture Absorption (100% humidity test)	---	---	.5%
(7) Fire Resistance	Incombustible	Incombustible	Incombustible

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(2) Equipment insulation shall be 2' x 8' or 2' x 4' blankets. A facing of 1" galvanized hex wire shall be used for irregular surfaces. A facing of 1/2" mesh expanded shall be used for cement finishes, and a facing of 3/8" rib-lath (raised) shall be used with rib turn out to provide air space or in to provide maximum rigidity.

Type D (Equipment)	Philip Carey Rock Wool Blanket	Johns-Manville Blanket Banroc	Owens-Corning Metal Mesh Blanket
(1) K Factor at Mean Temperature of 300°F	.35	.34	.40
K Factor at Mean Temperature of 400°F	.43	.40	.50
K Factor at Mean Temperature of 500°F	.49	.48	---
(2) Acid Resistance of Insulating Material	---	---	---
(3) Density (A.S.T.M. 303 Test)	8 lbs/ cu. ft.	8 lbs/ cu. ft.	2.4 lbs/ cu. ft.
(4) Water Absorption (Immersion)	---	400% by weight	---
(5) Maximum Temperature	1200°F	1000°F	1000°F
(6) Shrinkage (A.S.T.M. 356 Test)			
500°F	N. A.	N. A.	N. A.
800°F	N. A.	N. A.	N. A.
1000°F	N. A.	N. A.	N. A.
(7) Water Soluble Chlorides (Pipe corrosion accelerator; Recommended for stainless steel and aluminum)	High (Not Recommended)	10 ppm (Recommended)	---
(8) Fire Resistant	Incombustible	---	Incombustible

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4.1.5 Type E - Mineral Wool Block (for ducts, tanks and equipment) -

Properties shall be as follows:

(1) Blocks shall consist of mineral wool, interwoven to form a porous, easily cut or bent block. Shall be in 18" or 36" lengths, and 6" and 12" widths.

Type E (Equipment)	Philip Carey Mineral Wool Block	Johns-Manville H. T. Banroc Block	Eagle-Picher PV Super-temp
(1) K Factor at Mean Temperature of 400°F	.40	.42	.40
K Factor at Mean Temperature of 600°F	.47	.51	.47
K Factor at Mean Temperature of 1000°F	.63	.75	.63
(2) Acid Resistance of Insulating Material	---	No	---
(3) Density (A.S.T.M. 303 Test)	20 lbs/ cu. ft.	15 lbs/ cu. ft.	18-19 lbs/ cu. ft.
(4) Water Absorption (Immersion)	Negligible	---	Negligible
(5) Temperature Rating (Max.)	1900°F	1800°F	1900°F
(6) Shrinkage (A.S.T.M. 356 Test)			
500°F	---	---	---
1000°F	---	---	---
1900°F	2%	4% (1800°F)	2%
(7) Soluble Chlorides (Recommended for use with Stainless Steel or aluminum)	High (Not Recommended)	---	Low (Recommended)
(8) Fire Resistant	Incombustible		Noncombustible

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4.2 Low Temperature Insulation - Below 500°F -

4.2.1 Type F - 85% Magnesia, Calcium Silicate, or Expanded Silica -

Properties shall be as follows:

(1) Pipe insulation shall be in sections up to 14" size. Larger pipe sizes shall be in segments and curved blocks.

(2) Equipment insulation shall be in block with widths of 3", 6", 9" and 12", and lengths of 18" and 36".

