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UNION CARBIDE CORPORATION
CHEMICALS AND PLASTICS
ENGINEERING
SOUTH CHARLESTON, WEST VIRGINIA

TRANSMITTAL MEMORANDUM

October 11, 1968

To: Holders of Thermal Insulation Manual - Volume I - Specifications

Copy: Mr. G. F. Ours

From: Mr. W. G. Hammar

Subject: Revised Pages for Thermal Insulation Manual - Volume I - Specifications

We are forwarding for inclusion in Thermal Insulation Manual - Volume I - Specifications the following pages:

Spec 10-JU, p. 1:	Add - Support pads added, graphite pipe slides added.
Spec 22-H, 22-HSS, p. 1:	Revise cushioning blanket, change temperature limit.
Spec 23-H, 23-HSS, p. 1:	Revise cushioning blanket, change temperature limit, correct fabrication adhesive.
Spec 25-H, pp. 1 and 2:	Same as above.
Spec 31-H, 31-HSS, p. 1:	Add 31-HSS to spec number.
Spec 32-HFP, 32-HFPSS, p.1:	Revise cushioning blanket.
Spec 43-H, 43-HSS, pp.1-4:	Change title, add contact adhesive, correct errors in copy.

These pages should be placed in their proper places in Thermal Insulation Manual - Volume I - Specifications and superseded pages should be removed and destroyed.

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Subject: Revised Pages for Thermal Insulation Manual - Volume I - Specifications

Questions concerning content of the manual should be directed to Mr. W. C. Turner. Questions concerning distribution should be directed to Mr. W. G. Hammar. Both are at the following address: Union Carbide Corporation, Technical Center, P. O. Box 8361, South Charleston, West Virginia 25303.

UNION CARBIDE GROUP I DIVISIONS

STANDARDS PROGRAM

C. B. Smith Jr.

C. B. Smith, Jr.
for W. G. Hammer

CBS:clk

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UNION CARBIDE CORPORATION
CHEMICALS AND PLASTICS
ENGINEERING
SOUTH CHARLESTON, WEST VIRGINIA

TRANSMITTAL MEMORANDUM

October 2, 1967

To: Holders of THERMAL INSULATION MANUAL - VOLUME I - SPECIFICATIONS

Copy: G. F. Ours

From: W. G. Hammar

Subject: Revised Page for THERMAL INSULATION MANUAL - VOLUME I - SPECIFICATIONS

We are forwarding for inclusion in the "Thermal Insulation Manual - Volume I - Specifications" the following revised page:

43-HSS 1 SPRAYED URETHANE FOAM October 1967

This page should be placed in its proper place in "Thermal Insulation Manual - Volume I - Specifications", and the superseded page should be removed and destroyed.

Questions concerning content of "Thermal Insulation Manual - Volume I - Specifications" should be directed to Mr. W. C. Turner. Questions concerning distribution should be directed to Mr. W. G. Hammar. Both are at the following address: Union Carbide Corporation, Technical Center, P. O. Box 8361, South Charleston, West Virginia 25303.

UNION CARBIDE GROUP I DIVISIONS
STANDARDS PROGRAM

W. G. Hammar

WGH:dg
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ENGINEERING DEPARTMENT
OLEFINS DIVISION

UNION CARBIDE CORPORATION
SOUTH CHARLESTON, WEST VIRGINIA

TRANSMITTAL MEMORANDUM

July 31, 1967

To: Holders of THERMAL INSULATION MANUAL - VOLUME I - SPECIFICATIONS

Copy: Mr. G. F. Ours

From: W. G. Hammar

Subject: New and Revised Pages for "Thermal Insulation Manual - Volume I - Specifications"

We are forwarding for inclusion in "Thermal Insulation Manual - Volume I - Specifications" the following pages:

Contents 1
2 Rev July 1967

Spec 10-LSP

Spec 22-HSP

Spec 10-J, 10-JSS 1 Rev July 1967
2

Spec 10-L, 10-LSS 1 Rev July 1967
2

Spec M 27 Rev July 1967
28 Rev July 1967
29 Rev July 1967
30

Spec 43-HSS

These pages should be placed in their proper places in "Thermal Insulation Manual - Volume I - Specifications" and superseded pages should be removed and destroyed.

Questions concerning content of "Thermal Insulation Manual - Volume I - Specifications" should be directed to Mr. W. C. Turner. Questions concerning distribution should be directed to Mr. W. G. Hammar. Both are at the following address: Union Carbide Corporation, Technical Center, P. O. Box 8361, South Charleston, West Virginia 25303.

UNION CARBIDE GROUP I DIVISIONS
STANDARDS PROGRAM

W. G. Hammar

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THERMAL INSULATION MANUAL

VOLUME I – SPECIFICATIONS

UNION CARBIDE

UNION CARBIDE CORPORATION
CHEMICALS AND PLASTICS OPERATIONS DIVISION
AND UNION CARBIDE CANADA LIMITED

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THERMAL INSULATION MANUAL — VOLUME I

Book No. 1125

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Birmingham, Alabama

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THERMAL INSULATION SPECIFICATIONS

INTRODUCTION

I. General

These Specifications describe the essential requirements for the purchase and application of thermal insulation materials.

They consist of General Specifications, Material Specifications, and Application Specifications. General Specifications are identified by the letters GS, Material Specifications by the letter M, and the Application Specifications by a two-digit number followed by one or more letters.

All materials required in the application of thermal insulation shall be as specified in Material Specifications - M.

The required Application Specification and the thickness of insulation to be used shall be indicated in an Insulation Design Schedule.

II. Letter Designations for Application Specifications

Letters following numbers in designations of Application Specifications (example: H or HSS in Specification No. 10-H, 10-HSS) indicate that the specified insulation is intended for a particular use, as follows:

B	Building construction
FP	Fire Protection
FX	Flexible insulation for exterior surface of ducts
FY	Flexible insulation for interior surface of ducts
H	Equipment and piping operating at high temperatures
J	Equipment and piping operating at moderate temperatures
OX	Equipment and piping in oxygen service
L	Equipment and piping operating at low temperatures
RX	Rigid insulation for exterior surface of ducts
RY	Rigid insulation for interior surface of ducts
SP	Spheres
SS	Insulation to be installed on stainless steel surfaces
U	Underground piping

III. Presentation of Format

GS, M, 10-H, etc (SPECIFICATION IDENTIFICATION)
I., II., III., etc (ARTICLES)
A., B., C., etc (SECTIONS)
1., 2., 3., etc (Items)
a., b., c., etc (Subsections)
(1), (2), (3), etc (Paragraphs)
(a), (b), (c), etc (Units)

Reference to a particular Paragraph (4) of Specification GS shall be indicated thus: GS.XV.B.2.a.(4). Closely related references within a division may be identified thus: Article XIV.B of this specification, Item 2.a.(4) of this section, or Paragraph (3) above.

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UNION CARBIDE

STANDARD

CHEMICALS AND PLASTICS OPERATIONS DIVISION
AND UNION CARBIDE CANADA LIMITED

THERMAL INSULATION SPECIFICATIONS

CONTENTS

SPECIFICATION - GS

General Specifications and Engineering Standards

ARTICLES:

I. Condition of surfaces
II. Insulation supports
III. Securement
IV. Nameplate clips
V. Junction of thermal insulation with fire-resistant materials
VI. Flashing
VII. Sealing of hot projection
VIII. Coating
IX. Protection from abuse
X. Protection cover
XI. Appearance
XII. Insulation for safety
XIII. Steam or electric traced installations
XIV. Weather-barrier mastic coating
XV. Metal jackets - stainless steel or treated steel

STANDARDS: EL-43, IS-31, IS-31A, IS-36, IS-40, IS-42, P-32, P-140, and P-140A.

SPECIFICATION - M

Material Specifications for Thermal Insulation and Accessories

ARTICLES:

I. Material - General
II. Properties
III. Dimensions of Curved Segments, Lagging, and Pipe Insulation
IV. Condition of Material
V. Preformed Valve, Fitting, and Flange Covers
VI. Specifications for Individual Insulation Materials
VII. Specifications for Individual Accessory Materials

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CONTENTS - cont'd

APPLICATION SPECIFICATIONS - (as listed)

Table A Material Specifications and Accessories

P & E = Piping and Equipment SS = Stainless Steel AD = Air Ducts

Specification Number and Designation	Description of Material	Operating Temperature Range, Degrees F	Miscellaneous Remarks Location of Application - Type of Service, etc. -
1-A	Cellular Glass	Atmospheric	Buildings
1-HP & HPSS	Cellular Glass	+ 70 to + 600	P & E, SS P & E
1-LP & LPSS	Cellular Glass	- 30 to + 400	P & E, SS P & E
1-UP & UPSS	Cellular Glass	+ 50 to + 350	Underground Piping SS Piping
1-LL & LSS	Cellular Glass	- 200 to + 400	P & E, SS P & E Low Temperature Service
1-HSP	Cellular Glass	- 40 to + 150	Sphere
1-OX	Cellular Glass	- 200 to Atmos	P & E - Oxygen Service
2-H & HSS	Rigid Urethane Foam	+ 50 to + 250	AD, P & E and SS P & E
2-L	Flexible Plastic Foam	+ 32 to + 180	AD, P & E
3-H	Fibrous Glass, high density	+ 70 to + 750	P & E
3-L	Fibrous Glass, high density	- 20 to + 100	P & E
3-H	Fibrous Glass, low density	+ 70 to + 350	P & E
3-RX	Fibrous Glass, rigid	+ 60 to + 150	AD - Exposed - Exterior Surface
3-RY	Fibrous Glass, rigid	+ 60 to + 150	AD - Interior Surface
3-FX	Fibrous Glass, flexible	+ 60 to + 150	AD - Concealed - Exterior Surface
3-FY	Fibrous Glass, flexible	+ 60 to + 150	AD - Interior Surface
4-H	Mineral Wool, aluminum faced	+ 60 to + 450	Large diameter storage tanks
4-J	Fibrous Glass, aluminum faced	+ 60 to + 350	Large diameter storage tanks
5-H & HSS	Asbestos Fibers	+ 70 to + 1000	Piping, SS Piping
20-H & HSS	Bonded Expanded Silica	+ 40 to + 1600	P & E, SS P & E - High Temperature
22-HSP	Bonded Expanded Silica	+ 70 to + 500	Sphere
23-H & HSS	Hydrated Calcium Silicate	+ 70 to + 750	P & E, SS P & E
23-H	Fibrous Calcium Silicate	+ 750 to + 1600	P & E - High Temperature
24-H HSS	Stainless Steel - Cased - Reflective	- 30 to + 1000	P & E, SS P & E
25-HFP & HFPSS	Bonded Expanded Silica	+ 40 to + 1600	P & E - Fire Protection
25-LFP & LFPSS	Bonded Expanded Silica - Cellular Glass	- 200 to + 400	P & E, SS P & E - Fire Protection
37-H	Insulation as Specified	- 40 to + 750	Underground Conduit
38-H	Urethane Foam - PVC Jacket	+ 50 to + 250	Underground Piping
39-H	Bituminous Fill	+ 220 to + 520	Underground Piping
40-L	Cork Filled PVA Mastic	- 34 to + 150	P & E
41-H	Sprayed Asbestos - "Amosite"	+ 40 to + 700	Equipment, Ducts, Steel, etc.
42-H	Sprayed Asbestos - "Crocidolite"	+ 40 to + 1350	Equipment, Ducts, Steel, etc.
43-H & HSS	Sprayed Urethane Foam	+ 50 to + 250	Equipment, Storage Tanks

THERMAL INSULATION GENERAL SPECIFICATIONS

I. SCOPE

These specifications describe the essential requirements for the application of thermal insulation materials. They also constitute an integral part of each individual specification.

II. PREPARATION OF SURFACES

A. Insulating material shall be applied to clean, dry surfaces only.

B. Where insulation is applied to carbon steel piping and equipment operating in the temperature range of 0 F to 150 F, the metal surfaces of such piping and equipment shall be coated by others, in accordance with Owner's Coating Specifications, prior to application of insulation.

C. Where insulation is applied to stainless steel piping and equipment, the metal surfaces of such piping and equipment shall be coated by others, in accordance with Owner's Coating Specifications, prior to application of insulation.

III. INSULATION SUPPORTS

A. Insulation on vertical equipment exceeding 1 ft 5 in. OD by 10 ft 0 in. high shall be supported in accordance with Owner's Standard IS-31.

B. Insulation on horizontal equipment, 4 ft 0 in. diameter and larger, shall be supported in accordance with Owner's Standard IS-36.

C. Insulation applied to bottom head, inside of skirt, on skirt supported vessels, shall be supported in accordance with Owner's Standard IS-42.

D. Insulation on dished heads of vertical equipment shall be supported in accordance with Owner's Standard IS-31, IS-31A, and IS-40.

E. Where necessary to prevent entrance of moisture, uppermost support shall be replaced with a metal protective plate, as described in Article X of this specification, entitled "Protective Cover".

F. Insulation on 3-inch NPS and larger vertical pipe and vertical vessels up to 1 ft 5 in. in diameter shall be supported by formed steel straps (see VII.A.2) bolted around pipe near bottom of run. Additional supports shall be installed on pipe at intervals of 21 feet of vertical run.

IV. REQUIREMENT

A. Tie-Wire Anchors. Angle clips, flat rectangular punched pins, and other approved attachments shall be used as insulation tie-wire anchors, where shape of vessel prevents normal methods of securement of prefomed insulating materials. Blank nuts, where required, shall be attached, non-pressure to vessel surface, by light fillet welds. Angle clips shall be installed in accordance with Owner's Standard IS-40. Pins shall be carbon steel or stainless steel to correspond with metal of the vessel.

B. Wire

1. Insulation shall be secured by wire applied at proper intervals by looping about the circumference, twisting ends tightly together to obtain proper securement, and pressing wire ends into insulation to prevent projection. Wire shall be used for securement of all inner layers of pipe insulation, and outer layers up to and including 12-inch OD. Wire shall be used for securement of all outer layers of pipe insulation, regardless of diameter, where weather-barrier is specified to be metal jacket.

2. Where shape of vessel prevents complete encirclement, securement shall be made to other tie-wires, wire cables, or anchors approved for [illegible].

C. Insulating Straps

1. All pipe insulation on traced lines shall be secured as noted in the individual specification.

2. Outer layer of pipe insulation over 12-inch OD shall be secured with insulation straps except when metal jacket is used.

3. Straps shall be applied to cylindrical insulation at proper intervals by looping strap about the circumference, stretching to suitable tightness by means of approved banding machine, and clamping in place at joint. Strap joint shall consist of one double-prong clip. Clips shall be staggered on the vertical face of pipe insulation.

4. Where shape of vessel prevents complete encirclement by straps, securement shall be made to tie-wires, wire cables, or other devices approved for this purpose.

5. Insulation straps shall be divided into lengths based on one strap joint for the first 15 feet of vessel circumference and one strap joint for each additional 12 feet, or part thereof. These joints shall be spaced at equal distances around the vessel. Vessels over 12 feet in diameter [illegible] where insulation, preformed panel insulation is specified, shall be equipped with vertical strap anchor angles spaced as shown on Owner's Standard Detail A.

6. Insulation straps on exterior of heating, ventilating, and air-conditioning ducts shall be as specified in individual specifications.

7. Pipe or ducts having a outer jacket up to 4 inches in outside diameter of low temperature cellular glass insulation shall be secured with [illegible] bands.

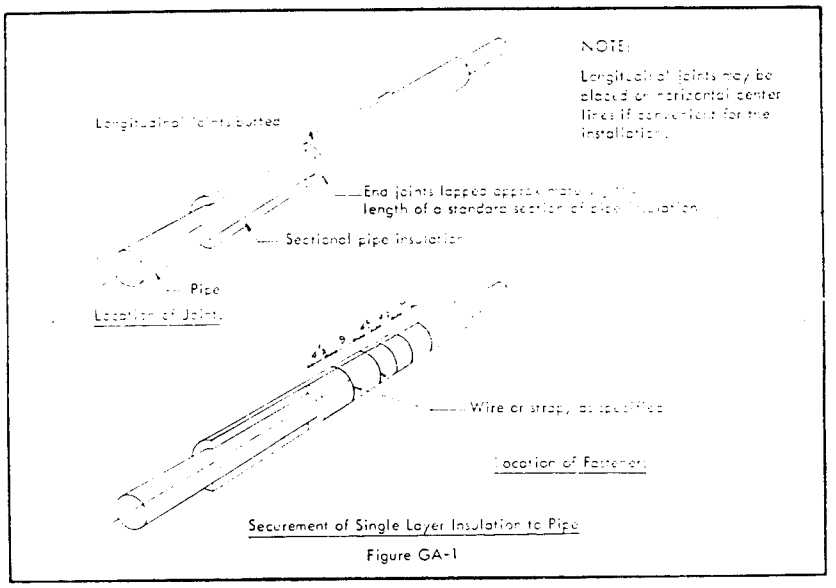
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[illegible] EQUIPMENT - [illegible]

[illegible] of Insulation Joints and Spacing of Straps and Wire

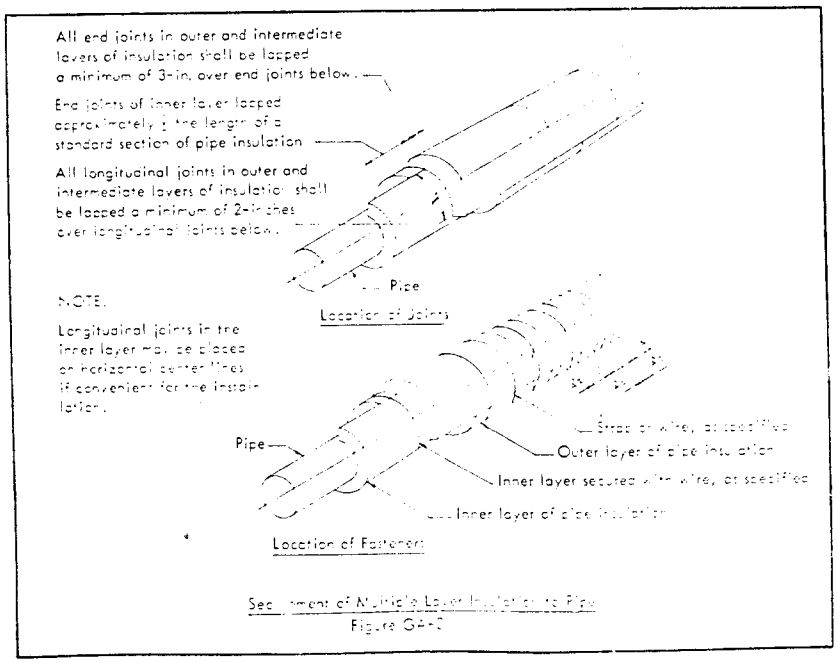
1. Spacing of insulation strap and/or securing wire shall be based on length of insulation block or section for equipment and pipe. Where [illegible] lengths of insulation are applied in staggered arrangement, four loops will be required at approximately 24-inch intervals so that [illegible] located no more than 4 inches from any end joint. Where 24-inch lengths are applied in staggered arrangement [illegible] loops per length. Where 18-inch lengths are applied in staggered arrangement [illegible] loops per length.

2. Spacing of strap and wire on pipe insulation shall be as shown in Figures GA-1 and GA-2.



Securement of Single Layer Insulation to Pipe

Figure GA-1

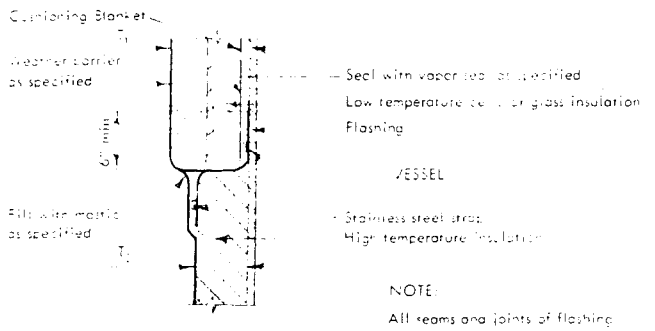


Securement of Multiple Layer Insulation to Pipe

Figure GA-2

FLASHING at Joints

5. Where a vertical vessel such as a column is insulated for gradient temperatures, with the low temperature above, flashing shall be installed at the junction of different thicknesses of insulation where noted in schedule to prevent condensate from entering the high temperature insulation or the vessel wall at the joint. Flashing material shall be as specified in the MATERIAL SPECIFICATIONS Article VII, A. 23. It shall be applied over the vapor seal and the outside of the insulation with the equipment insulation straps specified in the MATERIAL SPECIFICATIONS, Article III, A. All seams and joints of flashing shall be sealed with vapor seal as specified in the individual specifications. Typical installation is shown on Figure GA-3A.



Flashing at Butt Joints of Different Thicknesses of Insulation

Figure GA-3A

SEALING OF HOT PROJECTIONS

Where hot brackets, hangers, or supports project through the insulation and weather-barrier mastic or metal jackets, the junction shall be sealed with heat-resistant sealer as specified in Article XIV, B. 6 of this specification.

COATING

Coating of bare and insulated surfaces, where required, shall be done by others in accordance with Owner's Coating specification, and shall be applied to painted surfaces until such surfaces are completely finished and dry, in accordance with coating specification.

PROTECTION FROM ABUSE

All insulation subject to mechanical abuse, such as abrasion or crushing, or where otherwise required at designated by the Owner, shall be protected by a jacketing jacket of not thinner than 18 gage, minimum galvanized sheet metal. Jacket shall be secured firmly to insulation straps, spaced 12 inches maximum on centers, or sheet metal screws where use of straps is impracticable. Sheet metal jacketing shall be applied over low temperature insulation where possibility exists of piercing weather-vapor barrier membrane.

Corners of insulated ducts, breechings, and other flat-surfaced equipment shall be reinforced by installation of expanded metal corner bead. Bead shall be provided by the Insulation Contractor and installed by insulation mechanics, following application of insulating cement, securing it firmly to block tie wires. Cement shall be forced through lath flange to provide proper key.

PROTECTIVE COVER

All piping risers and intermediate points in the height of a vessel shall be protected from physical abuse and moisture penetration by a metal jacketing. Metal plate attached to vessel by means of a continuous weld immediately above insulation. This protection shall be applied over insulation in accordance with Owner's specification. Insulation may be beveled and mastic sealed to shed if desired, and sealed with vapor seal.

NAMEPLATE CLIPS

A. Insulation mechanics shall cooperate with other crafts in the placement of nameplates and nameplate clips.

B. On vessels insulated for service primarily above 32 F, nameplates shall not be covered by the insulation. The opening in the insulation shall be tapered to the nameplate perimeter.

C. For vessels and equipment which operate at or below 32 F, the Field Inspector will provide a nameplate extension clip in accordance with Owner's Standard EG-15.

JUNCTION OF THERMAL INSULATION WITH FIRE-RESISTANT MATERIALS

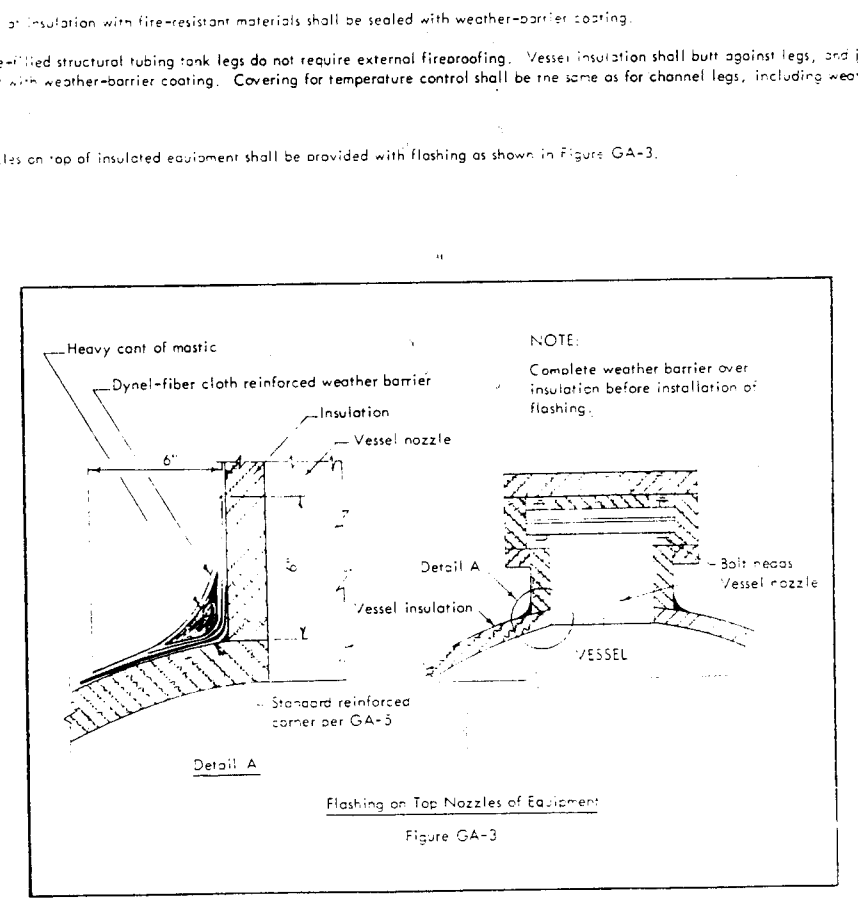
A. Insulation thickness on channel tank legs and similar equipment supports shall be not less than adjoining fire-resistant materials. Where the thickness of thermal insulation exceeds that of fire-resistant materials, surface of insulation shall be neatly and uniformly finished with a wide [illegible] and reinforced to provide the appearance of a continuous surface.

B. Butt joints of insulation with fire-resistant materials shall be sealed with weather-barrier coating.

C. Concrete-filled structural tubing tank legs do not require external fireproofing. Vessel insulation shall butt against legs, and junction shall be sealed with weather-barrier coating. Covering for temperature control shall be the same as for channel legs, including weather barrier.

FLASHING

A. All nozzles on top of insulated equipment shall be provided with flashing as shown in Figure GA-3.



Flashing on Top Nozzles of Equipment

Figure GA-3

[illegible] APPEARANCE

Jacket joints, selvage ends, and other irregularities of surfacing materials shall be concealed from general view wherever possible.

XII. INSULATION FOR SAFETY

A. Where it is required to insulate piping or equipment for safety, only that portion shall be insulated which is located 6 ft 0 in. or less above any platform or operating level. If the axis of the pipe or equipment is vertical, and, for horizontal axes, at all elevations 7 ft 0 in. or less above any floor or operating level. Piping in trenches, unless otherwise specified, shall not be insulated for safety below grating level. Exposed ends of insulation shall be sealed to provide proper seal and drainage.

B. Where specified, thermal insulation shall be omitted and protection provided by erection of a suitable safety guard. This guard will be provided by Owner.

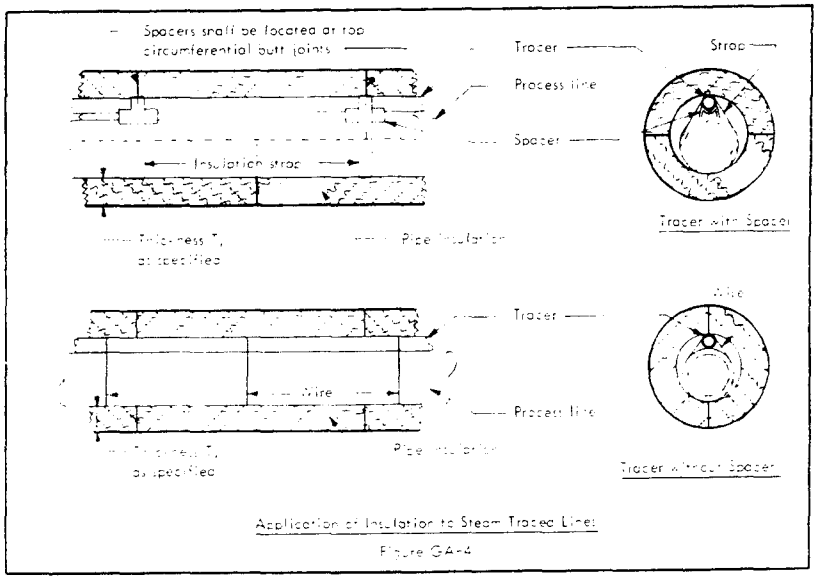
XIII. STEAM OR ELECTRIC TRACED INSTALLATIONS (as specified)

A. Steam Tracing System

1. Piping drawings, schedules and/or tracing drawings shall designate traced lines with the symbol ST (steam traced without spacers), or STW (steam traced with spacers).

2. Insulation. Pressed steel spacers shall be used only when specifically required for separation between the tracer and pipe. These spacers shall be furnished by the Insulation Contractor and as specified in the MATERIAL SPECIFICATIONS, Article VII.C.1.a.

3. Application. Type and size of tracer lines, methods of clamping, hanging and supporting them, and size of pipe insulation to be applied shall be in accordance with Owner's Standards P-140 and P-140A, and Figure GA-4 supplemented by Insulation Design Schedules and steam or electric tracing drawings, where required. In addition to assembly directions contained in Standards EL-43, P-140 and P-140A, pressed steel spacers and pressed steel clamps, where installed) shall be spaced on 18-inch centers for copper tracer lines. Temporary installation of assembly shall be done by the Owner.



Application of Insulation to Steam Traced Lines

Figure GA-4

4. Pipe insulation shall be applied in required sizes and carefully fitted to heated companion lines in the manner prescribed in these specifications and the individual specifications. Tracer assembly shall be firmly and permanently secured in place before application of insulation. Where spacers are specified, they shall be added or relocated where required to ensure firmness and separation of tracer from pipe.

5. Protective Wrapping. When aluminum piping is to be traced, or when otherwise required, aluminum piping shall be separated from tracer tubing by not less than two wrappings of glass cloth tape applied to the line. Care shall be taken that tracer line does not contact aluminum jacket at any point. Where tracer may touch the aluminum between supports, the line shall be wrapped with glass cloth tape to prevent contact. Finish surface shall be as specified in MATERIAL SPECIFICATIONS, Article VII.C.2.a.1&2.

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A.III STEAM OR ELECTRIC TRACED INSTALLATIONS - contd

5 Heat Transfer Cement Tracing System

1. The heat transfer cement used shall be suitable for the temperature and installation requirements. It shall be as called for on Insulation Design Schedule, Insulation Equipment and/or Line List, or as otherwise prescribed by the designer of the tracing system.

2. Materials

a. Heat Transfer Cement (See MATERIALS SPECIFICATIONS, Article Numbers as Noted)

(1) Standard Grade - VII. C. 2. a. (1).

(2) T-3 Grade - VII. C. 2. a. (2).

(3) T-63 Grade - VII. C. 2. a. (3).

(4) T-65 Grade - VII. C. 2. a. (4).

(5) T-50 Grade - VII. C. 2. a. (5).

(6) T-5 Grade - VII. C. 2. a. (6).

b. Accessories (See MATERIALS SPECIFICATIONS, Article Numbers as Noted)

(1) Primer for coating of aluminum surfaces prior to application of Standard Grade, T-3 Grade, and T-63 Grade heat transfer cements - VII. C. 2. a. (1).

(2) Mill Varnish Stripper - VII. C. 2. b. (2).

(3) Metal Retainer for Cement - VII. C. 2. b. (3).

(4) Pipe Insulation Strap - VII. A. 13.

(5) Clips for Pipe Strap - VII. A. 14.

3. Surface Preparation

a. Surface of pipe, or equipment to which heat transfer cement is to be applied shall be cleaned of dirt, rust, scale, paint, and varnish. Paint or varnish shall be removed with mill varnish stripper, in accordance with manufacturer's directions, on areas to which tracers and heat transfer cement are to be applied. Badly scaled or rusted steel shall be cleaned by sandblasting before application of tracer or heat transfer cement.

b. Galvanized or aluminum surfaces shall be primed with ALP Primer after cleaning, before application of Standard Grade, T-3 Grade, or T-63 Grade of heat transfer cement.

4. Application of Tracers - Type and size of tracers shall be as scheduled. Steam and liquid tracers shall be secured to pipe by straps or wire in accordance with Owner's Standard P-140. Electric tracers shall be installed in accordance with Owner's Standards EL-41 through EL-47. Tracers or plate coils shall be installed on equipment as scheduled, or shown on drawings. Care shall be taken if coils or tracers are installed on aluminum equipment or piping that the two metals do not come into contact. See Section A.5 of this Article.

5. Application of Heat Transfer Cements - After installation of tracers, except plate coils, on pipe and equipment, the specified grade of heat transfer cement shall be applied in accordance with one of the following procedures, as required:

a. Standard Grade and T-63 Grade cements shall be applied with hand tools, or with manual or power caulking guns having special nozzles. The cement shall be applied over the tracer in a layer approximately 1/4-inch thick, and forced into the recess at the line of contact between the tracer and the traced pipe or equipment. Special care shall be exercised to fill these recesses completely, to ensure maximum surface contact. The width of the peripheral contact of cement and pipe, pipe fittings, or equipment shall be a minimum of three times the diameter of the tracer. Over irregular surfaces such as pumps and valves, and where it is impossible to apply troweled cement may be troweled over tracers in a solid layer 1 1/4-inch thick. If thickness in excess of 3 1/4 inches is required, cement shall be installed in two layers, with air drying of at least 24 hours between applications. Application details are shown in Figure GA-44.

b. Where it is impossible or impracticable to clean pipe surfaces, or where vibration is excessive, e.g. pipe connected to reciprocating machinery, or where curing may be delayed, the Standard Grade and T-63 Grade cements shall be applied to straight pipe by means of metal retainers. The retainer shall be filled with sufficient cement to fill all voids between it, the pipe, and the tracer. The filled retainer shall be placed over the tracer and pulled tight with straps. Straps shall be placed on 24-inch centers with a common clip used at all adjoining retainers. Application details are shown in Figure GA-44. The retainers are shown in Figure GA-45.

(3) STEAM OR ELECTRIC TRACED SYSTEMS – contd

B. Heat Transfer Cement Tracing System – contd

3. Application of Heat Transfer Cements – contd

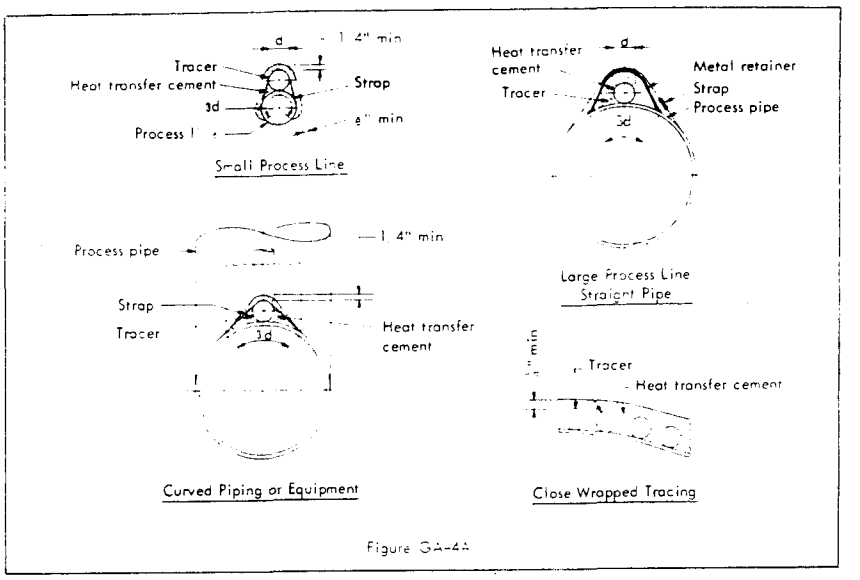
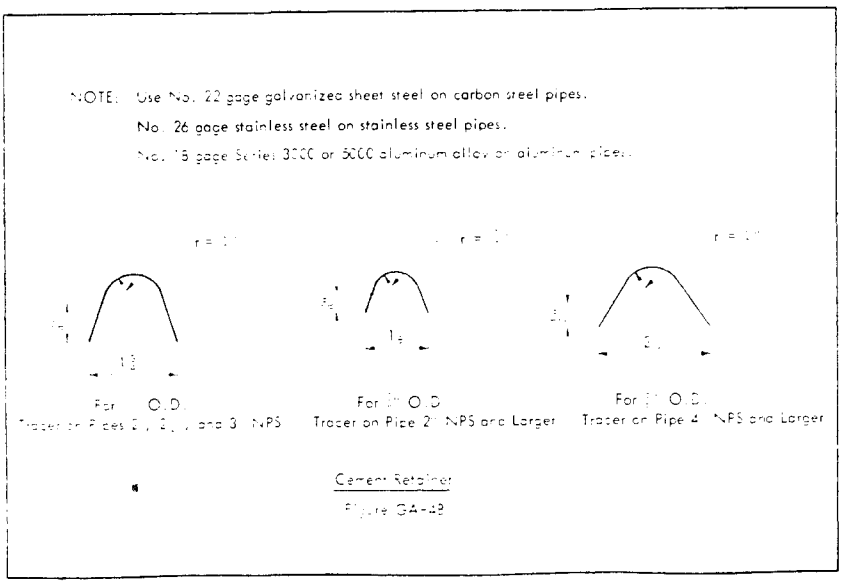


Figure GA-4A



Cement Retainer

Figure GA-4B

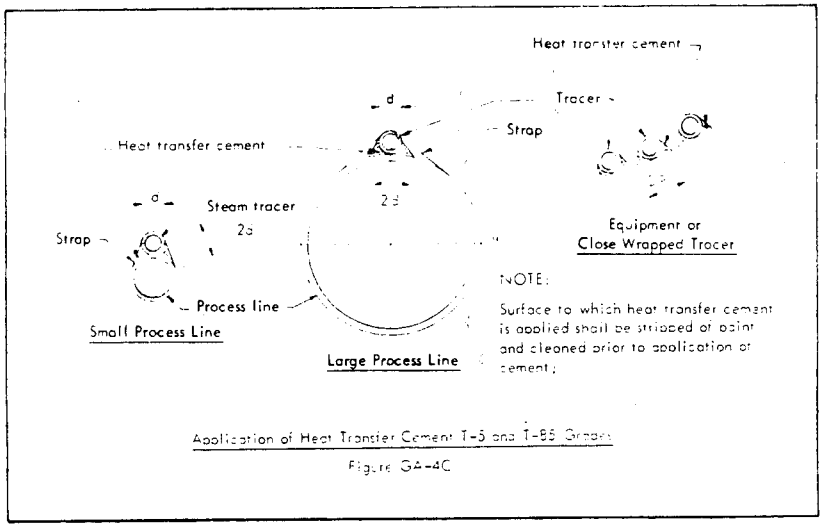
XIII. STEAM OR ELECTRIC TRACED SYSTEMS - contd

B. Heat Transfer Cement Tracing System - contd

3. Application of Heat Transfer Cement - contd

a. T-5 Grade cement, for plate coils, shall be applied to surfaces prepared in accordance with Articles XIII, B, 3, a, and c. Thickness of the cement shall be not less than 1/16 inch nor more than 1/8 inch. The plate coil, with the cement on the surface toward the vessel to which the coil is to be attached, shall be firmly and carefully pressed to the surface of the vessel to obtain a tight cement bond. Attachment of the plate to the vessel shall be as shown or called for on the drawings.

b. T-5 Grade, T-65 Grade, and T-80 Grade cements, which are supplied in cartridges, shall be applied with manual or power caulking guns. The cement shall be forced into the spaces adjacent to the line of contact between the tracer and the traced pipe or equipment. Sufficient pressure shall be exercised to fill these spaces completely, to ensure maximum surface contact. The width of the application on the pipe, pipe fittings, or equipment shall be a minimum of twice the diameter of the tracer. Application details are shown on Figure GA-4C.



Application of Heat Transfer Cement T-5 and T-65 Grades
Figure GA-4C

c. Weather and Temperature Restrictions

a. Standard Grade, T-3 Grade, and T-63 Grade heat transfer cements contain water and are water soluble. If these cements are applied without the use of metal retainers, a period of eight hours shall elapse before application of insulation and weather barrier. During this period and until insulation and weather barrier are installed, these cements shall be protected from rain, frost, and dew with temporary waterproofing.

b. The minimum application temperature for T-5 Grade and T-65 Grade heat transfer cement is 70 F. If the ambient temperature or the temperature of the cartridges of cement is below 70 F, the cartridges shall be heated above 70 F before application. T-65 Grade and T-80 Grade cements should be stored under refrigeration, but shall be heated above 70 F before use. If they have been stored at room temperature longer than 90 days, they shall be heated above 120 F before use, then shall be used within 24 hours.

d. Curing

a. Standard Grade, T-3 Grade, and T-63 Grade heat transfer cements shall be allowed to air set for a minimum of four hours prior to initial application of heat curing. Heat curing shall be done by gradually raising the temperature of the tracer to not more than 250 F nor more than 212 F. The cement shall be cured for four to six hours, except that large masses of cement, such as those on valves, and on close wrapped tracers for equipment such as domes and vessels, shall be cured for 24 hours. T-65 Grade cement, in addition to the curing time, shall be given a minimum of four hours of additional curing at 250 F.

b. Curing procedures are as follows:

[illegible] systems: Open trap end of tracer to atmosphere, then open valve at header just sufficiently to bleed air and condensate through the tracer. Maintain steam on the header for the curing time specified above.

[illegible] systems: Set thermostat at 200 F, or, if this is impossible, reduce voltage so that temperature of the tracer cannot exceed 212 F for the period of time specified above.

XIII. STEAM OR ELECTRIC TRACED SYSTEMS - contd

B. Heat Transfer Cement Tracing System - contd

7. Curing - contd

c. T-85 Grade cement requires no special curing technique. The setting or hardening time is proportional to the operating temperature. If installation operates at fairly low temperature (100 F to 150 F), this cement will remain soft and tacky for several months. If operating temperature is above 250 F, it will set hard in a few hours. T-85 Grade cement may be subjected to temperatures up to 375 F immediately after application.

d. T-80 Grade cement, for use at temperatures from below freezing to 300 F, requires no special curing. Its properties are similar to those of T-85 Grade cement.

e. T-5 Grade cement requires no curing, as it does not harden or set.

8. Application of Insulation

a. Insulation shall be as scheduled and shall be applied in accordance with the individual specifications.

b. Inside diameter of insulation to fit over traced piping shall be as called for in Owner's Standard P-140A.

XIV. WEATHER-BARRIER MASTIC COATING

Insulation shall be protected with a weather-barrier mastic coating unless otherwise specified.

A. Materials (See MATERIAL SPECIFICATIONS, Article Numbers as Noted)

1. Weather-Barrier Mastic - Trowel Grade - VII.B.1.a.

2. Weather-Barrier Mastic - Spray Grade - VII.B.1.a.

3. Reinforcing Cloth - VII.B.1.b.

4. Mastic (Caulking) - VII.A.45.

5. Heat-Resistant Sealer - VII.A.42.

6. Expansion Strip - VII.A.10.

7. Lap Sealer - VII.A.46.

B. Application

1. Insulation shall be installed before application of weather barrier.

2. Surface of insulation shall be smooth, even and free of voids, and in relatively dry state.

3. On outside installations, insulation shall be sloped for water drainage.

4. Sharp outside corners of insulation shall be rounded off as shown in Figure GA-5.

5. A heavy fillet of mastic shall be applied to all inside corners of insulation, and to inside corners of metal projections of moderate and low temperatures, prior to application of weather-barrier mastic.

