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BASF Wyandotte Corporation		INSULATION SPECIFICATIONS FOR HOT PIPING	TECHNICAL STANDARD
Compiled by Engineering	DATE 3/16/71		240-03.01 SHEET 1 OF 12

6/18/73 Revision 4/16/73

1.0 SCOPE

This standard defines the extent of insulation, materials and methods to be used for insulating piping in hot service.

2.0 USES

2.01 This standard is written for the use of BASF WYANDOTTE Engineers. It may be included in contracts and/or used to augment contract drawings. It may be used in whole or in part, as designated by the Project Manager.

2.02 The materials and methods described herein are suitable for use in normal process plant atmospheres, for operating temperatures from 100°F. to 1200°F. The Project Manager shall specify other materials or methods for applications at higher temperatures, or where the atmosphere is corrosive to the materials specified. In addition, the Project Manager shall give special consideration to the techniques and insulating materials specified for application to stainless steel or nickel pipes. These special considerations (low chloride insulation for stainless steels and low sulfur insulation for nickel) shall be detailed separately.

2.03 This standard may also be used for insulating hot cylindrical vessels 24" O.D. and less.

3.0 SUPPLEMENTARY REQUIREMENTS

This standard shall be supplemented by the following (where applicable):

3.01 Insulation Contract, necessary drawings, and Pipeline Insulation Schedule.

3.02 Technical Standard 275-01, "Specifications for Storage and Protection of Construction Materials."

3.03 Additions to or deletions from this standard that may be necessary because of special design conditions.

4.0 GENERAL REQUIREMENTS

4.01 The Insulation Contractor shall supply, deliver and apply all insulating materials and supplies as specified. He shall furnish all required supervision, labor, materials, tools, scaffolding, transportation, unloading, storage facilities and every item of expense necessary to complete this work.

4.02 The Insulation Contractor shall install his work in a way and at such times that a minimum of cutting and patching of other construction is necessary. All repairs shall match the original conditions.

4.03 The work shall be conducted in such manner as not to damage any existing building structure, floor or equipment. Any such damage shall be repaired at the expense of the Insulation Contractor.

4.04 The Insulation Contractor shall furnish and install any additional supports and anchorage other than those shown on drawings and not provided by others that may be required to adequately support the insulation.

4.05 Hand cleaning of all surfaces to be insulated shall be done by the Contractor prior to application of insulation, unless otherwise specified in the Insulation Contract. Contractor shall remove grease and dirt by wire brushing or other acceptable cleaning means. The surfaces normally shall not be painted, and if required, will be done by others.

4.06 Contractor shall apply insulation only after piping has been tested and proved tight (with no evidence of leakage), unless otherwise specified or approved. Insulation shall not conceal the location of system components.

4.07 Insulation shall be new and undamaged, delivered to the site in unbroken factory cartons, and shall be neatly and tightly applied in unbroken pieces (except where the nature of the application makes this impossible). Unless otherwise specified, all materials shall be applied in strict conformity with the recommendations and instructions of the manufacturers.

4.08 Contractors shall submit with their proposals such information on intended practices and application methods not covered in these specifications for approval. The following are typical items that shall be included where applicable:

(a) Additional insulation supports
(b) Expansion joints in insulation
(c) Insulation of steam tracing and trap assemblies

4.09 Insulation materials must be protected from the weather at all times, from delivery to the finished weather coating and/or acceptance. As the work progresses, each day's work shall be weatherproofed before being left for the night. Protect installed portions with tarps, some type of approved water shed, or equal.

4.10 Factory-applied jackets shall be used for all straight piping, and wherever possible for fittings. Anodized aluminum or stainless steel sheet metal screws shall be used.

4.11 Unless otherwise specified, the standard type of insulation finish shall be alloy aluminum, stainless steel, or a suitable weatherproof fiber jacket. Fiber jacket that is furnished pre-applied to the insulation shall be asbestos free.

4.12 Flanges in all steam, exhaust steam, and superheated steam lines shall be insulated whenever the line is specified to have insulation.