Type F (Pipe and Equipment)	Philip Carey Carey-temp	Johns-Manville 85% Magnesia	Owens-Corning Kaylo
(1) K Factor at Mean Temperature of 100°F	.34	.35	.33
K Factor at Mean Temperature of 200°F	.39	.385	.37
K Factor at Mean Temperature of 300°F	.43	.42	.42
(2) Acid Resistance of Insulating Material	---	Low (Depends on Jacketing)	---
(3) Density (A.S.T.M. 303 Test)	10 lbs/ cu. ft.	11 lbs. cu. ft.	11 lbs/ cu. ft.
(4) Water Absorption (Immersion)	---	---	---
(5) Temperature Rating	1600°F	600°F	1200°F
(6) Shrinkage (A.S.T.M. 356 Test)			
100°F	N. A.	N. A.	N. A.
300°F	N. A.	N. A.	N. A.
500°F	N. A.	N. A.	N. A.
(7) Soluble Chlorides (Recommended for use with stainless steel or aluminum)	Low (Recommended)	---	Low (Recommended)
(8) Fire Resistant	Incombustible	Incombustible	Incombustible

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4.2.2 Type G Molded Fiberglass or Rockwool -

(1) Properties of piping insulation - Shall be in sections 36 inches long. Shall be composed of fine fiberglass wool bonded and molded to conform to pipe with factory applied jackets of glass cloth. Insulation shall be as follows:

Type G - Molded Fiberglass or Rockwool (Pipe Insulation)	Philip Carey Thermo-glas	Owens-Corning Stan-dard Density	Owens-Corning Heavy Density	Johns-Manville 500°F Micro-Lok
(1) K Factor @ Mean Temperature of 100°F	.23	.23	.25	.24
K Factor at Mean Temperature of 200°F	.27	.27	.30	.28
K Factor at Mean Temperature of 300°F	.31	.31	.30	.34
(2) Acid Resistance of Insulating Material	---	Low-Depends on Jacketing		Medium (Use Metal-On)
(3) Density lbs/cu. ft.	3.5-3.75	4	7¼	3.5-3.75
(4) Water Absorption (95% R.H.)	---	---	---	2% by weight
(5) Maximum Temperature	350°F	400°F	450°F	500°F
(6) Shrinkage				
100°F	N. A.	N. A.		N. A.
200°F	N. A.	N. A.		N. A.
300°F	N. A.	N. A.		N. A.
(7) Soluble Chlorides (Pipe corrosion accelerators; recommended for use with stainless steel and aluminum)	High Chlorides (Not Recommended)	None (Recommended)	None (Recommended)	300-1000 ppm (not recommended)
(8) Fire Resistant		Incombustible	Incombustible	

(2) Properties of equipment insulation - Shall be in lengths 48" and widths of 24". Shall be composed of fine fiberglass wool preformed with thermo-setting resin, with factory applied jackets. Insulation shall be as follows:

Type G - Molded Fiberglass or Rockwool (Board)	Johns-Manville Spintex 416	Owens-Corning PF-615	Owens-Corning PF-617	Philip Carey Thermoglas
(1) K Factor at Mean Temperature of 100°F	.23	.27	.27	.23
K Factor at Mean Temperature of 200°F	.27	.32	.31	
K Factor at Mean Temperature of 300°F	.32	.40	.38	
(2) Acid Resistance of Insulating Material	---	Depends on Finish	Depends on Finish	Low
(3) Density	9 lbs/ cu. ft.	6 lbs/ cu. ft.	9 lbs/ cu. ft.	3 lbs/ cu. ft.
(4) Water Absorption (Humidity)	---	---	---	---
(5) Maximum Temperature	450°F	450°F	450°F	250°F
(6) Shrinkage				
100°F	N. A.	N. A.		N. A.
200°F	N. A.	N. A.		N. A.
300°F	N. A.	N. A.		N. A.
(7) Soluble Chlorides (Pipe corrosion accelerators; recommended for stainless steel or aluminum)		None (Recommended)	None (Recommended)	High Chlorides (Not recommended for stainless or aluminum)
(8) Fire Resistant	Yes	---	---	Yes

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4.2.3 Type H - Molded Fiberglass or Rockwool with Metal Jackets - (Properties are the same as 4.2.2 Material-Molded fiberglass, except with metal jackets (factory installed) of stainless steel or aluminum.