6. A heavy fillet of heat-resistant sealer shall be applied around all metal projections which will be above 180 F in service. The sealer shall be applied outward from the junction of the projection for a distance six inches on the metal and six inches over the surface of the insulation.

7. Insulation shall be protected from weather as soon after installation as possible. However, standard mastic shall not be applied when atmospheric temperature is below 32 F or when temperature is expected to be as low as 25 F within the next 24 hours. Low temperature mastic shall be used when atmospheric temperature is less than 32 F but above 20 F.

8. Where mastic is to be spray applied, adjacent areas not to be coated, such as valve stems, handles, gauge glasses, instruments, equipment, structural steel, floors or walls, shall be masked or otherwise protected.

9. Spray application shall consist first of a spray tack coat of spray grade weather-barrier mastic into which the reinforcing cloth is thoroughly embedded. Joints of reinforcing shall be uniform and not less than two inches in width, and shall have a smooth unbroken surface. All inside and outside corners shall be rounded and the weather-barrier coating provided with an overlapped layer of reinforcing cloth as shown in Figure GA-5. After the first coat has taken its set, a second coat shall be spray applied which completely covers and fills all voids in the cloth. The combined thickness of the weather-barrier coating and reinforcing cloth shall not be less than 55 mils when dry, or approximately 3/32 to 4/32-in. total wet film.

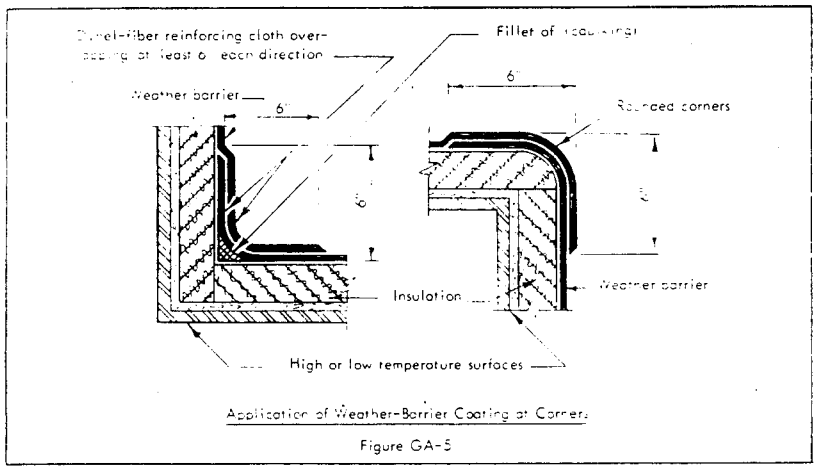
A. WEATHER-BARRIER MASTIC COATING - cont'd

5. Application - cont'd

a. Polymer or hydraulic application shall consist of first bonding the reinforcing cloth to the surface with small amounts of weather-barrier mastic. Cloth strips shall be butted taut with joints overlapped uniformly two inches. All inside and outside corners shall be rounded and the weather-barrier coating provided with an overlapped layer of reinforcing cloth as shown in Figure GA-5. Trowel grade weather-barrier mastic shall then be troweled or palmed over cloth, pressing it through the mesh to obtain bond with insulation surface. Care shall be taken that openings in weave of cloth are completely sealed. After weather barrier has partly set, it shall be water brushed to a smooth, even surface. The combined thickness of the weather-barrier coating and reinforcing cloth shall not be less than 1/16 inch when dry or approximately 0.80 to 1.32-in. total wet film.

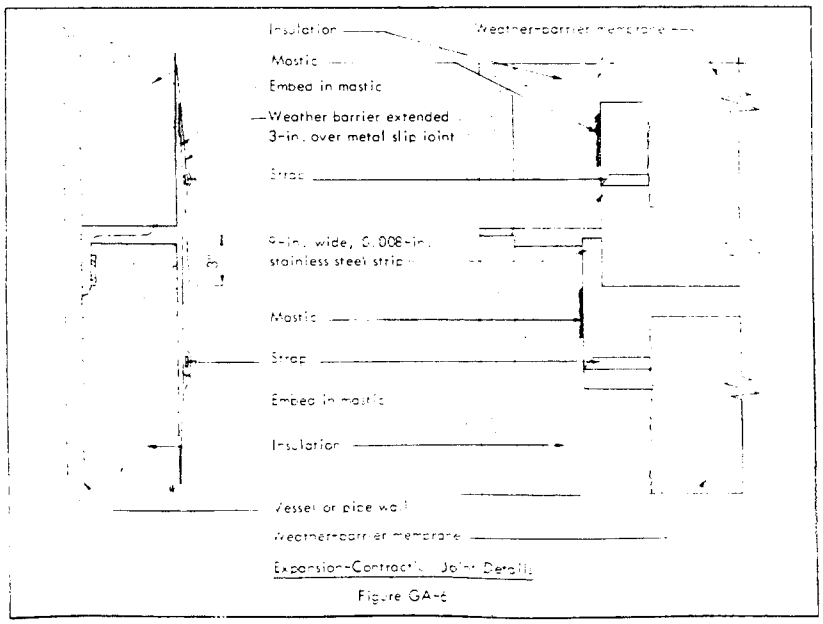
b. Weather-barrier membrane shall be carried out six inches onto metal, beyond termination of insulation and supports, skirts, or other projections, and shall be sealed to the metal.

c. Expansion joints in weather barrier over expansion openings in high temperature insulation shall be constructed with expansion strip, as shown in Figure GA-6. Joints installed in vertical position shall be arranged to shed water. Joints installed in horizontal position shall be arranged in the same manner except that a bead of lap sealer shall be placed between the two layers of expansion strip so as to prevent moisture penetration but not to restrict movement between sheets.



Application of Weather-Barrier Coating at Corners

Figure GA-5



Expansion-Contraction Joint Detail

Figure GA-6

VII. WEATHER-BARRIER MASTIC COATING - contd

B. Application - contd

13. Contraction joints in low-temperature insulation shall be as called for in individual specifications.

14. Unless otherwise specified, outer finish of indoor insulation shall be same as called for in these weather-barrier specifications.

C. METAL JACKETS - STAINLESS STEEL OR TREATED STEEL

The letter M added to the regular designation of any application specification (examples: 10-HM, 10-JM, etc) indicates that the weather barrier shall consist of a jacket of Type 430, or any austenitic type, stainless steel. The letters MT added to the regular designation indicate that the weather barrier shall consist of vinyl-coated galvanized steel. Split systems of weather barrier shall be specifically designated (example: 22-HM for fittings and 23-HM for straight pipe).

A. Materials

1. Weather-barrier Stainless Steel and Carbon Steel Jackets (See MATERIAL SPECIFICATIONS, Article Numbers as Noted)

a. Equipment over 24 inches OD - VII. B. 2. a. and VII.B.3.a.

b. Equipment 24 inches OD and under - VII. B. 2. b. and VII.B.3.b.

c. Pipe Preformed Jacket - VII. B. 2. c.

d. Smooth jacket for pipe - VII. B. 2. d.

e. Closure band for both ends of pipe jackets - VII. B. 2. e. and VII.B.3.c.

f. Preformed jackets for fitting covers - VII. B. 2. f.

2. Accessories (See MATERIAL SPECIFICATIONS, Article Numbers as Noted)

a. Sheet Metal Screws - VII. A. 32.

b. Equipment Insulation Strap - VII. A. 11.

c. Pipe Insulation Strap - VII. A. 13.

d. Clips for Equipment Strap - VII. A. 12.

e. Clips for Pipe Strap - VII. A. 14.

f. "S" Clips - VII. A. 27.

g. Jacket Support Clips - VII. A. 28.

h. Stainless Steel Wire - VII. A. 17.

i. Expansion Strip - VII. A. 10.

j. Lap Sealer - VII. A. 46.

k. Heat-Resistant Sealer - VII. A. 42.

B. Application

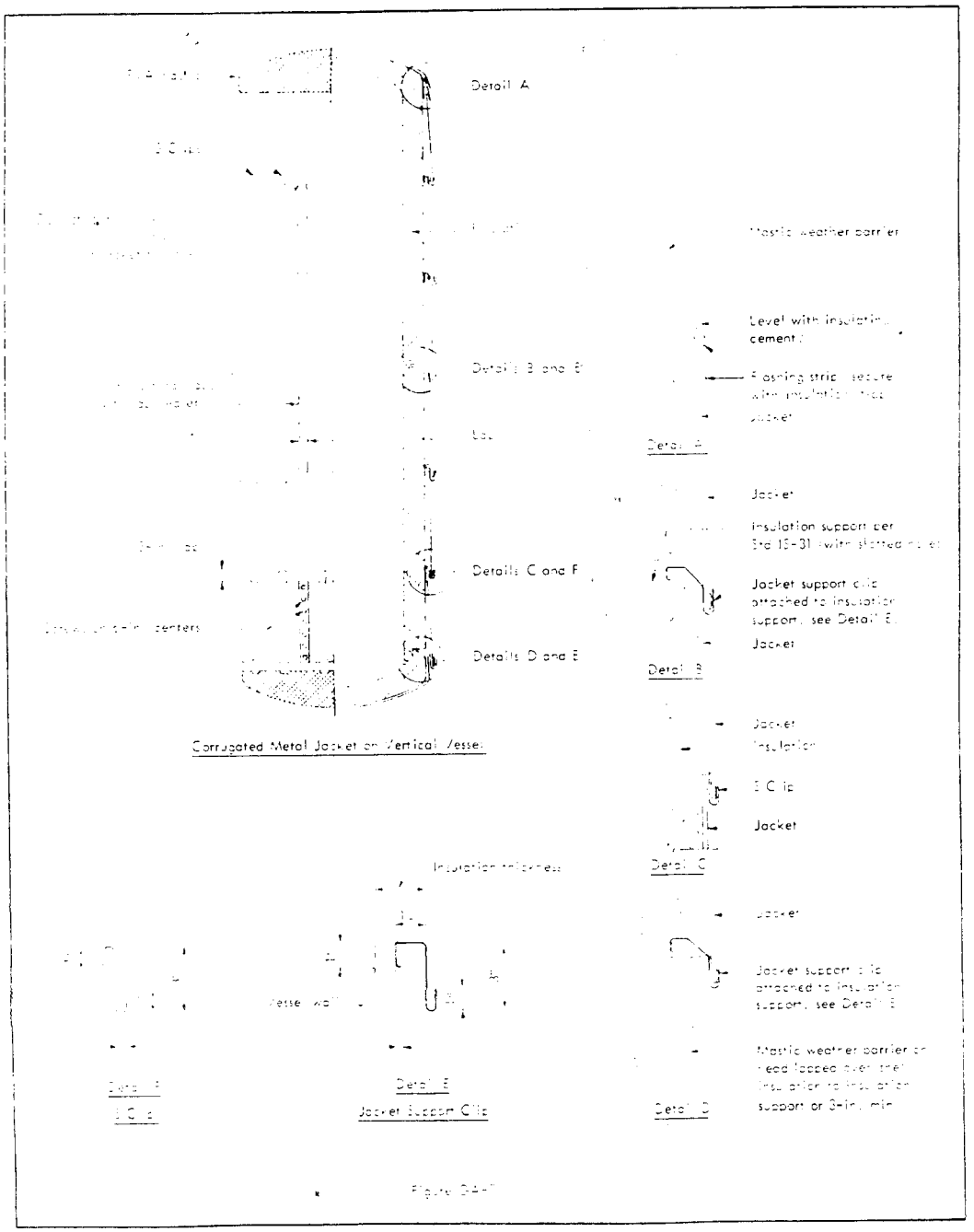
1. Equipment

a. Equipment insulation secured with bands shall be recessed under band clips. Clips shall be embedded flush with insulation to provide a smooth, even surface for application of jacket.

b. Jacket shall be installed from bottom up. The first course shall be supported by jacket support clips attached to insulation support. Vertical joints shall be lapped a minimum of three inches. A bead of lap sealer shall be placed between the layers of metal on all vertical joints before joint is fastened together with screws on six-inch centers. Care shall be taken that screws do not pierce circumferential joint preventing relative motion between two courses of jacket. Subsequent courses of jacket shall be supported by "S" clips, and lapped three inches to shed water. At top of vessel a six-inch wide stainless steel flashing strip shall be embedded in weather-barrier mastic and banded in place. It shall lap top course of jacketing three inches, but shall not be attached to the jacket. Additional weather barrier, used over vessel head, shall be applied down over flashing to provide water shed. Details are shown in Figure GS-7 for corrugated metal jacket.

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METAL JACKETS - STAINLESS STEEL OR TREATED STEEL - cont'd



A. METAL JACKETS - STAINLESS STEEL OR TREATED STEEL - cont'd

5. Application - cont'd

a. Equipment - cont'd

(1) When smooth stainless steel jacket is used, a bead of lap sealer shall be placed between the layers on each vertical joint before joint is fastened together with screws on six-inch centers. Vertical and circumferential joints shall be lapped a minimum of three inches. The first course of jacket shall be supported by jacket support clips attached to the vessel insulation support. Subsequent courses of jacket shall be supported by "S" clips, overlapped three inches to shed water. Jacket shall be secured circumferentially with 1/2-inch stainless steel bands, above circumferential joint, and on 18-inch centers. Sheet metal screws shall be installed in jacket to aid in spacing and to prevent slipping of bands. Care shall be taken that neither the screws nor the bands bind the circumferential joint preventing relative motion between two courses of jacket. Top flashing shall be as specified for vertical vessels over 24 inches in diameter. Details are shown in Figure GA-6 and GA-7.

(2) When preformed stainless steel jacket with Z joint is used to cover small vessels, vertical or horizontal, it shall be installed in the manner specified for application of preformed pipe jacket in Item 2.a of this section. Details are shown in Figure GA-9.

(3) Horizontal vessels jacketed with the corrugated or smooth stainless steel (depending upon size) shall be insulated in same manner as vertical vessels except that all circumferential joints shall be sealed with a bead of lap sealer placed between the layers of metal before securing the jacket in place with strap. Strap shall be placed directly over the joint. The longitudinal laps shall be installed as above to shed water, and shall be secured on six-inch centers with screws. Details are shown in Figure GA-10.

(4) Heads of vessels shall be jacketed with preformed or field formed smooth surface stainless steel jacket. All joints of preformed head jackets shall be fastened together to form a watertight assembly. Field formed jacket joints, or joints where preformed jackets fit together, shall have laps sealed with joint sealer. Jacketing shall be secured in place by straps, screws, or other approved fasteners.

(5) Insulation on irregular surfaces and vessel tops, where use of metal jacket is impracticable, shall be protected with PVA mastic weather-barrier coating as called for in Article XIV.B. of this specification.

2. Piping

a. Preformed and prepolied stainless steel jackets with preformed longitudinal Z joint shall be applied as follows:

(1) Inner layer of insulation, if any, shall be secured with stainless steel wire if high temperature, or with glass filament tape if low temperature.

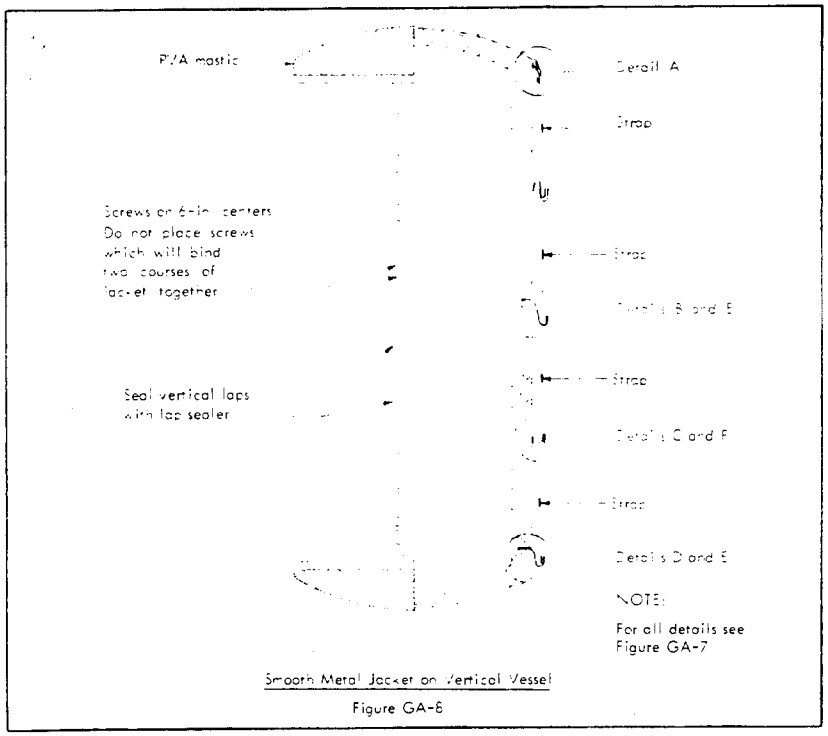
(2) Factory attached jacket to a single or outer layer insulation shall be installed with the insulation. Insulation and jacket shall be installed by placing the insulation around the pipe, or inner layer, and engaging the Z joint. Longitudinal laps on horizontal pipe shall be located on horizontal centerline of pipe with open end down to ensure runoff of water. Jacketing over 8 inches and smaller shall be secured with one strap at center of the assembly. Larger diameter insulation and jacketing shall be secured with two straps, each approximately 12 inches from end of assembly. Details are shown in Figure GA-8.

(3) Where necessary (such as where insulation must be cut to fit around obstructions) to install the single or outer layer of insulation prior to the installation of jacket, the insulation shall be secured with wire. Ends of wire shall be twisted and embedded in surface of insulation so as to provide a smooth even surface for application of the jacket. Jacket shall then be installed as specified above.

(4) The butt joint between adjacent assemblies shall be sealed with a closure band. If non-setting sealer or closure band is selected with adhesive, the paper shall be removed before installation. Closure bands shall be secured with stainless steel straps

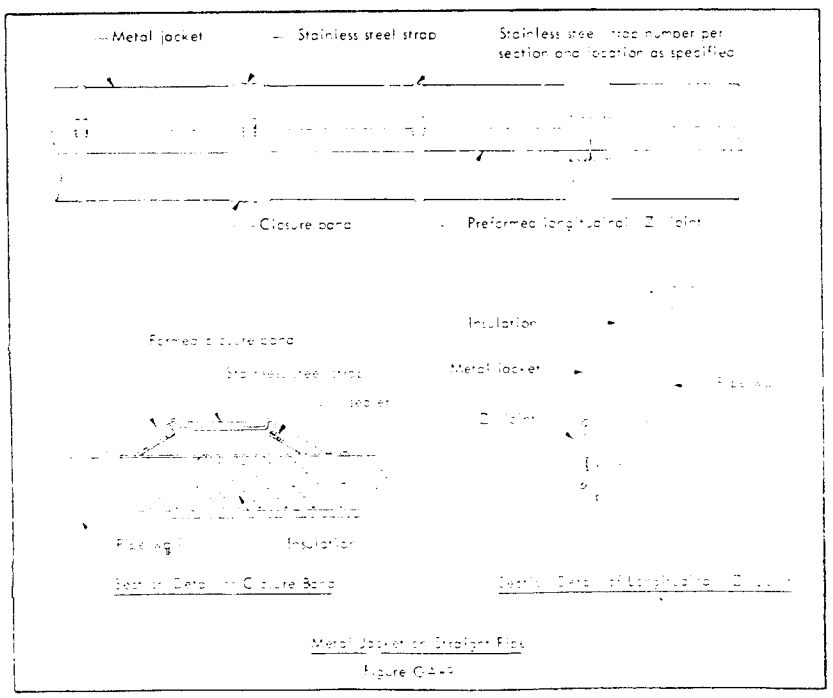
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METAL JACKETS - STAINLESS STEEL OR TREATED STEEL - cont'd



Smooth Metal Jacket on Vertical Vessel

Figure GA-6



Metal Jacket on Straight Pipe

Figure GA-8

METAL JACKETS - STAINLESS STEEL OR TREATED STEEL - contd

B. Application - contd

2. Piping - contd

c. Stainless steel jackets for insulation valve covers and insulation fitting covers shall, where possible, be factory or shop preformed to fit the covers in accordance with ASTM Recommended Practice C 450, latest revision. Jackets shall be secured to covers by screws, strap, or fasteners furnished by the manufacturer, depending upon their design. All laps shall be installed to shed water or shall be sealed with lap sealer.

d. Field cut and formed jackets for closely connected and special fittings shall be fabricated and formed of soft annealed stainless steel strip. All joints shall be lapped a minimum of two inches and shall be sealed with lap sealer. Formed pieces shall be secured with stainless steel strap or screws.

e. Hot metal projections through the insulation and weather-barrier jackets shall be seal caulked with heat-resistant sealer.

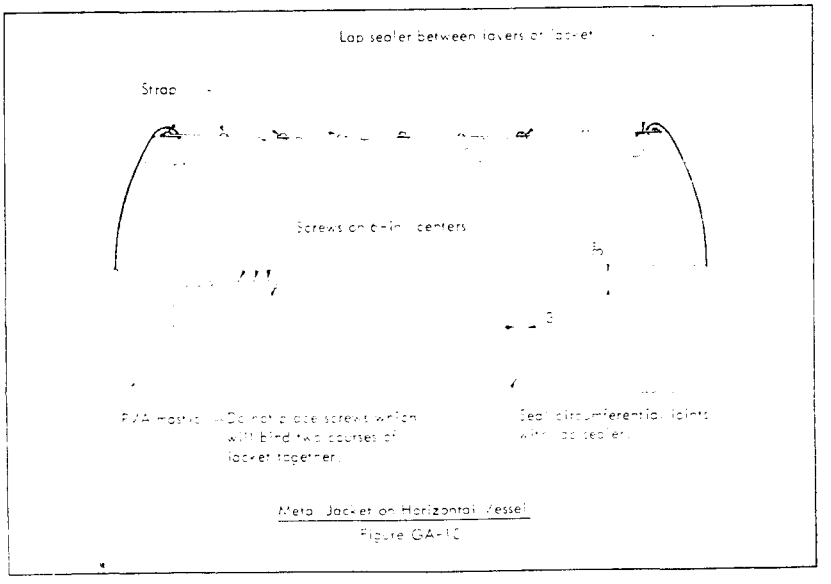
3. Metal Jackets in Combination with Weather-Barrier Mastics - Where especially specified, the stainless steel jacketing may be used in combination with weather-barrier mastics.

a. Equipment

(1) Where vessel heads are specified to be weather protected with mastic and the cylindrical section to be protected with metal jacketing, the mastic shall be installed in accordance with Article XIV.B. of this specification. Metal at cylindrical section of vertical vessel shall be lapped over bottom head mastic at least three inches. At top of vessel a six-inch wide stainless steel flashing strip shall be embedded into weather-barrier mastic and banded into place. It shall lap top course of jacketing three inches, but it shall not be attached to the jacket. Additional weather-barrier mastic used over head insulation shall be carried down over the flashing to provide water shed. Details are shown in Figure GA-7.

(2) At junction of weather-barrier mastic and jacket of horizontal vessel the mastic shall be lapped over the metal jacket for a minimum of three inches.

b. Piping - Where straight pipe is metal jacketed and fittings weather protected with mastic, the mastic weather barrier shall be installed in accordance with Article XIV.B. of this specification. The mastic weather barrier on fittings shall be lapped over the pipe jacketing one inch. Where possible, over this butt joint between the mastic weather barrier on fittings and the metal pipe jacket a closure band shall be installed as specified in Article XV. B. 2. a. (4) of this specification.

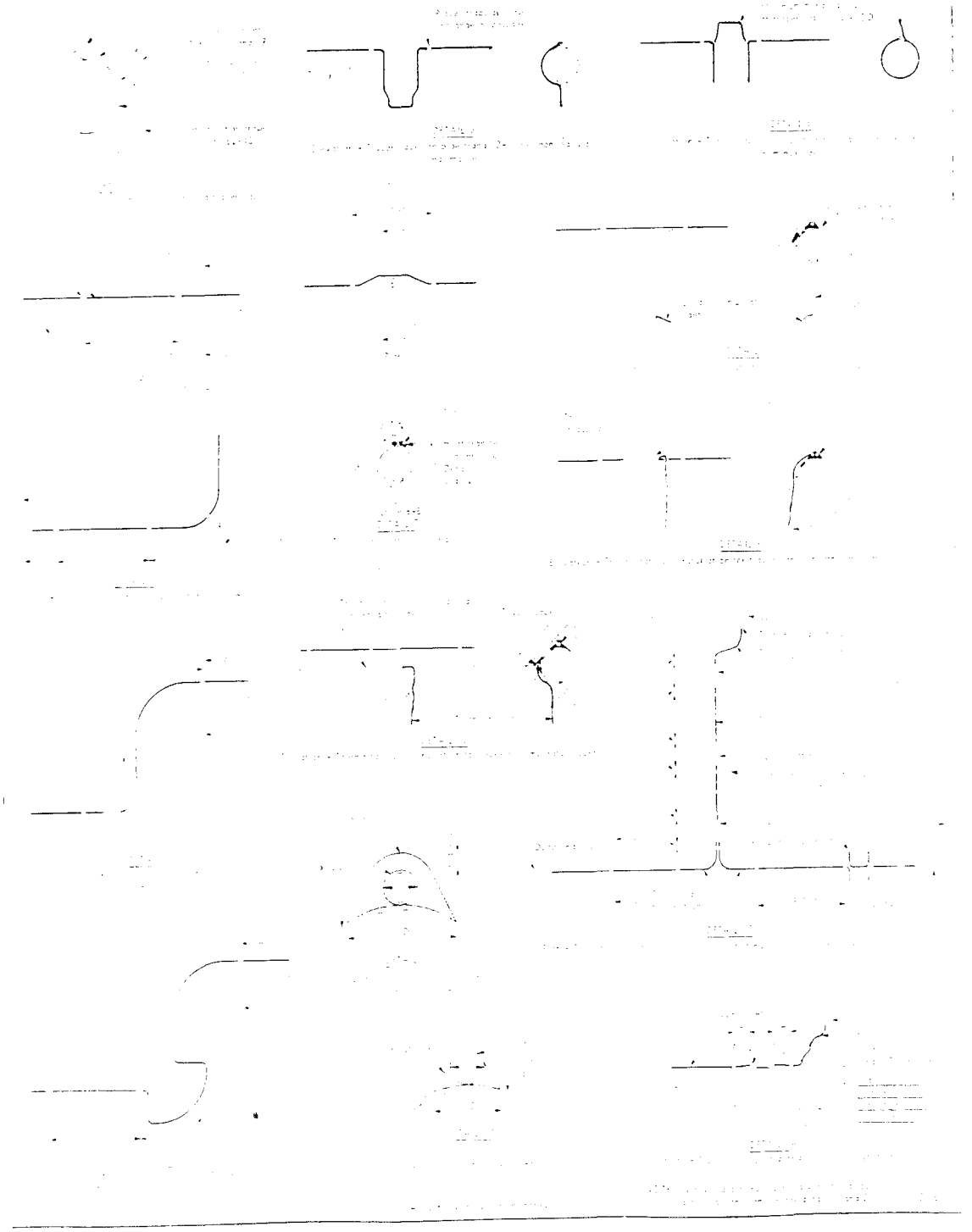


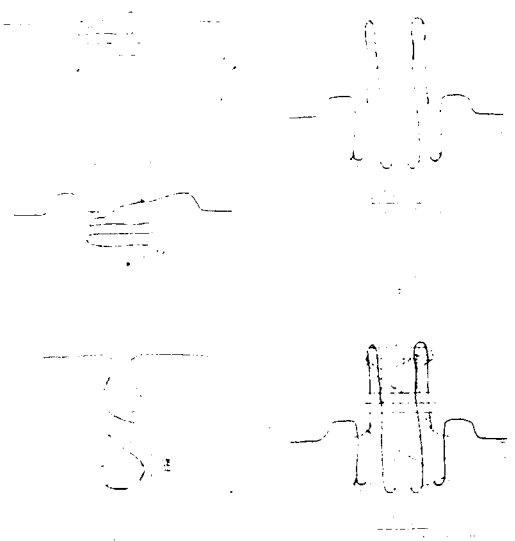
Metal Jacket on Horizontal Vessel
Figure GA-10

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ELECTRIC TRACING SYSTEM DETAILS AND MATERIALS





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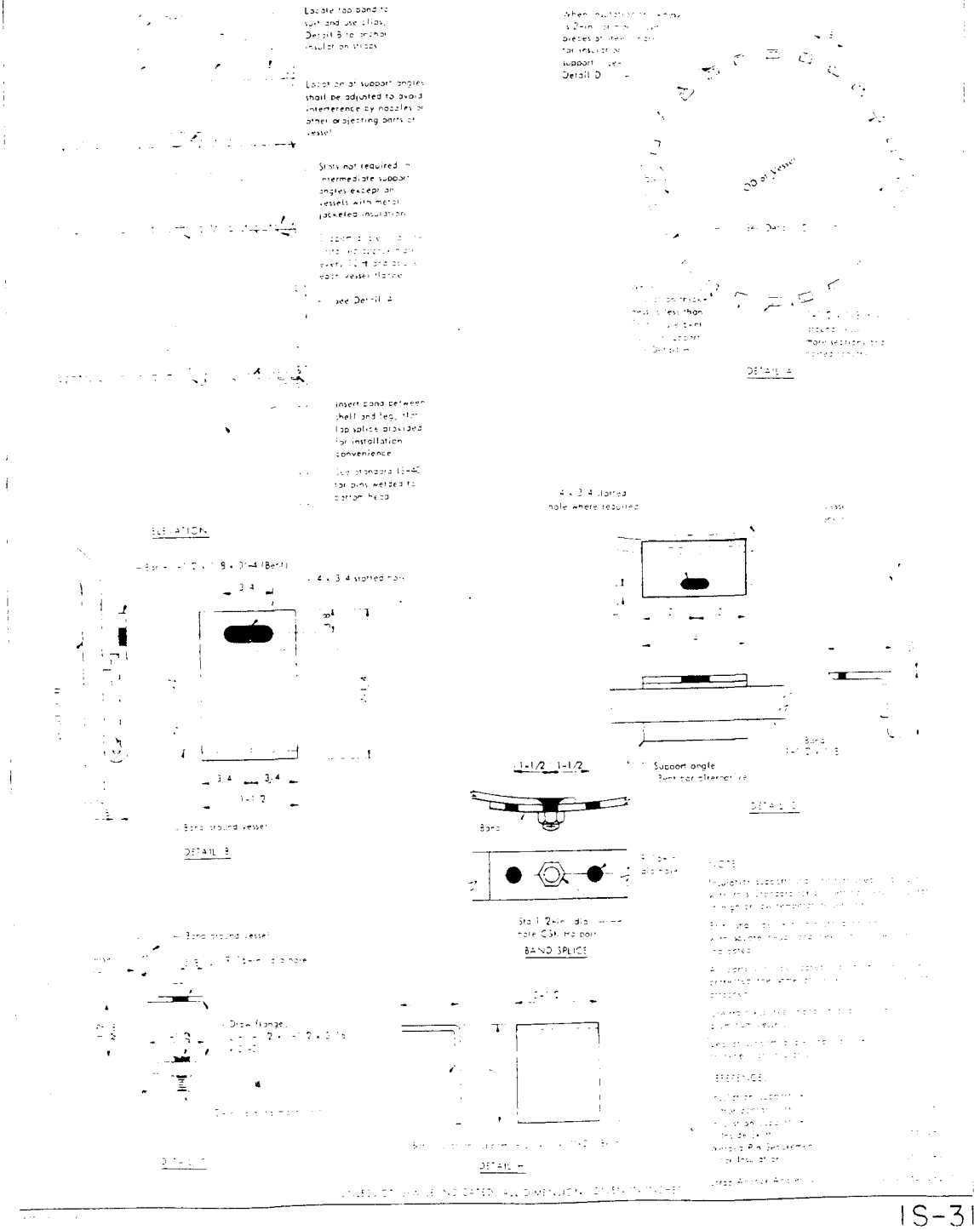
STANDARD

CHEMICALS, OLEFINS, PLASTICS, SILICONES DIVISIONS AND UNION CARBIDE CANADA

DETAIL

NUMBER IS-31
ISSUED 9-26-56
REVISED 4-1-66

INSULATION SUPPORTS - VERTICAL VESSELS OVER 1'-5 OD AND 10'-0 HIGH



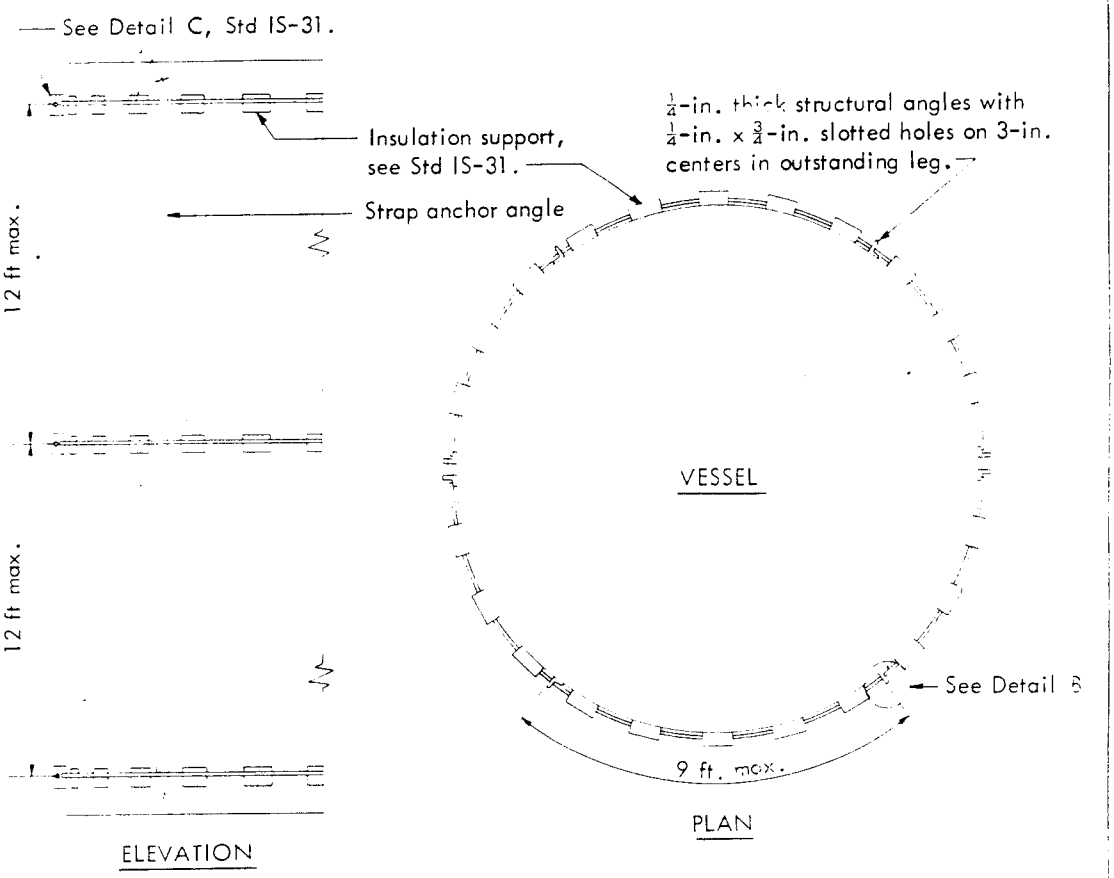
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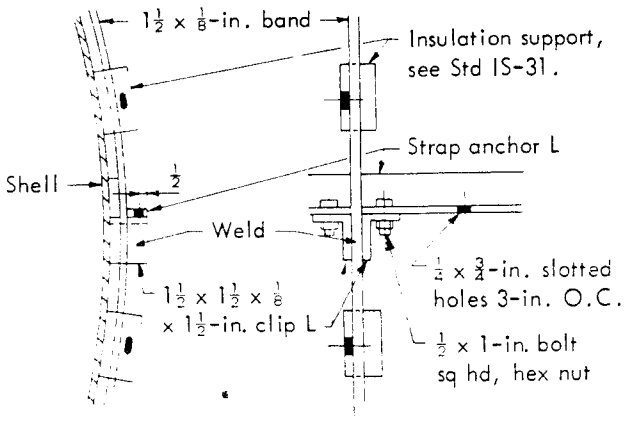
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STRAP ANCHOR ANGLES FOR INSULATION





DETAIL B

O.D. of Vessel	No. of Angles Required
15'-0 to 27'-0	4
27'-1 to 36'-0	6
over 36'-0	One angle for each 9-ft. or fraction thereof

NOTE:

Length of angle legs to vary with thickness of insulation.

Angles to be spaced equally, as nearly as possible, around circumference of vessel.

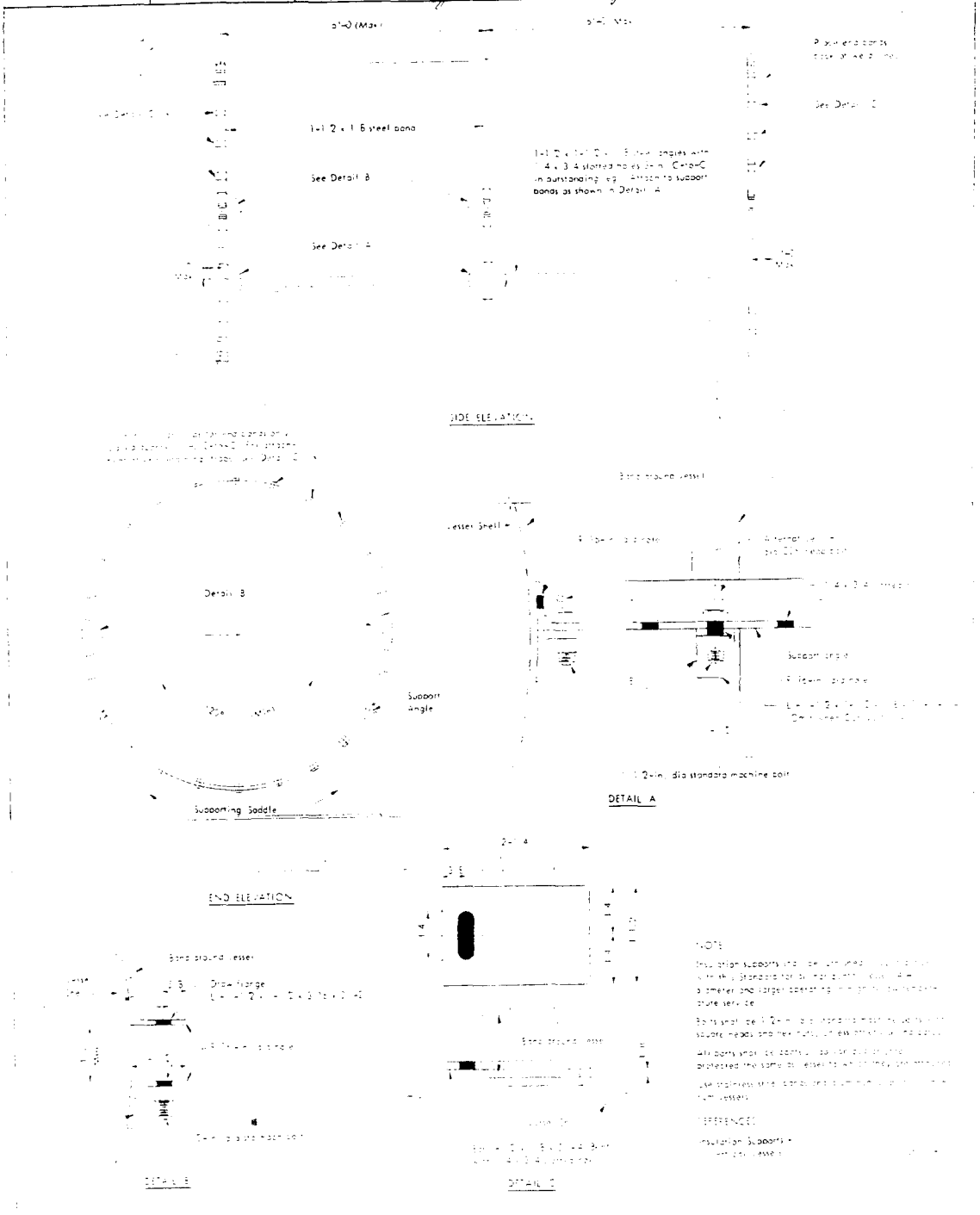
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Union Carbide trial exhibit UC-4586: W. G. Hammar Transmittal Memoranda and Union Carbide Thermal Insulatio...
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UNION CARBIDE CORPORATION CHEMICALS AND OLEFINS DIVISIONS SOUTH CHARLESTON WEST VIRGINIA	INSULATION SUPPORTS - HORIZONTAL VESSELS	ENGINEERING STANDARD NO. IS-36

ASSY. OR DET.	SPONSOR	REVIEWED BY	APPROVED BY	ISSUED	REVISED
DETAIL	DEPT 936	S.H. Smith, Jr.	F.L. Cameron	9-26-56	11-13-64



UNLESS OTHERWISE INDICATED, ALL DIMENSIONS ARE IN INCHES

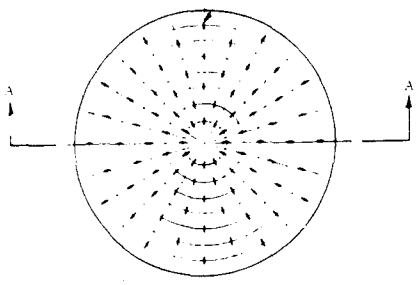
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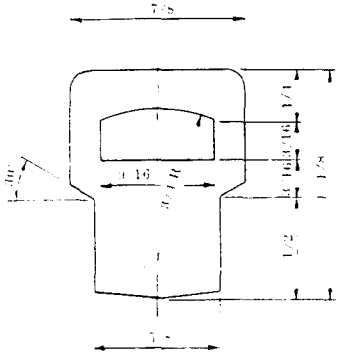
UNION CARBIDE CORPORATION OLEFINS DIVISION SOUTH CHARLESTON WEST VIRGINIA	WELDED PIN SECUREMENT FOR INSULATION	ENGINEERING STANDARD NO IS-40

CLASSIFICATION	SPONSOR	REVIEWED BY	APPROVED BY	ISSUED	REVISED
DETAIL	DEPT 936	S H Smith, Jr.	F L Crawford	2-15-63	8-23-63

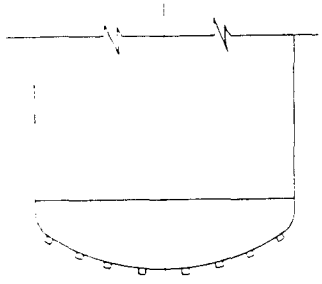
Pins welded to bottom head of DH tank on 12-in. centers each way, staggered, with 7 5/8-in. dimension in radial direction.