4.13 Flanges and valve bodies in hot process lines shall not be insulated except as follows:

(a) Flanges and valve bodies in steam, water or electric traced lines shall be insulated unless otherwise specified.

(b) Flanges and valve bodies in process lines shall be insulated where heat loss is critical to its effect on the operation. Insulation for these will be specifically noted on the Pipeline Insulation Schedule.

4.14 Lines operating above 450° F. shall not have flanges insulated until they have been in operation and bolts retightened, and approved by BASF-WYANDOTTE's Field Representative.

4.15 Bonnets of valves shall not be insulated unless otherwise specified.

4.16 Bodies of safety valves are not to be insulated unless otherwise specified.

4.17 Seal, vent chambers and drip pots in pipelines shall not be insulated unless steam traced.

4.18 The inlet side of all steam trap piping shall be insulated, except for a cooling section of 18" to 24" before thermostatic or thermo-dynamic type traps. The trap shall not be insulated. Outlet piping shall not be insulated, except for personnel protection, freeze protection, or other specified reasons.

4.19 Drain and vent valves in insulated lines shall be insulated up to and including the valve.

4.20 Branch lines from pipes which are steam traced shall be insulated up to and including the first block valve in the branch, unless the entire branch is steam traced.

4.21 All insulation materials, whether wet or dry, shall be non-corrosive to the surfaces insulated and to metal jackets where used.

4.22 All pipe and supports to be permanently set before insulation is started. Disturbed pipe and supports shall be restored to their original location and alignment when the insulating is complete. Generally, all insulation shall be applied with piping at ambient temperatures.

5.0 APPLICATION

5.01 Pipe insulation shall be applied with joints tightly butted and pointed up with suitable insulating cement, except where allowance for expansion is required. Loose glass wool shall be used at expansion joints. When multiple layers are applied, the end and longitudinal joints shall be staggered between layers. All single layer insulation shall be installed with the longitudinal joint on the side of the pipe. The exposed ends of all insulation shall be neatly beveled to the pipe with insulating cement.

5.02 At flanges, pipeline insulation shall be stopped off at a suitable distance from the flange so that flange bolts can be withdrawn without disturbing the insulation. Each break shall be weatherproofed, whether flanges are subsequently insulated or not.

5.03 Any small voids in the insulation, at joints or elsewhere, shall be filled with insulating cement.

5.04 Outer layer (or single layer) with its factory-applied metal jacket attached, shall be applied with all joints firmly butted together. The insulation and jacket shall be held in place with the continuous friction type joint provided with the jacket. (Temporary metal straps or elastic bands may be required on larger sizes until joint seals are applied.)

5.05 On horizontal piping, the longitudinal joints shall be located on the side of the pipe and in weather-wise position to shed water. On fittings, the joint shall be located as required to make the pieces fit over it, but in weather-wise position. Joints between pieces shall be sealed with a weatherproof compound and secured with preformed aluminum bands and clips. Sections over 18" long shall have an extra 3/4" stainless steel strap applied near the center of each piece.

5.06 Flanged elbows, valve bodies, fittings, and irregular surfaces, which cannot be economically jacketed with metal, shall be smoothed off with insulating cement and weatherproofed with two 1/8" coats of weather-proofing mastic reinforced between layers with an open weave glass cloth. Finish flush with metal jacket and cover joint with 2" wide aluminum strap.

5.07 Sectional and segmental pipe insulation shall be applied one layer at at time to give the required thickness.

5.08 On long vertical lines over 39 feet in height, insulation support rings shall be welded to the pipe, the outer leg to be 1/2" less than the insulation thickness. A 1" space under the support ring, packed with resilient glass wool, shall be provided as an expansion joint. Sealing strap over expansion joint to be 3" or more in width. (NOTE: Support rings not required for fiberglass insulation, unless otherwise specified or approved.)

5.09 Pipe bends shall be insulated with mitered pieces cut from straight pipe insulation. Pieces may be either prefabricated or field cut. Adjoining pieces shall be butted together so as to completely cover the bend. Each piece shall be held in place as for straight pipe. Joints and void shall be filled with insulating cement, and special metal seals similar to straight pipe shall be applied over them. Miter cuts shall be made so that slip-joint of jacket is in weather-wise position.