"Johns-Manville Microtuf". . . . . 350°F

"Philip Carey Thermoglas". . . . . 350°F

"Owens-Corning Glas-Klad". . . . . 450°F

4.3 Insulating Cement - Cement shall be composed principally of mineral wool with a K factor of 0.85 maximum at 500°F Mean Temperature. It shall not corrode steel and shall withstand temperatures up to 1000°F without cracking or powdering. Cement shall be:

"Johns-Manville 450". . . . . Maximum Service 1800°F

"Eagle-Picher One Cote". . . . . Maximum Service 1000°F

"Philip Carey MW-One". . . . . Maximum Service 1000°F

"OC-110". . . . . Maximum Service 1000°F

4.4 Asphalt (Bitumen) Mastics -

4.4.1 Breathing Type - Shall be a water emulsion blend of petroleum asphalt (or bitumen), asbestos fiber and filler, and non-flammable as practicable in the dry state. Shall weatherproof insulation but permit escape of water vapor. Shall trowel evenly and smoothly. Shall be as follows:

"Johns-Manville Insulkote ET" . . . Maximum Service 250°F

"Benjamin Foster H.I. Mastic" . . . Maximum Service 200°F

"Philip Carey Thermotex B". . . . . Maximum Service 200°F

4.4.2 Spray Type - Shall be a protective asphalt coating compound of chemical dispersion type. Shall provide protection of insulation against weather, corrosion and chemical attack. Shall be suitable for spraying easily with a conventional roofer's or undercoater's spray gun. Shall be non-toxic and shall not contain volatile hydrocarbons.

"Eagle-Picher Spray Mastic". . . . Maximum Service 200°F

"Benjamin Foster H.I. Mastic". . . Maximum Service 200°F

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4.4.3 Vapor Barrier Type - Shall be a heavy plastic-type coating of asbestos fiber, asphaltum, and special oils for application with trowel or caulking gun. Shall bond securely to metal, wood, concrete, paint, and insulation materials specified herein: Shall be as follows:

"Eagle-Picher Stalastic #HT" . . . . . Maximum Service 700°F

"Philip Carey Insulation Seal" . . . . . Maximum Service 200°F

"Benjamin Foster CI Mastic 60-25" . . . Maximum Service 200°F

4.5 Lagging Adhesive - Cement shall be suitable for cementing canvas to insulation, shall have high bond strength, shall be vermin and mold resistant, durable, and shall increase the fire resistance of canvas. Shall be as follows:

Benjamin Foster 81-42" . . . . . Maximum Service 200°F

"Insul-Coustic 140" . . . . . .Maximum Service 180°F

4.6 Pasted Canvas - This material shall be supplied with pipe insulation and shall be eight ounces per square yard.

4.7 Roofing Felt - Material shall be first-quality asbestos felt, weighing not less than 45 lb. per 100 sq. ft. and shall conform to A.S.T.M. Specification D-250. Asphalt softening temperature shall be not less than 185°F.

4.8 Polyvinyl Acetate Covering - Polyvinyl acetate covering shall be Vimasco Corporation WC-1, Insul-Coustic Corporation Vi-AC Mastic Co., or Philip Carey PVA No. 100. Color of covering shall be in accordance with the Color Code ACS-400-37, and color shall be integral and shall not require painting. Thickness shall be 1/16" to 1/8" (dry film) as required by application.

4.9 Wire Mesh - Wire mesh shall be zinc-coated (galvanized) hexagonal steel, 1" mesh, with wire size not less than 18 gauge.

4.10 Weather Resistant Paint - Paint shall bond to metals and the insulating materials and finishes specified herein. It shall provide an elastic, durable, tough coating for weather protection under mildly corrosive conditions. All surface preparation, paint, and paint application shall conform to the Armco Paint Standard.