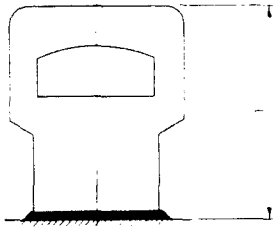
Bottom View - DH Tank



Before Welding



Elevation A-A



After Welding

Front Elevations of Pin

NOTE:

This standard applies only to carbon steel vessels over 6 ft OD and operating at temperatures above 70 F.

Pins shall be as manufactured by KSM Products, Inc, Moorestown, New Jersey, or approved equal.

Pins shall be welded to vessel with a KSM CD-60 Capacitor Discharge Stud Welding Unit (or approved equal) with accessory chuck to suit pins.

Pins are 1/8 in. thick.

REFERENCES:

Insulation Supports - Vertical Vessels IS-41
Insulation Supports - Inside of Vessel Skirt IS-42

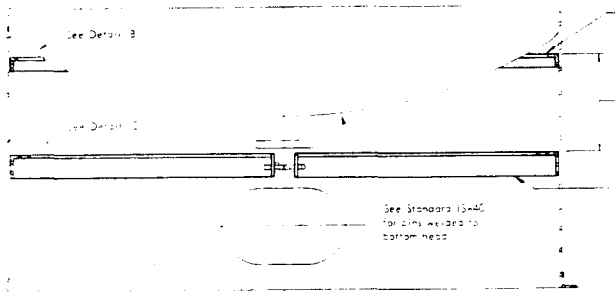
All dimensions given in inches

Union Carbide trial exhibit UC-4586: W. G. Hammar Transmittal Memoranda and Union Carbide Thermal Insulatio...
ACL Doc 19137 · Page 37 of 328
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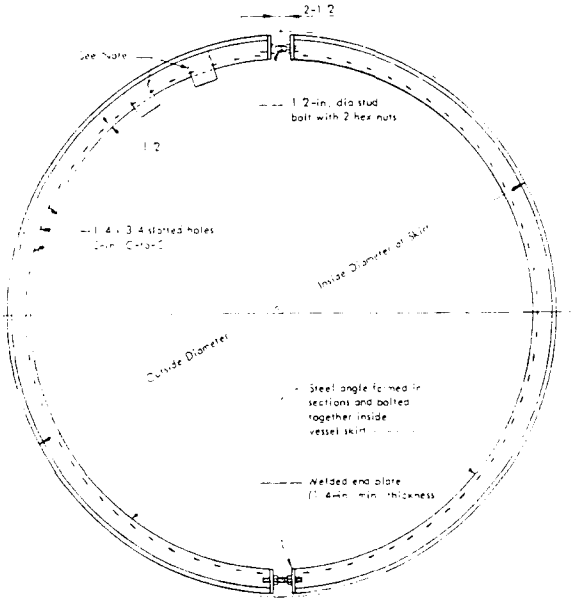
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UNION CARBIDE CORPORATION CHEMICALS AND OLEFINS DIVISIONS SOUTH CHARLESTON, WEST VIRGINIA	INSULATION SUPPORTS - INSIDE OF VESSEL SKIRT	ENGINEERING STANDARD NO. IS-42

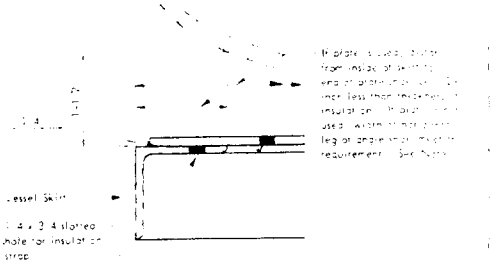
CLASSIFICATION	SPONSOR	REVIEWED BY	APPROVED BY	ISSUED	REVISED
DETAIL	DEPT 936	S H Smith Jr	F L Comerford	9-26-56	11-13-64



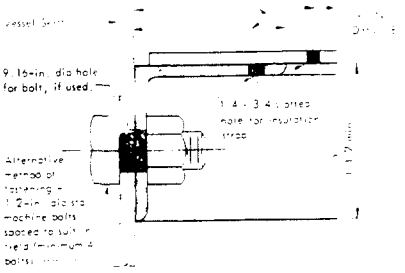
SECTION



DETAIL A
(Bottom View)



DETAIL B



DETAIL C

NOTE

REFERENCES

UNLESS OTHERWISE INDICATED, ALL DIMENSIONS GIVEN IN INCHES

Union Carbide trial exhibit UC-4586: W. G. Hammar Transmittal Memoranda and Union Carbide Thermal Insulatio…
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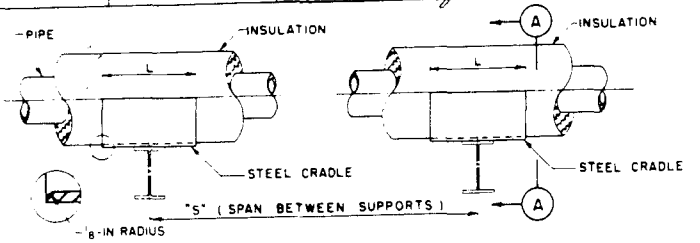
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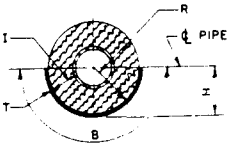
UNION CARBIDE CORPORATION
CHEMICALS OLEFINS, PLASTICS AND SILICONES DIVISIONS

CRADLE SUPPORTS FOR INSULATED PIPES

ENGINEERING STANDARD NO **P-82**

CLASSIFICATION	SPONSOR	REVIEWED BY	APPROVED BY	ISSUED (AS IS-18)	REVISED
DATA	DEPT 936	S H Smith Jr.		5-25-51	9-1-65





SECTION A-A

LEGEND
H = DIMENSION FROM ℄ OF PIPE TO BOTTOM OF CRADLE
T = CRADLE THICKNESS
L = CRADLE LENGTH

B = PLATE WIDTH BEFORE FORMING
R = BENDING RADIUS FOR PLATE ("H" MINUS "T")
S = SPAN, IN FEET, BETWEEN SUPPORTS.

NOM PIPE SIZE	DIMENSIONS	"I" INSULATION THICKNESSES (NOMINAL) 1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7	7 1/2	8	8 1/2	9	10	"L" CRADLE LENGTH "S" SPAN 10-FT	12-FT	15-FT	18-FT	20-FT	25-FT	NOM PIPE SIZE
1/2	H	1 1/2	2	2 1/2	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7 1/4	7 3/4	8 1/4	—	—	—	—	—	10	—	—	—	—	—	1/2
	T	14 GA				1/8				3/16				1/4												
	B	4 1/2	6 1/4	7 3/4	10 3/8	12	13 1/2	15	17	18 1/2	20	22	23 1/2	25	—	—	—	—	—							
3/4	H	1 1/2	2	2 1/2	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7 1/4	7 3/4	8 1/4	—	—	—	—	—	10	—	—	—	—	—	3/4
	T	14 GA				1/8				3/16				1/4												
	B	4 1/2	6 1/4	7 3/4	10 3/8	12	13 1/2	15	17	18 1/2	20	22	23 1/2	25	—	—	—	—	—							
1	H	1 3/4	2 1/4	2 7/8	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7 1/4	7 3/4	8 1/4	—	—	—	—	—	10	10	—	—	—	—	
	T	14 GA				1/8				3/16				1/4												
	B	5 1/2	7	8 3/4	10 3/8	12	13 1/2	15	17	18 1/2	20	22	23 1/2	25	—	—	—	—	—							
1 1/2	H	2	2 1/2		3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7 1/4	7 3/4	8 1/4	8 3/4	9 1/4	9 3/4	10 1/4	10 3/4	11 3/4	10	10	—	—	—	1/2
	T	14 GA				1/8				3/16				1/4					5/16							
	B	6 1/4	7 3/4	10 3/8	12	13 1/2	15	17	18 1/2	20	22	23 1/2	25	26 1/2	28	30	31 1/2	33	36							
2	H	2 1/4	2 7/8		3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7 1/4	7 3/4	8 1/4	8 3/4	9 1/4	9 3/4	10 1/4	10 3/4	11 3/4	10	10	10	—	—	2
	T	14 GA				1/8				3/16				1/4					5/16							
	B	7	8 3/4	10 3/8	12	13 1/2	15	17	18 1/2	20	22	23 1/2	25	26 1/2	28	30	31 1/2	33	36							
3	H	2 7/8		3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7 1/4	7 3/4	8 1/4	8 3/4	9 1/4	9 3/4	10 1/4	10 3/4	11 1/4	12 1/4	10	10	10	—	—	3
	T	14GA			1/8			3/16				1/4					5/16									
	B	8 3/4	10 3/8	12	13 1/2	15	17	18 1/2	20	22	23 1/2	25	26 1/2	28	30	31 1/2	33	34 1/2	37 1/2							
4	H	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7 1/4	7 3/4	8 1/4	8 3/4	9 1/4	9 3/4	10 1/4	10 3/4	11 1/4	11 3/4	12 3/4	10	10	10	12	—	—	4
	T	1/8				3/16				1/4					5/16											
	B	10 3/8	12	13 1/2	15	17	18 1/2	20	22	23 1/2	25	26 1/2	28	30	31 1/2	33	34 1/2	36	39							
6	H	4 1/2	5		5 1/2	6	6 1/2	7 1/4	7 3/4	8 1/4	8 3/4	9 1/4	9 3/4	10 1/4	10 3/4	11 1/4	11 3/4	12 1/4	12 3/4	13 3/8	10	10	12	16	16	—	6
	T	1/8			3/16				1/4						5/16					3/8						
	B	13 1/2	15		17	18 1/2	20	22	23 1/2	25	26 1/2	28	30	31 1/2	33	34 1/2	36	37 1/2	39	42 1/2						
8	H		6	6 1/2	7 1/4	7 3/4	8 1/4	8 3/4	9 1/4	9 3/4	10 1/4	10 3/4	11 1/4	11 3/4	12 1/4	12 3/4	13 3/8	13 7/8	14 3/8		10	12	16	16	20	—	8
	T	—	—	3/16				1/4						5/16					3/8							
	B		18 1/2	20	22	23 1/2	25	26 1/2	28	30	31 1/2	33	34 1/2	36	37 1/2	39	40 3/4	42 1/2	45 1/2							
10	H		7 1/4	7 3/4	8 1/4	8 3/4	9 1/4	9 3/4	10 1/4	10 3/4	11 1/4	11 3/4	12 1/4	12 3/4	13 3/8	13 7/8	14 3/8	14 7/8	15 3/8		12	16	20	20	24	—	10
	T	—	3/16			1/4					5/16					3/8			7/16							
	B		22	23 1/2	25	26 1/2	28	30	31 1/2	33	34 1/2	36	37 1/2	39	40 3/4	42 1/2	44	45 1/2	48 3/4							
12	H			8 1/4	8 3/4	9 1/4	9 3/4	10 1/4	10 3/4	11 1/4	11 3/4	12 1/4	12 3/4	13 3/8	13 7/8	14 3/8	14 7/8	15 3/8	15 7/8	16 3/8		12	16	20	24	24	—	12
	T	—	—	1/4					5/16					3/8					7/16							
	B			25	26 1/2	28	30	31 1/2	33	34 1/2	36	37 1/2	39	40 3/4	42 1/2	44	45 1/2	47	48 3/4	51 3/4							
14	H			8 3/4	9 1/4	9 3/4	10 1/4	10 3/4	11 1/4	11 3/4	12 1/4	12 3/4	13 3/8	13 7/8	14 3/8	14 7/8	15 3/8	15 7/8	16 3/8	17 3/8		16	20	24	24	30	36	14
	T	—	—	1/4					5/16					3/8					7/16							
	B			26 1/2	28	30	31 1/2	33	34 1/2	36	37 1/2	39	40 3/4	42 1/2	44	45 1/2	47	48 3/4	50 1/4	53 1/2							
16	H			9 3/4	10 1/4	10 3/4	11 1/4	11 3/4	12 1/4	12 3/4	13 3/8	13 7/8	14 3/8	14 7/8	15 3/8	15 7/8	16 3/8	16 7/8	17 3/8	18 1/2		16	20	24	30	36	42	16
	T	—	—	1/4					5/16					3/8					7/16	1/2						
	B			30	31 1/2	33	34 1/2	36	37 1/2	39	40 3/4	42 1/2	44	45 1/2	47	48 3/4	50 1/4	51 3/4	53 1/2	56 1/2							
18	H			10 3/4	11 1/4	11 3/4	12 1/4	12 3/4	13 3/8	13 7/8	14 3/8	14 7/8	15 3/8	15 7/8	16 3/8	16 7/8	17 3/8	17 7/8	18 1/2	19 1/2		20	24	30	36	36	42	18
	T	—	—	5/16				3/8					7/16					1/2								
	B			33	34 1/2	36	37 1/2	39	40 3/4	42 1/2	44	45 1/2	47	48 3/4	50 1/4	51 3/4	53 1/2	55	56 1/2	59 1/2							
20	H			11 3/4	12 1/4	12 3/4	13 3/8	13 7/8	14 3/8	14 7/8	15 3/8	15 7/8	16 3/8	16 7/8	17 3/8	17 7/8	18 1/2	19	19 1/2	20 1/2		24	24	30	36	42	48	20
	T	—	—	5/16			3/8					7/16					1/2									
	B			36	37 1/2	39	40 3/4	42 1/2	44	45 1/2	47	48 3/4	50 1/4	51 3/4	53 1/2	55	56 1/2	58	59 1/2	62 1/2							
24	H			13 3/8	14 3/8	14 7/8	15 3/8	15 7/8	16 3/8	16 7/8	17 3/8	17 7/8	18 1/2	19	19 1/2	20	20 1/2	21 1/8	21 5/8	22 5/8		30	30	36	42	48	54	24
	T	—	—	3/8				7/16					1/2					5/8								
	B			42 1/2	44	45 1/2	47	48 3/4	50 1/4	51 3/4	53 1/2	55	56 1/2	58	59 1/2	61	62 1/2	64 1/2	66	69							

ALL DIMENSIONS GIVEN IN INCHES

(OVER)

936.130.003

P-82

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ENGINEERING STANDARD NO. P-82

NOTE:

Dimensional insulation data is taken from standard insulation tables. It should be noted that the insulation OD and ID are standardized to match the OD of standard nominal pipe sizes, and for thicknesses over 2 1/2-in., multilayer construction is used.

Cradle design is based on a maximum bearing value of 20 lb per sq in. for cellular glass, with one percent allowable deformation without damage to the insulation. Other types of insulation will tolerate greater pressures and higher percentages of deformation without loss of insulation values.

The bottom 120° arc has been established as the effective cross-sectional bearing area for insulation and supporting cradles, with the first inch of insulation next to the pipe absorbing the greatest proportion of the load pressure. Cradle material beyond the 120° arc is useful for installation and retention only.

The following equations are the results of complex formulae reduced to simplified ratios for ease of application.

$$T = .0125\, D_2 \qquad L = .0125\, \frac{12wS}{D_2} \quad \text{or} \quad .15\, \frac{wS}{D_2}$$

Where:

T = thickness of cradle in inches
L = length of cradle in inches
D_1 = OD of bare pipe in inches
D_2 = OD of insulation in inches
S = span between supports in feet
w = unit wt per foot of pipe, water, and insulation, plus 10% safety factor.
f = (20 lb/sq in.) bearing value for insulation
c = (1.5) coefficient of friction for longitudinal movement.

"T" and "L" have been adjusted to increments most suitable for practical application. "L" has been further controlled by the greater of three minimum values as follows:

(1) ten inches (2) one pipe diameter (3) $\frac{wcS}{D_1 f}$

Cradles are intended for use in straight run horizontal piping with flanges and fittings, short vertical runs less than S/2, and installations not subject to vibration.

Runs including valves or long vertical portions shall be treated with special consideration.

Where severe vibration is anticipated, such as in compressor lines, the insulation between the cradle and the pipe shall be resistant to vibration.

001

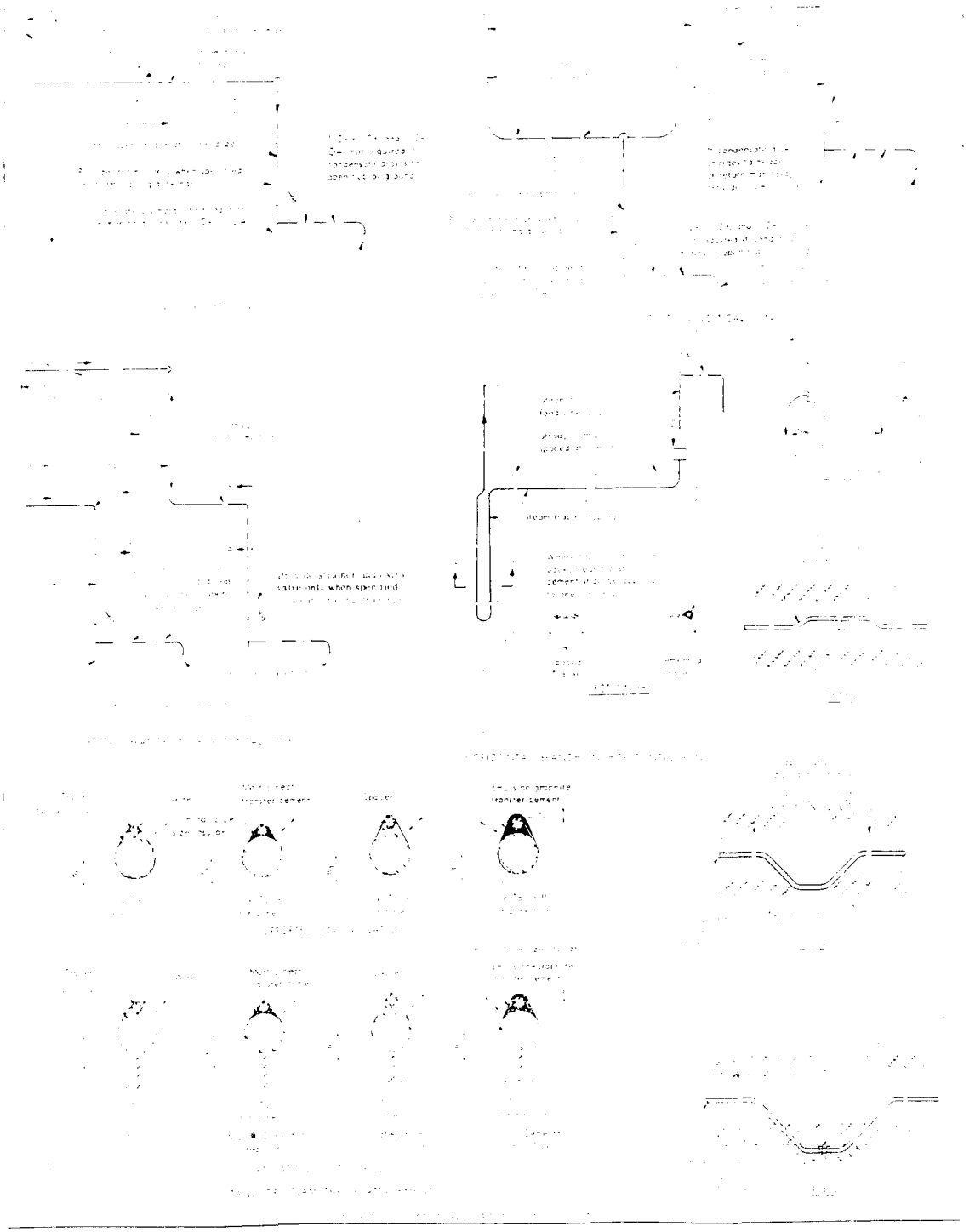
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STANDARD

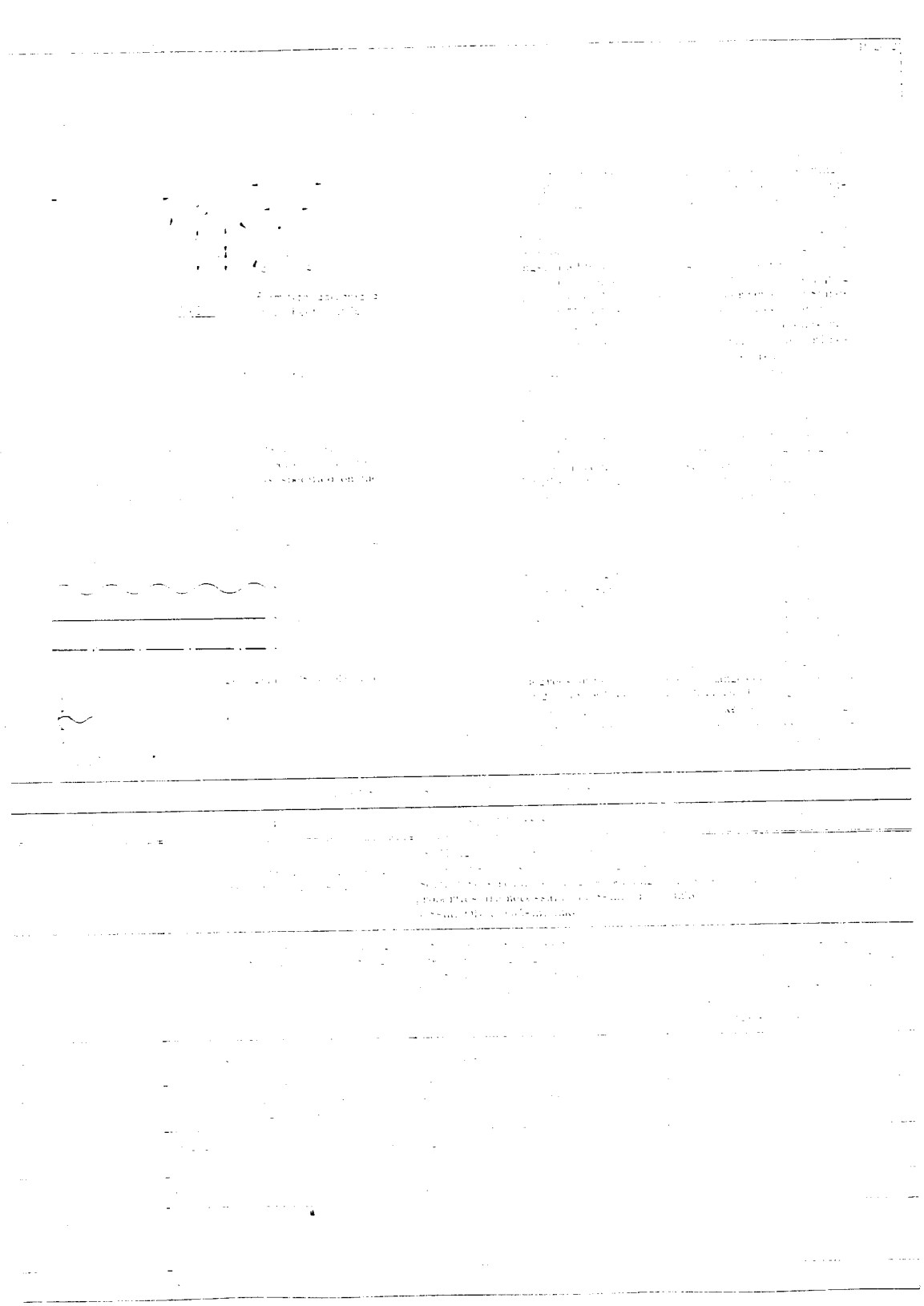
UNION CARBIDE

P-140
PIPING – DETAIL
6-1-66

STEAM TRACING SYSTEM DETAILS AND MATERIALS

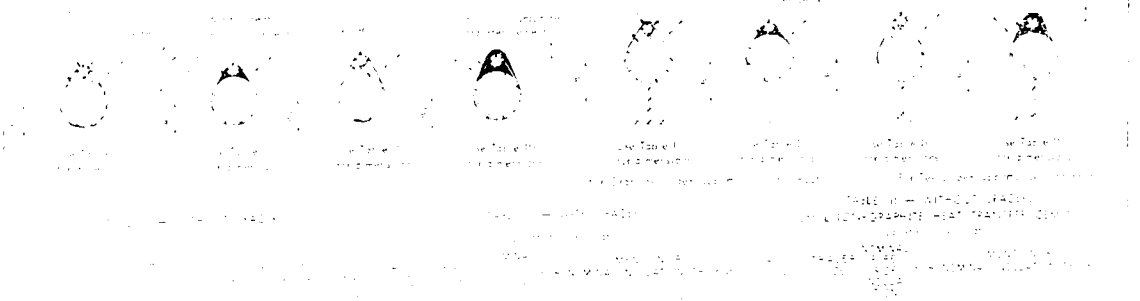


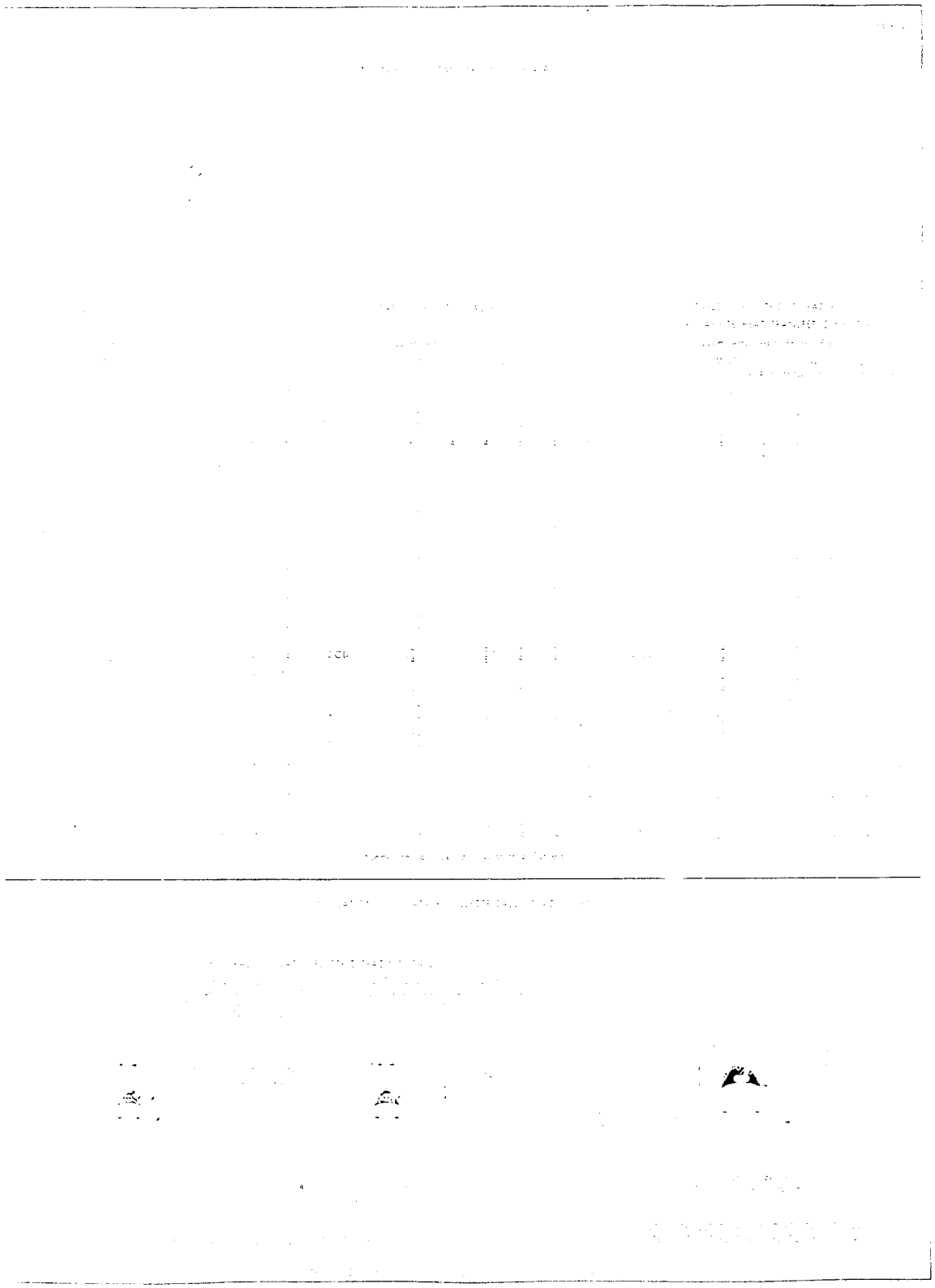
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INSULATION SIZES FOR HEAT TRACED SYSTEMS





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THERMAL INSULATION MATERIAL SPECIFICATIONS

SCOPE

These specifications describe the essential requirements for the purchase of thermal insulation, including block, pipe covering, preformed shapes, and accessory materials.

Materials and accessories as listed in individual specifications shall be of quality, type, or identification as called for in these Material Specifications.

I MATERIAL - GENERAL

A. Types and Dimensions

Material furnished under these specifications shall be of type and thickness listed on Insulation Design Schedules, Insulation Equipment and Pipe Lists, or as otherwise prescribed by the Purchaser.

1. Pipe insulation shall be furnished in conventional lengths, plus or minus not more than 3/32 inch, with ends cut square. Inside diameter shall fit firmly on specified pipe size and outside diameter shall correspond to a Nominal Pipe Size, with the exception of Specification No. 14, Preformed Flexible Plastic Foam.

B. Sampling for Testing. Where vendor is unable to provide acceptable test or performance data, to meet the requirements of these specifications, representative samples of insulating and accessory materials shall be submitted to the Purchaser in sizes and amounts required for testing. In all instances these samples, which shall be supplied without cost to Purchaser, shall be shipped by Vendor within seven days following receipt of written request.

C. Packaging. Unless otherwise agreed, material shall be packed in substantial containers, so constructed as to ensure safe delivery of material by common and other approved carrier in a condition satisfactory to the Purchaser.

D. Marking and Identification. Unless otherwise specified, shipping containers shall be legibly marked with name of material, size, type, and quantity contained therein; name of Insulation Contractor, if any, and purchase order number under which shipment is made. In addition, where required, container shall bear the work order number, the Item or Line Number for which material is intended, and its relative position and sequence of application.

E. Attachments

1. Standard lacquered or brass bands, customarily furnished by the manufacturer of pipe insulation, will not be required.

2. Canvas or other factory-applied surfacing, where required with insulating material, shall be as called for on bills of material or purchase requisitions.

F. Approved Equals. Other insulating and/or accessory materials may be approved by the Purchaser, but only where clearly shown that properties involved conform to these specifications.

II PROPERTIES

A. Properties of insulation shall be in accordance with the applicable standard ASTM Test Methods, latest revision.

B. Test values for a given insulating material shall be in accordance with limits called for in properties listed for that material within these specifications.

C. ASTM Test Methods for the following properties are:

Breaking Load - Calculated Flexural Strength - Block Insulation	C 203
Breaking Load - Calculated Flexural Strength - Pipe Insulation	C 446
Compressive Strength	C 165
Deflection Strength	C 209 - 14 through 16
Density - Block Insulation	C 303
Density - Pipe Insulation	C 302
Density - Blanket Insulation	C 167
Fire Resistance - Combustibility	E 136
Fire Resistance - Flammability of Plastic Foams and Sheeting	D 1692
Fire Resistance - Flame Spread	C 209 - Part 32
Hardness	C 569
Hot Surface Performance	C 411
Maximum Use Temperature	C 447
Resistance to Abrasion	C 421
Resistance to Dropping	C 487
Shrinkage after Heat Soaking	C 356
Specific Heat	C 351
Tensile Strength	C 209 - 18 through 24; C 446
Thermal Conductivity (Depending on Material and Temperature)	C 177, C 335, C 420, or C 518
Water Absorption	C 209 - 26 through 28
Water Vapor Transmission	C 355

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UNION CARBIDE

STANDARD

CHEMICALS AND PLASTICS OPERATIONS DIVISION
AND UNION CARBIDE CANADA LIMITED

M
INSULATION
FEBRUARY

... FLANGED ELEMENTS, LAGGING AND PIPE INSULATION

... insulation shall be in accordance with ASTM C 312 and C 521 ... latest revisions.

... flat side wall segments of insulation for hot equipment, and pipe insulation, with the excess ... Thickness 3-inch and greater shall be ... layers ... including 3-inch thickness. Thickness 3-inch and greater shall be ... layers ...

... Inches	Inner Layer Nominal Thickness, Inches	Middle Layer Nominal Thickness, Inches	Outer Layer Nominal Thickness, Inches
...	1-1/2	None	...
...	...	None	...
...	2	None	2-1/2
...	2-1/2	None	2-1/2
...	2-1/2	None	...
...	3	None	...
...	...	...	...
...	...	2-1/2	2-1/2
...	2-1/2	2-1/2	2-1/2
...	2-1/2	2-1/2	2
...	2-1/2	3	3
...	...	3	3

... insulation on ... 12 inches O.D. and over shall ... multiple layer application ... insulation shall be ... in accordance with ASTM Recommended Practice C 450, latest revision.

... insulated, cellular glass insulation on low temperature equipment and piping and all other specified ... piping 2-1/2-inch thickness. Insulation in excess of 2-1/2 inches total thickness shall be applied ... with the following table.

... Scheduled Thickness, Inches	Inner Layer Thickness, Inches	Outer Layer Thickness, Inches
...	1-1/2	...
2-1/2	2	...
...	...	...
4	...	...
4-1/2	...	3
...	...	...
5	3	2
...	...	2-1/2
6	4	...
...	...	...
...	4	...
8	4-1/2	3
...	...	3-1/2
...	5	4
9	...	...
...	6	4-1/2
10	...	5

... and marking, ... above specified.

... FITTINGS AND FLANGE COVERS

... valve, flange, all ... and tee covers, ... shall be ... in accordance with ASTM Recommended Practice C 450, latest revision.

... shall be ... with a ... of ...

... REQUIRED FOR ALL INSULATION MATERIALS

... shall be ... by Specification Number, ... of ... and ...

.1 SPECIFICATIONS FOR INDIVIDUAL INSULATION MATERIALS – cont'd

SPECIFICATION NO. 10: CELLULAR GLASS INSULATION

Composition

Material shall be composed of glass, completely inorganic, processed and cellulated at temperatures sufficient to produce a rigid, cellular thermal insulation.

Properties

Alkalinity . . . . . pH shall be between 6.9 and 7.5.

Capillarity . . . . . After 7 days on wet surface, gain in weight shall be 0%.

Coefficient of Expansion . . . . . Shall average 4.6×10^{-6} per degree F.

Combustibility . . . . . Shall be incombustible.

Compressive Strength . . . . . Shall be not less than 100 psi.

Density . . . . . Shall be not less than 8 lb per cu ft, nor more than 11 lb per cu ft.

Flexural Strength . . . . . Shall be not less than 75 psi.

Hygroscopicity . . . . . Two-inch cubes dried at 220 F to constant weight, then exposed to air at 70 F and 50 relative humidity for 14 days, shall not gain any weight.

Maximum Use Temperature . . . . . Maximum temperature without mechanical, thermal, or chemical failure shall be not less than 800 F.

Resistance to Acids . . . . . Shall be impervious to common acids and fumes except hydrofluoric and hot phosphoric.

Shear Strength . . . . . Shall be not less than 40 psi.

Specific Heat . . . . . Shall average 0.20 Btu per lb per degree F.

Tensile Strength . . . . . Shall be not less than 40 psi.

Thermal Conductivity . . . . . The thermal conductivity at the given mean temperatures shall not exceed the following values:

Mean Temp, °F	Btu inch, hr, sq ft, °F
0	0.36
100	0.42
200	0.48
300	0.56
400	0.63
600	0.74

Thermal Diffusivity at 75 F . . . . . Shall average 0.42 sq ft per day.

Water Absorption . . . . . After 24-hour submersion, shall not exceed 0.2% by volume (surface only).

Water Vapor Transmission . . . . . Shall have a WVT of zero grains per sq ft per hour.

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[illegible] SPECIFICATIONS FOR INDIVIDUAL INSULATION MATERIALS - cont'd

Union Carbide trial exhibit UC-4586: W. G. Hammar Transmittal Memoranda and Union Carbide Thermal Insulatio…
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II. SPECIFICATIONS FOR INDIVIDUAL INSULATION MATERIALS - cont'd

SPECIFICATION NO. 12 RIGID URETHANE FOAM

Composition

Material shall be composed of polyurethane foamed into a closed cell rigid thermal insulation.

Properties

Closed Cell Content . . . . . Shall be not less than 90%, as determined on sample 2" x 2" x 2" in accordance with ASTM D 1940.

Coefficient of Expansion . . . . . Shall not exceed the following

Temperature Range, °F	Coefficient of Expansion, per °F
-75 to 200	8.0×10^{-5}

When tested in accordance with ASTM D 696.

Combustibility . . . . . Shall not have burning extent over 2 inches when tested in accordance with ASTM D 1692.

Compressive Strength . . . . . Shall be not less than 15 psi at yield point in any direction when tested in accordance with ASTM D 1621.

Density . . . . . Shall be not less than 1.8 lb per cu ft, nor more than 2.5 lb per cu ft when tested in accordance with ASTM D 1622.

Flexural Strength . . . . . Shall be not less than 20 psi in any direction in accordance with ASTM D 790.

Maximum Use Temperature . . . . . Maximum temperature without mechanical, thermal, or chemical failure shall be not less than 250 F.

Resistance to Acids, Caustics and Solvents . . . . . Shall be resistant to common hydrocarbon solvents, mild acids and caustics provided that they do not exceed 10% concentrations. (Not resistant to ketones).

Shear Strength . . . . . Shall be not less than 21 psi in any direction when tested in accordance with ASTM C 273.

Specific Heat . . . . . Shall average 0.25 Btu per lb per degree F.

Thermal Conductivity . . . . . The thermal conductivity at the given mean temperatures shall not exceed the following values. Sample to be aged at 70 F for 20 days before test.

Mean Temp, °F	Btu (in)/(hr, sq ft, °F)
0	0.16
100	0.17

Thermal Shock Resistance . . . . . Shall not split, chip, crack, or otherwise fail when heated to 250 F and then quenched with water.

Water Absorption . . . . . After 24-hour submersion, increase in weight shall not exceed 0.15 lb per sq ft of exposed surface.

Water Vapor Transmission . . . . . Shall have water vapor transmission of less than 3 (Btu)(in)/(hr, sq ft, °F) when tested by wet cup method ASTM C 355.

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M. SPECIFICATIONS FOR INDIVIDUAL INSULATION MATERIALS - contd

SPECIFICATION NO. 14: PREFORMED FLEXIBLE PLASTIC FOAM

Composition

Material shall be preformed flexible foamed plastic, having a closed cell structure.

Properties

Alkalinity	pH shall be 5 to 9.
Combustibility	Shall be self-extinguishing.
Density	Shall be not less than 5 nor more than 8 lb per cu ft.
Maximum Use Temperature	Shall not fail mechanically, thermally or chemically when subjected to continuous temperature of 180 F (sheet insulation) or 200 F (pipe insulation).
Resistance to Acids	Shall have good resistance to most common acids.
Resistance to Caustics	Shall have good resistance to most common caustics.
Specific Heat	Shall average 0.42 Btu per lb per degree F.
Thermal Conductivity	The thermal conductivity at the given mean temperatures shall not exceed the following values:

Mean Temp, °F	Btu/inch, hr, sq ft, °F
75	0.26
120	0.27

Water Absorption (by immersion)	Shall not exceed 2.5% gain, by volume.
Water Vapor Transmission	Shall not exceed 0.15 perm, inch, by wet cup test.

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1. SPECIFICATIONS FOR INDIVIDUAL INSULATION MATERIALS - contd

SPECIFICATION NO. 15: PREFORMED FIBROUS GLASS - HIGH DENSITY (Over 10 lb per cu ft)

Composition

Material shall be composed of fibrous glass molded into pipe and block insulation with an inorganic non-punking binder. Insulation for low temperature service up to and including 1-1/2-inch thickness for 6-inch NPS and smaller pipe, and 2-inch thickness for 4-inch NPS and smaller pipe, shall have factory applied fire-retardant vapor-barrier jackets consisting of aluminum foil laminated with a special embossed white kraft paper reinforced with glass fiber yarn for puncture resistance, and having self-sealing longitudinal lap joints with a self-extinguishing pressure-sensitive adhesive protected by release paper.

Properties

Alkalinity	pH shall be 8.
Capillarity	After 7 days on wet surface, gain in weight shall be 0%.
Compressive Strength	7.38 psi at 10% deformation.
Density:	
Pipe	Shall be not less than 10 nor more than 13 lb per cu ft.
Block	Shall be not less than 10 nor more than 11 lb per cu ft.
Dimensional Stability	Linear shrinkage after heating for 24 hours at 1,000 F: 1.67%.
Hygroscopicity	When exposed to air at 120 F and 95% relative humidity for 96 hours, shall be less than 0.2% by volume.
Maximum Use Temperature	Shall be suitable for use from minus 120 F to plus 1,000 F without mechanical, thermal, or chemical failure.
Resistance to Acids	Good, except to hydrofluoric and phosphoric.
Resistance to Alkalies	Poor.
Specific Gravity	Shall average 2.6 true, 0.17 apparent.
Specific Heat	Shall average 0.20 Btu per lb per degree F.
Thermal Conductivity	The thermal conductivity at the given mean temperatures shall not exceed the following values:

Mean Temp, °F	Btu inch, hr sq ft, °F
0	0.28
70	0.29
100	0.31
200	0.35
300	0.39
400	0.44
500	0.47

Thermal Diffusivity at 75 F	0.4 sq ft per day.
Water Absorption (by immersion)	2.22%.
Sizes Available:	
Pipe	Dimensional standard sizes, 1-inch, 1-1/2-inch, and 2-inch thick up to 24-inch NPS in sectional form and 30-inch NPS in segmental form.
Block	1-inch, 1-1/2-inch, and 2-inch thick by 24 inches by 48 inches.
Water Vapor Transmission (through jacket)	Shall not exceed 0.02 perm.

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SPECIFICATION FOR INDIVIDUAL INSULATION MATERIALS - cont'd

SPECIFICATION NO. 15M - PREFORMED FIBROUS GLASS - LOW DENSITY (3 to 5 lb per cu ft)

Composition

Material shall be composed of fibrous glass molded into pipe insulation with a modified phenolic type binder. Insulation up to and including 1-1/2-inch thickness for 14-inch OD and smaller pipe, and 2-inch thickness for insulation sizes up to but not including 11-inch NPS, shall have factory-applied, fire-retardant vapor-barrier jackets consisting of aluminum foil laminated with a special embossed white kraft paper reinforced with glass fiber yarn for puncture resistance, and having self-sealing longitudinal lap joints with a self-extinguishing pressure-sensitive adhesive protected by release paper.