5.10 Sectional pipe insulation not having an attached metal jacket shall be secured with single loops of 16 gauge wire, or equal, at intervals not over 6 inches. The wire ends shall be bent and pressed into the insulation to avoid projections.

5.11 All ells and tees to be built-up with insulating cement applied in 1/2" layer so that outside diameter of fitting is the same as the adjacent pipe. Fittings molded of Calcium Silicate or expanded perlite may be used below 350°F.

5.12 Butt-weld elbows and full size T-welded branches shall be insulated with mitered pieces similar to pipe bends.

5.13 Butt-weld tees, valves, flanges and flanged fittings and valves shall be insulated to a thickness equal to adjacent pipe insulation. Pieces shall be cut or mitered from straight pipe insulation of the same size or larger size than adjacent piping if required.

5.14 Traced Lines

5.141 When lines are traced with one or more tracers, insulation shall be of sufficient size to house the assembly without distortion or damage to the insulation or tracer. Insulation with extended leg is preferred when suitable, since it provides more space between adjacent lines. (NOTE: When tracing with electrical MI cable, use caution when covering with fiberglass so as not to imbed tracer.)

5.142 When insulating cement is used for covering fittings, valves, etc., in traced lines, care shall be exercised to prevent the cement from getting between tracer and fitting. This may be accomplished by fastening the tracer to the fitting or valve at such points with several layers of asbestos tape before applying the insulating cement.

5.15 Personnel Protection

5.151 Personnel protection insulation shall be applied to piping from floor, platform, or grade, to a height of 7'0", or so located that operating personnel might come in contact with piping and receive an injury (burn) in the normal course of their duties.

5.152 Hot piping located in any service not insulated for heat conservation or for stability of operation, and which is located where operating personnel could receive an injury (burn), shall be covered with insulation and applied in accordance with the provisions listed below:

(a) Horizontal piping where the bottom of the pipe is lower than 7'0" above grade or working floor or platform.

(b) Those portions of vertical piping lower than 7'0" above grade or working floor or platform.

(c) Piping having its centerline closer than 2'0" to a working platform, in which case the piping shall be insulated to a height of 7'0" above the platform.

(d) Vertical piping that runs past or through several closely spaced platforms shall be insulated continuously, so that short bare pipe runs are eliminated.

6.0 INSULATION THICKNESS

6.01 Table I (Section 8.0) gives the operating temperature limits for 1" to 6½" insulation thicknesses on piping.

6.02 Table I (Section 8.0) may be used for heat conservation and/or personnel protection. It covers all insulation allowed by this standard. It is based on thermal conductivity values of 0.5, 0.6 and 0.7 at 400°F, 600°F and 800°F, respectively. When the conductivity varies considerably, adjustment of the required insulation thickness may be necessary.

6.03 Standard thicknesses and temperature limits for insulation are based on the ambient conditions of still air at 70°F. Adjustments to allow for wind velocity or surrounding air at any other temperature shall not be made, except to satisfy special process conditions.

6.04 Standard thicknesses and temperature limits for insulation are further based on a surface emissivity factor equal to 0.9. This factor is suitable for most dull finish surfaces, such as mastic or dark paint. For aluminum jacketing, the emissivity factor is expected to be about 0.2, having the effect of slightly improving the operating temperature limit for the most economical thickness and raising the insulation surface temperature.

6.05 Sectional and segmental pipe insulation shall be applied in the specified thickness, using one or more layers, if necessary. If insulation is more than 3" thick, it shall be applied in two or more layers. Piping operating at 600°F or higher shall be insulated with two or more layers with joints staggered.

6.06 The thickness of insulation for steam traced pipe shall be as follows:

6.061 Where lines are traced to maintain temperature of the process fluid during operation, a minimum insulation thickness of 1" will suffice.

6.062 In those cases where the line is traced to avoid solidification during downtime, and the operating temperature is higher than the steam temperature, thickness shall be determined using operating temperatures in Table I (Section 8.0).