4.11 Interior Insulation Paint - All insulation inside of buildings shall be painted. All paint shall be compatible with the insulating materials, finish, and auxiliary materials used. All surface preparation, paint, and paint application shall conform to the Armco Paint Standard. All painting on piping insulation shall conform to the Armco Piping Color Chart with the exception of that piping insulation exposed to a corrosive atmosphere (pickling lines, acids, etc.) or excessive heat (furnaces) which will require special paint subject to Owner's approval.

4.12 Glass Tape - Tape (for pipe where mechanical abuse is anticipated) shall be of knitted construction to permit expansion and smooth wrapping without gapping. Tape shall not contain asphalt as a weave set. Available in 1", 2", 4", 6" and 8" widths by 15 yard lengths. Shall be: "Benjamin Foster Company Sealfas Lagging Tape".

4.13 Glass Cloth - Cloth shall be of glass material, with a plain weave and shall increase the film strength of the coating. Asphalt shall not be used as a binder. Shall be as follows: "Benjamin Foster Company Mast-A-Fab".

5.0 APPLICATION METHODS

5.1 Materials and Workmanship - All insulation, finish and auxiliary materials used shall be new and meet the requirements of this Specification. The application workmanship shall be in accordance with best practice in every detail. All surfaces to be insulated shall be clean, dry and free of loose scale, grease, dirt, oil, rust, and water when insulation or coatings are applied. Painted piping, or equipment with paint in good condition, will require no further paint. Sufficient time shall be allowed to permit drying-out of insulation and cement before sealing. Surfaces to be insulated shall be warm, and in no case shall surface temperature fall below 40°F during application. Heat shall be applied to maintain a satisfactory temperature. Equipment and piping shall have been tested prior to application of insulation.

5.2 General Application Requirements for Piping and Equipment -

5.2.1 Layers - Where double layer insulation is specified, lateral and longitudinal joints at second layer shall be staggered with those of the first layer; canvas shall not be used between layers.

5.2.2 Soluble Chlorides - Piping or equipment which contains any stainless steel or aluminum materials shall have insulation applied which contains low soluble chlorides and is recommended for stainless steel and aluminum service.

5.2.3 Imperfections - Surface imperfections, chipped edges, small joints, cracks and holes not over 1" square shall be filled with insulating material or with insulating cement.

5.2.4 Supports - Angle supports shall be placed under bands and wires at the edges of flat surfaces or square-cornered equipment to prevent cutting the insulation. Insulation on vertical runs of pipe shall be supported by clips or other means (weight of upper segments of insulation shall not be supported by lower insulation). All items such as angles, flat bars, studs, floating rings, wire, etc. necessary to complete the Work shall be included in the Work.

5.2.5 Quality - The insulation on piping and equipment shall safely withstand the continuous service temperatures specified without cracking, disintegration, decrease in insulating properties, or otherwise failing.

5.2.6 Cement Application - Insulating cement shall be applied in layers not exceeding 1/4" thick each. Cement used on outer coating must be troweled smooth and allowed to dry before felt or canvas covering is applied.

5.2.7 Nameplates, Inspection Stamps, etc. - Nameplates, inspection stamps, identification tags, etc. shall not be covered with insulation. In problem areas where water may enter the insulation, the Engineer shall be notified in writing before insulation is applied.

5.2.8 Equipment - Blocks applied to cylindrical vessels and dished heads shall be kerfed or scored to provide full contact with vessel surface. Irregular surfaces shall be covered with insulating cement (reinforced if required). Expansion joints shall be furnished at insulation supports. Blocks applied to cylindrical vessels shall be supported by stainless steel bands on 12" centers with ends tucked-in, and impaling studs as required.

5.3 Application Requirements for Piping Only -

5.3.1 Tolerances - Pipe covering shall fit snugly on the pipe; inside circumference of pipe covering shall not vary from outside circumference of steel pipe (A.S.A. Specification B-36.10) by more than 1%.