Properties

Alkalinity	pH shall be between 7 and 10.
Capillarity	After 7 days on wet surface, gain in weight shall be 0%.
Density	Shall be greater than 3 and less than 5 lb per cu ft.
Hygroscopicity	When exposed to air at 120 F and 95% relative humidity for 96 hours, shall be less than 0.2% by volume.
Loss on Ignition	Shall be between 8 and 19% by weight.
Maximum Use Temperature	Shall be suitable for use from minus 120 F to plus 375 F without mechanical, thermal, or chemical failure.
Thermal Conductivity	The thermal conductivity at the given mean temperatures shall not exceed the following values:

Mean Temp, °F	Btu (in.)/(hr)(sq ft)(°F)
0	0.20
50	0.22
75	0.23
100	0.24
200	0.31

Thermal Diffusivity at 75 F	0.40 sq ft per day (5 lb) 0.77 sq ft per day (3 lb)
Water Absorption (by immersion)	Percentage of volume is very high, due to open-cell structure, but does not indicate water can run out.

VI. SPECIFICATIONS FOR INDIVIDUAL INSULATION MATERIALS - contd

SPECIFICATION NO. 17-RX: PREFORMED FIBROUS GLASS VAPOR SEAL RIGID-FACED INSULATION - for use on the exterior surfaces of heating, ventilating, and air conditioning ducts.

Composition

Material shall be composed of fibrous glass with a modified phenolic resin binder, formed into a rigid board and faced with a factory-applied vapor barrier of 0.0025-inch aluminum foil, having and Underwriters' Laboratory label with Flame Spread 15 to 20, Smoke Developed 0 to 10

Properties

Alkalinity	pH shall be between 7 and 10.
Capillarity	After 7 days on wet surface, gain in weight shall be 0%.
Density (average of 10 samples)	Shall be not less than 5.0 nor more than 9.0 lb per cu ft.
Hygroscopicity	When oven-dried to constant weight, then exposed to air at 70 F and 90% relative humidity for 14 days, gain in weight shall be less than 2%.
Resistance to Abrasion	Weight loss shall be less than the following: After first 10-minute run: 35% After second 10-minute run: 55%
Thermal Diffusivity at 75 F	Shall average not more than 0.77 sq ft per day.
Water Absorption (by immersion)	Percentage of volume is very high due to open fibrous structure, but does not retain if water can run out.

SPECIFICATION NO. 17-RY: PREFORMED FIBROUS GLASS COATED RIGID INSULATION - for use on the interior surfaces of heating, ventilating, and air conditioning ducts.

Composition

Material shall be composed of fibrous glass with a modified phenolic resin binder, formed into a rigid board, and coated on one side with neoprene compound.

Properties

Alkalinity	pH shall be between 7 and 10.
Capillarity	After 7 days on wet surface, gain in weight shall be 0%.
Density (average of 10 samples)	Shall be not less than 6.0 nor more than 6.[illegible] lb per cu ft.
Maximum Use Temperature	Shall be suitable for use from minus 120 [illegible] to [illegible] 250 F without mechanical, thermal, or chemical failure.
Resistance to Acids	Fairly good, except to hydrofluoric.
Resistance to Alkalies	Poor.
Specific Heat	Shall average 0.20 Btu per lb per cu ft.
Tensile Strength (Parting Strength, Average)	Shall be greater than 1.2 lb per gram of weight.
Thermal Conductivity	The thermal conductivity at the given mean temperatures shall not exceed the following values:

Mean Temp, °F	Btu inch, hr, sq ft, °F
75	0.26
100	0.27

Thermal Diffusivity at 75 F	0.8 sq ft per day.
Water Absorption (by immersion)	Percentage of volume is very high, due to open fibrous structure, but does not retain if water can run out.

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II. SPECIFICATIONS FOR INDIVIDUAL INSULATION MATERIALS - cont'd

SPECIFICATION NO. 18-FX: FIBROUS GLASS FLEXIBLE DUCT INSULATION - for use on the exterior surfaces of heating, ventilating, and air conditioning ducts that are in concealed spaces.

Composition

Material shall be composed of fibrous glass with a modified phenolic resin binder, formed into a flexible blanket and faced with a factory-applied fire-retardant vapor barrier of foil-reinforced kraft paper having a perm rating of not more than 0.05. Non-permanent fire-retardant treatments such as salts will not be allowed.

Properties

Acidity	pH shall be between 7 and 10.
Coolability	After 7 days on wet surface, gain in weight shall be 0%.
Density (average of 10 samples)	Shall be not less than 0.9 lb per cu ft.
Hygroscopicity	When oven-dried to constant weight, then exposed to air at 70 F and 90% relative humidity for 14 days, gain in weight shall be not more than 2 %.
Maximum Use Temperature (glass core)	Shall be suitable for use from minus 120 F to plus 375 F without mechanical, thermal, or chemical failure.
Resistance to Acids	Fairly good, except to hydrofluoric.
Resistance to Alkalies	Poor.
Specific Heat	Shall average 0.20 Btu per lb per degree F.
Tensile Strength (average parting strength)	Shall be more than 1.2 lb per gram of weight.
Thermal Conductivity	The thermal conductivity at the given mean temperatures shall not exceed the following values:

Mean Temp, °F	Btu/inch, hr, sq ft, °F
75	0.26
100	0.27

Thermal Diffusivity	2.5 sq ft per day.
Water Retention (by immersion)	Percentage of volume is very high, due to open fibrous structure, but does not retain water can run out.

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11 SPECIFICATIONS FOR INDIVIDUAL INSULATION MATERIALS - contd

SPECIFICATION NO 18-FY: FIBROUS GLASS FLEXIBLE DUCT INSULATION - acoustical and thermal insulation for use on the interior surfaces of supply and return air ducts carrying conditioned and warm air respectively.

Composition

Material shall be composed of fibrous glass with a modified phenolic resin binder, formed into a flexible blanket, and coated on one side with neoprene compound.

Properties

Alkalinity	pH shall be between 7 and 10.
Capillarity	After 7 days on wet surface, gain in weight shall be 0%.
Density (average of 10 samples)	Shall be not less than 2 lb per cu ft.
Erosion Resistance	Shall withstand air velocities up to and including 7,500 feet per minute with no erosion.
Flame Spread	Shall be less than 25.
Friction Coefficient	Shall not exceed 0.020.
Loss on Ignition	Shall be not less than 12 nor more than 20% by weight.
Maximum Use Temperature	Shall be suitable for use from minus 120 F to plus 250 F without mechanical, thermal, or chemical failure.
Noise Reduction Coefficient	Shall be 0.75 or above - No. 6 mounting.
Odor	Shall be essentially odorless.
Resistance to Acids	Fairly good, except to hydrofluoric.
Resistance to Alkalies	Poor.
Smoke Developed	Shall be less than 50.
Specific Gravity	Shall average 2.5 true, 0.030 apparent.
Specific Heat	Shall average 0.20 Btu per lb per degree F.
Thermal Conductivity	The thermal conductivity at the given mean temperatures shall not exceed the following values:

Mean Temp, °F	Btu/inch, hr, sq ft, °F
50	0.22
75	0.23
100	0.25

Thermal Diffusivity at 75 F	1.2 sq ft per day.
Water Absorption	Percentage of volume is very high, due to open fibrous structure, but does not retain if water can run out.

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SPECIFICATIONS FOR INDIVIDUAL INSULATION MATERIALS - cont'd

SPECIFICATION NO. 19-H MINERAL WOOL WITH INTEGRAL ALUMINUM FACING FOR VESSEL SIDE WALLS AND EXPANDED SILICA FOR VESSEL ROOFS OR HEADS

Composition

Material shall be composed of curly mineral wool preformed and bonded to 3/4 hard, 0.016-inch thick, ribbed 3003 alloy aluminum to form panels 30.3-inches wide by 100-inches long. Panels shall be factory drilled for studs when they are to be secured to vessel by stud welding. Panels shall not be drilled when they are to be secured to vessel by strapping.

Properties - Mineral Wool (Attached to Aluminum Facing)

Acidity . . . . . pH shall be not less than 6.0 nor more than 8.0.

Combustibility . . . . . Shall be incombustible.

Compressive Strength . . . . . Shall be not less than 0.28 psi at 10% deformation.

Density . . . . . Shall be not less than 4 nor more than 4.5 lb per cu ft.

Hygroscopicity . . . . . Shall be not more than 17% by weight.

Weight Loss at Temperature . . . . . Shall not fail mechanically, thermally, or chemically when subjected to surface or soaking temperature of 450 F.

Thermal Conductivity . . . . . The thermal conductivity at the given mean temperatures shall not exceed the following values:

Mean Temp, °F	Btu inch, hr, sq ft, °F
50	0.24
100	0.26
200	0.33
300	0.43

Thermal Diffusivity at 75 F . . . . . Shall average 0.02 sq ft per hr.

EXPANDED SILICA . . . . . As specified in SPECIFICATION NO. 22.

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SPECIFICATIONS FOR INDIVIDUAL INSULATION MATERIALS - contd

SPECIFICATION NO. 19-J: ALUMINUM-FACED FIBROUS GLASS PANELS AND FIBROUS GLASS ROOF INSULATION

Composition

For Side Walls. Material shall be composed of fibrous glass with a modified phenolic bi[illegible], with an integral 0.016-inch-thick embossed aluminum facing on one side, formed into panels 48 inches wide by 96 inches long.

For Roof or Heads. Material shall be composed of fibrous glass with resin binder, formed into a semi-rigid board and faced with factory-applied glass reinforced asphalt with a kraft finish.

Properties

		Aluminum Faced Fibrous Glass	Fibrous Glass Roof Insulation
Acidity	pH shall be	8.0 (min.), 10.0 (max.)	8.0 (min.), 10.0 (max.)
Capillarity	After 7 days on wet surface, gain in weight shall be	0	0
Coefficient of Expansion	Shall be	0	8.0×10^{-5} (Avg.)
Combustibility	Flash Point Melting Point " "	700 F (Resin) 1,200 F (Glass)	425 F (Asphalt) 150 F (Asphalt) 1,200 F (Glass)
Compressive Strength		0.7 psi at 10% deformation	10 psi at 10% deformation
Density		3.25 ± 10%	11 (min.), 18 (max.)
Hygroscopicity	Two-inch cubes dried at 220 F to constant weight, then exposed to air at 70 F, 90% R.H. for 14 days shall gain not more than	1% by weight	1% by weight
Maximum Use Temperature	Shall not fail mechanically, thermally, or chemically within temperature limits of	60 to 450 F	Atmospheric to 300 F
Resistance to Acids	Impervious to common acids and acid fumes except hydrofluoric and hot phosphoric	Yes	Yes
Resistance to Alkalies		Poor	Poor
Specific Heat	Shall average	0.2 Btu/lb	0.2 Btu/lb
Thermal Conductivity	When tested in accordance with ASTM C 177, latest revision, the thermal conductivity shall not exceed the following values at the given mean temperatures	Mean Temp., °F / Conductivity, Btu inch/hr, sq ft, °F 0 / 0.20 100 / 0.24 200 / 0.29 300 / 0.35	Mean Temp., °F / Conductivity, Btu inch/hr, sq ft, °F [illegible] / [illegible] 100 / 0.33 200 / 0.24
Thermal Diffusivity	Shall average, sq ft/hr	0.033	0.004 at 70 F (12 lb density)
Water Absorption	After 24-hour submersion weight gain shall not exceed	400%	400%

SPECIFICATIONS FOR INDIVIDUAL INSULATION MATERIALS - cont'd

SPECIFICATION NO. 21: ASBESTOS FIBER

Composition

Material shall be composed of asbestos fibers blended with suitable inorganic binder, processed and molded at sufficient temperatures to produce a rigid, homogeneous thermal insulation.

Properties

Absorptivity	Not over 85% of volume after 24 hours submersion.
Alkalinity	pH shall be 10.5.
Coefficient of Expansion (or Volume and Linear Shrinkage)	Shrinkage shall be less than 0.7% when heated to 750 F.
Combustibility	Shall be incombustible.
Compressive Strength	When tested in accordance with ASTM C 165, latest revision, the percentage of deformation produced by loading shall not exceed the following:

Deformation, %	Load, psi
2	5.5
5	11.0
10	17.0

Corrosiveness to Stainless Steel	Shall not contribute to stress corrosion of austenitic stainless steel.
Density	Shall be not less than 14 nor more than 16 lb per cu ft.
Flexural Strength	Shall be not less than 100 psi when tested in accordance with ASTM C 203, latest revision.
Hardness	A 1/8-inch ball point under a 1-kg load shall produce a maximum penetration of 0.40 mm.
Hygroscopicity	Two-inch cubes oven-dried to constant weight, then exposed to air at 70 F, and 90% relative humidity for 14 days, shall gain a maximum of 32.1% of the original weight.
Maximum Use Temperature	Maximum temperature without mechanical, thermal, or chemical failure shall be not less than 1,200 F.
Resistance to Acids and Caustics	Solutions or vapors of those commonly used in industry have negligible effect on physical characteristics.
Shrinkage	Shall be not more than 0.25% when tested at 1,200 F.
Specific Heat	Shall be not less than 0.22, nor more than 0.24, Btu per lb per degree F.
Thermal Conductivity	The thermal conductivity at the given mean temperatures shall not exceed the following values:

Mean Temp, F	Btu (sq ft, hr, deg F per in.)
100	0.32
200	0.37
300	0.43
400	0.49
500	0.57

Thermal Diffusivity	Shall be approximately 0.197 sq ft per hr.
Thermal Shock Resistance	Material shall not spall, chip, crack, or otherwise fail when heated to 750 F and then quenched with water.

VI. SPECIFICATIONS FOR INDIVIDUAL INSULATION MATERIALS - contd

SPECIFICATION NO. 25: HIGH TEMPERATURE CALCIUM SILICATE (1,800 F max.)

Composition

Material shall be composed of hydrous calcium silicate blended with asbestos fibers in suitable proportion, with or without inorganic filler added.

Properties

Alkalinity . . . . . pH shall be not below 8 and not above 10.5.

Coefficient of Expansion . . . . . 5×10^{-6} average on reheat to 1,200 F.

Combustibility . . . . . Shall be incombustible.

Compressive Strength . . . . . The percentage of deformation produced by loading shall not exceed the following:

Load, Psi	Deformation, %
50	2
110 ± 30	5

Density . . . . . Shall be not less than 11.5 lb per cu ft, nor more than 13.5 lb per cu ft.

Flexural Strength . . . . . Shall be not less than 75 psi.

Hardness . . . . . A 1/8-inch ball point under a 1-kg load shall produce a maximum penetration of 0.50 mm.

Hygroscopicity . . . . . When oven-dried to constant weight, then exposed to air at 70 F and 90% relative humidity for 14 days, shall gain a maximum of 10% of the original weight.

Maximum Use Temperature . . . . . Maximum temperature without mechanical, thermal, or chemical failure shall be not less than 1,800 F.

Resistance to Abrasion . . . . . Shall lose not more than 7.5% of original weight after first 10-minute run, and not more than 16% after second 10-minute run.

Resistance to Acids and Caustics . . . . . Shall be resistant to most common caustics (not considered an acid-resisting material).

Shrinkage . . . . . The shrinkage at the given temperatures shall not exceed the following percentages:

Temp, °F	Shrinkage, %
1,200	0.8
1,500	1.4
1,800	1.9

Specific Heat . . . . . 0.20 to 0.26 Btu per lb per degree F at 400 F.

Thermal Conductivity . . . . . The thermal conductivity at the given mean temperatures shall not exceed the following values:

Mean Temp, °F	Btu-inch, hr, sq ft, °F
100	0.41
200	0.45
300	0.49
400	0.53
600	0.63
800	0.73

Thermal Diffusivity at 400 F . . . . . Shall average 0.25 to 0.28 sq ft per day.

Thermal Shock Resistance . . . . . Shall not spall, chip, crack, or otherwise fail when heated to 1,800 F, then quenched with water.

Water Absorption . . . . . After 24-hour submersion, shall gain not more than 450% of the original weight.

NOTE: Specification No. 25 insulation shall be used as single and inner layer of multiple layer application. Middle and outer layers of multiple layer application shall be insulation as specified in MATERIAL SPECIFICATION NO. 23.

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SPECIFICATIONS FOR INDIVIDUAL INSULATION MATERIALS - contd

SPECIFICATION NO. 31: PREFABRICATED STAINLESS STEEL-CASED, ALUMINUM, OR STAINLESS STEEL REFLECTIVE INSULATION

Composition

Insulation shall consist of prefabricated units of all-metal construction comprised, in general, of a rigidized Type 302 stainless steel outer shell, enclosing aluminum sheets properly spaced and reinforced with Type 302 stainless steel supports (separators), arranged so as to form isolated air chambers. Units shall be removable, self-draining, and equipped with means of securement.

Properties

Emissivity . . . . . Shall be approximately 0.05.

Maximum Use Temperature . . . . . Shall be suitable for use from 33 F to 1,000 F without deterioration or cracking of parts.

Reflectivity . . . . . Shall be approximately 95%.

Make . . . . . Mirror Insulation Company "SC-MIRROR" insulation, or approved equal.

Form. Prefabricated stainless-cased aluminum reflective insulation shall be furnished in units, in the following forms, and which can be easily handled.

1. Sectional Pipe Insulation

a. Standard units shall be made of the following sheet materials:

Sheet Location	Material	Minimum Thickness of Sheet, In.
Outer shell		
Over 17-inch diameter	Type 302 SS	0.012 (Rigidized) or 0.0187 (Plain)
17-inch diameter and under	Type 302 SS	0.012 (Rigidized) or 0.015 (Plain)
Inner Sheets	Aluminum Alloy	0.006

b. Units shall be available in nominal pipe sizes of 1/2 inch to 24 inches, and shall be made in half sections. One circumferential edge of each unit and the longitudinal edges of one half section shall be extended to provide overlap and watershed. Units shall be fabricated to fit snugly together along joints to form effective thermal insulation.

c. Inner sheets shall have longitudinal edges flanged inward to provide reinforcement and a tight joint with opposing sheets upon closure.

d. Units shall be furnished with stainless steel fasteners, or other fastening devices where authorized.

2. Fitting covers shall be prefabricated, and of the same general composition and construction as sectional pipe insulation, except that the outer shell shall be Type 302 stainless steel 0.015 inch thick (minimum), the intermediate sheets shall be of light gage aluminum alloy suitable for forming, and the inner shall shall be Type 302 stainless steel 0.008 inch thick (minimum).

3. Equipment panels and head sections, both flat and curved, shall be fabricated of the same general composition and construction as sectional pipe insulation. Sheet materials shall be as follows:

Sheet Location	Material	Minimum Thickness of Sheet, In.
Outer Shell	Type 302 SS	0.015 (Rigidized) or 0.0187 (Plain)
Intermediate Sheets	Aluminum Alloy	0.06
Inner Shell	Type 302 SS	0.08

4. "Quick-Remove" units for piping or equipment, or both, shall be prefabricated and of the same general composition and construction as sectional pipe insulation, except that the outer and inner shells shall be of gages recommended by the manufacturer for the particular service requirement. These units shall be of heavy-duty construction and shall be design so as to be easily removed and reinstalled. To facilitate frequent removal and replacement, hinges and buckles shall be provided for securement.

5. Units shall be provided with cut-outs for supports, nozzles, and other projections through insulation, where shown on Purchaser's drawing.

6. The number of reflection surfaces and the spacing of the reflective sheets shall be in accordance with the manufacturer's standards.

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VI. SPECIFICATIONS FOR INDIVIDUAL INSULATION MATERIALS - cont'd

SPECIFICATION NO. 32-H: BONDED EXPANDED SILICA (Fire Protection)

Composition

Inner and outer layers to be as specified in MATERIAL SPECIFICATION No. 22.

SPECIFICATION NO. 32-L: BONDED EXPANDED SILICA — CELLULAR GLASS (Fire Protection)

Composition

1. Inner layer to be Cellular Glass as specified in MATERIAL SPECIFICATION No. 10.
2. Outer layer to be Bonded Expanded Silica as specified in MATERIAL SPECIFICATION No. 22.

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SPECIFICATIONS FOR INDIVIDUAL INSULATION MATERIALS - contd

SPECIFICATION NO. 37: INSULATED METAL CONDUIT

Composition

1. Insulated conduit is an insulated prefabricated pipe system, encased in a corrosion protected metal jacket.

2. Insulation material for use in conduit shall be as called for in Insulation Line and Equipment Lists, and as specified herein.

3. Insulated conduit shall be Ric-wil Hel-cor, Durant Pre-Sealed, Kaiser Ebko, or approved equal.

4. The insulated conduit piping system shall be purchased as a package unit, in accordance with the piping drawings and piping specifications, with all necessary accessories and installation instructions furnished by the conduit manufacturer.

SPECIFICATION NO. 39: UNDERGROUND BITUMINOUS FILL

Composition

Material shall be composed of granulated bitumen, or volcanic rock mixed with a bitumen, which when applied as loose fill and with heat applied within the pipe, produces a waterproof thermal insulation.

Properties

Capillarity . . . . . Water resistant.

Composition . . . . . Pure bitumen or bitumen with volcanic rock.

Density . . . . . 25 to 41 lb per cu ft.

Maximum Use Temperature . . . . . 220 F to 520 F - depending on grade.

Specific Heat . . . . . 300 F: 0.52 Btu per lb.
500 F: 0.61 Btu per lb.

Resistance to Acids . . . . . Not affected by most common acids.

Resistance to Caustics . . . . . Not affected by most common caustics.

Thermal Conductivity . . . . . Shall not exceed the following value at the given mean temperature:

Mean Temp, °F	Conductivity BTU (inch, or, sq ft, °F
300	0.54

Make . . . . . American Gilsonite Company Gilsulate, Miracle Adhesive Insulfil, or approved equal.

Grade . . . . . As required by temperatures.

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VI. SPECIFICATIONS FOR INDIVIDUAL INSULATION MATERIALS - contd

SPECIFICATION NO. 38. URETHANE FOAM INSULATED-PVC JACKET CONDUIT (FOR UNDERGROUND SERVICE)

Composition

1. Pipe, or tubing shall be preinsulated at the factory with rigid urethane foam insulation molded in PVC jacket conduit.

a. Pipe, or tubing, shall be as specified in the pipe schedule or on the drawings.

b. Insulation shall be rigid urethane having the following properties.

Compressive Strength	At 250 F shall be not less than 32 psi at yield point
Density	Shall be not less than 2.5 lb per cu ft.
Maximum Use Temperature	Maximum temperature, without mechanical thermal or chemical failure, shall be not less than 250 F.
Shear Strength	Shall be not less than 25 psi
Tensile Strength	Shall be not less than 80 psi.
Thermal Conductivity	The thermal conductivity at the given mean temperatures shall not exceed the following values:

Mean Temp, °F	Btu (in.)/(hr, sq ft, °F)
0	[illegible]
100	0.17

c. Conduit shall be of rigid vinyl (PVC) hi impact material having the following properties.

Combustibility	Shall be self-extinguishing.
Compressive Strength	Shall be not less than 8500 psi
Density	Shall be not less than 80 lb per cu ft.
Flexural Strength	Shall be not less than 13,000 psi
Durometer Hardness D	Shall be 78 ± 3.
Modulus of Elasticity	Shall be not less than 378,000 psi.
Tensile Strength	Shall be not less than 7000 psi.

d. Composite Structure. The conduit jacket shall have a minimum thickness of 60 mils through 4.00 Inch OD, 85 mils over 4.00 through 6.625 Inch OD and 110 mils above 6.625 inch through 12.750 OD. Crush resistance shall be not less than [illegible] lb linear in.

2. Fittings.

a. Fittings shall be pipe or tubing as specified in the pipe schedule or on drawings.

b. Fittings shall be preinsulated at the factory with rigid urethane foam insulation molded in PVC jacket conduit.

3. The insulated conduit piping system shall be purchased in accordance with the piping drawings and piping specifications [illegible] necessary accessories and installation instructions being furnished by the manufacturer.

4. Insulated urethane conduit system shall be as manufactured by Triangle Conduit & Cable Co., Inc., or approved equal.

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II. SPECIFICATIONS FOR INDIVIDUAL INSULATION MATERIALS - cont'd

SPECIFICATION NO. 41-H: SPRAYABLE AMOSITE ASBESTOS FIBERS AND INORGANIC BINDERS - STANDARD (for use up to 750 F) AND
SPECIFICATION NO. 42-H: SPRAYABLE CROCIDOLITE ASBESTOS FIBERS AND INORGANIC BINDERS - HIGH TEMPERATURE (for use above 750 F up to 1,350 F)

Composition

Material shall be a blend of asbestos fibers and inorganic fibers suitable for spraying, together with atomized water, by proper equipment onto a surface, and which, when dried, forms a homogeneous thermal insulation that is bonded to the surface. The grade of blend which is suitable for service up to 750 F shall be composed of amosite asbestos. The grade of blend which is suitable for service up to 1,350 F shall be composed of crocidolite asbestos.

Properties

With exception of maximum temperature limits, both blends of the material shall have the following properties after being installed and allowed to dry.

Alkalinity	pH shall be not less than 9.0 nor more than 10.0.
Combustibility	Shall be incombustible.
Compressive Strength	Compressive strength shall be not less than [illegible] psi at 25 per cent deformation.
Density	Density shall be not less than 8 lb per cu ft nor more than 13 lb per cu ft.
Hardness	Average penetration 1/8 inch ball point under 1-kg load shall be less than 3 mm.
Hygroscopicity	When dried to constant weight, then exposed to air at 70 F and 90% relative humidity for 14 days, shall gain a maximum of 5% of the original weight.
Maximum Use Temperature	Amosite blend shall be suitable for temperatures up to 750 F and crocidolite blend shall be suitable for temperatures up to 1,350 F without mechanical, thermal, or chemical failure.
Resistance to Caustics	Shall be resistant to most caustics.
Resistance to Solvents	Shall be resistant to most solvents.
Specific Heat	Specific heat shall be between 0.23 and 0.27 Btu per lb per degree F at 300 F.
Thermal Conductivity	The thermal conductivity at the given mean temperatures shall not exceed the following values:

Mean Temp, °F	Conductivity Btu-in., hr, sq ft, °F
100	0.34
200	0.39
300	0.43
400	0.48
500	0.52
600	0.56
700	[illegible]

Thermal Diffusivity	Shall average 0.010 to 0.017 sq ft per hour at 300 F.
Thermal Shock Resistance	Material shall not spall, crack, or otherwise fail when heated to its maximum service temperature and then quenched with water.
Vibration Resistance	Shall have good resistance to mechanical vibration.

Installation Characteristics

Sprayability	Shall be suitable for spraying, together with atomized water, by machine onto surfaces to be insulated.
Application	Shall adhere to clean, bare metal and clean painted metal surfaces.
Drying	Shall dry sufficiently for application of weather-barrier mastic in 24 hours at 70 F, 50% relative humidity, and air velocity at 2 feet per minute.
Curing	Shall reach 90% of ultimate strength in 7 days.
Setting Time	Shall set in 2 to 3 hours at 70 F, 50% relative humidity.

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VI. SPECIFICATIONS FOR INDIVIDUAL INSULATION MATERIALS - contd

SPECIFICATION NO. 40-J: CORK-FILLED POLYVINYL ACETATE MASTIC

Composition

Material shall be composed of inert fillers, 5 K asbestos fibers having a maximum length of 1/8-inch, 40 per cent by weight of cork granules, and a polyvinyl acetate binder of the copolymer type, Vimasco WC-1, Type C, or approved equal.

Properties

Alkalinity	pH shall be not less than 6.3 nor more than 7.3.
Combustibility	When tested in accordance with MIL-S-19554A, material shall be rated as self-extinguishing.
Density	Shall be not less than 20.5 per cu ft, nor more than 23.5 lb per cu ft.
Elasticity	Dried sample 1 inch wide by 3 inches long by 1/8 inch thick shall have minimums of 50% elongation and 10% recovery.
Flexibility	Dried sample 1 inch wide by 3 inches long by 1/8 inch thick, at 65 F sample and ambient temperature, shall not crack when bent around a 1/2-inch mandrel, then returned, in 5 seconds.
Hygroscopicity	When oven-dried to constant weight, then exposed to air at 70 F and 14% relative humidity for 14 days, shall gain not more than 10% of the original weight.
Maximum Use Temperature	Shall be suitable for use from 34 F to 150 F without mechanical, thermal, or chemical failure.
Resistance to Chemicals	See Tables I and II.
Shore Hardness (Durm A)	Shall not exceed 65.
Shrinkage	Shall be not more than 45% from wet state to dry state.
Specific Gravity	0.725 to 0.864, wet state.
Tensile Strength	Shall be not less than 1,000 psi.
Thermal Shock	Shall not spall, chip, crack, or otherwise fail when heated to 180 F and then quenched with water.
Total Solids	Shall be not less than 55%.
Weight per Gallon	7.20 lb.

VII. SPECIFICATIONS FOR INDIVIDUAL ACCESSORY MATERIALS

A. Fabrication and Application Accessories

1. Cushioning Blanket - High Temperature (for temperature above 350 F and on stainless steel) TWF: White glass wool blanket, 2 lb per cu ft, Fiberglas, as manufactured by Owens-Corning, or approved equal.

2. Cushioning Blanket - Low and Moderate Temperature (for temperature up to 350 F): Resin binder, 3 lb per cu ft, Aercore as manufactured by Owens-Corning, Superfine as manufactured by Pittsburgh Plate Glass, Ultralite as manufactured by Gustin-Bacon, Spintex as manufactured by Johns-Manville, or approved equal.

3. Cushioning Glass Fiber Molded Pipe Insulation - High Temperature (for temperature above 350 F and on stainless steel): Molded glass wool pipe insulation, Multi-Temp as manufactured by Owens-Corning, or approved equal.

4. Cushioning Glass Fiber Molded Pipe Insulation - Low and Moderate Temperature (for temperature up to 350 F): Phenolic resin bonded molded pipe insulation, Snap-On, as manufactured by Gustin-Bacon, or approved equal.

5. Mineral Wool Blanket: Spun rock wool, 8 to 12 lb per cu ft, with one-inch 20-gage stainless steel or monel hexagonal mesh on one or both sides, as required. Suitable for temperatures up to 1,200 F. As manufactured by Baldwin-Ehret-Hill, Detrick, Eagle-Picher, Johns-Manville, or approved equal.

6. Insulating Cement: Hydraulic setting, Baldwin-Ehret-Hill Powerhouse, Eagle-Picher One Coat, or approved equal.

7. Insulating Cement: Careytemp Asbestos Cement (for Specification No. 22 only).

8. Finishing Cement: Hard surface, Eagle-Picher No. 106, Johns-Manville 678, Detrick T-60, or approved equal.

9. Formed Steel Strapping: For insulation supports on 3-inch NPS and larger vertical pipe and vertical vessels up to 1 ft 5 in. OD - Acrofix as manufactured by Acro Metal Stamping Company, or approved equal.

10. Expansion Sleeve: Type 304 or 430 stainless steel strip, smooth, 9 inches wide, 0.008 inch thick (minimum).

11. Equipment Insulation Strap: 1/2 inch by 0.020 inch Type 304 or 430 dead soft annealed stainless steel, as manufactured by A. J. Gerrard, Techalloy, or approved equal.

12. Clips for Equipment Strap: 1/2 inch by 7/8 inch, double-pronged stainless steel as manufactured by A. J. Gerrard, Techalloy, or approved equal.

13. Pipe Insulation Strap: 3/8 inch by 0.015 inch, Type 304 or 430 dead soft annealed stainless steel, as manufactured by A. J. Gerrard, Techalloy, or approved equal.

14. Clips for Pipe Strap: 3/8 inch by 1/2 inch, double-pronged stainless steel, as manufactured by A. J. Gerrard, Techalloy, or approved equal.

15. Expansion Springs or Bands: Spring, Type 302 stainless steel, 1-3/16 inch wide by 3.8 inch thick by 4 inches long, breather spring as manufactured by Techalloy or approved equal. Expansion Band, 3/4 inch by 0.020 inch stainless steel, Expand-R-Strap as manufactured by A. J. Gerrard or approved equal.

16. Clips for Expansion Springs or Bands: 3/4 inch by 7/8 inch double-pronged stainless steel, as manufactured by A. J. Gerrard, Techalloy, or approved equal.

17. Stainless Steel Wire: 0.0475 inch diameter (18 gage) dead soft annealed Type 304 or 430 stainless steel.

18. Wire Netting: One inch, hexagonal mesh, 20 gage, Type 304 or 430 stainless steel, or monel.

19. Welding Pins: 1 8 inch by 1 inch by 1-3/16 inch rectangular mild steel welding pins per KSM Drawing S-6318.

NOTE: Use stainless steel welding pins for stainless steel equipment.

20. Stainless Steel Pins: 4d stainless steel nails.

21. Stainless Steel Skewers: 16d stainless steel nails.

22. Welding Pin Insulation Fasteners: 10 gage by length equal to thickness of insulation plus 1 2 inch, pointed, carbon steel or stainless steel as required, as manufactured by KSM, Nelson Stud, or approved equal.

23. Pin Clips: Clips for 10-gage insulation pins, carbon steel or stainless steel as required, as manufactured by KSM, Nelson Stud, or approved equal.

24. Strap Anchor Clip: A. J. Gerrard's strap hanger or approved equal.

25. Staples: 5 8 inch by 1 2 inch, stainless steel, A. J. Gerrard or approved equal.

26. Welded Steel Wire Fabric: 6 by 6 by 6. Fabric shall meet all requirements of ASTM A 185, latest revision.

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SPECIFICATIONS FOR INDIVIDUAL ACCESSORY MATERIALS - contd

A. Fabrication and Application Accessories - contd

37. [illegible] Clips: 1 inch wide by 4 inches deep, made of 0.032-inch-thick Type 304 or 430 stainless steel, bent to allow a 3-inch lap of [illegible] support as shown in Figure GA-7 in GENERAL SPECIFICATIONS.

38. Jacket Support Clips: 1 2 inch wide by 4 inches deep, made of 0.032-inch-thick Type 304 or 430 stainless steel, bent to secure to insulation support and to allow 3-inch lap of metal jacket as shown in Figure GA-7 in GENERAL SPECIFICATIONS.

29. Studs: 1 4 inch, 20 thread, length equal to insulation thickness minus 3.8 inch. As manufactured by KSM, Nelson Stud, or approved equal.

30. Stud Nuts: 1 4 inch, 20 thread, aluminum nut with Hypalon washer, as manufactured by KSM, Nelson Stud, or approved equal.

31. Aluminum Flashing: 3003 aluminum, 0.010 inch thick, embossed aluminum sheet, fabricated and formed as shown in Figure 19-H-1.

32. [illegible] Screws: Stainless steel Type A, pan head, gimlet point, self-tapping, No. 7 by 3 8 inch, furnished with Neoprene [illegible] washers.

33. Glass Tape: 1 inch wide glass filament, vinyl backed, No. 400 Dutch Brand; 3 4 inch wide glass filament, vinyl backed, [illegible] Tape or approved equal.

34. High Temperature Fabricating Cement for Cellular Glass: Keene's cement.

35. Moderate Temperature Fabricating Cement for Cellular Glass: RT-1000P as manufactured by Miracle Adhesive or approved equal.

36. Low Temperature Fabricating Cement for Cellular Glass: 180 F melt - steep asphalt.

37. High Temperature Fabricating Cements for Calcium Silicates and Asbestos Fibers: Insulation adhesive as manufactured by A. P. Green, Proto Stik as manufactured by Refractory & Insulation Company, or approved equal.

38. High Temperature Fabricating Cement for Expanded Silica: Careytemp adhesive as manufactured by Philip Carey or approved equal.

39. High Temperature Anti-Abrasive Coating: Keene's cement.

40. High and Low Temperature Anti-Abrasive Coating and Joint Sealer (only anti-abrasive coating and joint sealer suitable on stainless steel): Thurmalox Silicon No. 70 Black, as manufactured by The Dampney Company.

41. Low Temperature Anti-Abrasive Coating: Code 310 as manufactured by Pomrod or approved equal.

42. Heat-Resistant Sealer: Paste Consistency 30-43 (in 10-oz tubes) as manufactured by Benjamin Foster or approved equal.

43. [illegible] Asphalt Joint Sealer: Vicarlon 49 as manufactured by Vimasco or approved equal.

44. Asphalt Joint Sealer: Lion Oil Lox Temp as manufactured by Lion Oil Company or approved equal.

45. Mastic: Mastic 703 C as manufactured by Vimasco, Code 400 8 Type K as manufactured by Pomrod, or approved equal.

46. Lap Sealer: Sure Joint No. IC-405 as manufactured by Insul-Coustic or approved equal.

47. Adhesive Cement: Vimasco "J" seal "S", or approved equal (for oxygen service).

48. Joint Sealer: Vimasco Lox-Seal F or approved equal (for oxygen service).

49. Neoprene: 1 16 inch thick, U. S. Rubber No. M-8891, Hercules No. 765-N, or approved equal.

50. Sealing Cement: Pittsburgh Corning Pittcote 300 Trowel Grade, or approved equal.

51. [illegible] Vapor Barrier: Phillip Carey Fire-Chex Vapor Barrier Sheet, or approved equal.

52. Roofing Primer/Contact Adhesive: Phillip Carey Fire-Chex No. 400, or approved equal.

53. Roofing Asphalt: Phillip Carey Steep Manso Asphalt, or approved equal.

54. Roofing Felt: [illegible] Asphalt Saturated - Phillip Carey Feltex, or approved equal.

55. Roofing Joint Sealer: Phillip Carey Joint Sealer, or approved equal.

56. Flashing Cement: Phillip Carey C-3 Flashing Cement, or approved equal.

57. Roofing-Sheathing Paper: Phillip Carey Red Rosin Dry Sheet, or approved equal.

58. [illegible]: Pittsburgh-Corning P. C. Mastic 100, or approved equal.

VII SPECIFICATIONS FOR INDIVIDUAL ACCESSORY MATERIALS - contd

A. Fabrication and Application Accessories - contd

59. Asphalt Emulsion: Pittsburgh-Corning P. C. Asphalt Emulsion, or approved equal.

60. Wire Mesh: Keystone Wire and Wheel Company "Keymesh", or approved equal.

61. Lath Clips: Pittsburgh-Corning P. C. Metal Lath Clips, or approved equal.

62. Angle Pins: Pittsburgh-Corning P. C. Angle Pins, or approved equal.

63. Ceiling Cement: Minnesota Mining and Manufacturing Company CTA-11 Soft Rubber Based Ashesive, or approved equal.

64. Anti-Sagging Solution: One part starch, 24 parts calcium chloride, 91 parts water (by volume).

65. Contact Adhesive (Standard): No. 520 Adhesive as manufactured by Armstrong, C-C-300 as manufactured by Owens-Corning, No. 375 as manufactured by Rubatex Corp., or approved equal.

66. Contact Adhesive (High Temperature): No. 620 Adhesive as manufactured by Armstrong, or approved equal.

67. Vinyl Finish: Armaflex Finish as manufactured by Armstrong, or approved equal.

68. Flexible Sealer: L.T. Sealer as manufactured by Armstrong, or approved equal.

69. PVA Finish Coating (color as specified): Insulcolor as manufactured by Armstrong, Viny-Lag as manufactured by Vimasco, Code 512 as manufactured by Pamrod, or approved equal.

70. Water Barrier Coating: Roskote 612XM as manufactured by Royston, or approved equal.

71. Low Temperature Water Barrier Coating: Roskote 612XP as manufactured by Royston, or approved equal.

72. Fire-Retardant Vapor Barrier Jackets and Butt Joint Strips: Laminated aluminum foil and special embossed white kraft paper reinforced with glass fiber yarn for puncture resistance, with a self-extinguishing pressure-sensitive adhesive protected by release paper; Type FRJ as manufactured by Owens-Corning, or approved equal.

73. Grip Nails: Length equal to insulation thickness, as manufactured by Owens-Corning, Johns-Manville, or approved equal.

74. Duct Adhesive: Spark-Safe Adhesive 85-20 as manufactured by Benjamin Foster, IC-230 Fire Retardant Adhesive as manufactured by Insul-Coustic Corporation, or approved equal.

75. Adhesive Type Pins: Type N with speed washers and adhesive as manufactured by Gem-Nail, or approved equal.

76. Nylon Clip Pins: Cliplo Hangers as manufactured by Benjamin Foster, or approved equal.

77. Nylon Clip Pin Adhesive: Cliplo Adhesive 82-11 as manufactured by Benjamin Foster, or approved equal.

78. Finishing Cement: BD-2 as manufactured by Armstrong, or approved equal.

79. Split Welding Pins: 1 8 inch by 3 8 inch rectangular welding pins as manufactured by KSI, 1 inch by 3 8 inch R2P rectangular split pins as manufactured by Nelson Stud, or approved equal.

80. Asbestos Paper: Asbestos paper, 0 0625 inch thick (32 lb per 100 sq ft) as manufactured by Johns-Manville, or approved equal.

81. Asbestos Paper Adhesive: Sodium silicate adhesive. Fibrous adhesive as manufactured by Johns-Manville, or approved equal.

82. White Vapor-Barrier Adhesive: As manufactured by Owens Corning Corporation.

83. Flashing: Lexsuco F62 Flexible Flashing as manufactured by Lexsuco, Inc., or approved equal.

84. Fire-Retardant Vapor-Barrier Jacket: Laminated white kraft paper and foil reinforced with glass yarn, Type FRJ as manufactured by Owens-Corning Corporation.

85. Reinforcing Cloth for Underground Cellular Glass Insulation: 10 by 10 tar-impregnated glass fabric cloth as manufactured by Pittsburgh-Corning, or approved equal.

86. Glass Wool Metal Mesh Blanket: White glass wool, expanded metal lath on one side - Fiberglas Metal Mesh Blanket Type L Style L, or approved equal.

87. Glass Wool Block Insertion Supports: Yellow glass "Pipe Insulation Supports" as manufactured by Pamrod, or approved equal.

88. Reinforcing Cloth for Cellular Glass: Pittsburgh 1000, as manufactured by Pittsburgh-Corning, or approved equal.

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STANDARD SPECIFICATIONS

UNION CARBIDE

[illegible]
UNION CARBIDE CANADA

M
INSULATION
26
JULY 1966

[illegible] MATERIALS [illegible]

[illegible]

[illegible] Foam Insulation: [illegible] Brand No. 472, or approved equal.

[illegible] Preformed Fibrous Glass Insulation [illegible] glass cloth.

[illegible] Preformed Fibrous Glass Insulation: [illegible] Adhesive No. 81-27 as manufactured by Benjamin [illegible]

[illegible] No. [illegible] as manufactured by the 3M Company, 81-20 as manufactured by [illegible]

[illegible] Preformed Fibrous Glass Insulation [illegible] expanded metal lath on one side, [illegible]

[illegible] Adhesive No. 81-33 [illegible]

[illegible] as manufactured by [illegible], Monolar 60 - 36 as manufactured by Benjamin Foster, or approved equal.

[illegible] No. [illegible] as manufactured by the 3M Company, IC-225 as manufactured [illegible] by Benjamin Foster, or approved equal.

[illegible] as manufactured by [illegible] No. 33 as manufactured by the 3M Company, or approved equal.

[illegible] Low-Density Preformed Fibrous Glass Insulation: No. 82-07 as manufactured by Benjamin Foster, No. [illegible] the 3M Company, or approved equal.

[illegible] Adhesive [illegible] for Low-Density Preformed Fibrous Glass Insulation: No. 706 as manufactured [illegible] Insul-Coustic Corporation, or approved equal.

