

PLAINTIFF'S
EXHIBIT

ETCQ-407

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1. GENERAL

- 1.1 Intent. The intent of this specification is (1) to define the materials to be used for insulation of vessels, equipment, and piping in hot service, and (2) to define certain details of insulation application. The purpose of this insulation is to conserve heat (H) and/or to protect personnel (P). Any specific details not covered herein shall be in accordance with best area practice.
- 1.2 OSHA COMPLIANCE. All design and construction done in the United States under this specification shall be in strict compliance with the Williams-Steiger Occupational Safety & Health Act of 1970 (84 Stat. 1593, 1600; 29 U.S.C. 655, 657) as revised.
- 1.3 Scope. This specification covers the design and application of heat insulation systems for piping and equipment (vessels, columns, pumps, etc). It is intended to serve as a basis for contractor's bidding and performance. It is also intended to serve as a basic engineering guide to standardize and simplify the solution of recurring insulation problems.
- 1.4 Line List. A separate document, the LINE LIST indicates the pipe lines to be insulated in accordance with this specification. Insulation thickness will also be specified in the LINE LIST.
- 1.5 Equipment List. A separate document, the EQUIPMENT LIST, indicates the equipment to be insulated in accordance with this specification. The insulation thickness will also be specified in the EQUIPMENT LIST.
- 1.6 Special Requirements
 - a. Lower Limit. Surfaces normally operating at less than 200 F shall not be heat insulated unless specifically required for personnel protection or special process reasons.
 - b. Personnel Protection. Personnel protection insulation shall be applied to piping and equipment operating above 150 F which may be accidentally touched by personnel. Such hot surfaces shall be insulated to a height of 7' above or 3' to each side of normal walking or working areas (including platforms and ladders). Personnel protection insulation shall not be continued beyond normal working areas. Alternatively, guards of expanded metal may be used if specified by Ethyl.
 - c. Valves, Flanges, & Fittings. Valves, flanges, and fittings, except unions, in steam and boiler feed water service shall be insulated. Valves, flanges, and flanged fittings in other services shall not be insulated except where required for personnel protection or special process reasons. Welded and screwed fittings, except unions, in insulated lines shall be insulated; expansion joints shall not be insulated.
 - d. Steam Traps. Steam traps shall not be insulated except for personnel protection. Inlet piping to steam traps shall be insulated. Discharge piping which returns to a condensate collection system shall be insulated. Piping which discharges to a drain shall not be insulated EXCEPT FOR PERSONNEL PROTECTION.
 - e. Steam Tracing. Steam traced piping or equipment shall be covered with oversized insulation to include the tracer lines. Insulation thickness shall be selected from Table I. Steam traced systems shall be completely insulated including equipment, valves, flanges, fittings, and tracer line loops.
 - f. Hydro Test. All equipment shall be pressure tested before the application of insulation.
 - g. Nameplates. Nameplates shall not be insulated. Insulation surrounding vessel

2. PIPING

- 2.1 Material. Piping to 1200F shall be insulated with calcium silicate, mineral fiber, or expanded perlite; all products shall be asbestos free. Acceptable materials are:

Calsilite, Calsilite 1200	Johns Manville, Thermo 12
Celotex, Careytemp 1500	Keene, Thermasil
Eagle Picher, Epitherm 1200	Owens Corning, Kaylo 10
Forty Eight, MF	Pabco, Super Caltemp NA.
Holmes, Unisite	

Other materials may be used with Ethyl Corporation approval. In periods of material shortage, piping to 400F may be insulated with Pittsburgh Coming Foamglas. Insulation thickness shall be as specified in the Line List; insulation thickness for piping not shown in the Line List shall be per Table 1.