5.3.2 Steam-Traced Lines - Pipe covering on steam-traced lines shall be sized so as to enclose both pipe line and tracer, and shall fit as snugly as possible (preferably molded with extra long legs). Steam-traced expansion loops shall be boxed in with block insulation wired in place and finished same as adjoining insulation. If the traced line may at times be below dew-point temperature, such as a steam-traced cold-water line, then the insulation shall be sealed to make all joints vapor-tight.

5.3.3 Sectional Covering - Sectional covering shall be used for pipe up to the largest size commercially available; on larger pipes, blocks or segments shall be used. Segments shall be curved to fit the surface to which they are applied, and shall be cut radially to fit against each other. All joints between blocks and sections of pipe covering, both butt and longitudinal, shall be pointed with insulating cement.

5.3.4 Wire Binding - Each layer of pipe covering shall be tightly bound to the pipe with independent loops of wire for pipe sizes 1/2" to 6" inclusive, spaced not to exceed 12" on centers; for pipe sizes larger than 6" nominal diameter, wire loops of 16 gauge annealed galvanized wire shall be used and spaced not to exceed 9" centers. (On insulation with metal jacketing, the above paragraph applies only to interior layers.)

5.3.5 Flanges, Fittings and Valves - All surfaces of flanges, fittings, and valves shall be insulated in a similar manner with the same kinds and thicknesses of insulation, finishes, and jacketing as that specified for the pipe line of which they are a part, except that steam traps shall not be covered.

5.3.6 Valve Bonnets - Valve bonnets shall be covered to a point immediately below the vent plugs if the bonnets are of the flanged or welded type.

5.3.7 By-Pass Connections - The by-pass connections on valves shall be insulated in accordance with specification for piping of the same size.

5.3.8 Flange Insulation - On 450°F and higher temperature steam, and on boiler feed discharge lines, flange insulation shall be applied in such a manner that insulation can be removed without destroying adjacent pipe covering. Pipe covering shall be stopped off at line flanges a sufficient distance to permit easy removal of all bolts. This shall be done by reducing thickness by beveling the insulation at both sides of the joint. For each size of pipe, the amount of this reduction shall be fitted over such reduced covering. Insulation for line flanges shall lap over the pipe covering for a distance equal to the thickness of the pipe covering, but never less than 2 inches per lap. Flanges shall not be insulated until after they have been retightened.

5.3.9 Outdoor Applications - Outdoor pipe lines shall be covered with metal jackets or shall have a weatherproof jacket or other weatherproof type finish. Special care shall be taken to provide a tight seal where hangers or supports penetrate the outdoor jacket and finish. On horizontal pipe, the seams of a metal jacket shall be on the side of the pipe with the lap downward with no raw edges of metal exposed. Piping located close to the ground or where jacket might be injured shall be protected with a steel jacket.

5.3.10 Temperature/Humidity - On hot temperature lines or equipment with insulation without metal jackets, where humidity is above 70% or where insulation contains equivalent moisture from dew, fog, or rain, the outer jacket shall not be applied until lines are heated and insulation is dry.

5.3.11 Pipe Hangers - Where pipe hangers are attached to the pipe, they shall be covered with the pipe covering. When necessary part of the inside surface of the insulation shall be removed to maintain a continuous unbroken, outer surface of the pipe covering. The insulation around the hanger clamps shall be sealed with finish cement and carefully flashed if outdoors. If necessary to remove or displace hangers while insulating, the pipe and hangers shall be returned to original position when completed.

Where necessary to support an insulated pipe outside the insulation, 12 gauge galvanized steel half-round shields shall be installed (minimum of 8 inches long and diameter to fit insulation.)

5.3.12 Expansion Joints - Where insulation is 3 inches or more in thickness and pipe temperature does not exceed 750°F, expansion joints in the insulation shall be installed midway between fixed points of the insulation (e.g., between anchors) limiting the cumulative movement of the pipe covering at each expansion joint to 3 inches maximum.