[illegible] No. 81-?? as manufactured by Benjamin Foster, IC-203 as manufactured by Insul-Coustic Corporation, or approved equal.

[illegible] No. 60-30N as manufactured by Benjamin Foster, or approved equal.

[illegible] Preformed Fibrous Glass [illegible] Faced Insulation: 8-oz canvas.

[illegible] Preformed Fibrous Glass [illegible] Faced Insulation: [illegible] aluminum foil, 4 inches [illegible]

[illegible]

[illegible] Glass Insulation [illegible] adhesive [illegible] as manufactured by Fomrco, or approved equal.

[illegible] rock wool with [illegible] Monel hexagonal wire netting on one side and galvanized [illegible]

[illegible]

[illegible] as manufactured by [illegible]

[illegible] 3M [illegible] as manufactured by Nelson Stud, or approved equal. [illegible] Nelson Stud, or approved equal.

[illegible]

[illegible] approved equal.

[illegible] approved equal.

VII. SPECIFICATIONS FOR INDIVIDUAL ACCESSORY MATERIALS - contd

A. Fabrication and Application Accessories - contd

113. Glass Reinforcing Cloth: 20 x 20 mesh with starch binder, as manufactured by Perma-Glas Mesh Corporation, The Glas-Mesh Company, Benjamin Foster Corporation, or approved equal.

114. Nylon Strap: 1 2 inch x 0.020 inch nylon strapping as manufactured by A. J. Gerrard, or approved equal.

115. Crimp Clips: 1 2 inch stainless steel crimp-type seal as manufactured by A. J. Gerrard, or approved equal.

116. Water Sealer: Joint sealer - Pamseal 10, as manufactured by Pamrod, or approved equal.

117. Stainless Steel Wire: 14 gage aeaa soft annealed Type 304 or 430 stainless steel.

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.11 SPECIFICATION FOR INDIVIDUAL ACCESSORY MATERIALS - Contd

B Weather Barrier

1. MASTIC WEATHER BARRIER

a. Trowel (or palm) Grade - Specification Designation WC
Spray (or brush) Grade - Specification Designation WB

.1) SCOPE

These specifications cover a latex based mastic for use as a weather-barrier coating over thermal insulation.

.2) GENERAL

Mastic coatings supplied under these specifications shall be nonflammable when wet and fire resistant when dry. The mastic shall be suitable for application by troweling and palming or by brushing and spraying. In a one-coat application and without fabric reinforcement, it shall be possible to apply the mastic on a vertical substrate without evidence of sliding or slipping and to achieve a minimum dried thickness of 1/16-inch. The mastics shall be suitable for application at atmospheric and substrate temperatures in the range of 20° F to 150° F[1]. The coating must not skin-over so quickly as to prevent brushing out previously applied material. The dried material shall form a tough, elastic, fire resistive and chemical resistive weather-barrier coating. Coatings shall be homogeneous in color and shall match the color standards supplied to the purchaser. The product shall be free of objectionable odor and shall possess no characteristics toxic to the applicator or user. It shall be free of any constituents which cause skin irritation. The coating shall resist the ravages of weather such as rain, sleet, snow, wind, temperature changes, and solar radiation without cracking, peeling, becoming brittle, blistering, or otherwise disintegrating.

.3) PROPERTIES

For acceptance a mastic shall meet the general requirements of Paragraph .2 and satisfy the following specific requirements. The manufacturer shall submit a certified test report from an approved independent laboratory that the material of each grade supplied has been tested and does comply with the test requirements of these specifications.

.1) Solids Content

Solids content of trowel (or palm) grade - Specification Designation WC shall not be less than 50% by volume.

.2) Cup Test

The purpose of this test is to demonstrate good film flexibility (cohesion) and good adhesion of the mastic in the initial drying period following application.

The procedure is:

Allow the mastic to age at least forty-eight hours after it has been made before using it to prepare test specimens.

Fill with mastic an open top aluminum weighing dish, 2-3/8 inches in diameter and 3/8-inch deep, with crimped edges and tab[2]. Avoid large voids. Tamp the container by dropping it a few inches on the bench to remove voids in the mastic.

Allow the mastic to dry under normal laboratory atmospheric conditions (70° - 75° F and 50-75% R.H.) until the weight of cup and mastic is essentially constant on two successive days' weighings.

The basis of acceptance is:

After reaching constant weight, the surface of the mastic in the cup shall be free of cracks and tears.

The mastic shall adhere to the top lip of the cup throughout the test.

.3) Elongation Test

The purpose of this test is to demonstrate acceptable elastic properties of the mastic film at low ambient temperatures following a simulated accelerated aging procedure.

The Preparation of Mastic Film Test Specimens shall be as follows:

Allow mastic to age at least forty-eight hours after it has been made before casting wet films.

Cast a 1/16-inch thick wet film of the mastic on a Teflon or other plastic flat surface by screeding it with a bar over 1/16-inch edge dams. The wet film should be about 14" x 14" x 1/16".

Allow this film to dry at 70° - 75° F and 50-75% R.H. for a minimum of sixteen hours.

Remove the cast film, about 1/32-inch thick after drying and cut dumbbell test specimens. The dumbbell test specimens shall be 1/8-inch wide and 1-1/2-inches long in the narrow portion and have an overall length of [illegible] inches.

Curing of Dumbbell Test Specimens:

Support the dumbbell specimens flat on aluminum foil and bake for one-half hour in a forced air circulating oven at 150° F.

Bake the specimens for one-half hour in the forced circulation oven at 225° F.

Bake for [illegible] 2 hours in the forced circulation oven at 300° F.

Condition the baked specimens for 24 hours at 70° - 75° F and 50-75% R.H. before testing.

---

[1] More than one grade of the mastic may be supplied in order to cover this wide range of temperatures.

[2] This item is commercially available from Fisher Scientific Laboratories.

VII. SPECIFICATIONS FOR INDIVIDUAL ACCESSORY MATERIALS - Contd

(3) PROPERTIES - Contd

(c) Elongation Test - Contd

Testing:

Measure the elongation of the cured dumbbell specimens from stress-strain curves run on an Instron Universal Tester (*or equivalent*) at a strain rate of two inches per minute at 35° F.

Note: The test as specified shall be run in a forced draft environmental chamber mounted in the Universal Tester so that the specimens can be maintained at the desired temperature. The dumbbell specimen shall be installed in the environmental chamber and maintained at specified temperature for at least five minutes prior to testing.

Basis of Acceptance:

The percent of elongation of the dumbbell specimens with the 1-1/2" x 1/8" narrow sections shall be: tested at 35° F - 30% minimum, tested at 20° F - 15% minimum. At least four dumbbell specimens shall be tested and the results averaged.

(d) Fire Retardance Test

Thin films of the mastic, tested in accordance with the provisions of ASTM E 162 "Test for Surface Flammability of *Materials*", shall exhibit a Flame Spread Index not to exceed 35. The mastic film shall be cast wet to a thickness of 1/16-inch on a smooth 1/4-inch thick asbestos-cement board 18 inches by 6 inches and allowed to dry at 70° - 75° F and 50 - 75% R.H. for at least 16 hours. The dried film (approximately 1/32-inch thick) shall be further conditioned before testing as required by ASTM E 162.

(e) Chemical Resistance

The chemical resistance of the dried coating shall be typical of materials based on a polyvinyl acetate latex.

(4) APPLICATION CHARACTERISTICS

The mastic shall be supplied in air-tight containers ready for easy application either (one) by troweling or palming - Designation WC, or (two) by brushing or spraying - Designation WB. The container shall be labeled as to grade.

The mastic shall be ready for application with a minimum amount of mixing in its container.

Acceptance on the basis of applicability will be determined by *Purchaser's personnel*. *Mastic selected at random will* be used.

(5) PACKAGING AND SHIPPING

(a) *Packaging and Marking*

The coating shall be supplied in standard containers suitably coated inside or packaged to prevent corrosion. The containers shall be labeled to show product name, number, grade, and color. Any change in product shall be renamed and renumbered to prevent confusion with previously tested product. A coded batch number shall be shown on each container identifying the month and year of manufacture.

(b) Application Instructions

Manufacturer of coating shall furnish to the consumer all necessary application and use instructions.

(c) Shipping

It shall be the responsibility of the manufacturer to request, and the duty of the carrier to maintain conditions throughout shipping to prevent the mastic from freezing in transit. Any material received in frozen condition, or ruined because of freezing en route, shall be replaced at no expense to the purchaser.

(6) SHELF LIFE

(a) Mastic shall have a 6 month minimum shelf-life after it is received by purchaser. Consistancy shall not have changed sufficiently to make application difficult, nor shall the solids settled to the bottom require more than a minimum of mixing.

(b) It shall be resistant to growth of mold or mildew.

b. Reinforcing cloth shall be 100% Dynel, 44 inches wide, Leno weave, weighing 2.65 ounces per square yard, with count of 16 x 8, employing 18/2 in the warp and 9/2 in the filling, and fabric wet out with 8% solution of PVA then dried at 250° F; as manufactured by West Point Pepperell, McCampbell-Granitevillle, or approved equal.

c. Mastic (caulking) - Section A.45. of this Article.

d. Heat-Resistant Sealer - see Section A.42. of this Article.

e. Expansion Strip - see Section A.10. of this Article.

f. Lap Sealer - see Section A.46. of this Article.

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UNION CARBIDE

STANDARD

CHEMICALS AND PLASTICS OPERATIONS DIVISION
AND UNION CARBIDE CANADA LIMITED

M
INSULATION
ST
FEBRUARY 19[illegible]

[illegible] MATERIALS [illegible]

[illegible]

[illegible] Specification Designation M

[illegible]

This specification covers the material specifications for stainless steel weather barrier jacket and accessories used to use as a weather barrier over thermal insulation.

Materials for this specification for the stainless steel jackets and closure bands are:

[illegible] insulation sections of vertical equipment over 2'-0" (OD shall be stainless steel, 0.16-inch [illegible] gauge, not less than 0.006-inch thick, 36 inches wide, as manufactured by ITAL-Caustic, or approved equal.

[illegible] 2'-0" (OD and below shall be stainless steel jackets, 0.16-inch [illegible] gauge, not less than 0.006-inch thick, 36 inches wide, as manufactured by ITAL-Caustic, or approved equal.

Flat [illegible] jacket material shall be austenitic stainless steel, one quarter hard, not less than 0.008-inch thick [illegible] designated insulation outside diameter, with preformed intermediate [illegible] inch. Where desired, this [illegible] jackets shall be attached to the pipe insulation.

[illegible] shall be stainless steel, one quarter hard, not less than 0.008-inch thick.

Fitting jackets for [illegible] shall be austenitic stainless steel, one quarter hard, not less than 0.008-inch thick, [illegible] to the outside diameter of designated pipe insulation. Closure bands shall be furnished with [illegible] for [illegible] tightening, non-setting sealing compound, or foam tape seal. Bands shall be capable of [illegible] when installed on metal jacket. Closure bands shall be Seal-er-Band as manufactured by Insul-Caustic Corporation, [illegible] as manufactured by Johns-Manville, or approved equal.

Preformed jackets for fitting covers shall be suitable for installation over preformed insulation covers fabricated in accordance with ASTM Recommended Practice C 450, latest revision. The fitting cover jacket shall be austenitic stainless steel, not less than 0.008-inch thick, as manufactured by Mirror Insulation Company, Metals Unlimited, or approved equal.

Accessories for Stainless Steel Weather Barriers

[illegible] Metal Screws - Section A.12 of this Article.

[illegible] Insulation Strap - Section A.11 of this Article.

[illegible] Insulation Strap - Section A.10 of this Article.

[illegible] Adjustment Strap - Section A.13 of this Article.

[illegible] Strap - Section A.14 of this Article.

[illegible] Clips - Section A.27 of this Article.

[illegible] Jacket Support Clip - Section A.28 of this Article.

[illegible] Stainless Steel Wire - Section A.17 of this Article.

[illegible] Stainless Steel Type 304 or 410 bead sprinkled with [illegible] Section A.[illegible] of this Article.

[illegible] Section A.40 of this Article.

[illegible] Section A.42 of this Article.

II. SPECIFICATIONS FOR INDIVIDUAL ACCESSORY MATERIALS - cont'd

B. Weather Barriers - cont'd

1. Treated Carbon Steel Weather Barrier - Specification Designation MT

a. Scope

These specifications cover the material specifications for treated carbon steel weather barrier vessel and pipe jackets, and the accessories required for use as a weather barrier over thermal insulation.

b. Material Specifications for the treated steel jackets and closure bands are

1) Jackets for vertical equipment over 24 inches OD shall be carbon steel, 0.010-inch thick, zinc protected and vinyl finished on both sides, with polyethylene and kraft paper on one side, and 3 1/6-inch corrugations, in coil form, 36 inches wide, color as specified, Tuf-Jac as manufactured by Insul-Caustic, Smith Products, or approved equal.

2) Jackets for equipment 24 inches OD and under and for pipe insulation shall be carbon steel, 0.010-inch thick, zinc protected and vinyl finished on both sides, with polyethylene and kraft paper on one side, smooth, 36 inches wide, color as specified, Tuf-Jac as manufactured by Insul-Caustic, Smith Products, or approved equal.

3) Closure bands for both ends of pipe jackets shall be carbon steel, 0.010-inch thick, zinc protected and vinyl finished on both sides, precut and preformed to fit outside diameter of designated pipe insulation. Closure bands shall be furnished with factory installed high-temperature non-setting sealing compound, or foam tape seal on each inside edge to provide water seal when installed on metal jacket. Closure band shall be Sealer-Band as manufactured by Insul-Caustic Corporation, Smith Products, or approved equal.

4) Preformed jackets for fitting covers shall be suitable for installation over preformed insulation covers fabricated in accordance with ASTM Recommended Practice C 450, latest revision. The fitting cover jacket shall be treated carbon steel, not less than 0.006-inch thick as manufactured by Mirror Insulation Company, Metals Unlimited, or approved equal.

c. Accessories for Treated Steel Weather Barriers

1) Sheet Metal Screws - Section A.32. of this Article.

2) Equipment Insulation Strap - Section A.11. of this Article.

3) Pipe Insulation Strap - Section A.13. of this Article

4) Clips for equipment strap) - Section A.12. of this Article.

5) Clips (for pipe strap) - Section A.14. of this Article.

6) S Clips - Section A.27. of this Article

7) Jacket Support Clips - Section A.28. of this Article.

8) Stainless Steel Wire - Section A.17. of this Article.

9) Flashing Strip - Stainless Steel, Type 304 or 430, dead soft annealed, flat, smooth, 6-inches wide, minimum 0.008-inch thick.

10) Lap Sealer - Section A.40. of this Article.

Heat Resistant Sealer - Section A.42. of this Article.

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[illegible] INDUSTRIAL ACCESSORY MATERIALS - cont'd

Union Carbide trial exhibit UC-4586: W. G. Hammar Transmittal Memoranda and Union Carbide Thermal Insulatio…
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VII. SPECIFICATIONS FOR INDIVIDUAL ACCESSORY MATERIALS - cont'd

C. Tracing Accessories

1. Air Convection Tracing System

a. Accessories. Pressed steel spacers shall be No. 18 gage, constructed as shown on Owner's Standard P-140, and as manufactured by A. J. Gerrard, or approved equal.

b. Protective Wrapping. Glass cloth tape - see Item 2.b.(6). of this Section.

2. Heat Transfer Cement Tracing System

a. Materials - Heat transfer cement shall be one of the following grades, as manufactured by the Thermon Manufacturing Company, or approved equal.

(1) Standard Grade, water soluble, suitable for use on tubular heat traced piping and equipment, whose temperature may vary from minus 320 F to plus 600 F.

(2) T-3 Grade, water soluble, suitable for temperatures minus 320 F to plus 600 F. For use in bonding strip heaters and plate-type coils to equipment or large piping. Slow setting for application to large areas.

(3) T-63 Grade, water soluble, suitable for temperatures from minus 320 F to plus 1,250 F.

(4) T-65 Grade, not water soluble, for temperatures minus 100 F to plus 375 F. For use in extremely moist or corrosive atmospheres. Also suitable on systems not insulated.

(5) T-80 Grade, not water soluble, for temperatures minus 100 F to plus 325 F. For use in extremely moist or corrosive atmospheres, or when installation is made during freezing weather. Easier to apply in cold weather than the T-65 Grade. Also suitable on systems not insulated.

(6) T-5 Grade, not water soluble, for temperatures minus 200 F to plus 125F. Especially for use on cooling applications. Will not harden. Does not require curing prior to use of tracer.

b. Accessories

(1) Primer for coating of aluminum surfaces prior to application of Standard Grade, T-3 Grade and T-63 Grade of heat transfer cements. Shall be ALP Primer as manufactured by Thermon Manufacturing Company, or approved equal.

(2) Mill Varnish Stripper shall be suitable for the removal of mill varnish from steel pipe or equipment. It shall be T-350 Electro Cold Stripper as manufactured by Allied Finishing Specialties Company, or approved equal.

(3) Metal Retainer for Cement - Bent metal retainer for some applications of heat transfer cement. Dimensions and material shall be as shown in Figure GA-48 in GS, General Specifications.

(4) Pipe Insulation Strap - Section A.13. of this Article.

(5) Clips for Pipe Strap - Section A.14. of this Article.

(6) Glass Cloth Tape - Tightly woven glass fabric with pressure sensitive adhesive, with dielectric strength of 4,000 volts. Suitable for temperatures from minus 110 F to plus 500 F. It shall be high-low temperature glass tape, No. 7000 as manufactured by Mystik Adhesive Products, Tuck No. 59 as manufactured by Technical Tape Company, or approved equal.

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THERMAL INSULATION APPLICATION SPECIFICATIONS

CELLULAR GLASS

SCOPE

This specification describes the essential requirements for the application of shaped cellular glass insulation for use in building roofs, walls, ceilings, and floors.

SECTION A - MATERIALS

1. INSULATION MATERIAL

   Insulation shall be as specified in MATERIAL SPECIFICATION NO. 10.

2. THICKNESS AND SIZES OF INSULATION

   a. Cellular glass block insulation shall be 2, 2-1/2, 3, 3-1/2, 4, 4-1/2, or 5 inch thick, as specified, and either 12-inch by 18-inch or 24-inch by 24-inch size.

   b. Cellular glass boards shall be 1-1/2 inch thick and 24-inch by 48-inch size, with factory-attached kraft paper on both sides. Thickness shall be 1-1/2 inch or a multiple of 1-1/2 inch, as specified.

3. ACCESSORY MATERIALS

   Accessory materials shall be as specified in the MATERIAL SPECIFICATIONS, article numbers as noted

Roofing Cement	VII. A. 50	Bead Mastic	VII. A. 55
Roofing Vapor Barrier	VII. A. 51	Asphalt Emulsion	VII. A. 56
Roofing Fire-Resistant Adhesive	VII. A. 52	Wire Mesh	VII. A. 60
Roofing Asphalt	VII. A. 53	Lath Clips	VII. A. 61
Roofing Felt	VII. A. 54	Angle Pins	VII. A. 62
Roofing Joint Sealer	VII. A. 55	Ceiling Cement	VII. A. 63
Flashing Cement	VII. A. 56	Anti-Adhering Solution	VII. A. 64
Rosin-Sized Paper	VII. A. 57		

SECTION B - APPLICATION

1. ROOF INSULATION ON METAL DECK

   a. Deck shall be plane, dry, clean, and free from holes. Any holes or open joints shall be covered with 6-inch-wide strips of asphalt felt set in flashing cement, or sealed with joint sealer.

   b. If metal deck has a slope greater than 1-1/2 inch per foot, nailing strips of treated wood equal in height to the thickness of insulation shall be secured to the deck to hold the insulation in place. These strips shall be spaced so that each 4-foot-wide course is held in place. A space of 1/4 inch shall be allowed between ends of strips.

   c. Fire-resistant adhesive shall be applied to deck in ribbons approximately 6 inches on centers and 1/4 inch in diameter, at a rate of approximately 0.4 gal per 100 sq ft.

   d. Cellular glass insulation shall be immediately embedded in the fire resistant adhesive in parallel courses with staggered end joints. All joints shall be tightly butted.

   e. If more than one layer of cellular insulation is specified, the second layer shall be applied to the first by firmly and immediately embedding it in molten hot mopped steep roof asphalt. Joints shall be tightly butted and shall be staggered with relation to the layer below.

   f. Underwriters' Laboratories Class "A" built-up roofing shall be applied over clean, dry cellular glass insulation.

   g. Installation shall be as shown in Figure 10-B-1.

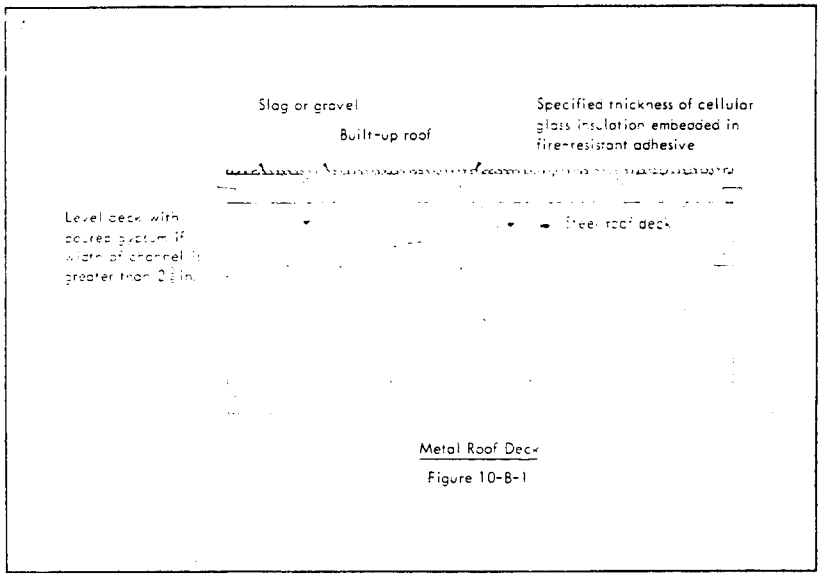
2. ROOF INSULATION ON MONOLITHIC CONCRETE OR GYPSUM, OR PRECAST SLABS OF CONCRETE OR GYPSUM

   a. Deck shall be plane, dry, and free from holes.

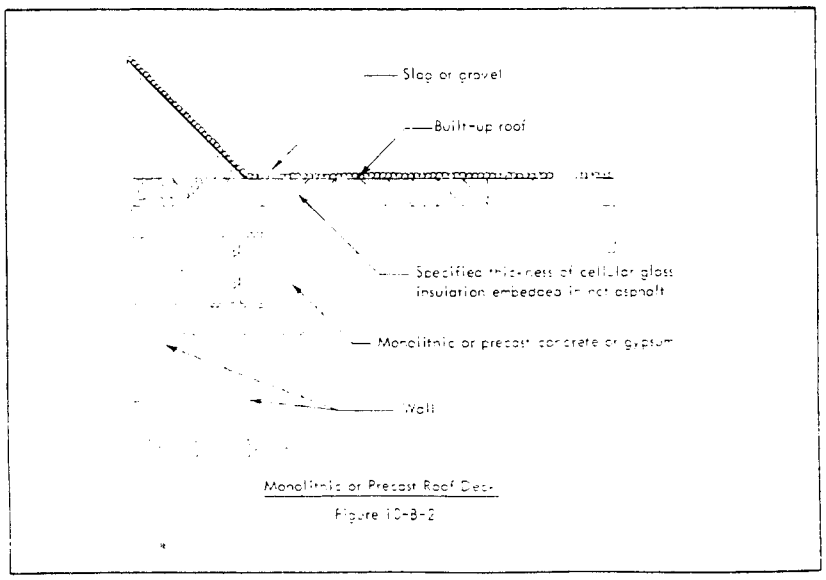
   b. Joints of precast slab shall be covered with 6-inch-wide 15-lb felt laid in flashing cement.

   c. Cellular glass insulation shall be installed in accordance with Items 1.b, c, d, e, and f of this section, and as shown in Figure 10-B-2

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Metal Roof Deck
Figure 10-B-1



Monolithic or Precast Roof Deck
Figure 10-B-2

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SECTION B - APPLICATION - cont'd

1. ROOF INSULATION ON WOOD DECK

a. Deck shall be plane, dry, and free from holes.

b. Any knotholes shall be covered with metal.

c. The deck shall be covered with rosin-sized paper lapped at least 2 inches, and secured to the deck with 1-inch roofing nails through tin caps.

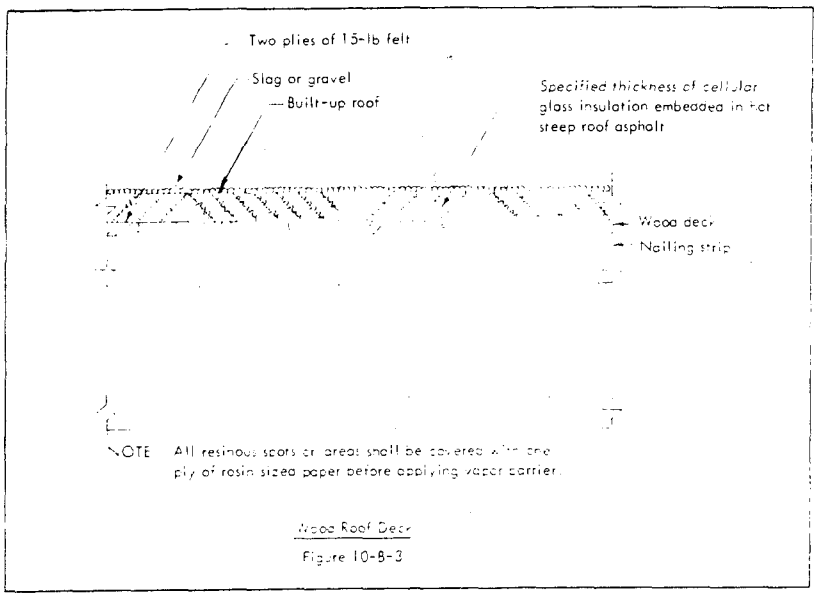
d. If the humidity of the interior is excessive, two plies of 15-lb felt shall be applied with mopping of hot steep roof asphalt. Felt shall be applied by lapping each sheet 19 inches, leaving 17 inches exposed, and mopping hot steep roof asphalt between felts so that at no place shall [illegible] felt.

e. Insulation shall be applied by embedding it in hot mopped steep roof asphalt, in parallel courses with staggered end joints. All joints shall be tightly butted.

f. If more than one layer of insulation is specified, the second layer shall be applied to the first layer by firmly and immediately embedding it in hot mopped steep roof asphalt. Joints shall be staggered with relation to layer below.

g. Underwriters' Laboratories Class "A" built-up roofing shall be applied over clean dry cellular glass insulation.

h. Insulation shall be as shown in Figure 10-B-3.



Wood Roof Deck
Figure 10-B-3

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SECTION B - APPLICATION - conta

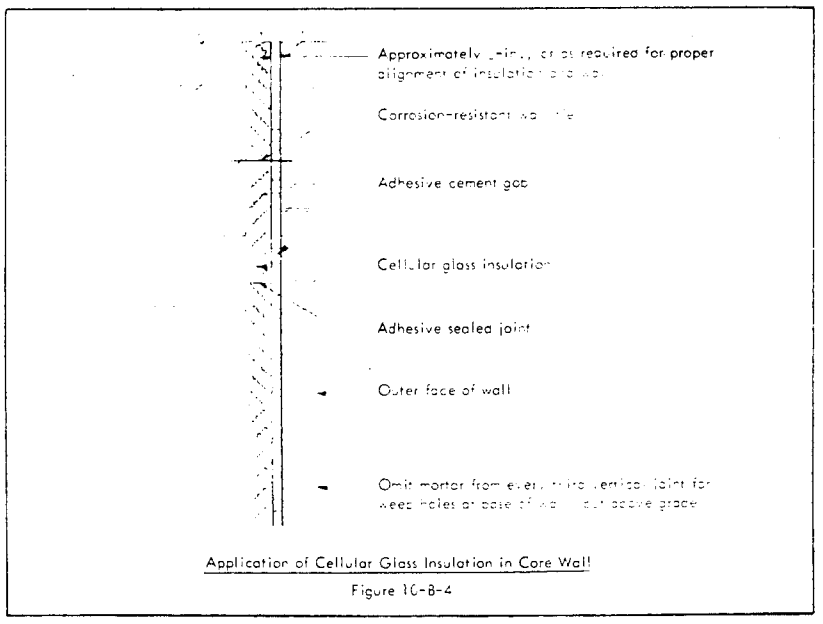
4. INSULATION FOR CORE WALLS

a. Inner masonry walls shall be plumb, straight, and true to dimensions, with full mortar joint to provide a smooth surface for installation of insulation. Wall ties shall be properly spaced to permit proper tie with outer wall.

b. Cellular glass insulation shall be installed by use of four gobs of adhesive cement located near corners of the back face of the block, and a 1/8-inch-thick trowel coat of the adhesive on the edges. Each block shall be laid true and plumb, with sufficient manual pressure to ensure tight joints and good contact with masonry wall. Points where wall ties extend through the insulation shall be sealed off with adhesive cement.

c. Outer wall shall be erected with a 1-1/4-inch space between it and the insulation. Weep holes shall be provided at the base.

d. Installation shall be as shown in Figure 10-B-4.



Application of Cellular Glass Insulation in Core Wall
Figure 10-B-4

5. INSULATION FOR MASONRY WALL LINING

a. Masonry wall shall be plumb, straight, smooth, and clean.

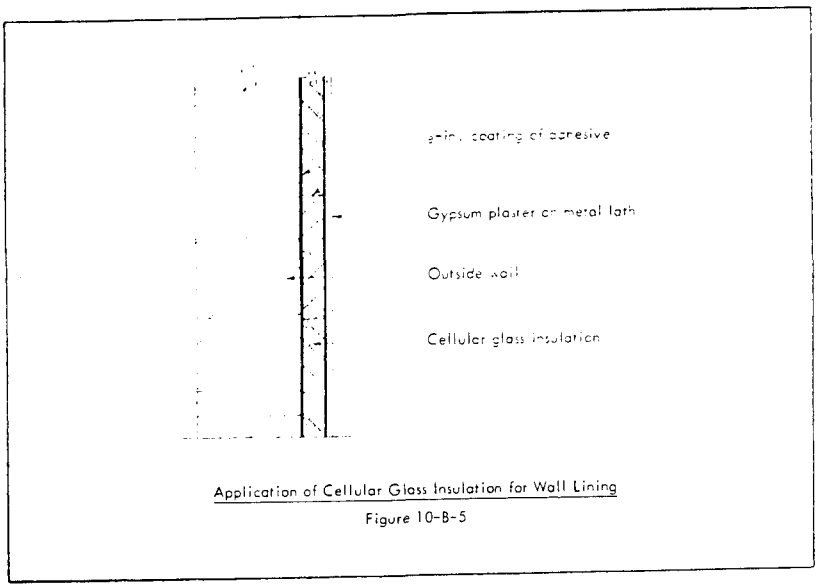
b. A 1/8-inch-thick coat of adhesive shall be applied to the back face of each block of cellular insulation, and to edges of each block to form a seal.

c. Each block shall be laid true and plumb with sufficient manual pressure to ensure tight joints and good contact with masonry wall.

d. Installation shall be as shown in Figure 10-B-5.

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SECTION B - APPLICATION - contd



Application of Cellular Glass Insulation for Wall Lining
Figure 10-B-5

5. INSULATION FOR EXISTING CONCRETE CEILINGS

a. Concrete ceiling shall be plane, smooth, dry, and clean.

b. A full coat of ceiling cement shall be applied with a 1/8-inch square-cut serrated trowel.

c. A uniform 1/8-inch-thick coat of adhesive shall be applied to edges of each block of cellular glass insulation, where the edges are to contact

d. Blocks of cellular glass insulation shall be installed in staggered joint construction, with sufficient manual pressure to ensure good contact with the ceiling. All joints shall be tightly butted.

6. INSULATION FOR NEW CONCRETE CEILINGS

a. Forms for concrete slabs shall be constructed to allow for thickness of the cellular glass insulation.

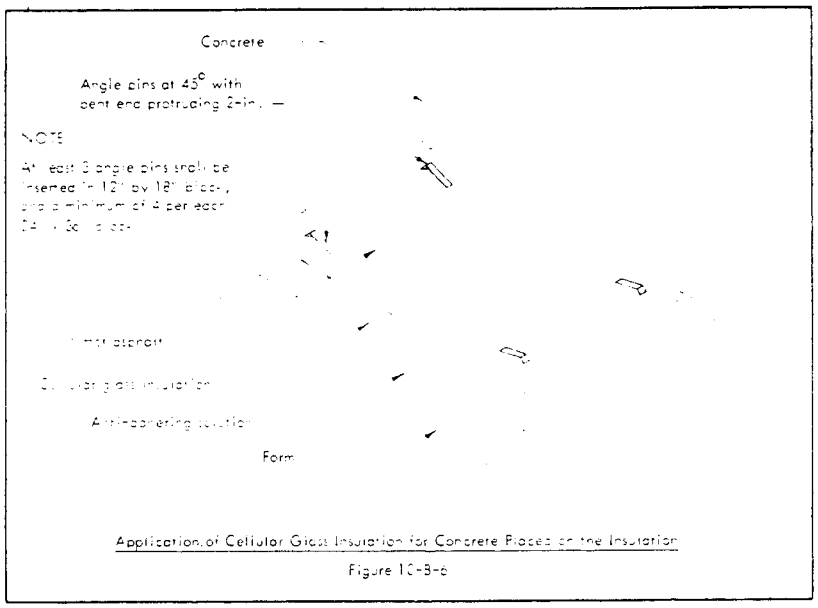
b. Forms shall be coated with anti-adhering solution.

c. While anti-adhering solution is still wet, blocks of cellular glass insulation, in parallel courses with staggered end joints, shall be placed in the form. The top surface of the insulation shall be immediately flood-mopped with hot asphalt.

d. After concrete reinforcement is placed, angle pins shall be inserted in the insulation at a 45-degree angle. At least three pins shall be used on each 12-inch by 12-inch block, and at least four pins on each 24-inch by 12-inch block. Bent end of pin shall protrude at least 2 inches into concrete as shown in Figure 10-B-6.

e. Concrete shall then be placed over the insulation.

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Application of Cellular Glass Insulation for Concrete Placed on the Insulation

Figure 10-B-6

[illegible] FINISH

[illegible] surface of cellular glass insulation shall be given a brush coat of asphalt emulsion.

[illegible] shall be fastened to insulation with lath tiles or [illegible] staples. Lath tiles shall be [illegible] and butt at corners with corner bead.

Gypsum plaster, mixed on the job, shall be applied to the wire mesh in two coats having a maximum total thickness of 1/2 inch.

Coating shall be [illegible] emulsion as specified in Union Carbide Corporation Design and Construction Coating Specifications.

CONCRETE FLOOR SLABS

Poured on Wall - Method

Where specified, insulation shall be applied to foundation walls, as shown in Figure 10-B-7.

Insulation shall be installed on inside surface of foundation wall with a thin layer of asphalt emulsion.

A layer of [illegible] felt, cut to the thickness of the floor slab, shall be applied to the insulation to prevent concrete from [illegible] insulation.

Built-on Method

Where specified, insulation shall be applied to foundation walls as shown in Figure 10-B-8.

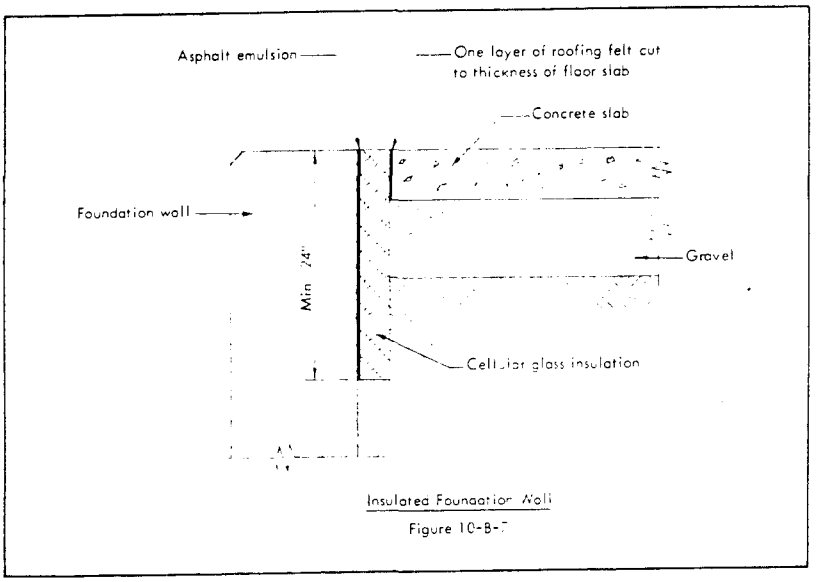
A layer of [illegible] approximately 1 inch thick shall be applied over gravel before pouring insulation. Insulation shall extend [illegible] from [illegible] with a minimum of 24 inches, or under [illegible] as specified.

[illegible] insulation with a [illegible] gravel coating.

After insulation is installed as specified, the entire surface shall be [illegible] with a 1/8 [illegible] minimum coat of hot asphalt [illegible] pouring floor slab. Asphalt shall be heated to a temperature not exceeding 360°F.

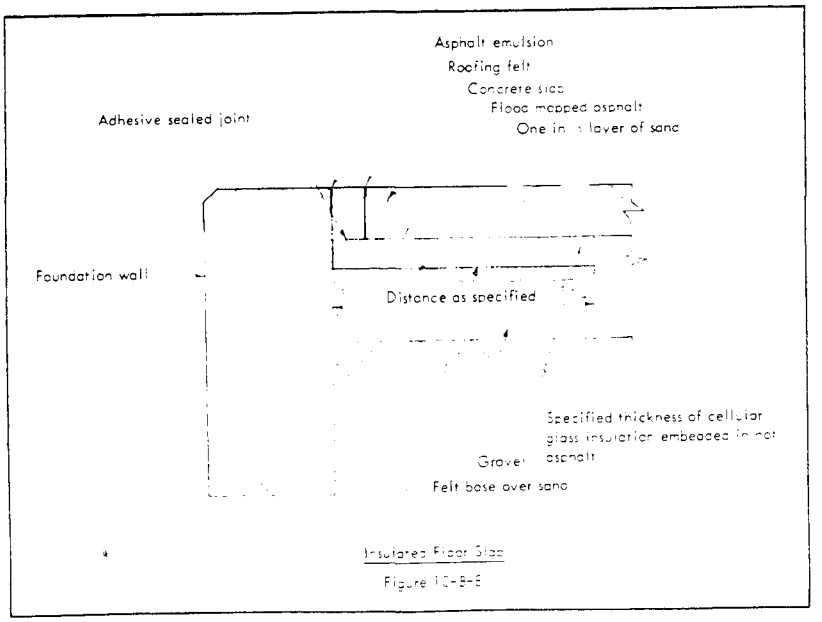
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SECTION B - APPLICATION - contd



Insulated Foundation Wall

Figure 10-B-7



Insulated Floor Slab

Figure 10-B-8

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THERMAL INSULATION APPLICATION SPECIFICATIONS

CELLULAR GLASS

SCOPE

This specification describes the essential requirements for application of shaped cellular glass insulation for use on equipment and piping normally operating at temperatures above 70 F and up to and including 600 F. It is applicable to both indoor and outdoor service.

The second designation, 10-HSS, indicates that this specification shall be used for stainless steel equipment and piping. However, Specification 10-HSS shall be subject to the use of accessory materials specified for stainless steel.

Procedures described in the GENERAL SPECIFICATIONS are applicable to and constitute an integral part of this specification.

SECTION A - MATERIALS

1. INSULATION MATERIAL

[illegible] shall be as specified in MATERIAL SPECIFICATION NO. 10.

2. ACCESSORY MATERIALS

Accessory materials shall be as specified in the MATERIAL SPECIFICATIONS, article numbers as noted.

Cushioning Material:
- Equipment Operating Above 350 F . . . . . VII.A. 1
- Equipment Operating at 350 F and Below . . . VII.A. 2
- Piping Operating Above 350 F . . . . . VII.A. 3
- Piping Operating at 350 F and Below . . . . VII.A. 4

Insulating Cement . . . . . VII.A. 6
Pipe Insulation Support . . . . . VII.A. 9
Equipment Insulation Strap VII.A.11
Clips for Equipment Strap VII.A.12
Pipe Insulation Strap VII.A.13
Clips for Pipe Strap VII.A.14
Stainless Steel Wire VII.A.17
Welding Pins VII.A.19
Stainless Steel Pins VII.A.20
Stainless Steel Skewers VII.A.21
Strap Anchor Clip VII.A.24
Staples VII.A.25
Strapping Tape VII.A.33
High Temperature Fabricating Cement VII.A.34
Heat-Resistant Sealer VII.A.42
Non-Setting Sealer VII.A.38
Weather-Barrier Mastic (color as specified) . . . VII.B.1.a
Reinforcing Cloth VII.B.1.a
Stainless Steel Weather Barrier (Designation M) . . VII.B.2
Treated Steel Weather Barrier (Designation MT) . . VII.B.3

3. ACCESSORY MATERIALS - SPECIFICATION 10-HSS

Accessory materials for Specification 10-HSS shall be the same as those listed in Item 2 above, with the following omissions:

Cushioning Material for Equipment and Piping . . . VII.A.2, 3 and 4

SECTION B - APPLICATION

1. EQUIPMENT

a. Insulation Supports. Equipment shall be provided with insulation supports as specified in Article II of the GENERAL SPECIFICATIONS.

b. Thickness Schedule. Unless otherwise specified, insulation in excess of three inches total thickness shall be applied in multiple layers as specified in Article III.B of the MATERIAL SPECIFICATIONS.

c. Cushioning Blanket

(1) On vertical equipment, except stainless steel, two layers of cushioning blanket shall be applied over the top head and compressed to one-inch thickness, and one layer to the sides and bottom head and compressed to one-half-inch thickness, before application of the cellular glass insulation. Blanket shall be secured in place with a minimum amount of stainless steel wire. Cellular glass insulation shall then be applied over the blanket in the manner described in this specification. Cushioning blanket shall not be considered as part of the specified insulation thickness.

(2) On horizontal equipment, except stainless steel, one layer of cushioning blanket shall be applied over the entire surface and compressed to one-half-inch thickness, and secured in the same manner as that specified in Paragraph (1) above.

(3) On stainless steel vertical or horizontal equipment, the specified white glass wool blanket shall be applied in the same manner as that specified in Paragraph (1) or (2) above.