7.0 MATERIALS

7.01 Table II (Section 9.0) lists the approved types of insulation referred to in this specification.

7.02 For temperatures from 100° F. to 350° F., Glass Fiber, Calcium Silicate (asbestos free) or Expanded Perlite type insulation may be used.

.03 For temperatures from 351° F. to 1200° F., only Calcium Silicate (asbestos free) or Expanded Perlite type insulation shall be used, unless otherwise specified or approved.

7.04 Types of Insulation Finishes are specified in Tables IIA and IIB (Section 9.0).

7.05 It is recommended that all grade level pipeway and sleeper system lines be insulated with Calcium Silicate (asbestos free) or Expanded Perlite for strength.

7.06 Calcium Silicate to be asbestos free.

8.0 WEATHERPROOFING APPLICATION

8.01 Piping shall be finished with approved jacketing applied directly over the blanket.

8.02 On vertical piping, the metal jacketing shall be supported on "S" clips. The sheets shall be secured with bands spaced on 18" centers with one band at each circumferential lap. In addition to bands, screws shall be installed on vertical seams on 12" centers. Band loops shall be installed on each band to prevent vertical movement. Loops shall be spaced on 15 foot centers but not less than two loops per band. All screws shall be installed on ridges of corrugated weatherproofing.

8.03 On horizontal piping, the metal jacketing shall be secured with bands spaced on 18" centers. Sheet metal screws shall be installed on all seams on 12" centers.

8.04 Longitudinal laps on 1¼" corrugated jacketing shall be one and one half corrugations. Longitudinal laps on 3/16" corrugated jacketing shall be a minimum of 2". All circumferential laps shall be a minimum of 3".

9.0 ATTACHMENTS

9.01 A system of designating insulation specifications by means of code numbers shall be incorporated in a Pipeline Insulation Schedule as follows:

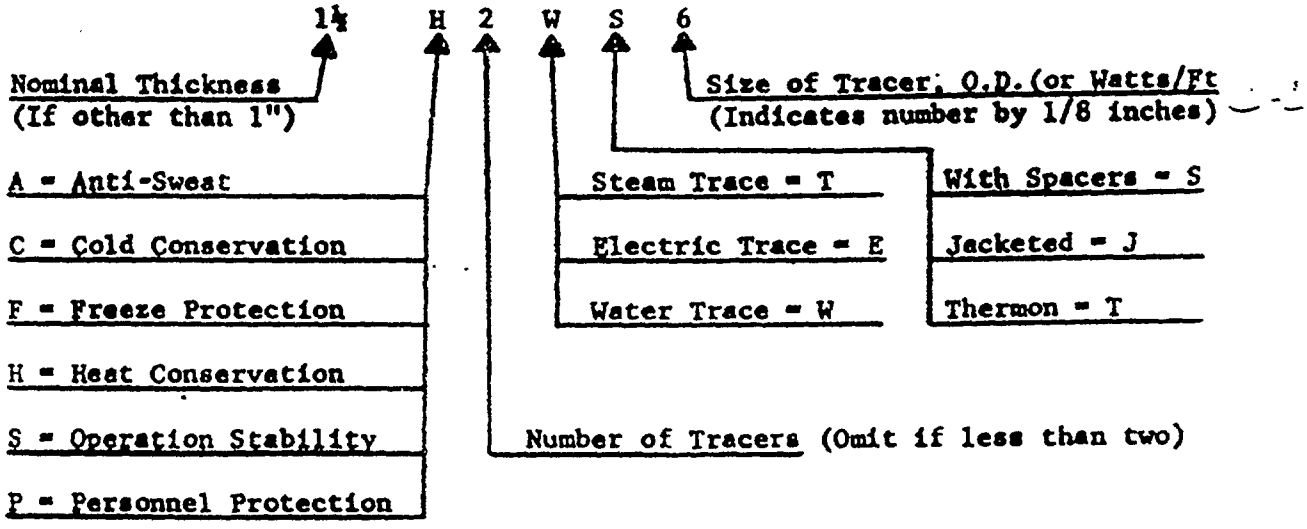
EXAMPLES:

1½ H/2TS4 = 1½" thick for heat conservation, with two ½" steam tracers on spacers

1½ H/T4 = 1½" thick for heat conservation, with ½" steam tracer

H/2T3 = 1" thick for heat conservation, with two 3/8" steam tracers

H/WJ = 1" thick for heat conservation, with water jacket



NI indicates no insulation required.