5.3.13 Movement of Pipe Covering - For spans between fixed points which would permit more than 3 inches movement in the pipe covering, added fixed points in the form of lugs or angles shall be installed. Adjacent sections of pipe covering between expansion joints shall be stapled together with 3" x 1" galvanized iron staples placed every 6 inches around the circumferential joint. Where the temperature is above 750°F, similar procedure to the above is to be followed except that the maximum movement of the pipe covering per expansion joint is to be limited to 1".

5.3.14 Canvas - Where canvas is to be applied, Standard 8 ounce canvas shall be factory-applied, (F.A.) if possible. For on-the-work-site-application, insulation on indoor piping shall be securely and smoothly wrapped with 8 ounce canvas pasted in place with cold water paste (no sewing permitted). Canvas shall be free from wrinkles and other flaws, longitudinal seams or joints shall be located in the least visible sector of the covering. Adhesive shall be brush applied and canvas shall not be dipped.

5.3.15 Bare Lines/Safety - All bare lines whose contents are 140°F or over, shall be insulated to a point 7'-0" above the floor when such pipes are in the vicinity of stairways, ladders, walkways, or operating aisles or where such piping may injure operating personnel who come into contact with it. This shall include boiler soot blower piping as well as power piping.

5.3.16 Application Requirements for Blanket Piping Insulation with Metal Jackets - Protective jacketing shall not exceed .016 inch in thickness. (Metal jacketing exceeding .016 inch must be applied by sheet metal workers.)

(1) Blanket shall be so cut that the abutting joints between sections, and the longitudinal joints in each section, knit tightly together so joints will not be a source of excessive heat loss. Blanket, after wrapping around the pipe, shall have the facing selvages laced or tied together with 18-gauge wire, or special tabs furnished with the blanket.

(2) On bends, the selvages shall be secured on the outside radius to permit shortening of wire mesh on inside radius to conform to pipe contour.

(3) Where several pipes are in closely spaced arrangement, the blanket shall be applied over the entire pipe assembly, including any steam tracer.

(4) When specified on the drawings, the casings of pumps shall be insulated with removable blankets constructed to fit the pumps. These blankets shall be provided with fastening hooks to hold them in place and shall be pulled tight against the pump casings.

5.3.17 Application Requirements for Anti-Sweat Pipe Covering - Insulation shall be sectional type, 1 inch thick, bonded glass fibers with an integral asphalt saturated asbestos jacket, or aluminum covered Kraft. Insulation shall be as follows:

"Johns-Manville Micro-Lok" . . . . . Cold Water 50°F

"Eagle-Picher Superglas" (low temp.) . . . Refrigerant Lines to -120°F

"Eagle-Picher Superglas" (White Dual). . . Chilled +35°F

"Owens-Corning Heavy Density" with FRJ
and self-sealing lap . . . . . Cold Water -120 to +450°F

"Philip Carey Thermoglas" with FRVB . . . To - 120°F

5.3.18 Application Requirements for Steam-Traced Lines - Hot oil or water lines where steam traced outdoors shall have covering as specified in Item 5.3.2 with jacketing as specified in 5.3.9.

6.0 PRECAUTIONS

6.1 Safety precautions are to be followed where materials handled may cause harmful effects.

6.2 No paint or plastic finish of any kind shall be applied over insulating or finish cement until such cement is thoroughly dry.

6.3 On piping located where people might brush against it, the crimps and twists of exposed bands and wires shall be located to minimize possibility of catching on them.

6.4 All insulation cut or damaged in making connections to existing insulated piping shall be patched and put into original state.

6.5 Tarpaulins shall be spread over equipment for protection from dirt and rubbish from the insulation application.

6.6 Piping and equipment shall have been previously tested and released by the Engineer before any pipe covering or equipment insulation is applied.

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