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SECTION B - APPLICATION - cont'd

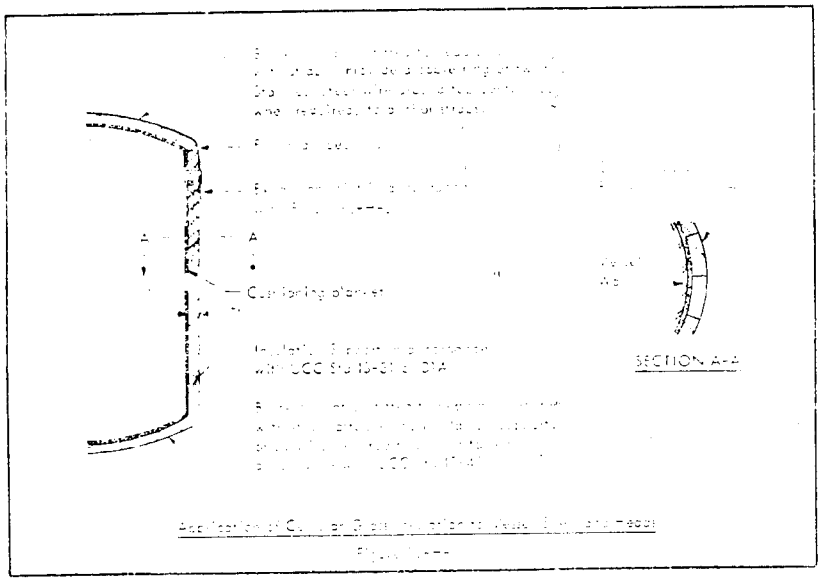
EQUIPMENT - cont'd

Curved Surfaces

1. Cellular glass block insulation for sides and bottom heads of vertical vessels shall be shop-fabricated and fitted to allow a 1/2-inch space for cushioning blanket between block and vessel.

2. Cellular glass block insulation for top heads of vertical vessels shall be shop-fabricated and fitted to allow a 1-inch space for cushioning blanket between block and vessel.

3. Block insulation shall be applied over cushioning blanket on all equipment with all joints tightly butted. Multiple layers shall be applied so that the butt joints of one layer do not coincide with those of any other layer. Typical installation is shown in Figure 10-H-1



Application of Cellular Glass Insulation on Curved Surfaces of Vessel Ends and Heads

Figure 10-H-1

Securement

(1) Where contour of vessel permits firm and effective attachment, all layers of cellular glass insulation shall be secured in place with stainless steel insulation straps. Where required, insulation straps shall be attached to strap anchor angles in accordance with Owner's Standard 15-31A. Insulation applied to irregular surfaces, where use of straps is impracticable, shall be secured with stainless steel wire attached to welding pins as shown here, and shall be fitted together and sealed with insulating cement.

2. Cellular glass insulation on bottom heads of vertical equipment shall, at manhole openings, be held in place with stainless steel insulation straps secured to insulation supports as shown in Owner's Standards 15-31, 15-3a, and 15-42. On large diameter vessels (over 12 ft OD) where use of straps is impracticable, insulation shall be secured by wire attached to welding pins in accordance with Owner's Standard 15-42 and as shown in Figure 10-H-2

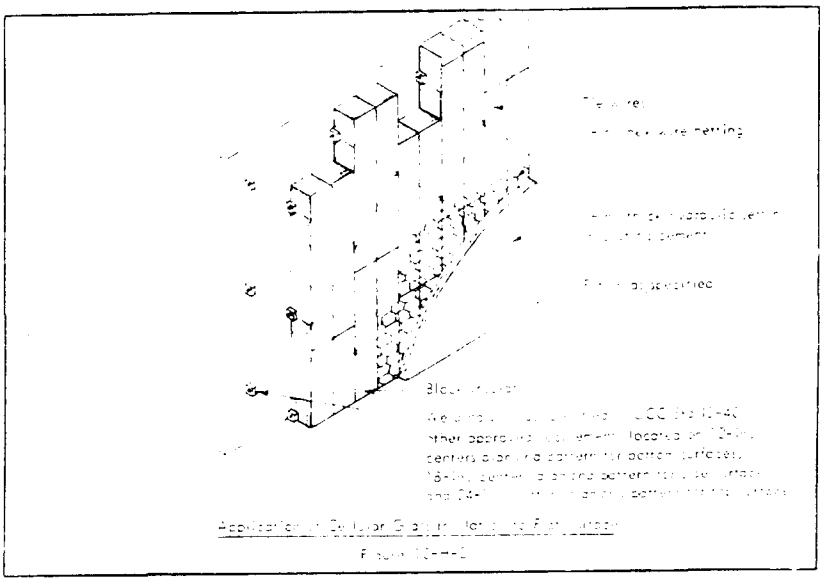
Flanges: Manhole flanges, piping flanges, and vessel flanges shall be insulated unless otherwise specified.

Flat Surfaces: Flat block shall be applied to flat surfaces in the same manner as previously specified for curved surfaces when operating temperature of equipment is in excess of 150 F. When operating temperature of equipment is 150 F or below, cushioning material may be omitted and block applied directly to metal surfaces. Securement shall be by wire attached to welding pins as shown in Figure 10-H-2

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SECTION B - APPLICATION - cont'd

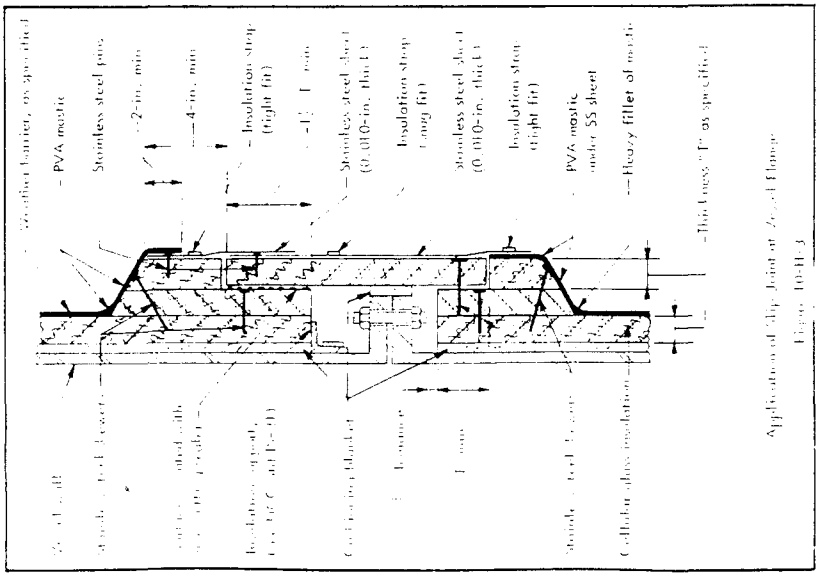
EQUIPMENT - cont'd



Application of Outer Sheet for Insulation Finish
Figure 10-HSS-2

Expansion Joints

Where vessel flanges are insulated, expansion joints, constructed as shown in Figure 10-HSS-3, shall be provided at the flange



Application of Slip Joint at Vessel Flange
Figure 10-HSS-3

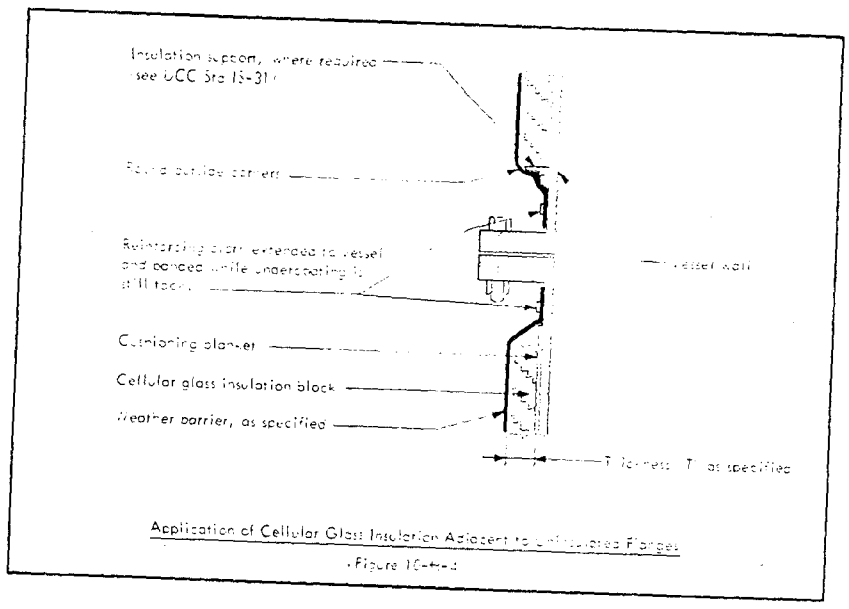
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SECTION B - APPLICATION - cont'd

EQUIPMENT - cont'd

Expansion Joints - cont'd

2. Where vessel flanges are uninsulated, the reinforcing cloth of the weather barrier on the adjacent vessel insulation shall be extended to the flat or inside face, coated with heat resistant sealer, and sanded while sealer is still tacky. A second application of sealer shall be applied over the reinforcing cloth and securement. Typical installation is shown in Figure 10-H-4.



Application of Cellular Glass Insulation Adjacent to Uninsulated Flanges
Figure 10-H-4

3. Long runs of expansion of vessels shall be provided for by installing expansion joints in the insulation, as shown in Figure 10-H-5, where insulation one thickness is specified for a vessel, or insulation adjacent to the flange of the vessel is in one layer similar to that shown in Figure 10-H-5.

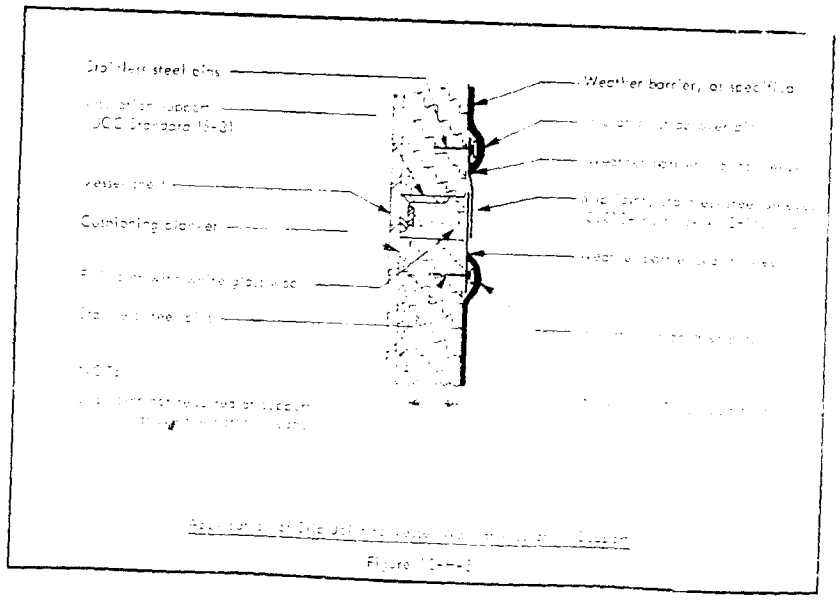


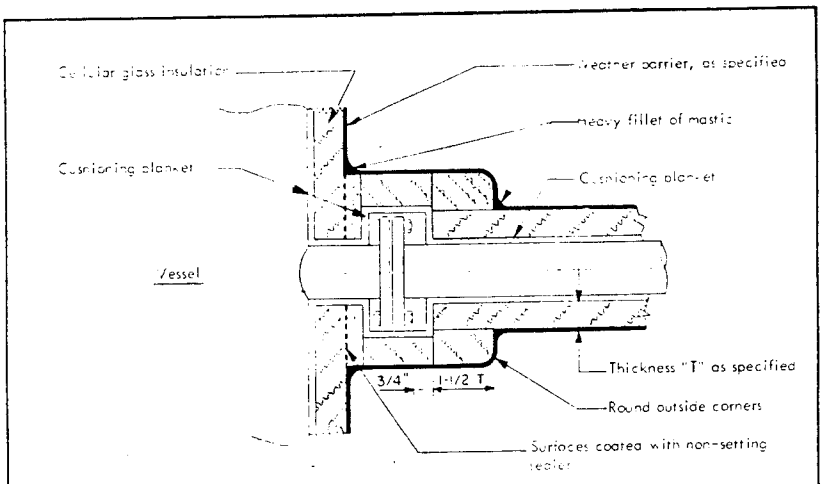
Figure 10-H-5

SECTION B - APPLICATION - contd

EQUIPMENT - contd

Expansion Joints - contd

4. One inch of cushioning material shall be packed around nozzles and projections where they extend through the insulation, to prevent crushing of the insulation by contraction and expansion of the vessel. Typical application is shown in Figure 10-H-6.



Application of Cellular Glass Insulation to Horizontal Nozzle

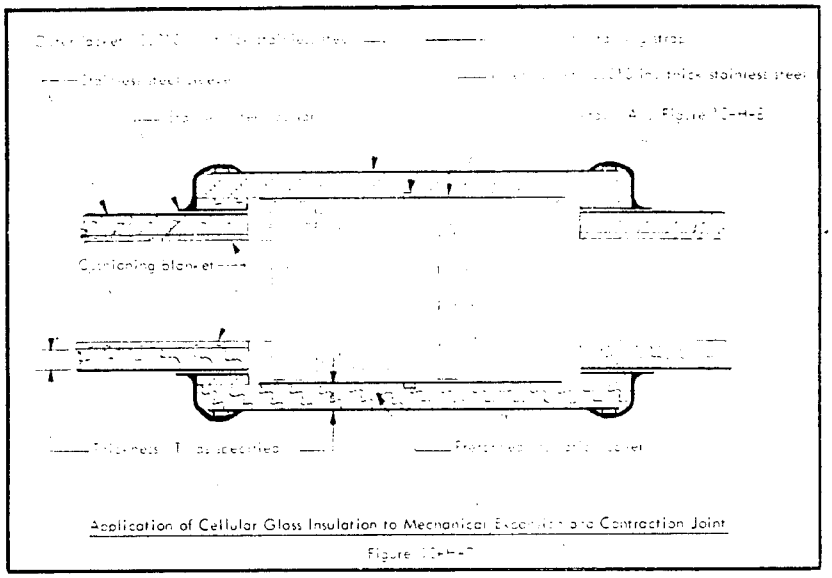
Figure 10-H-6

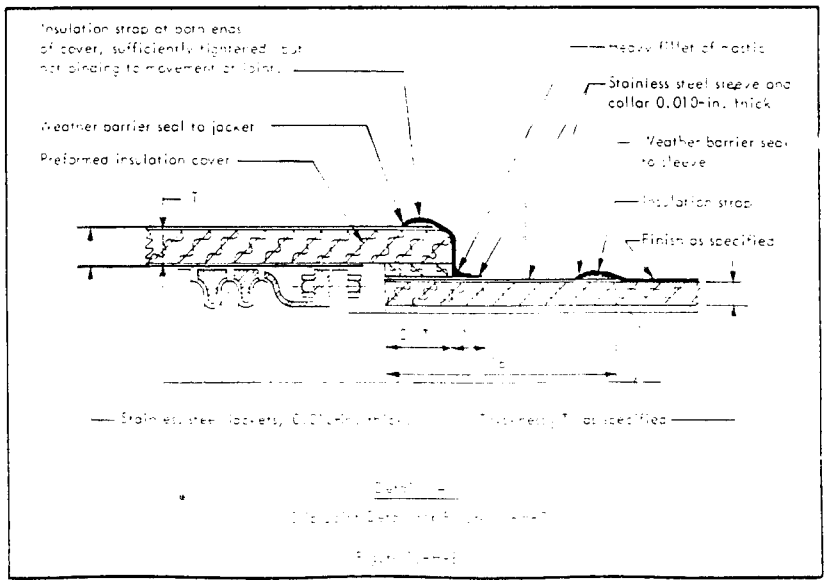
5. Mechanical Expansion Joints - Corrugated mechanical expansion joints in piping (usually listed as equipment items) shall be insulated as shown in Figures 10-H-7 and 10-H-8. A slip joint shall be provided by applying an 18-inch-long sleeve of 0.010-inch-thick stainless steel over the pipe insulation at each end of the expansion joint, placed flush with the butt end of the pipe covering. The sleeve shall be secured with bands at one end only, that farthest from the expansion joint cover. A collar band of 0.010-inch-thick stainless steel of sufficient length to project one inch beyond the expansion joint insulation cover shall be applied over the sleeve and held in place by the expansion joint cover when installed as specified with insulation straps. The longitudinal laps of the stainless steel bands shall be a minimum of 2 inches, and shall be arranged so as to shed water. Weather-barrier mastic shall be applied to the ends of the expansion joint cover and carried down and across the butt joints. Weather-barrier mastic shall cover all the stainless steel weather jacket on the expansion joint cover.

Where expansion joints are installed vertically in piping, the slip joint at the top shall be omitted and the expansion joint cover secured and fastened to the pipe covering.

SECTION B - APPLICATION [illegible]

EQUIPMENT [illegible]



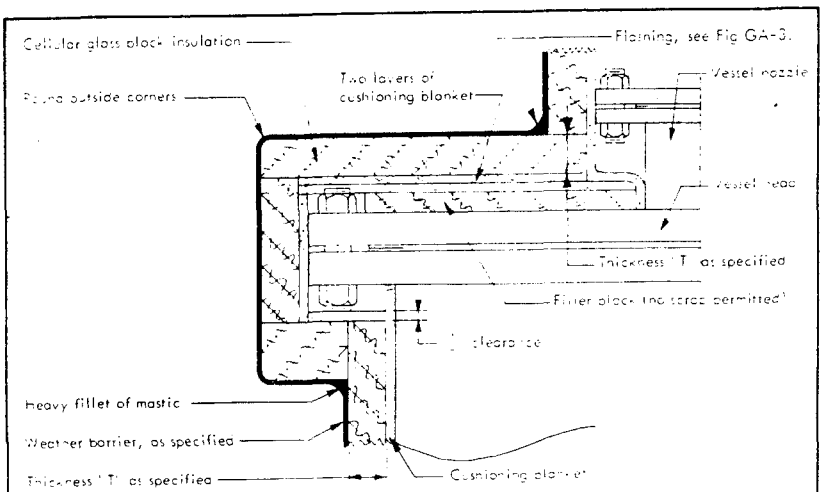


SECTION B - APPLICATION - cont'd

EQUIPMENT - cont'd

Flat Heads

1. Insulation on top of flat heads of vertical equipment shall be applied in the same manner as previously described in this specification. Water pockets shall be eliminated and proper drainage provided as shown in Figure 10-H-9.



Application of Cellular Glass Insulation to Flat Equipment Head

Figure 10-H-8

2. All nozzles on top of insulated equipment shall be provided with flashing as shown in Figure GA-3 of the GENERAL SPECIFICATIONS.

Tank Legs

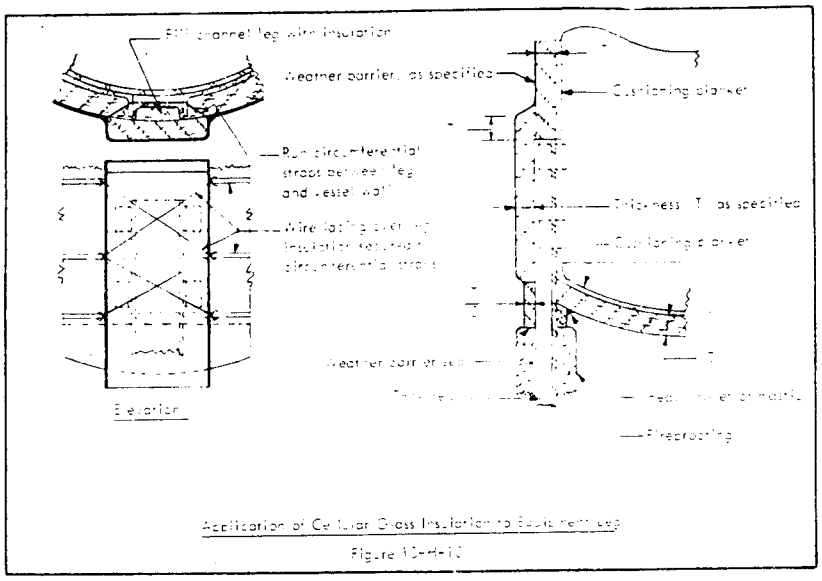
1. Concrete-filled structural tubing legs shall be insulated as specified in Article V.C. of the GENERAL SPECIFICATIONS.

2. Channel legs shall be insulated with block which shall extend over channel flanges and down channel legs to [illegible] adjacent material. Thickness shall be 1-2 that specified for body of vessel. Body insulation shall be brought up to and butted [illegible] tank leg flange.

3. Rectangular blocks between channel flanges and over channel flanges between body insulation and [illegible] with cement. Surface of fireproofing material abutting tank leg insulation shall be coated with weather barrier coating. Insulation shall be as shown in Figure 10-H-10.

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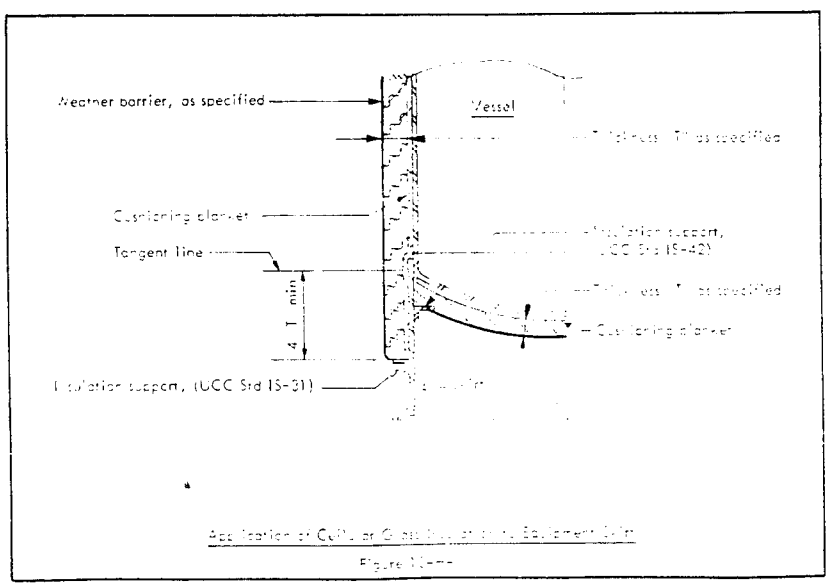
EQUIPMENT - cont'd



Application of Cellular Glass Insulation to Support Leg

Figure 10-H-12

Vessel Skirts - Skirts supporting vertical equipment shall be insulated outside ... Insulation shall extend downward, from junction of ... bottom head, a distance of not less than four times the specified thickness or to ... whichever is greater. Where specified, ... size of skirt shall be insulated. Thickness shall be as specified for body of vessel. ... provided for bottom head insulation in accordance with Owner's Standards ... (Insulation shall be ... 10-H-11.



Application of Cellular Glass Insulation to Equipment Skirts

Figure 10-H-13

SECTION B - APPLICATION - cont'd

EQUIPMENT - cont'd

c. Traced Instruments. Tracing and insulation on traced equipment shall be installed as specified in Article XIII of the GENERAL SPECIFICATIONS.

d. Weather Barrier. Weather-barrier coating or jacket, whichever is called for, shall be applied as specified in Articles XIV.B and XV.B, respectively, of the GENERAL SPECIFICATIONS. Mastic weather barrier shall be used unless metal jacket is called for as follows:

1) Weather barrier consisting of stainless steel jacketing, where required, shall be called for by the addition of the letter *M* to the specification designation, thus 10-HM or 10-HSSM.

2) Weather barrier consisting of treated steel jacketing, where required, shall be called for by the addition of the letters MT to the specification designation, thus 10-HMT or 10-HSSMT.

2. PIPING

a. Application

1) Pipe insulation shall be supported and secured as specified in Article III of the GENERAL SPECIFICATIONS.

2) Insulation with a thickness of 2½ inches total thickness shall be applied in multiple layers as specified in Article III.E of the MATERIAL SPECIFICATIONS.

3) Pipe insulation shall be applied to piping in a staggered position in accordance with Figures GA-1 and GA-2 of the GENERAL SPECIFICATIONS.

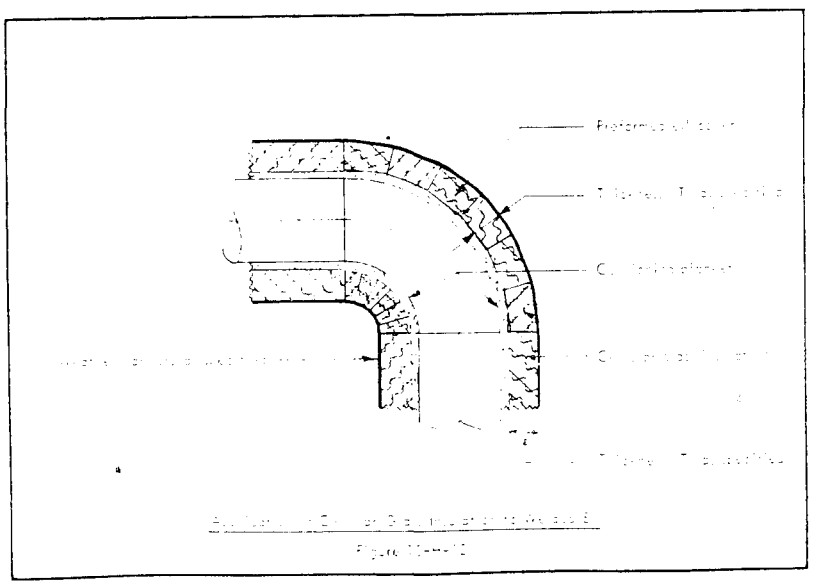
4) Piping operating at temperatures of 350 F and below, except stainless steel, shall have one-half-inch-thick preformed cushioning material applied before application of cellular glass insulation and secured with a minimum of four staples per three-foot section. Piping operating at temperatures below 350 F except stainless steel, or where preformed cushioning material is not available, shall have one-inch-thick cushioning blanket secured with stainless steel wire and compressed to approximately one-half-inch thickness, applied before application of cellular glass insulation. Cushioning material shall not be considered as part of the specified insulation thickness.

5) All stainless steel piping shall have one-inch-thick white glass wool cushioning blanket, as specified for stainless steel, secured with stainless steel wire and compressed to approximately one-half-inch thickness, applied before application of cellular glass insulation.

6) Insulation shall be applied with all joints tightly butted and fitted to eliminate voids. Large voids shall not be filled with weather-barrier mastic, but eliminated by either refitting or replacing insulation. Any rounded corners on the insulation surfaces to be butted shall be trued before application.

c. Fitting, Flange, and Valve Covers

1) Welded fitting covers shall be fabricated to an inside diameter one inch greater than the outside diameter of the welded fitting to allow [illegible] cushioning material.



Application of Cover or Blanket at Welds and Flanges

Figure [illegible]-2

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SECTION B - APPLICATION - cont'd

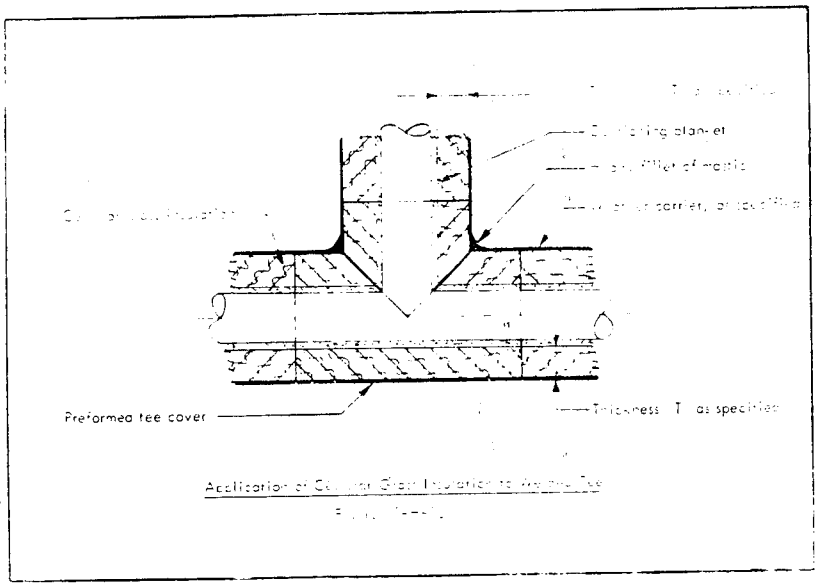
1. PIPING - cont'd

c. Fittings, Flange, and Valve Covers - cont'd

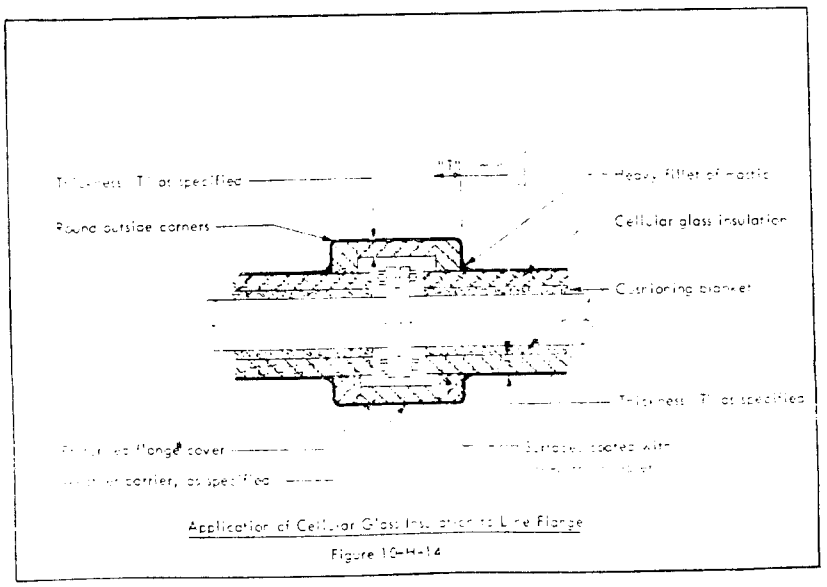
2) With exception of ball and plug valves, all fittings, flanges, and valves over three-inch NPS shall be insulated with covers prefabricated in accordance with ASTM Recommended Practice C 450, latest revision.

3) Ball and plug valve covers shall be field fabricated of proper sized pipe covering.

4) Screwed and welded fitting covers for three-inch NPS and smaller piping may be field fabricated.



Application of Cellular Glass Insulation to Welding Tee



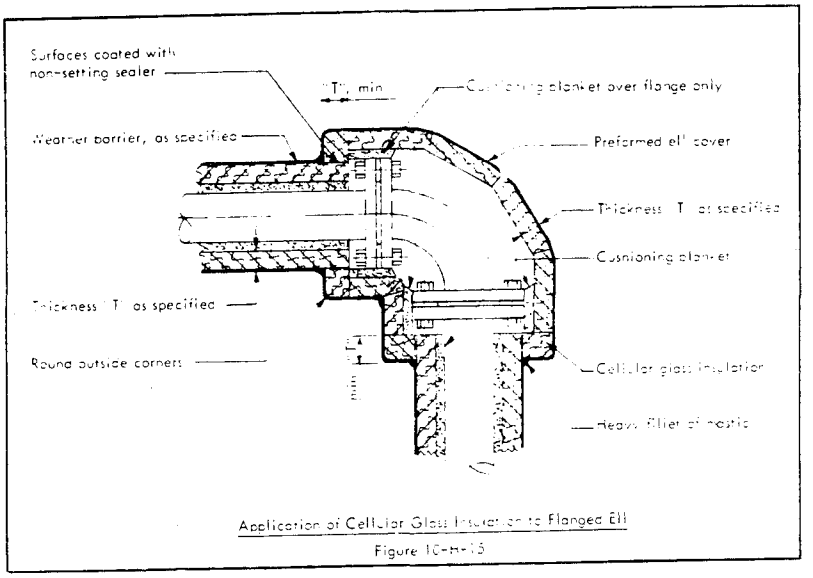
Application of Cellular Glass Insulation to Line Flange

Figure 10-H-14

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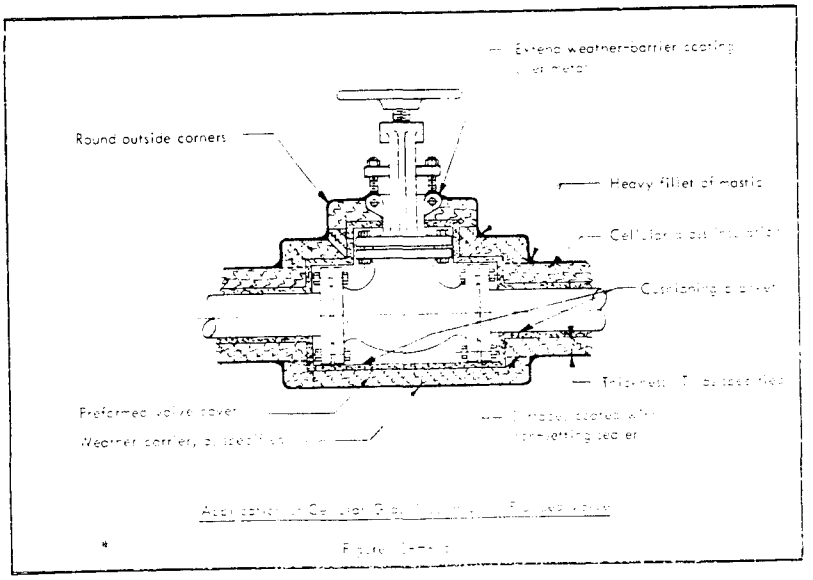
SECTION B - APPLICATION - contd

2. PIPING - contd



Application of Cellular Glass Insulation to Flanged Elbow

Figure 10-H-15



Application of Cellular Glass Insulation to Flanged Valve

Figure 10-H-16

SECTION B - APPLICATION - cont'd

2. PIPING - cont'd

c. Fittings, Flanges, and Valve Covers - cont'd

(2) Valves and tees packed and filled around valve stem and packing gland assembly with heat-resistant sealer to eliminate water pockets.

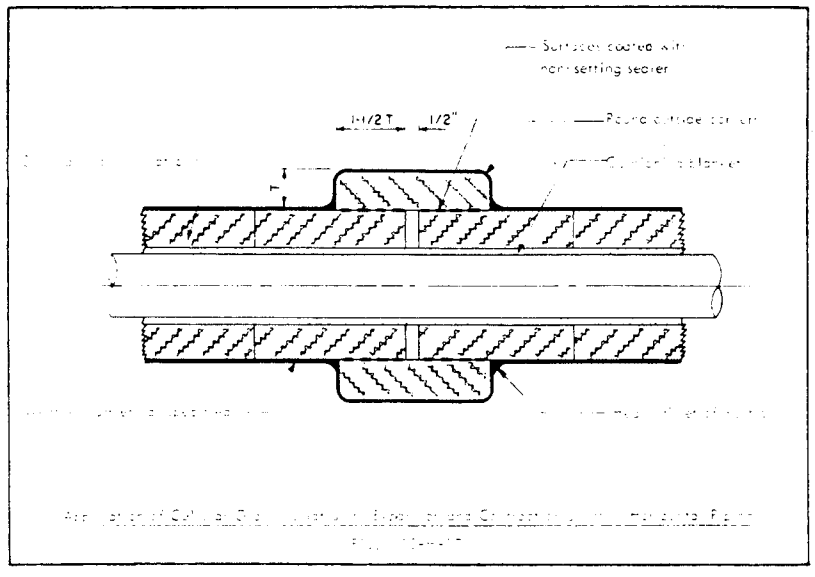
b. Cementing of shop assemblies shall be done with fabricating cement. In all cases the joints shall be as thin as possible with just sufficient cement to obtain good adhesion and complete closure. In no case will wide cement joints, or voids and holes plugged with cement, be permitted.

c. Expansion and Contraction Joints

(1) Expansion and contraction joints shall be installed as shown in Figure 10-H-17 or 10-H-18. In both horizontal and vertical straight run piping, at intervals as follows:

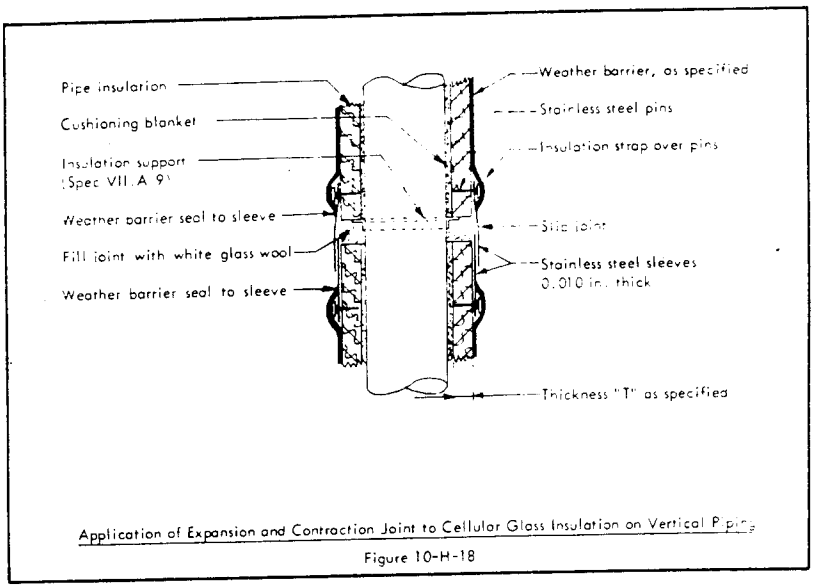
Up to 2½-inch thick insulation	- one for each 60 feet
3-inch to 5-inch thick insulation	- one for each 45 feet
5½-inch to 7½-inch thick insulation	- one for each 30 feet

(2) Where flanged fittings or valves occur within these intervals, expansion and contraction shall be provided for in the flange cover, and [illegible] joints in the insulation will not be required.



SECTION B - APPLICATION - contd

2. PIPING - contd



Application of Expansion and Contraction Joint to Cellular Glass Insulation on Vertical Pipe

Figure 10-H-18

d. Securement. Cellular glass pipe insulation shall be secured with pipe insulation straps.

e. Traced Installations. Tracing and insulation on traced lines shall be installed as specified in Article XIII of the GENERAL SPECIFICATIONS.

f. Weather Barrier. Weather-barrier coating or jacket, whichever is called for, shall be applied as specified in Articles XIV.B and XV.B, respectively, of the GENERAL SPECIFICATIONS. Mastic weather barrier shall be used unless metal jacket is called for as follows:

(1) Weather barrier consisting of stainless steel jacketing, where required, shall be called for by the addition of the letter M to the specification designation, thus 10-HM or 10-HSSM.

(2) Weather barrier consisting of treated steel jacketing, where required, shall be called for by the addition of the letters MT to the specification designation, thus 10-HMT or 10-HSSMT.

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THERMAL INSULATION APPLICATION SPECIFICATIONS

CELLULAR GLASS

SCOPE

This specification describes the essential requirements for application of shaped cellular glass insulation for use on equipment and piping normally operating at temperatures above 50 F and up to and including 400 F. It is applicable to both indoor and outdoor service.

The second designation, 10-JSS, indicates that this specification shall be used for stainless steel equipment and piping.

Procedures described in the GENERAL SPECIFICATIONS are applicable to and constitute an integral part of this specification.

SECTION A - MATERIALS

1. INSULATION MATERIAL

[illegible] as specified in MATERIAL SPECIFICATION NO. 10.

2. ACCESSORY MATERIALS

Accessory materials shall be as specified in the MATERIAL SPECIFICATIONS, article numbers as noted.

Insulating Cement	VII. A. 6	Strap Anchor Clip	VII. A. [illegible]
Pipe Insulation Support	VII. A. 9	Stressing Tape	VII. A. [illegible]
Equipment Insulation Strap	VII. A. 11	Moderate Temperature Fabricating Cement	VII. A. [illegible]
Clips for Insulation Strap	VII. A. 12	Heat-Resistant Sealer	VII. A. [illegible]
Pipe Insulation Strap	VII. A. 13	Glass Wool Metal Mesh Blanket	VII. A. [illegible]
Clips for Pipe Strap	VII. A. 14	Non-Setting Sealer	VII. A. [illegible]
Stainless Steel Wire	VII. A. 17	Weather-Barrier Mastic (color as specified)	VII. B. [illegible]
Welding Pins	VII. A. 19	Reinforcing Cloth	VII. B. [illegible]
Stainless Steel Pins	VII. A. 20	Stainless Steel Weather Barrier (Designation M[illegible]	VII. B. [illegible]
Stainless Steel Skewers	VII. A. 21	Treated Steel Weather Barrier (Designation M[illegible]	VII. B. [illegible]
		High and Low Temperature Anti-Abrasive Coating	VII. A. [illegible]

SECTION B - APPLICATION

1. EQUIPMENT

a. Insulation Supports. Equipment shall be provided with insulation supports as specified in Article II of the GENERAL SPECIFICATIONS.

b. Thickness Schedule. Unless otherwise specified, insulation in excess of 2-1/2 inches total thickness shall be applied in multiple layers as specified in Article III, E, of the MATERIAL SPECIFICATIONS.

c. Curved Surfaces

(1) Cellular glass block insulation (curved segments or shaped head segments) shall be shop fabricated to fit the diameter of the vessel to which it is applied. Block insulation shall be applied to equipment with all joints tightly butted. Multiple layers of insulation shall be so applied that the butt joints of one layer do not coincide with those of any other layer. Typical installation is shown in Figure 10-J-1.

(2) Inner surface of vessel insulation shall be coated with the specified high and low temperature anti-abrasive coating, and allowed to dry before installation.

d. Flat Surfaces. Block insulation shall be applied to flat surfaces in staggered position with all joints tightly butted. Multiple layers shall be applied so that the butt joints of one layer do not coincide with those of any other layers.

e. Flanges. Manhole flanges, blind flanges, and vessel flanges shall be insulated unless otherwise specified.

f. Securement

(1) Curved Surfaces

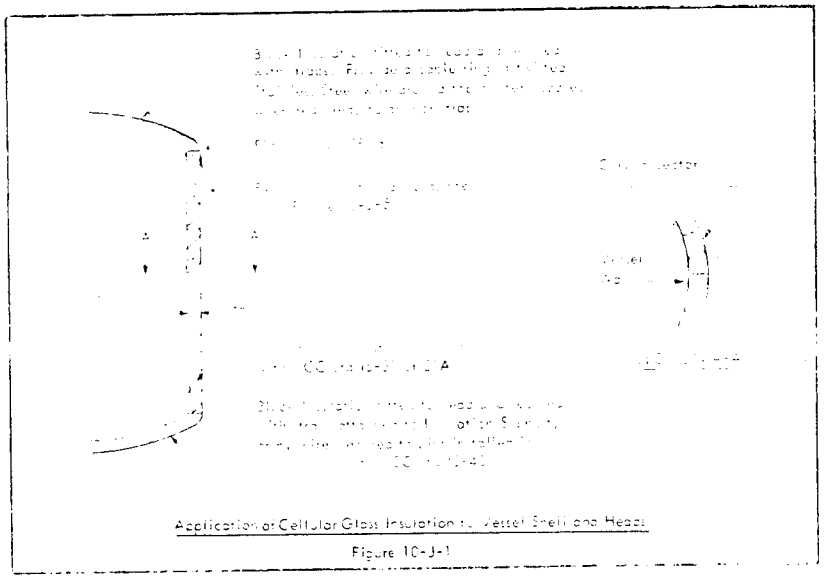
(a) Where contour of vessel permits firm and effective attachment, all layers of cellular glass insulation shall be secured in place with stainless steel insulation strap. Where required, insulation strap shall be attached to strap anchor angles in accordance with Owner's Standard 15-31A. Insulation applied to irregular surfaces, where use of strap is impracticable, shall be secured with stainless steel wire attached to welding pins, drawn taut and ends twisted together and pressed into insulation.