9.02 Table I - Operating Temperature Limits for Insulation

PIPE SIZE	INSULATION THICKNESS	°F. TEMPERATURE LIMIT
1" and smaller	1"	350°
	1½"	625°
	2"	900°
	2½"	1050°
	3"	1200°
1½"	1"	250°
	1½"	450°
	2"	675°
	2½"	1050°
	3"	1200°
2"	1"	250°
	1½"	500°
	2"	625°
	2½"	900°
	3"	1100°
	3½"	1200°
3"	1"	250°
	1½"	350°
	2"	550°
	2½"	700°
	3"	900°
	3½"	1050°
	4"	1200°
4"	1"	200°
	1½"	350°
	2"	550°
	2½"	700°
	3"	900°
	3½"	1050°
	4"	1200°
6"	1"	200°
	1½"	300°
	2"	400°
	2½"	525°
	3"	600°
	3½"	825°
	4"	1050°
	4½"	1200°
8"	1"	200°
	1½"	300°
	2"	400°
	2½"	525°
	3½"	750°
	4"	900°
	4½"	1200°

PIPE SIZE	INSULATION THICKNESS	°F. TEMPERATURE LIMIT
10"	1½"	225°
	2"	325°
	2½"	470°
	3"	625°
	3½"	700°
	4"	825°
	4½"	1050°
	5"	1200°
12"	1½"	225°
	2"	350°
	2½"	450°
	3"	600°
	3½"	700°
	4"	825°
	4½"	975°
	5"	1050°
	5½"	1200°
14"	1½"	200°
	2"	350°
	2½"	400°
	3"	525°
	3½"	600°
	4"	750°
	4½"	900°
	5"	1050°
	5½"	1200°
16"	2"	300°
	2½"	350°
	3"	475°
	3½"	600°
	4"	700°
	4½"	825°
	5"	970°
	5½"	1200°
18"	2"	275°
	2½"	325°
	3"	470°
	4"	700°
	5"	900°
	5½"	1050°
	6"	1200°
20"	2"	200°
	2½"	350°
	3"	475°
	3½"	600°
	4½"	750°
	5"	900°
	5½"	1050°
	6"	1200°

9.02 Table I - (Continued)

PIPE SIZE	INSULATION THICKNESS	°F. TEMPERATURE LIMIT
24"	2"	200°
	2½"	350°
	3"	450°
	3½"	600°
	4"	700°
	4½"	750°
	5"	900°
	5½"	1050°
	6½"	1200°

PIPE SIZE	INSULATION THICKNESS	°F. TEMPERATURE LIMIT
Over 24"	2½"	200°
	3"	350°
	3½"	450°
	4"	600°
	4½"	700°
	5"	750°
	5½"	900°
	6"	1050°
	6½"	1200°

9.03 Table II - Insulation Materials

ITEM	TEMPERATURE RATING - °F	DESCRIPTION
PIPE AND TUBE (PLAIN)	1200	CALCIUM SILICATE, ASTM C533 Type I; Fed. Spec. HH-I-523c Type II; Class A (uncovered). Hydrous Calcium Silicate, molded sectional pipe sizes 36" long.
	350	GLASS FIBER, HEAVY DENSITY, Fed. Spec. HH-I-558a, Form D, Type III, Class 12. Molded sectional pipe sizes 36" long.
PIPE AND TUBE (WITH ALUMINUM JACKET)	1200	CALCIUM SILICATE, ASTM C533, Type I; Fed. Spec. HH-I-523c, Type II, Class C (0.016" Aluminum). Hydrous Calcium Silicate, molded sectional pipe sizes with Type 3003 Alloy, smooth jacket.
INSULATING CEMENT		MINERAL WOOL CEMENT, ASTM C195; Fed. Spec. SS-C-160, Type III, Grade U
FINISH CEMENT	1100	MINERAL WOOL FINISHING CEMENT, Hydraulic Setting. ASTM C449; Fed. Spec. SS-C-160, Type III, Grade F.
WEATHERPROOF MASTIC		WEATHERPROOFING CEMENT, Fibrated Asphalt emulsion base with mineral filler. WEATHERPROOF MASTIC FINISH, Vinyl-Acrylic type, fire resistive.
PIPE AND TUBE (PLAIN)	1500	EXPANDED PERLITE, ASTM C-610 (Uncovered) molded sectional pipe sizes, 36" long. (Careytemp 1500)
PIPE AND TUBE (WITH ALUMINUM JACKET)	1500	EXPANDED PERLITE