- 2.2 Securement. Tie wire shall be 18-8 soft-annealed stainless steel. 16 gage for 10" and smaller pipe. 14 gage for 12" and larger pipe.
- 2.3 Weatherproofing. Insulation shall be weatherproofed with 0.016" thick x 3/16" corrugated aluminum with factory attached moisture barrier. Secure aluminum with 1/2" long x #8 STL sheet metal screws on 9" centers. All laps shall be at least 2" and shall shed water.
- 2.4 Fittings. Fittings smaller than 2" shall be covered with insulating cement (JM 450 or approved equal) and weatherproofed with GPM mastic (Ben Foster 35-01 alum gray or approved equal) 1/16" dry film thickness. Fittings 2" and larger shall be insulated with a material comparable to the adjacent pipe insulation and weatherproofed with GPM mastic (Ben Foster 35-01 alum gray or approved equal) 1/16" dry film thickness. The mastic shall be reinforced with Ben Foster Mast-a-Fab. Preformed aluminum fitting covers may be used if economical and available.
- 2.5 Details. Details of piping insulation shall be as shown in figures 1 through 4.
- 2.6 Hangers & Supports. At all pipe hangers and supports, the necessary cutouts shall be carefully made and weatherproofed with heat resistant mastic, Foster 95-10 or approved equal up to 350F; above 350F use Eagle Picher Stalastic.
- 2.7 Single Layer Application. For single layer application, the circumferential joints shall be staggered and the longitudinal joint shall be on the underside of horizontal runs.
- 2.8 Double Layer Application. For double layer application, the inner layer shall be applied as the single layer in the preceding paragraph. The outer layer shall be applied with the joints staggered longitudinally and circumferentially with respect to the inner layer. Each layer shall be secured as shown for a single layer.
- 2.9 Supports. Insulation on vertical lines shall be supported by ring flanges welded to the pipe. Supports shall be supplied by the Insulation Contractor or as directed by the Ethyl Engineer. Ring OD shall be 1/2" less than insulation OD. Start at bottom of line and install ring flanges at 21' intervals as needed. Allow for bolt removal at pipe flanges. See Fig.2.

3. EQUIPMENT

3.1 Material

- a. Small Cylindrical. Equipment to 1200F and 24" and less in diameter shall be insulated with calcium silicate, mineral fiber, or expanded perlite pipe covering all products shall be asbestos free. Acceptable materials are

Calsilite, Calsilite 1200
Calotex, Careytemp 1500
Eagle Picher, Epitherm 1200
Forty Eight, MF
Holmes, Unisite

Johns Manville, Thermo 12
Keene, Thermafil
Owens Corning, Kaylo 10
Pabco, Super Caltemp NA.

Other materials may be used with Ethyl Corporation approval. In periods of material shortage, equipment to 400F may be insulated with Pittsburg Corning Foam.

- b. Large Cylindrical. Equipment to 1200F and larger than 24" in diameter shall be insulated with curved block or beveled lags of the type and brand name specified in Par. a above.
- c. Flat. Flat surfaces to 1200F shall be insulated with flat block of the type and brand name specified in Par. a above.
- d. Thickness. Insulation thickness shall be as specified in the Equipment List. Insulation thickness for equipment not shown in the Equipment List shall be per Table

- 3.2 Securement. Bands for equipment insulation shall be $\frac{1}{2}$ " x 0.020" 18-8 stainless steel with 18-8 stainless steel seals, A. J. Gerrard or equal. 12" on centers.

3.3 Weatherproofing

- a. Vertical Jacket. Vertical straight shells shall be weatherproofed with 0.016" thick x $1\frac{1}{2}$ " corrugated aluminum with factory attached moisture barrier.
- b. Horizontal Jacket. Horizontal straight shells shall be weatherproofed with 0.016" thick smooth aluminum with factory attached moisture barrier.
- c. Vertical Seams. Vertical seams in aluminum jacketing shall be secured with $\frac{1}{2}$ " long x #8 STNLS STL sheet metal screws on 6" centers.
- d. Circumferential Seams. Circumferential seams in aluminum jacketing shall be secured with a $\frac{1}{2}$ " x 0.020" 18-8 stainless steel band at each seam. Continue to apply bands circumferentially on 18" centers.
- e. Z Clips. Z support clips made from $\frac{1}{2}$ " x 0.020" stainless steel band shall be installed at the circumferential seams on 18" centers on vertical vessels.
- f. Projections. At all projections (nozzles, brackets, etc) the necessary cutouts shall be carefully made and weatherproofed with heat resistant mastic, Foster 95-1 or approved equal up to 350F; above 350F use Eagle Picher Stalastic.
- g. Heads. Heads shall be weatherproofed as detailed in Fig. 6. Alternatively, if economical, available, and approved by Ethyl, a formed cover of 0.020" thick smooth aluminum with factory attached moisture barrier may be used.

- 3.4 Details. Details of equipment insulation shall be as shown in Figures 5 through 12.

- 3.5 Irregular Surfaces. Pumps, turbines, and other irregular surfaces shall be insulated and weatherproofed the same as vessel heads.