(b) Cellular glass insulation on bottom heads of vertical equipment, or heads of horizontal equipment, shall be held in place with stainless steel insulation strap secured to insulation supports as shown in Owner's Standards 15-31, 15-36, and 15-42. Insulation on heads of large diameter vessels (over 12 ft OD), where use of strap is impracticable, shall be secured by wire attached to welding pins in accordance with Owner's Standard 15-40 and similar to flat surface application shown in Figure 10-J-2.

(2) Flat Surfaces. Flat block shall be applied to flat surfaces by wire attached to welding pins as shown in Figure 10-J-2.

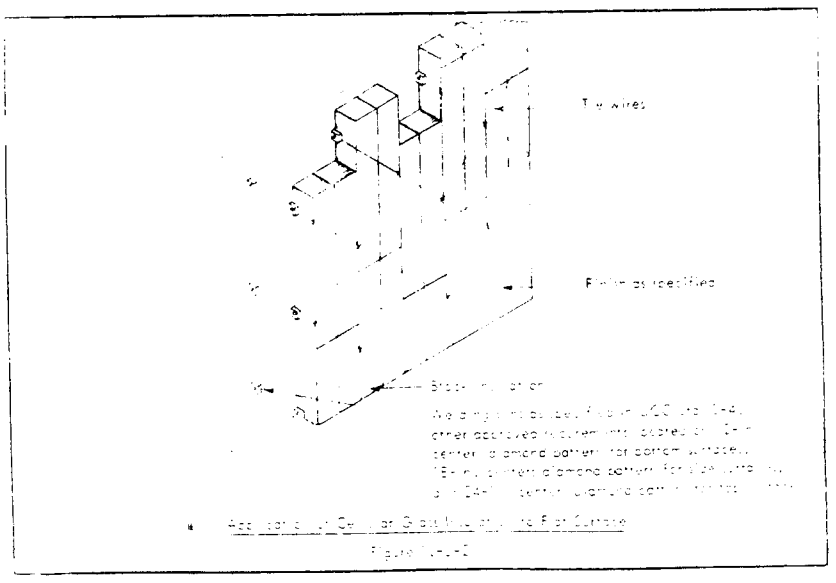
SECTION B - APPLICATION - cont'd

EQUIPMENT - cont'd



Application of Cellular Glass Insulation to Vessel Shell and Heads

Figure 10-J-1



Application of Cellular Glass Insulation to Pipe Supports

Figure 10-J-2

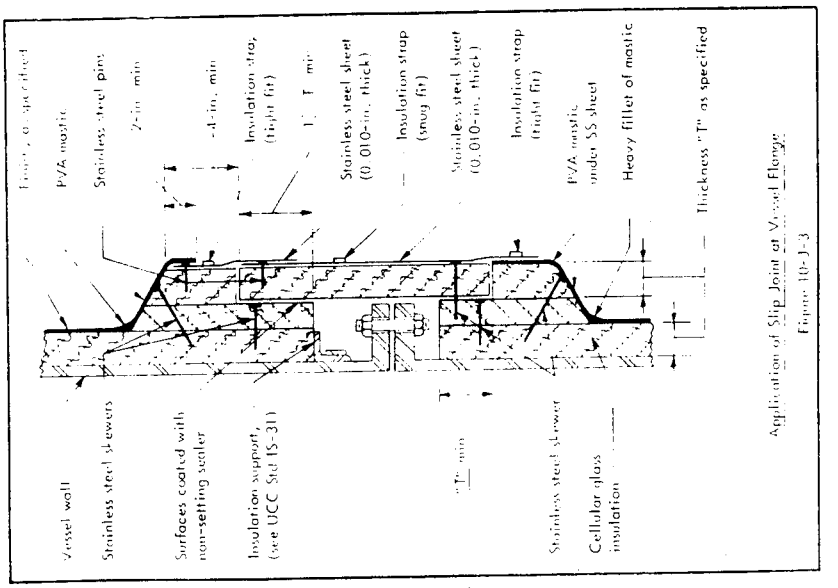
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SECTION B - APPLICATION - cont'd

EQUIPMENT - cont'd

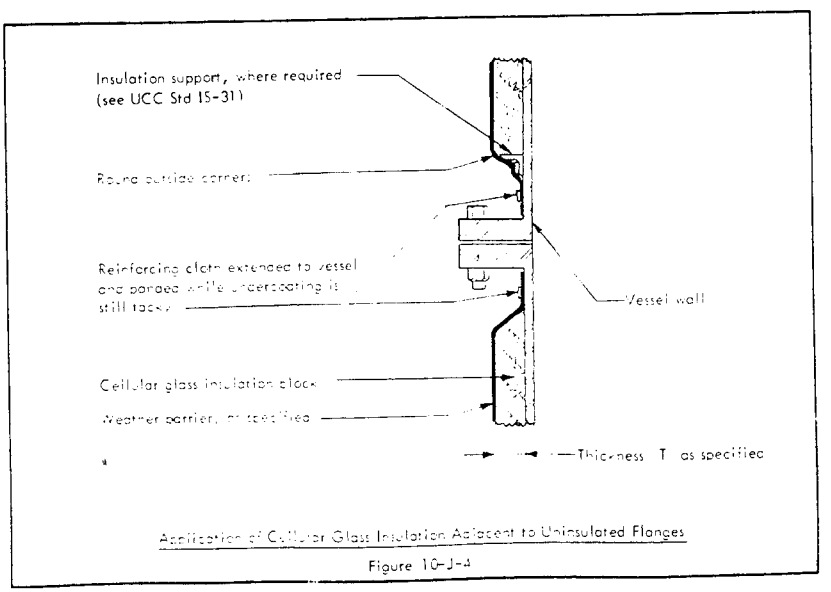
3 Expansion Joints

(1) Where vessel flanges are insulated, expansion joints, constructed as shown in Figure 10-J-3, shall be provided at the flanges.



Application of Slip Joint at Vessel Flange
Figure 10-J-3

(2) Where vessel flanges are uninsulated, the reinforcing cloth of the weather barrier on the adjacent vessel insulation shall be extended to metal of vessel body, coated with heat-resistant sealer, and bonded while sealer is still tacky. A second application of sealer shall then be applied over the reinforcing cloth and securement. Typical installation is shown in Figure 10-J-4.



Application of Cellular Glass Insulation Adjacent to Uninsulated Flanges
Figure 10-J-4

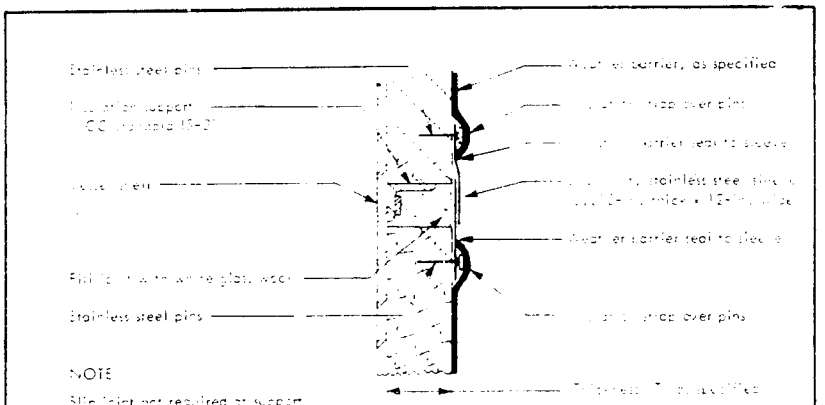
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SECTION B - APPLICATION - cont'd

EQUIPMENT - cont'd

5. Expans on Joints - cont'd

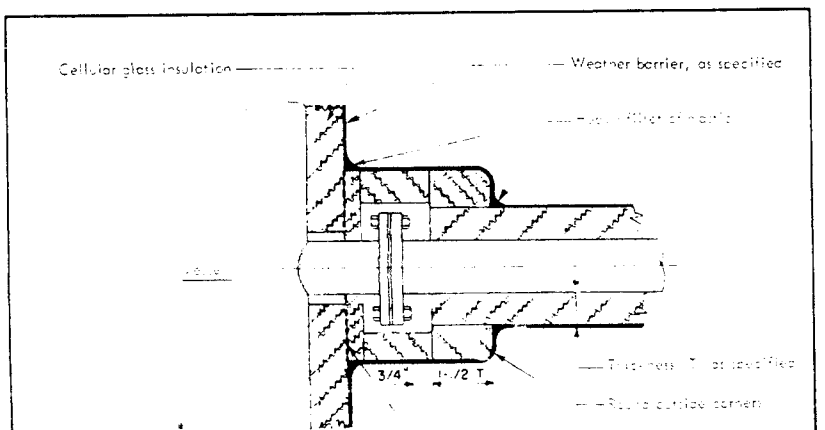
-3 Longitudinal expansion of vessels shall be provided for by installing expansion joints at the insulation supports as shown in Figure 10-J-5. When more than one thickness is specified for a vessel, an insulation support shall be provided at the junction of two different thicknesses and insulated in a manner similar to that shown in Figure 10-J-5.



Application of Slip Joint to Vessel Wall at Insulation Supports

Figure 10-J-5

4. Where nozzles and projections extend through the insulation they shall be insulated as shown in Figure 10-J-6.



Application of Cellular Glass Insulation at Nozzles and Manways

Figure 10-J-6

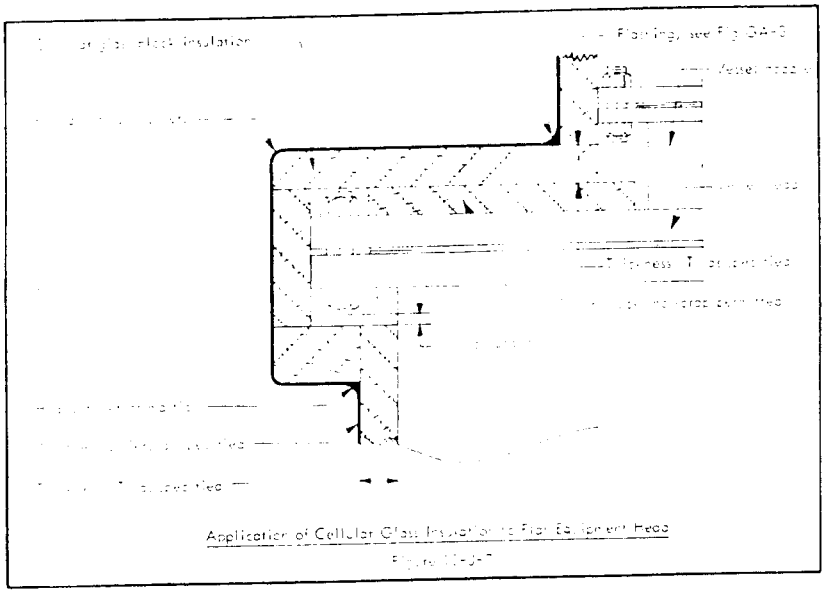
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SECTION B - APPLICATION

EQUIPMENT - cont'd

Flat Heads

Application of top of flat heads of vertical equipment shall be applied in the same manner as previously described in this specification except that gussets shall be eliminated and proper drainage provided as shown in Figure [illegible].



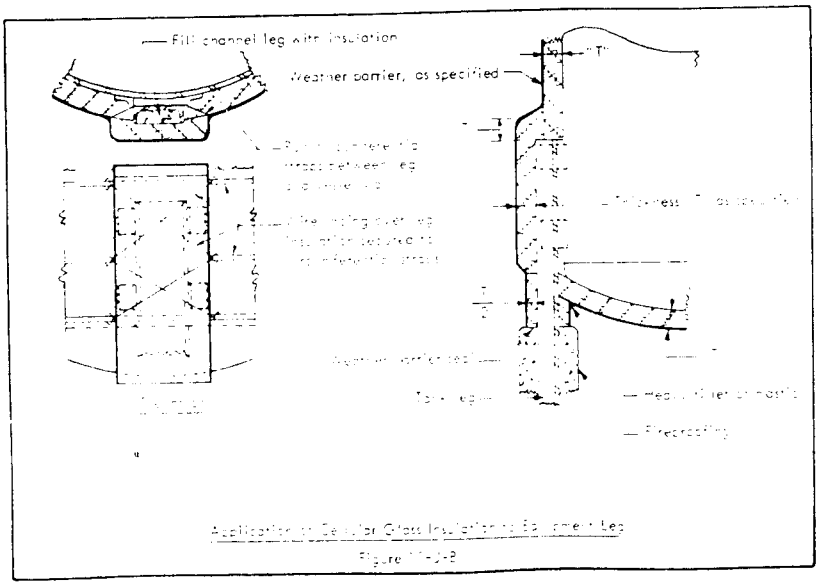
Application of Cellular Glass Insulation to Flat Equipment Head

Figure [illegible]

[illegible] nozzles on top of insulated equipment shall be provided with flashing as per Figure GA-6 of the GENERAL SPECIFICATIONS.

Vessel Legs

Structural steel supporting legs shall be insulated as specified in Article [illegible] of the GENERAL SPECIFICATIONS.



Application of Cellular Glass Insulation to Equipment Leg

Figure [illegible]

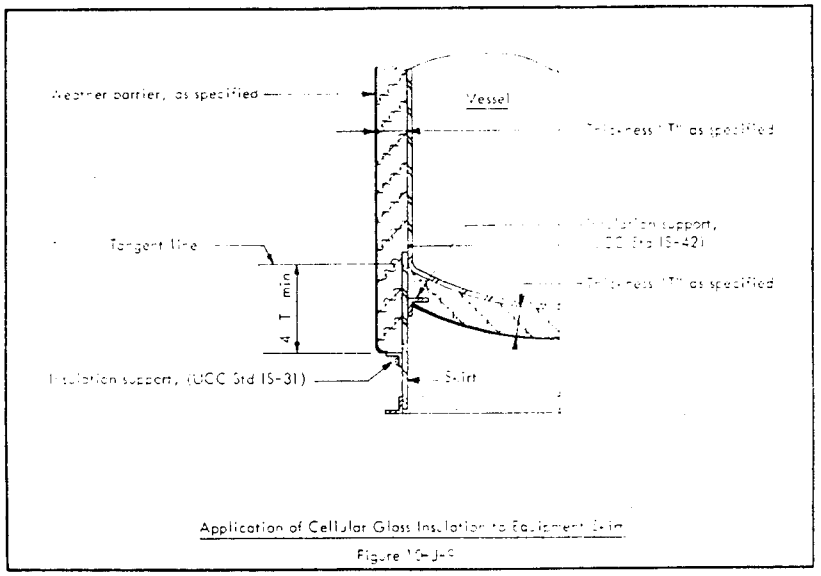
EQUIPMENT - cont'd

Vessel Legs - cont'd

2. Vessel legs shall be insulated with block which shall extend over channel flanges and down channel legs to junction with any fire-resistant material. Thickness shall be one-half that specified for body of vessel. Body insulation shall be brought up to and butted firmly against tank leg flange.

3. Reentrant space between channel flanges and over channel flanges between body insulation shall be filled with block cemented in place with insulating cement. Surface of fireproofing material abutting tank leg insulation shall be coated with specified weather-barrier coating. Installation shall be as shown in Figure 10-J-8.

Vessel Skirts. Skirts supporting vertical equipment shall be insulated outside. Insulation shall extend downward, from junction of skirt with bottom head, a distance of not less than four times the specified thickness or to concrete pad, whichever is nearer. Where specified, entire surface of skirt shall be insulated. Thickness shall be as specified for body of vessel. An insulation support and welded pin securement shall be provided for bottom head insulation in accordance with Owner's Standards IS-42 and IS-40, respectively. Installation shall be as shown in Figure 10-J-9.



Application of Cellular Glass Insulation to Equipment Skirt
Figure 10-J-9

Traced Installations. Tracing and insulation on traced equipment shall be installed as specified in Article XIII of the GENERAL SPECIFICATIONS.

Weather Barrier. Weather-barrier coating or jacket, whichever is called for, shall be applied as specified in Articles XI-A-3 and XI-B respectively, of the GENERAL SPECIFICATIONS. Mastic weather barrier shall be used unless metal jacket is called for as follows:

1. Weather barrier consisting of stainless steel jacketing, where required, shall be called for by the addition of the letter M to the specification designation, thus 10-JM or 10-JSSM.

2. Weather barrier consisting of treated steel jacketing, where required, shall be called for by the addition of the letters MT to the specification designation, thus 10-JMT or 10-JSSMT.

PIPING

a. Pipe Insulation

Pipe insulation shall be supported as specified in Article II of the GENERAL SPECIFICATIONS.

1. Insulation thicknesses in excess of 2½ inches shall be applied in multiple layers as specified in Article III-B of the MATERIAL SPECIFICATIONS.

2. Pipe insulation shall be applied to piping in a staggered position in accordance with Figure GA-1 and GA-2 of the GENERAL SPECIFICATIONS.

3. Insulation shall be applied with all joints tightly butted and fitted to eliminate voids. Large voids shall not be filled with weather-barrier mastic, but shall be filled either by refitting or readjusting insulation. Any rounded corners or voids on surfaces to be butted shall be filled with insulation.

4. Butt joints, end joints and core of all fitting covers shall be given a smooth, brush or trowel coat of weather-barrier mastic and allowed to dry to a [illegible] before application. Care shall be exercised to obtain a thin, even coat of sufficient thickness only to cover and fill the [illegible] of the [illegible].

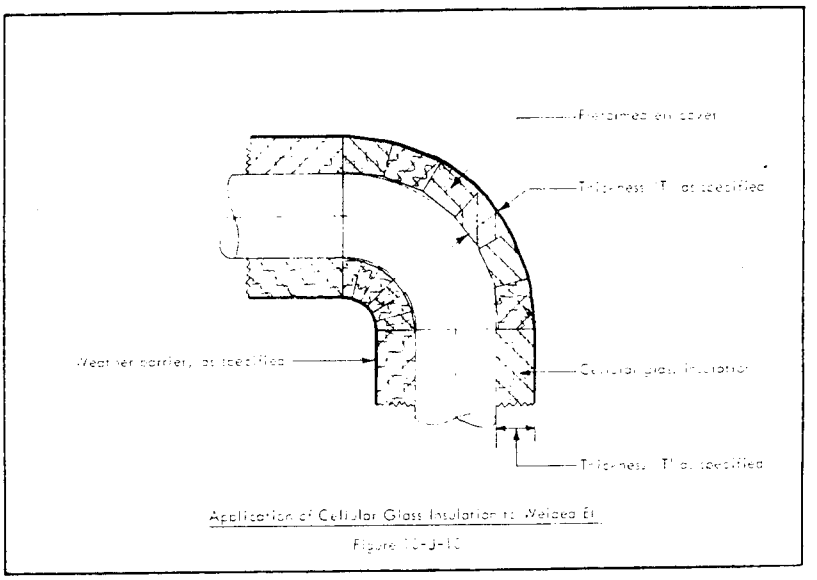
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SECTION B - APPLICATION - cont'd

2. PIPING - cont'd

b. Fitting, Flange, and Valve Covers

1) Fitting, flange, and valve covers shall be prefabricated in accordance with ASTM Recommended Practice C 450, latest revision



Application of Cellular Glass Insulation to Welded Fi

Figure 10-J-10

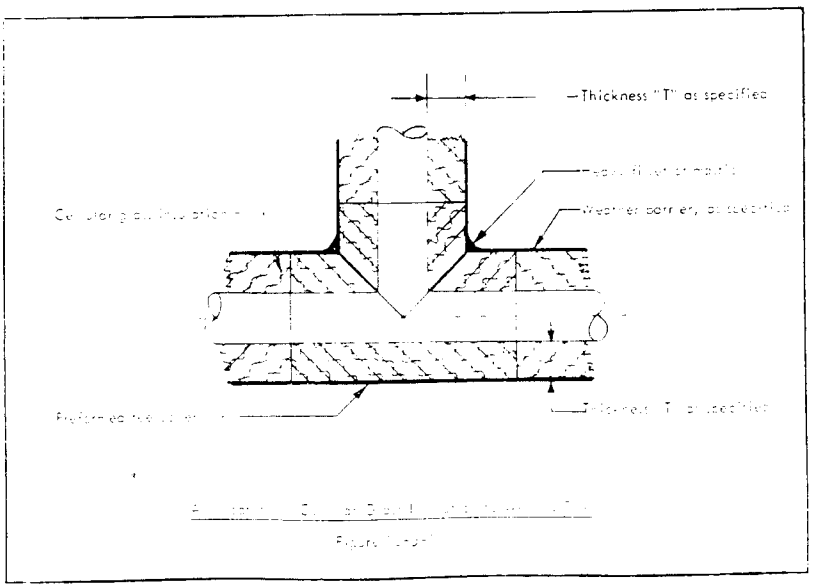
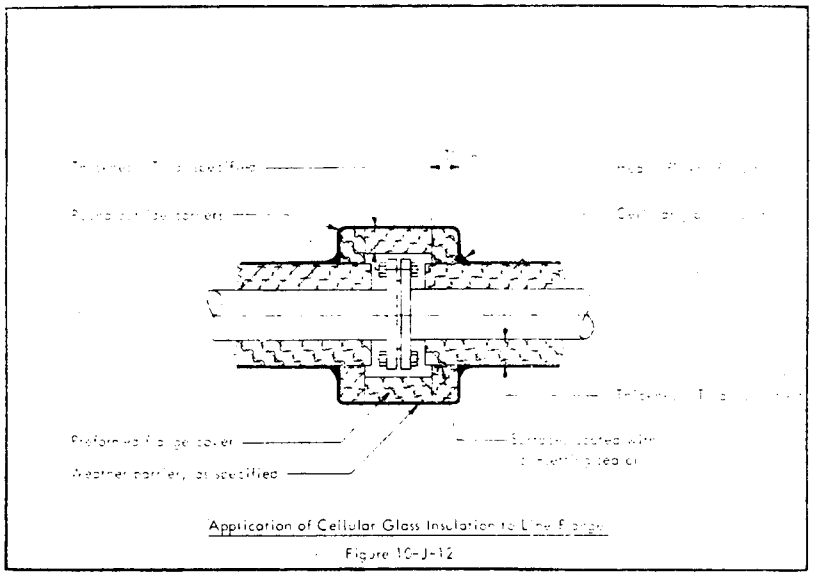
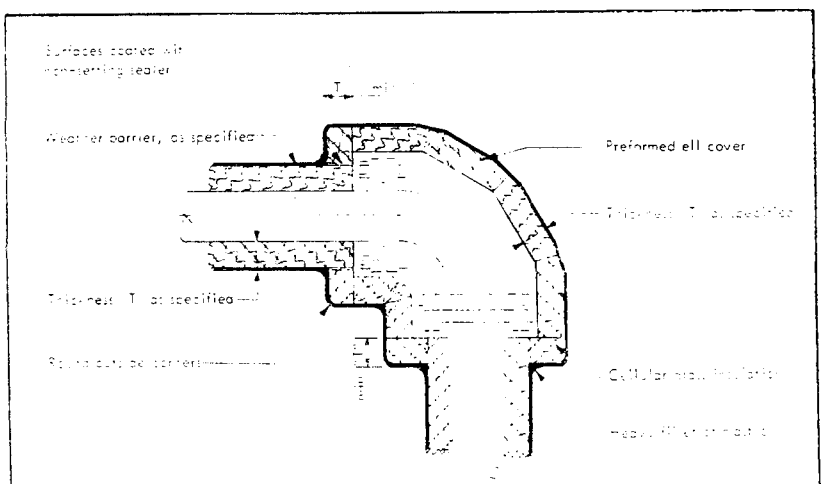


Figure 10-J-



Application of Cellular Glass Insulation to Line Flange

Figure 10-J-12

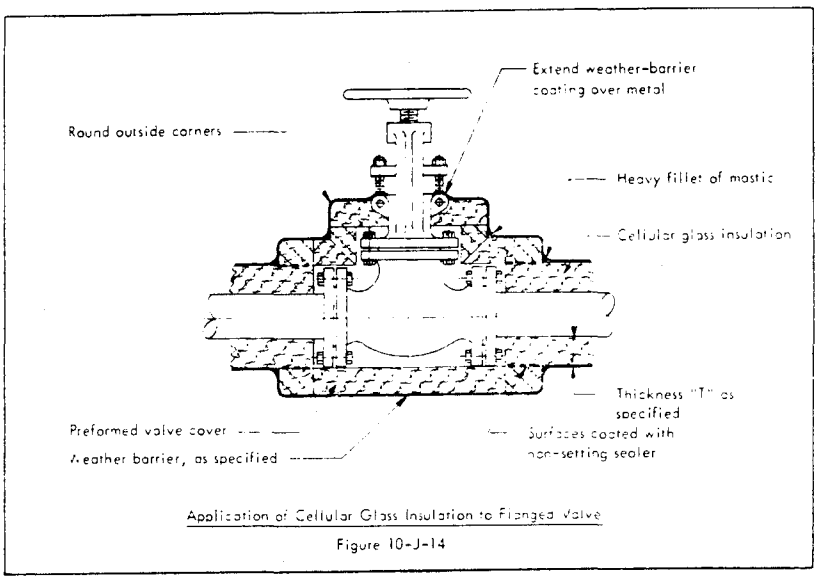


Union Carbide trial exhibit UC-4586: W. G. Hammar Transmittal Memoranda and Union Carbide Thermal Insulati…
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SECTION B - APPLICATION - contd

2. PIPING - contd

a. Fitting, Flange, and Valve Covers - contd

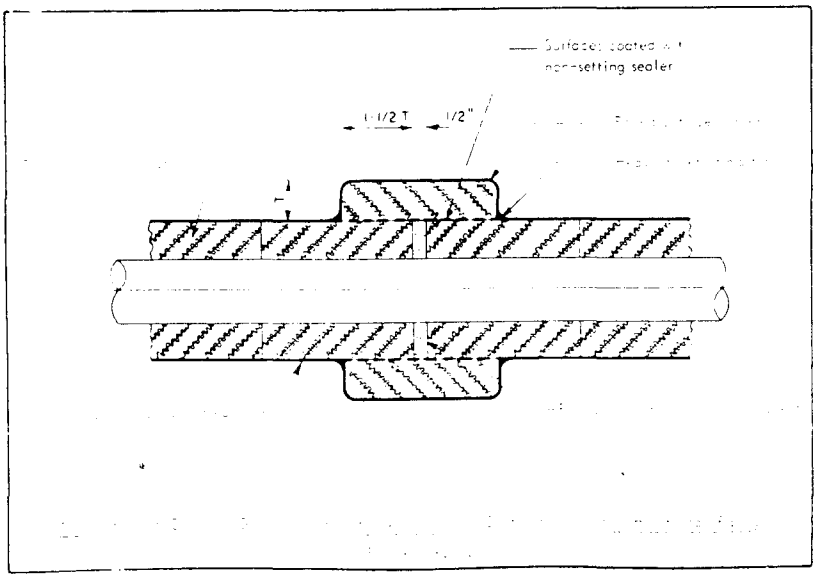


Application of Cellular Glass Insulation to Flanged Valve

Figure 10-J-14

2. All valves shall be packed and filled around valve stem and packing gland assembly with heat-resistant sealer to eliminate water pockets.

3. Cementing of shop assemblies shall be done with fabricating cement. In all cases the joints shall be as thin as possible with just sufficient cement to obtain good adhesion and complete closure. In no case will wide cement joints, or voids and holes plugged with cement, be permitted.



SECTION B - APPLICATION - cont'd

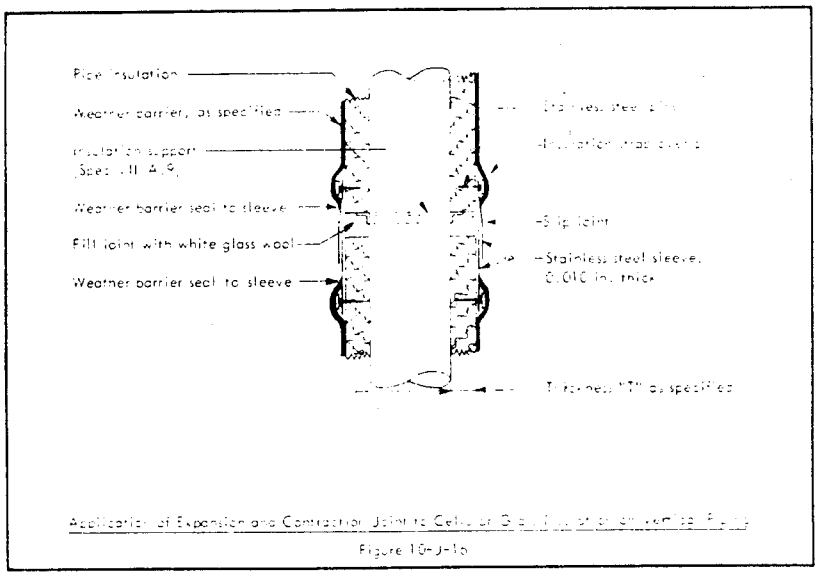
I. PIPING - cont'd

E. Expansion and Contraction Joints

1. Expansion and contraction joints shall be installed as shown in Figure 10-J-15 or 10-J-16, in both horizontal and vertical straight run piping, at intervals as follows:

Up to 2½-inch thick insulation	- one for each 60 feet
3-inch to 5-inch thick insulation	- one for each 45 feet
5½-inch to 7½-inch thick insulation	- one for each 30 feet

2. Where flanged fittings or valves occur within these intervals, expansion and contraction shall be provided for in the flange cover, and expansion-contraction joints in the insulation will not be required.



Application of Expansion and Contraction Joints to Cellular Glass Insulation on Stainless Steel Pipe
Figure 10-J-15

d. Securement. Cellular glass pipe insulation shall be secured with pipe insulation straps.

e. Traced Installations. Tracing and insulation on traced lines shall be installed as specified in Article XIII of the GENERAL SPECIFICATIONS.

f. Weather Barrier. Weather-barrier coating or jacket, whichever is called for, shall be applied as specified in Articles XIII.B and XIII.C, respectively, of the GENERAL SPECIFICATIONS. Mastic weather barrier shall be used unless metal jacket is called for as follows:

1. Weather barrier consisting of stainless steel jacketing, where required, shall be called for by the addition of the letter M to the specification designation, thus 10-JM or 10-JSSM.

2. Weather barrier consisting of treated steel jacketing, where required, shall be called for by the addition of the letters MT to the specification designation, thus 10-JMT or 10-JSSMT.

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THERMAL INSULATION APPLICATION SPECIFICATIONS

CELLULAR GLASS
(Underground Service)

SCOPE

This specification describes the essential requirements for application of shaped cellular glass insulation for use on piping operating at temperatures above 50 F and up to and including 350 F. It is applicable only to underground service.

The second designation, 10-JUSS, indicates that this specification shall be used for stainless steel piping.

Procedures described in the GENERAL SPECIFICATIONS are applicable to and constitute an integral part of this specification.

SECTION A - MATERIALS

1. INSULATION MATERIAL

Insulation shall be as specified in MATERIAL SPECIFICATION NO. 10.

2. ACCESSORY MATERIALS

Accessory materials shall be as specified in the MATERIAL SPECIFICATIONS, article numbers as noted.

Stainless Steel Wire	VII. A. 17	High Temperature Fabrication Cement	VII. A. 34
Pipe Insulation Strap	VII. A. 13	Joint Sealer	VII. A. 33
Clips for Pipe Strap	VII. A. 14	Reinforcing Cloth	VII. A. 35
Anti-Abrasive Coating (for stainless steel)	VII. A. 40	Water-Barrier Coating	VII. A. 70
Anti-Abrasive Coating	VII. A. 39	Graphite Pipe Slides For Support Pads	STD. F-220
Concrete Support Pad (Field Poured)			

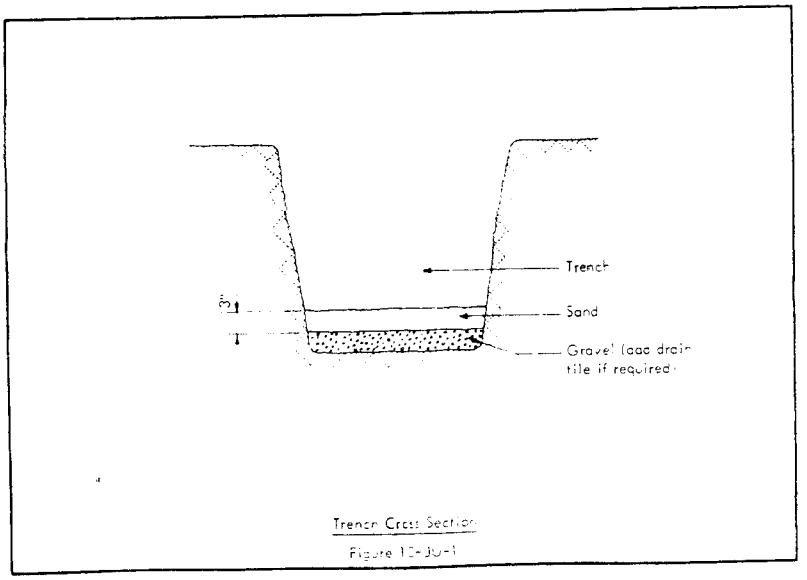
SECTION B - APPLICATION

1. GENERAL PREPARATION

a. Pipe Trench

(1) Where water table requires it, adequate drainage shall be provided by means of a French drain or sufficient gravel fill as shown in Figure 10-JU-1.

(2) A sand bed with a minimum thickness of 3 inches shall be provided over gravel as shown in Figure 10-JU-1.



Trench Cross Section
Figure 10-JU-1

SECTION B - APPLICATION - contd

1. GENERAL PREPARATION - contd

b. Pipe Pipe shall be cleaned of oil, grease, dirt, rust, and scale, and shall be coated in accordance with the Coating Schedule.

c. Insulation

(1) Fitting covers shall be prefabricated. However, expansion chamber elbows shall be sufficiently oversize to allow for pipe movement.

(2) Bore and all edges and ends of pipe insulation and fitting insulation shall be coated with anti-abrasive coating and allowed to dry before installation.

(3) If pipe to be insulated is of stainless steel, the anti-abrasive coating shall be Thur-Ma-Lox Silicon No. 70 Black; otherwise, the anti-abrasive coating shall be Keene's cement. See Section A.2, Accessory Materials, of this specification.

2 PIPING

a. Application of Insulation to Straight Pipe

(1) Insulation in excess of 2-1/2 inches thick shall be applied in multiple layers as specified in Article III. E. of the MATERIAL SPECIFICATIONS.

(2) Pipe insulation shall be applied in staggered position, in accordance with Figures GA-1 and GA-2 of the GENERAL SPECIFICATIONS.

(3) Insulation shall be applied with all joints tightly butted and fitted to eliminate voids. Large voids shall not be filled with coating or cement, but shall be eliminated by refitting or replacing insulation.

(4) Piping operating above 212 F shall be installed without buttered insulation joints. Piping operating below 212 F shall be installed with all butt and edge joints buttered with joint sealer before application. These joints shall be drawn together when insulation is applied, so that only a very thin, vapor-tight, joint-seal coat separates the insulation sections.

(5) Inner layers and outer layers up to and including 12 inch OD of cellular glass insulation shall be secured with stainless steel wire at proper intervals, as specified in Article III. B. 1. of the GENERAL SPECIFICATIONS.

(6) Single layers and outer layers over 12 inch OD of cellular glass insulation shall be secured with stainless steel strap and double-pronged stainless steel clips at proper intervals, as specified in Articles III. C. 2. and III. D. 1. of the GENERAL SPECIFICATIONS.

b. Finish Application

(1) The insulation shall be sprayed, brushed, or gloved with water-barrier coating to a thickness of not less than 1/8 inch. While coating is still tacky, tar-impregnated glass fabric reinforcing cloth shall be laid smooth and thoroughly embedded in the coating. Cloth shall be overlapped approximately 3 inches to provide strength at joint equal to that maintained elsewhere.

(2) Before surface becomes dry to touch, a second coating shall be sprayed, brushed or gloved over the reinforcing cloth, not less than 1/8 inch thick, and with smooth unbroken surface.

(3) While second coating is still tacky, another layer of reinforcing cloth shall be laid smooth and thoroughly embedded in the coating.

(4) Before surface becomes dry to touch, a third 1/8-inch-thick coating shall be sprayed, brushed or gloved over the second layer of reinforcing cloth.

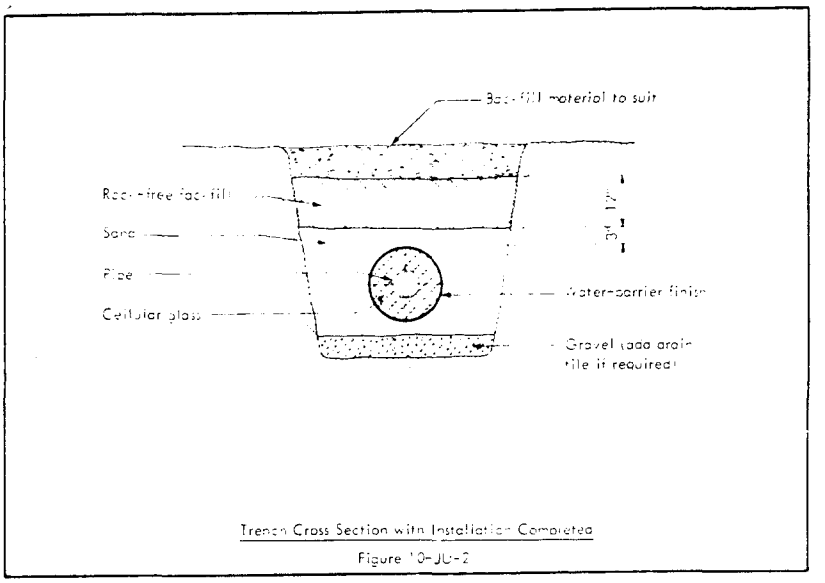
(5) Coating and reinforcing cloth layers shall be built up in a uniform manner to prevent uneven contraction and tendency toward surface cracks.

c. Backfill

(1) After water-barrier finish has dried, the insulated piping shall be carefully laid on the sand bed.

(2) Backfill over the insulated pipe with sand to a minimum depth of 3 inches. The next layer of backfill shall be a minimum of 1 foot of rock-free earth. The balance of the trench can be filled with any available fill material. A section of complete installation is shown in Figure 10-JU-2.

2. PIPING - cont'd



Trench Cross Section with Installation Completed

Figure 10-JU-2

3. EXPANSION CHAMBERS

a. Application of Pipe Insulation Expansion Chambers

(1) An expansion chamber shall be provided to allow for pipe movement at lead-off lines, expansion loops, and where pipe changes direction at elbows.

(2) Expansion chambers shall be prefabricated of cellular glass pipe insulation of specified thickness for straight pipe, but not [illegible] thick.

(3) The inside diameter of the expansion chamber insulation shall be a minimum of 4 inches greater than the outside diameter of the pipe; however, if pipe movement is greater than 2 inches in each direction, this outside diameter shall be increased to allow for free movement of the pipe in the chamber.

(4) The oversize pipe covering shall overlap the straight regular size insulation at least six inches.

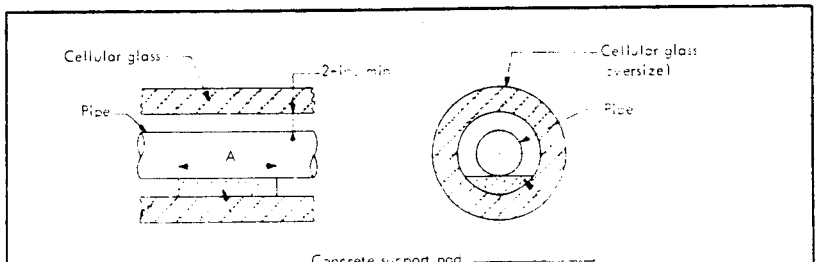
(5) Concrete pipe supports molded to fit inside the bottom of the expansion chamber insulation shall support the bare pipe and maintain [illegible] movement of the pipe inside the expansion chamber. A table for determining length and spacing of these concrete support seats is shown in Figure 10-JU-3.

b. Details of expansion chamber at lead-off lines are shown in Figure 10-JU-4.

c. Details of expansion chamber for elbows or expansion loops are shown in Figures 10-JU-5 and 10-JU-6.