9.04 Table IIA - Insulation Materials and Finish

ITEM	NOMINAL SIZE	DESCRIPTION
ALUMINUM PROTECTIVE JACKET (PIPING)	Up to 30" O.D. Insulation	Piping Jacket to be factory formed Aluminum Alloy Type 3003, 3/4 Hard, 0.016", smooth surface with moisture barrier on inside surface.
		When required by specifications, elbows (except flanged) to be covered with "Humped" or other approved preformed aluminum jacket or mitered segments of factory material as used on straight pipe. (Type 3003 Alloy)
	Over 30" O.D. Insulation	Vertical Piping to have jacket of corrugated or plain surface Aluminum Alloy, Type 3003, 0.024" thick with factory attached moisture barrier.
		Horizontal Piping to have jacket of plain surface Aluminum Alloy Type 3003, 0.024" thick with moisture barrier.
STAINLESS STEEL PROTECTIVE JACKET (PIPING)	Up to 30" O.D. Insulation	Piping Jacket to be factory formed stainless steel, Type 302, 0.010" thick, smooth surface, 2B Finish.
		Elbows (except flanged) to be covered with approved Stainless Steel preformed jacket or mitered segments of factory jacketed material as used on straight pipe. (Type 302 Alloy)
	Over 30" O.D. Insulation	Apply Type 302 Stainless Steel jacketing as specified for horizontal vessels.

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9.05 Table IIB - Accessories for Insulation and Jacket Application
(For Use With Pipe Insulation)

ITEM	DESCRIPTION
IRON WIRE	Annealed, No. 16 Gauge.
BANDING TAPE	Scotch Brand No. 45 (for use in place of iron wire).
WIRE MESH	1" Hexagonal, No. 20 Gauge, Galvanized After Weaving.
MONEL OR STAINLESS STEEL BANDS	3/4" x 0.020" thick with clips. GERRARD COMPANY
ALUMINUM SEALING COLLAR	Type 3003 Alloy, 2" wide x 0.016" thick, preformed, lined with a permanent plastic sealing compound, complete with locking strip attached. Same as above, except without locking strip. (Separate bands required)
ALUMINUM BAND	1-1/2" or 1-3/4" wide x 0.030" thick, preformed for use with mitered insulation segments, complete with sealing compound and 18 gauge aluminum clip.
ALUMINUM TWO-PIECE "HUMPED" ELBOWS	0.025" minimum thickness, Type 3003 Alloy.
SHEET METAL SCREWS	"Topseal" Type "B" Hex Head No. 14 Stainless Steel self-tapping screw with "Weath-R-Seal" washer. Type "A" Sheet Metal Screw, aluminum or stainless steel with "Weath-R-Seal" type washer.
CAULKING COMPOUNDS	JOHNS-MANVILLE, "Albaseal" Compound for use with "Miter-Seal." PARR PAINT & COLOR COMPANY "Alumilastic." U.S.STEEL "Insul-Mastic 507."
SEALING COLLAR	Stainless Steel (Type 302), 2" wide x 0.010" thick, lined with a permanent plastic sealing compound, plain ends for use with separate bands. JOHNS-MANVILLE, "Snap-Strap."
STAINLESS STEEL TWO-PIECE "HUMPED" ELBOW	Stainless Steel (Type 302), two-piece "Humped" elbow, 0.010" minimum thickness.