SECTION B - APPLICATION - contd

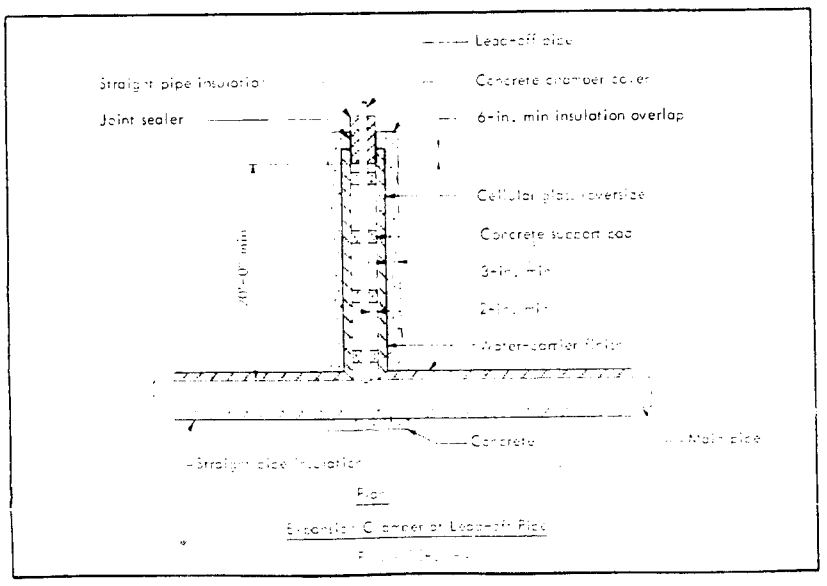
EXPANSION CHAMBERS - contd



Nominal Pipe Size (Inches)	Length of Concrete Pad Dim. A (Inches)	Max C-to-C Spacing (Feet)
3 and smaller	6	5
4	6	4
5	12	5
6	12	5
8	12	4
10	12	3
12	Continuous	—

Size and Spacing of Concrete Support Pads

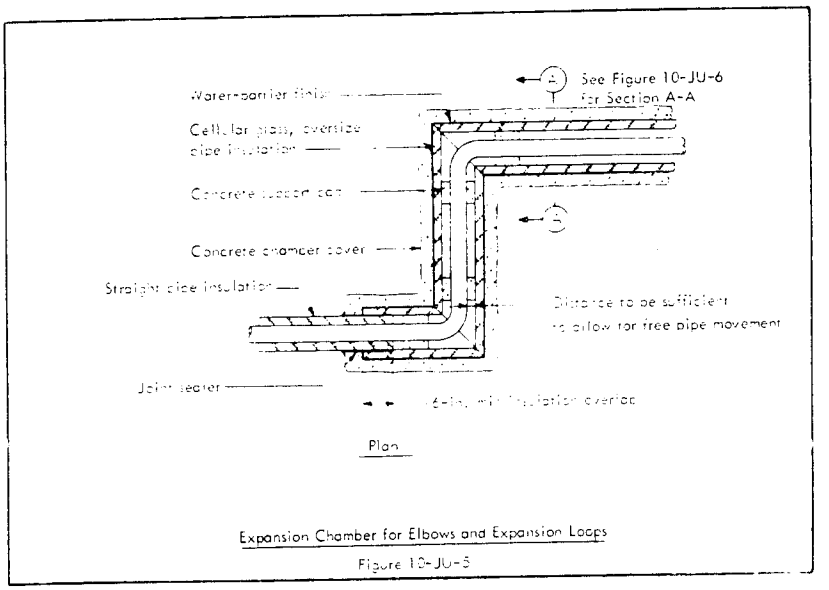
Figure 10-JU-3



Expansion Chamber at Leak-off Pipe

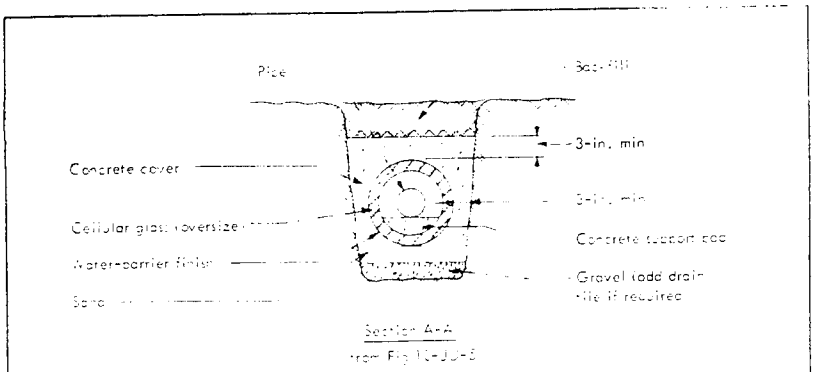
SECTION B - APPLICATION - cont'd

3. EXPANSION CHAMBERS - cont'd



Expansion Chamber for Elbows and Expansion Loops

Figure 10-JU-5



Expansion Loop Cross Section with Insulation Completed

Figure 10-JU-6

SECTION B - APPLICATION - contd

2. EXPANSION CHAMBERS - contd

Field Application. The expansion chamber shall be given the same water-barrier finish as that for straight piping.

Expansion Chamber Concrete Cover

(1) After water-barrier finish has dried, the insulated piping and expansion chamber shall be carefully laid on the sand bed. It should be noted that the sand must be scooped where expansion chambers are to be installed so as to compensate for the increased diameter of asbestos pipe insulation at which the chamber is constructed.

(2) Expansion chamber shall then be encased in concrete which shall be not less than 2" thick on top and sides, as shown in Figure 2 below.

Backfill. Backfilling of expansion chamber concrete cover may be of any suitable fill [illegible]

3. BURIED INSTALLATIONS

Buried piping and underground lines shall be installed as specified in Part XIII of the GENERAL SPECIFICATIONS.

4. ANCHORS

(1) Anchor piping design shall be such that pipe movement does not exceed the [illegible] provided by expansion chambers.

(2) Anchors shall be provided as near as possible to the elbow where it rises above ground [illegible] standard elbow insulation can be [illegible] [illegible]

THERMAL INSULATION APPLICATION SPECIFICATIONS

CELLULAR GLASS

SCOPE

This specification describes the essential requirements for application of shaped cellular glass insulation for use on equipment and piping normally operating at temperatures below 70 F, and including cycle operating and thawout service up to and including 400 F. It is applicable to both indoor and outdoor service.

The second designation, 10-LSS, indicates that this specification shall be used for stainless steel equipment and piping. However, this specification shall be subject to the use of accessory materials specified for stainless steel.

Procedures described in the GENERAL SPECIFICATIONS are applicable to and constitute an integral part of this specification.

SECTION A - MATERIALS

1. INSULATION MATERIAL

Insulation shall be as specified in MATERIAL SPECIFICATION NO. 10.

2. ACCESSORY MATERIALS

Accessory materials shall be as specified in MATERIAL SPECIFICATIONS, article numbers as listed.

Cushioning Material		Strap Anchor Clip	VII.A.20
Equipment Operating Above 350 F	VII.A. 1	Strapping Tape	VII.A.22
Equipment Operating at 350 F and Below	VII.A. 2	Fabricating Cement	VII.A.26
Pipe Insulation Support	VII.A. 9	Vinyl Asphalt Joint Sealer	VII.A.40
Equipment Insulation Strap	VII.A.11	Mastic	VII.A.42
Clips for Equipment Strap	VII.A.12	Lap Sealer	VII.A.43
Pipe Insulation Strap	VII.A.13	Curved Wood Block Insulation Supports	VII.A.57
Clips for Pipe Strap	VII.A.14	Non-Setting Sealer	VII.A.58
Stainless Steel Wire	VII.A.17	Weather-Barrier Mastic (Color as Specified	VII.B.[illegible]
Sealing Pins	VII.A.19	Reinforcing Cloth	VII.B.[illegible]
Stainless Steel Sleeves	VII.A.21	Modified Asphalt Sealer	VII.A.116

3. ACCESSORY MATERIALS - SPECIFICATION 10-LSS

Accessory materials for Specification 10-LSS shall be the same as those listed in Item 2 above, with the following omissions. However, the sealer - Material Specification VII.A.116 should be used in place of Material Specification VII.A.43.

Cushioning Material:
Equipment . . . . . VII.A. 2
Vinyl Asphalt Joint Sealer VII.A.40

SECTION B - APPLICATION

1. EQUIPMENT

a. Insulation Supports. Equipment shall be provided with insulation supports as specified in [illegible] of the GENERAL SPECIFICATIONS.

b. Thickness Schedule. Unless otherwise specified, insulation in excess of 2½ inches total thickness shall be applied in multiple layers as specified in Article III.B of the MATERIAL SPECIFICATIONS.

c. Cushioning Blanket

1) On all equipment operating below 350 F, except stainless steel, a 1-inch thick cushioning blanket shall be applied over the entire surface as a cushioning material before application of the cellular glass insulation. Blanket shall be held in place with a minimum amount of stainless steel wire. Cellular glass insulation shall then be applied over the blanket in the manner described in this specification. Cushioning material shall not be considered as part of the specified insulation thickness.

2) On all equipment operating above 350 F, except stainless steel, a 1-inch thick white glass wool cushioning blanket shall be applied over the entire surface, compressed to 1-inch thickness, and secured in the same manner as that specified in Paragraph 1) above.

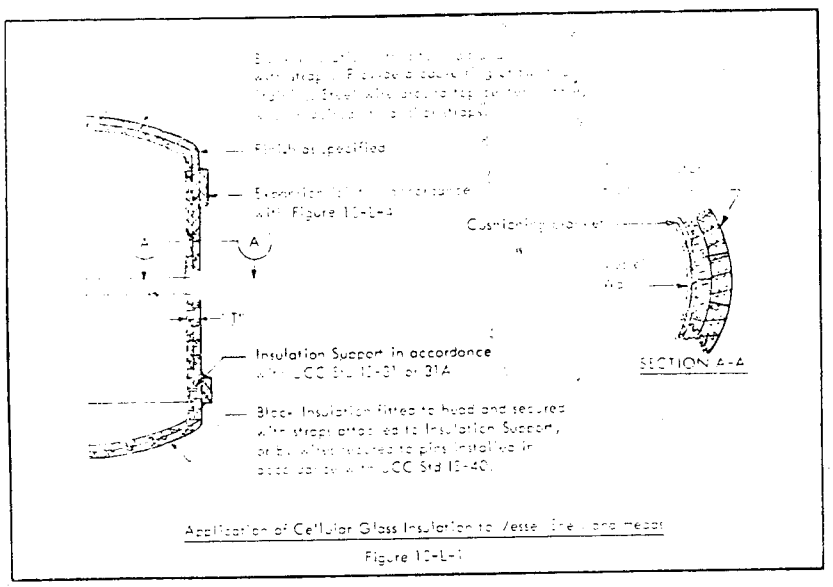
3) On all stainless steel equipment, a 1-inch thick white glass wool cushioning blanket, as specified for stainless steel, shall be applied over the entire surface, compressed to 1-inch thickness, and secured in the same manner as that specified in Paragraph 1) above.

SECTION B - APPLICATION - cont'd

Cut-to-size

Cellular glass insulation shall be shop fabricated and fitted to allow a 1-inch space for cushioning blanket between block and vessel. Block insulation may be applied over cushioning material or all equipment, with all joints tight, butted. Multiple layers of insulation shall be applied so that the joints of one layer do not coincide with those of any other layer.

All joints within a layer as well as all layers for single layer of formed insulation shall be sealed with a buttered coat of the specified joint sealer. Joints shall be filled to sufficient thickness to provide proper adhesion, seal, and cushion between the individual pieces of insulation. Typical [illegible] Figure 10-L-1.



Application of Cellular Glass Insulation to Vessel Shell and Heads
Figure 10-L-1

Attachment

Where construction will permit firm and effective attachment, all layers of block insulation shall be secured to a stable surface by means of insulation straps. Where required, insulation strap shall be attached to strap anchor angles in accordance with Owner's Standard [illegible]. Insulation applied to irregular surfaces, where use of insulation straps is impracticable, shall be secured with stainless steel wire attached to [illegible] and twisted together and pressed into insulation.

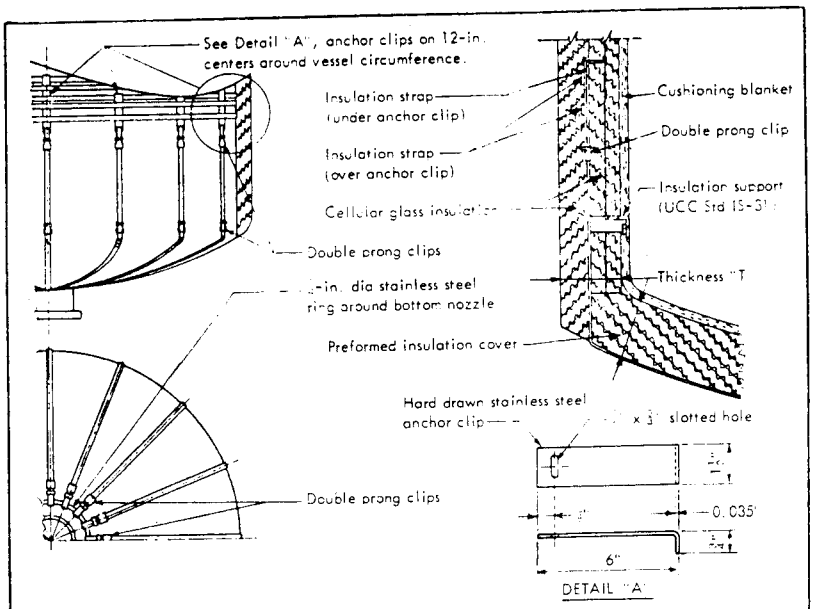
All bottom heads of cellular glass insulation of bottom heads of vertical equipment, or heads of horizontal equipment, shall be held in place with insulation straps secured to insulation supports, as shown in Owner's Standards 15-3b, 15-3c, and 15-4b. Other layers of insulation applied on bottom heads of vertical equipment, or heads of horizontal equipment, shall be secured with insulation straps as shown in Figure 10-L-2.

Where specified, insulation shall be applied directly to metal surfaces, such as ductwork, with adhesive or other approved attachments. Where insulation is secured with adhesive, it shall be embedded firmly in a surface coat.

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SECTION 3 - APPLICATION - contd

1 EQUIPMENT - contd



Securement for Cellular Glass Insulation on Bottom Vessel Head

Figure 10-L-2

f. Flat Surfaces. Block shall be applied to flat surfaces in the same manner as specified for curved surfaces, except where it is specified to be applied directly to metal surfaces with adhesive or other approved securement.

g. Expansion and Contraction Joints

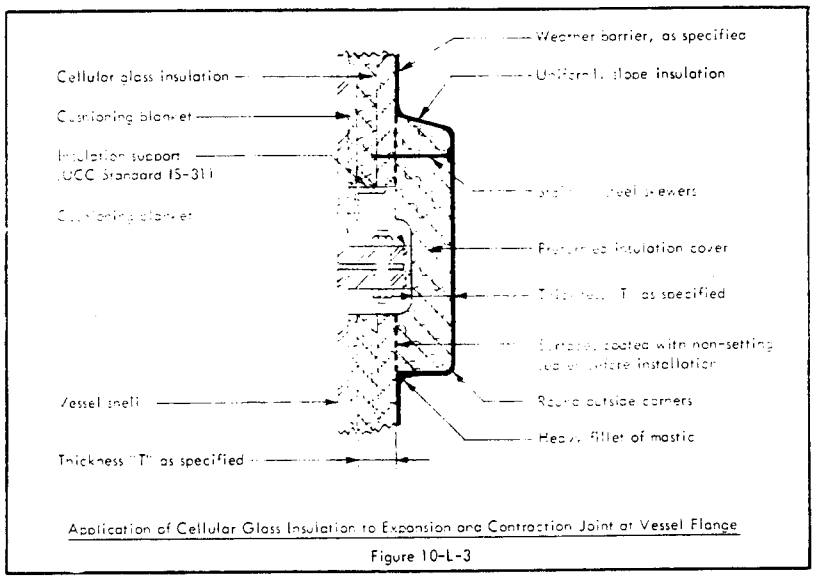
(1) Expansion-contraction joints, constructed as shown in Figure 10-L-3, shall be provided at vessel flanges. Where movement is likely to occur, non-setting sealer shall be applied to surfaces of insulation, as shown, to provide proper slip joint.

(2) Longitudinal expansion and contraction of vessels shall be provided for by installing expansion-contraction joints at the insulation supports as shown in Figure 10-L-4. Where more than one thickness of insulation is specified for a vessel, an insulation support shall be provided at the junction of two different thicknesses, and insulated in a manner similar to that shown in Figure 10-L-4. Lap sealer shall be applied to surfaces of insulation to provide proper slip joint where movement is likely to occur.

(3) A 1-inch space shall be provided around nozzles and projections where they extend through the insulation, as shown in Figure 10-L-3. Where movement is likely to occur, non-setting sealer shall be applied to surfaces of insulation to provide proper slip joint.

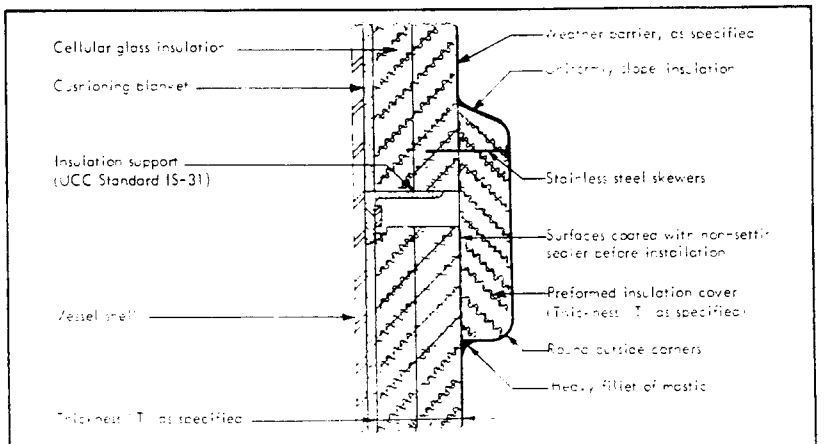
SECTION B - APPLICATION - cont'd

EQUIPMENT - cont'd



Application of Cellular Glass Insulation to Expansion and Contraction Joint at Vessel Flange

Figure 10-L-3



NOTE: Slip joint not required at support directly above the bottom head.

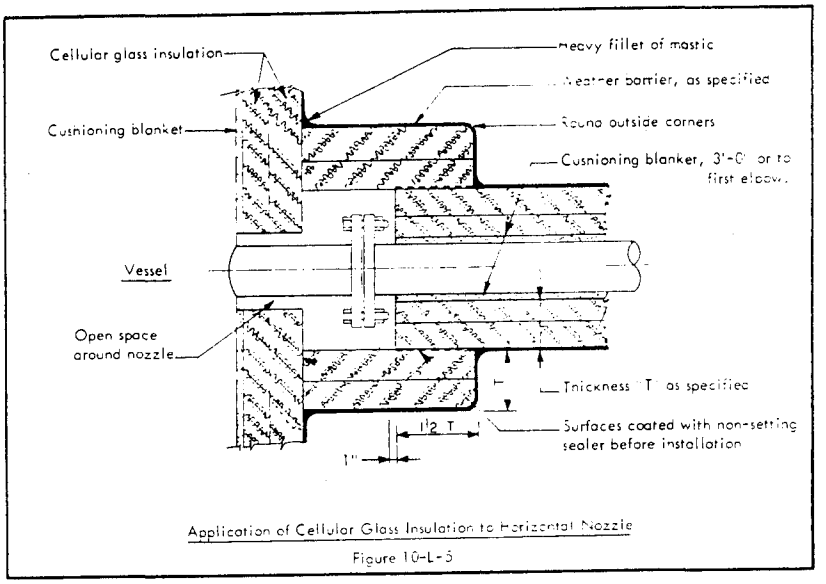
Application of Cellular Glass Insulation to Expansion and Contraction Joint at Insulation Supports

Figure 10-L-4

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SECTION B - APPLICATION - contd

1 EQUIPMENT - contd

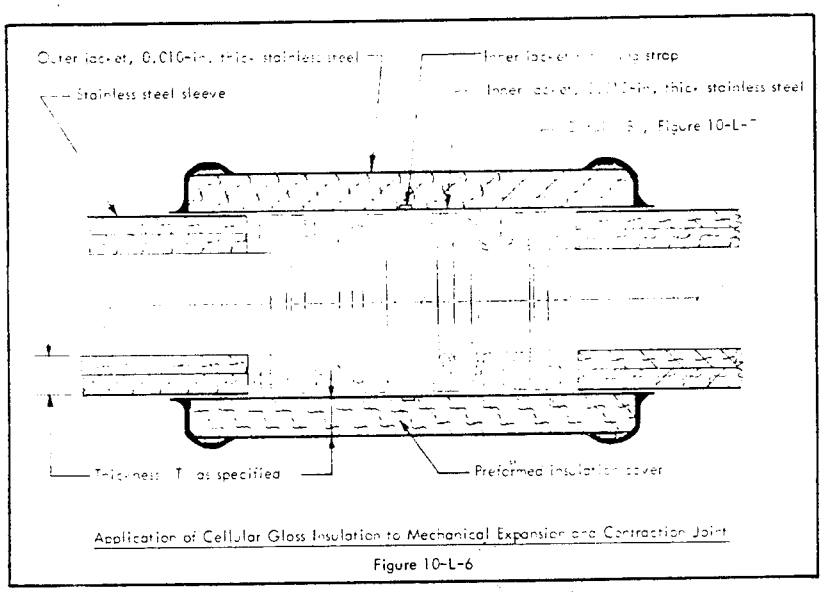


Application of Cellular Glass Insulation to Horizontal Nozzle

Figure 10-L-5

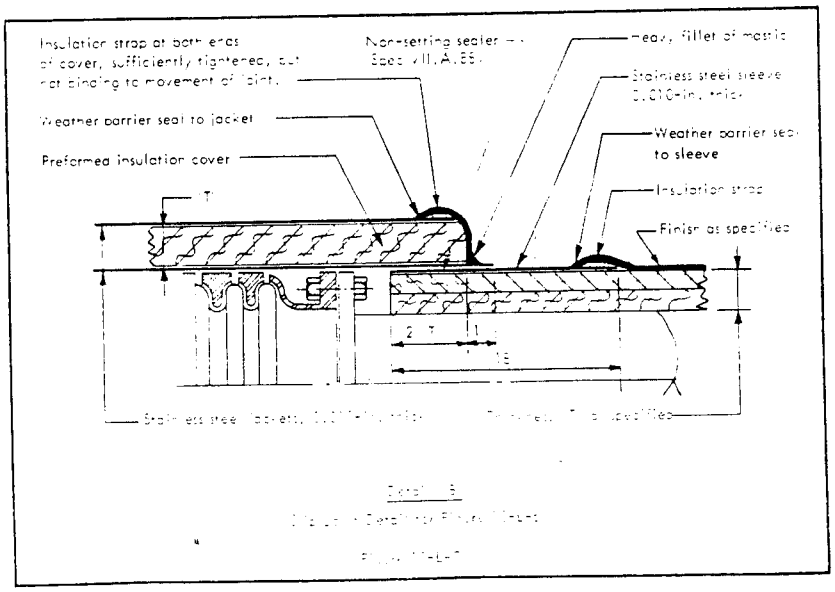
- Mechanical Expansion Joints. Corrugated mechanical expansion joints in piping usually listed as equipment items shall be installed as shown in Figures 10-L-6 and 10-L-7. A slip joint shall be provided at both ends of the corrugated item when horizontally installed in piping. Apply a stainless steel sleeve 18 inches long by 0.010-inch thick over the pipe insulation at each end of the expansion joint, placed flush with the butt end of the pipe covering. The sleeve shall be secured with a strap at one end only, outside the slip joint surfaces. The inner stainless steel jacket shall extend 2 x "T" plus 1 inch over the sleeves at each end and be secured with one strap around the middle. The outer stainless steel jacket and insulation cover shall extend 2 x "T" over each end of the slip joint and be secured with straps as required. The inside diameter of the stainless steel sheets shall be a minimum of 2 inches, placed so as to shed water. Weather-barrier mastic shall be applied to the ends of the insulation cover and sealed to both metal jackets. If the pipe insulation diameter is less than the inner jacket diameter, the slip joint shall be made as shown in Figures 10-H-7 and 10-H-8.

Where expansion joints are installed vertically, in piping, the slip joint at the top shall be omitted and the expansion joint cover secured fastened to the pipe covering.



Application of Cellular Glass Insulation to Mechanical Expansion and Contraction Joint

Figure 10-L-6



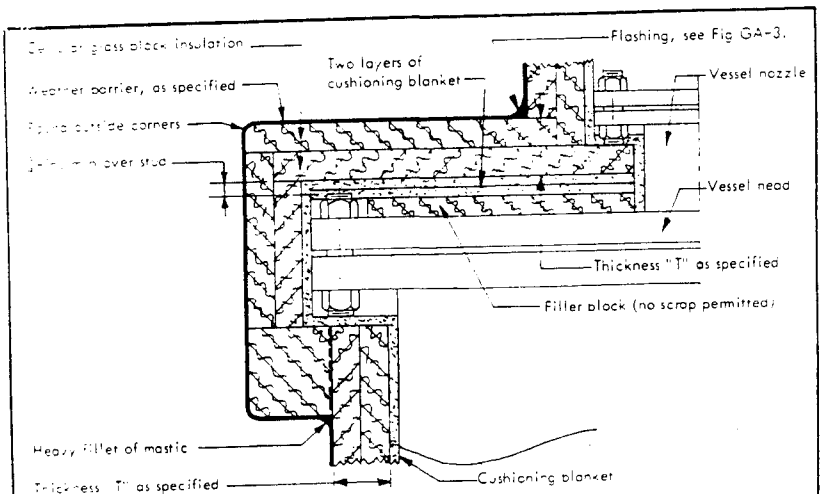
SECTION B - APPLICATION - cont'd

1. EQUIPMENT - cont'd

f. Flat Heads

f.1 Insulation on top of flat heads of vertical equipment shall be applied in the same manner as previously described in this specification. Water pockets shall be eliminated and proper drainage provided as shown in Figure 10-L-8.

f.2 All top nozzles on insulated equipment shall be provided with flashing as shown in Figure GA-3 of the GENERAL SPECIFICATIONS.



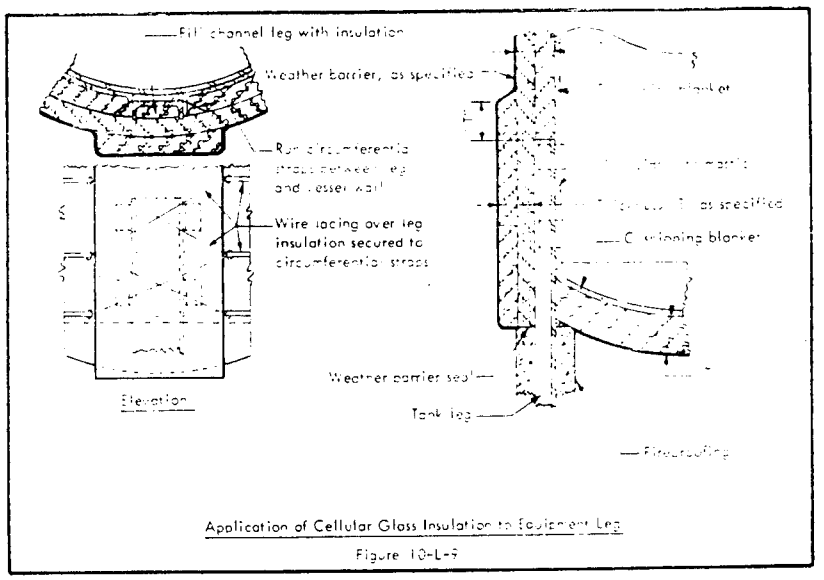
Application of Cellular Glass Insulation to Flat Equipment Head
Figure 10-L-8

g. Vessel Legs

g.1 Concrete-filled structural tubing legs shall be insulated for a distance not less than four times the specified insulation thickness, measured from the junction of the vessel with the leg. Thickness over the leg shall be not less than one-half that specified for body of vessel.

g.2 Channel legs shall be insulated with block which shall extend over channel flanges and down channel legs to the junction with any fire-resistant material, or a distance of four times insulation thickness, but not less than 24 inches. Thickness shall be as specified for body of vessel but not less than two inches. Body insulation shall be butted firmly against tank leg flange.

g.3 Re-entrant space between channel flanges shall be filled with block cemented in place with the specified adhesive cement. Surface of fire-resistant material abutting tank leg insulation shall be coated with weatherbarrier coating. Insulation shall be as shown in Figure 10-L-9.



Application of Cellular Glass Insulation to Equipment Leg

Figure 10-L-9

- Vessel Skirts - Skirts supporting vertical equipment shall be insulated inside and outside. Insulation shall extend downward, from [illegible] of skirt with insulated bottom head, a distance of not less than four times the thickness of insulation, but never less than 1 foot. Insulation on inside or outside of skirts shall be as specified for body of vessel, but not less than 2 inches. Insulating material shall be secured to inside of skirt with adhesive cement. Support for inside skirt insulation and bottom head insulation shall be in accordance with Owner's Standard [illegible] and shall be as shown in Figure 10-L-10.

Equipment Supports

Where equipment is supported or cradled, vessel insulation shall extend over [illegible] as shown in Figure 10-L-11.

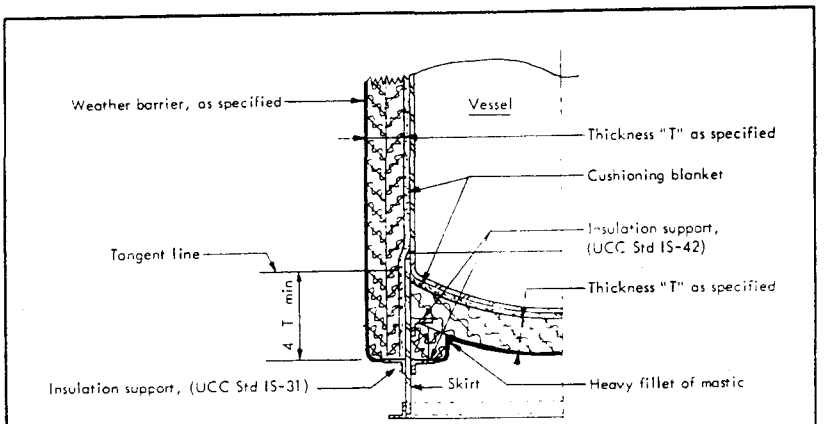
Where equipment is supported by structural steel members, insulation shall [illegible] not less than four times the specified insulation thickness, measured from junction of vessel with insulated support leg. Thickness of insulation over steel supports shall be not [illegible] specified for body of vessel. Thickness of insulation over support legs shall be the same as that of body insulation [illegible] as shown in Figure 10-L-12.

- Weather-Barrier Coating - Weather-barrier coating shall be applied as specified in Article [illegible] of the GENERAL SPECIFICATIONS.

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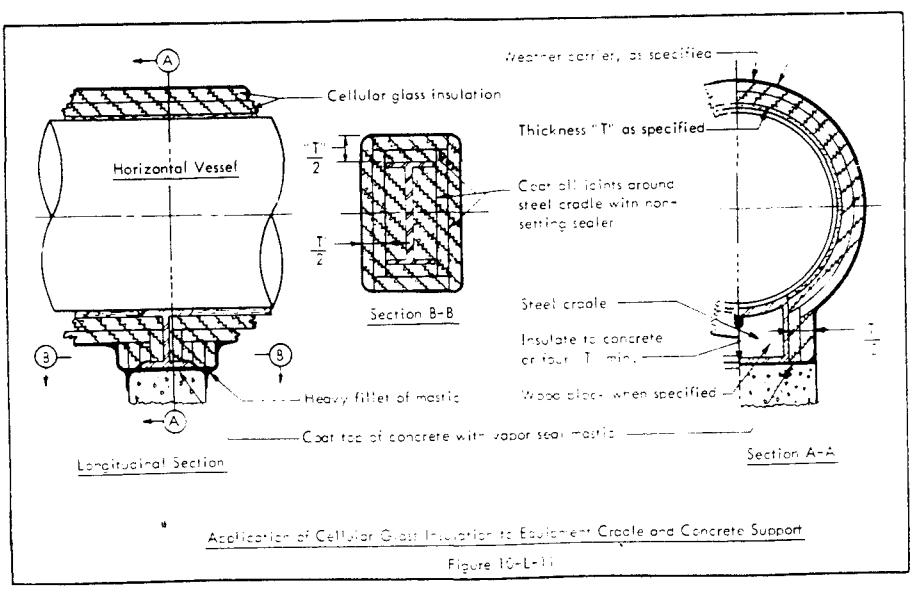
SECTION B - APPLICATION - cont'd

1. EQUIPMENT - cont'd



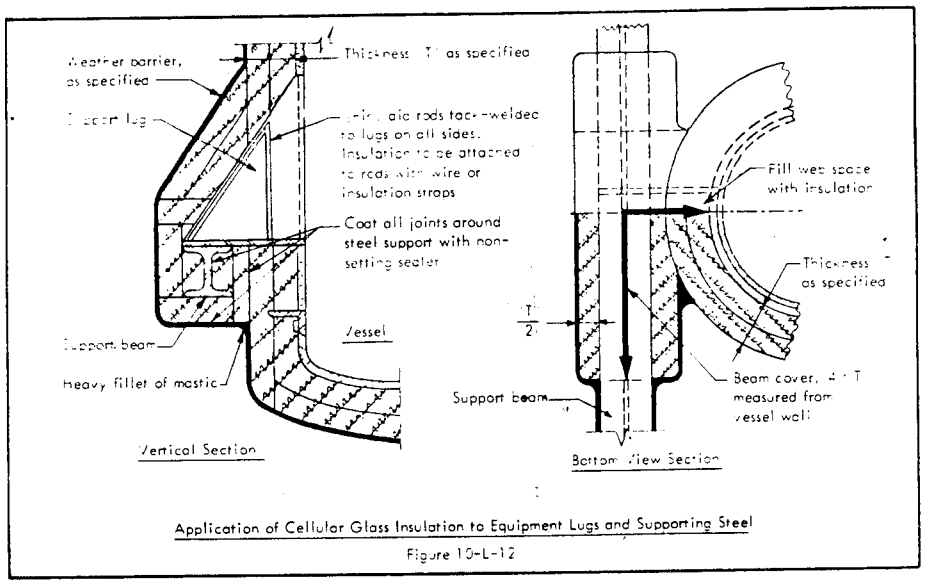
Application of Cellular Glass Insulation to Equipment Skirt

Figure 10-L-10



Application of Cellular Glass Insulation to Equipment Cradle and Concrete Support

Figure 10-L-11



Application of Cellular Glass Insulation to Equipment Lugs and Supporting Steel

Figure 10-L-12

I. PIPING

a. Pipe Insulation

1. Pipe insulation shall be supported and secured as specified in Article III of the GENERAL SPECIFICATIONS.

2. Insulation thickness in excess of 2½ inches shall be applied in multiple layers as specified in Article III.E of the MATERIAL SPECIFICATIONS.

3. Pipe insulation shall be applied in staggered position, in accordance with Figures GA-1 and GA-2 of the GENERAL SPECIFICATIONS.

4. All butt edges and ends of both layers (or single layer) of insulation shall be buttered with joint sealer before application. The joints shall be drawn together when insulation is applied, so that only a very thin, vapor-tight, vapor-seal coat separates the sections of insulation.

5. Insulation shall be applied with all joints tight, butted and firmed, to eliminate voids. Large voids shall not be filled with joint sealer, but eliminated either by refitting or replacing insulation. Any rounded corners on the insulation surfaces to be butted shall be trued before application.

6. When scheduled for installations where thermal shock is expected, a cushioning material, as specified, shall be applied to bare pipe before application of cellular glass insulation.

Union Carbide trial exhibit UC-4586: W. G. Hammar Transmittal Memoranda and Union Carbide Thermal Insulati…
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SECTION B - APPLICATION - cont'd

2. PIPING - cont'd

a. Fitting, Flange, and Valve Covers

(1) Fitting, flange, and valve covers shall be prefabricated in accordance with ASTM Recommended Practice C 450, latest revision, using not 180 F asphalt as a fabricating cement.

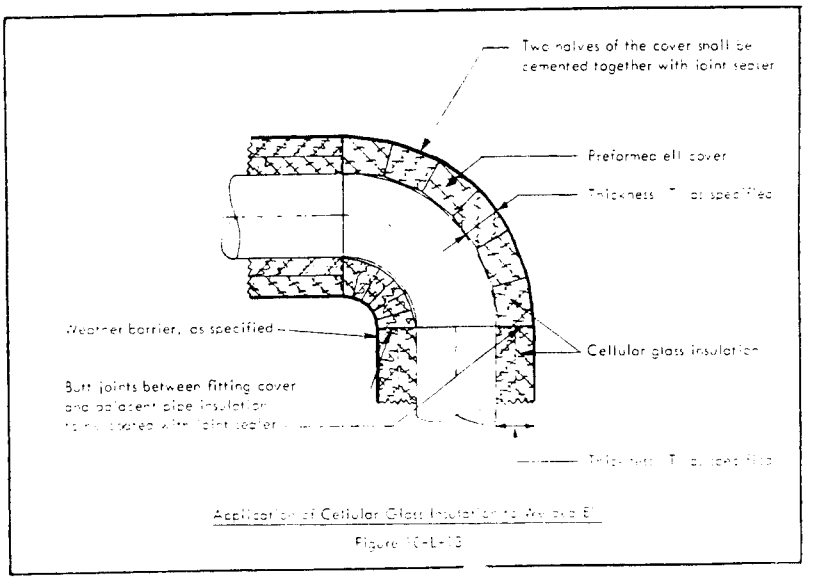
(2) Welded fitting covers shall be fabricated to fit snugly on the pipe. The two halves of the cover shall be cemented together with joint sealer. The adjacent pipe insulation shall be fitted tightly to the butt ends of the fitting cover and sealed as specified for piping. Typical fitting covers are shown in Figures 10-L-13 and 10-L-14.

(3) Flange, flanged fitting, and flanged valve covers shall be fabricated and fitted to extend over adjacent pipe insulation so as to provide a close-fitting slip joint at each end. The two halves of the cover shall be cemented together with joint sealer.

(4) All valves shall be packed and filled around valve stem and packing gland asterisk with joint sealer to avoid water pockets.

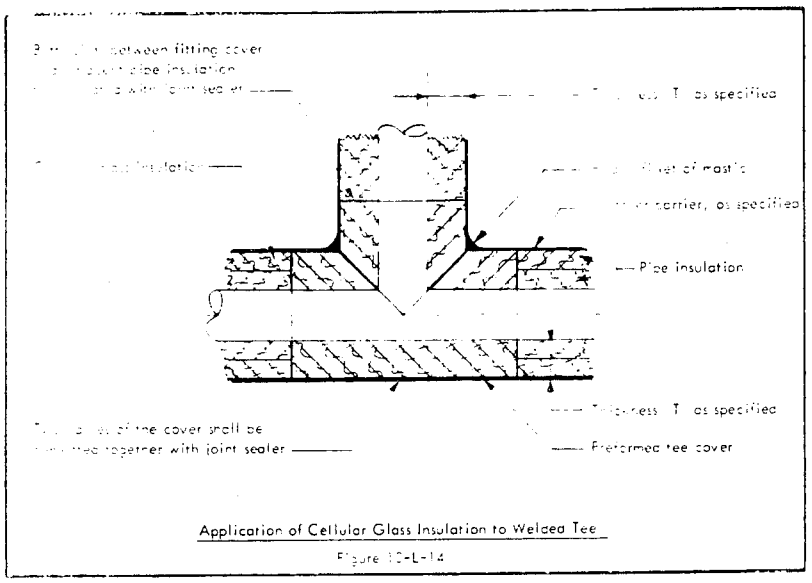
(5) Installations of typical covers are shown in Figures 10-L-15, 10-L-16, and 10-L-17.

(6) All fittings shall be fitted and assembled with very thin, tight joints. Cementing of shoe assemblies shall be done with not 180 F asphalt. In all cases the joints shall be thin, with just sufficient asphalt to obtain good adhesion and complete closure. In no case will wide asphalt joints, or holes plugged with asphalt, be permitted.

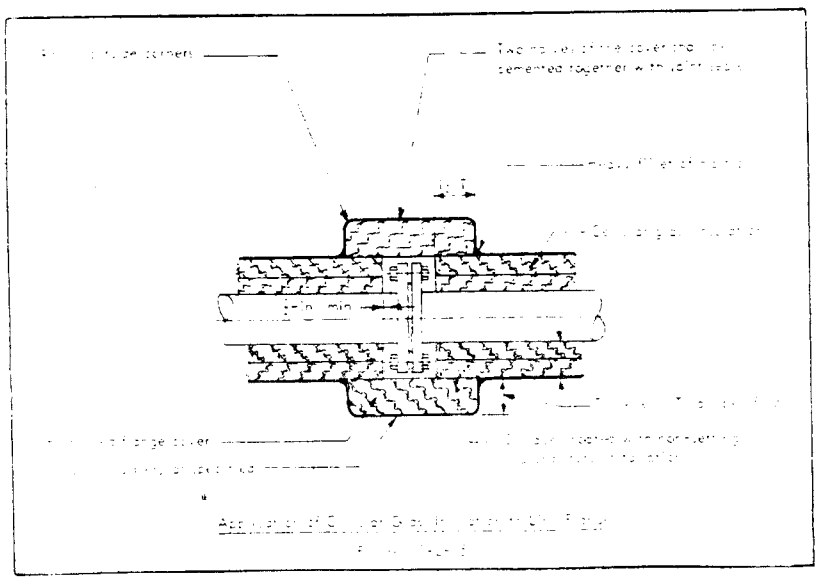


Application of Cellular Glass Insulation to Pipe and Fittings

Figure 10-L-13

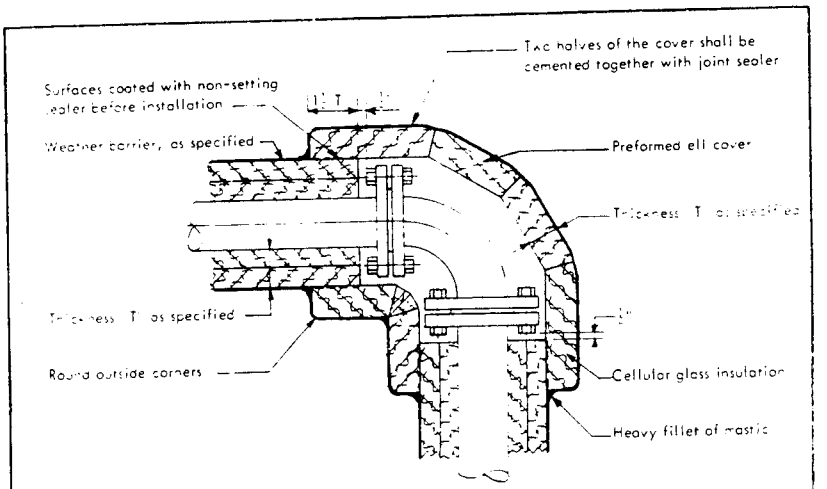


Application of Cellular Glass Insulation to Welded Tee
Figure 10-L-14



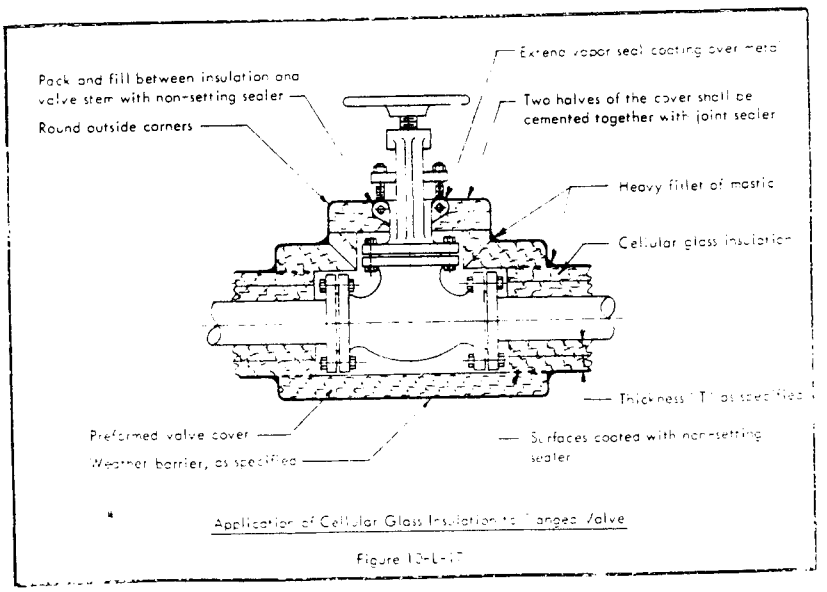
SECTION B - APPLICATION - cont'd

2 PIPING - cont'd



Application of Cellular Glass Insulation to Flanged Ell

Figure 10-L-16



Application of Cellular Glass Insulation to Flanged Valve

Figure 10-L-17

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SECTION B - APPLICATION - cont'd

A. PIPING - cont'd

1. Cellular Glass

a. Cellular glass pipe insulation larger than 4-1/2 inches in outside diameter shall be secured with insulating cement.

b. Inner layers, and outer layers 4-1/2 inches and less in outside diameter, shall be secured with stapling tape.

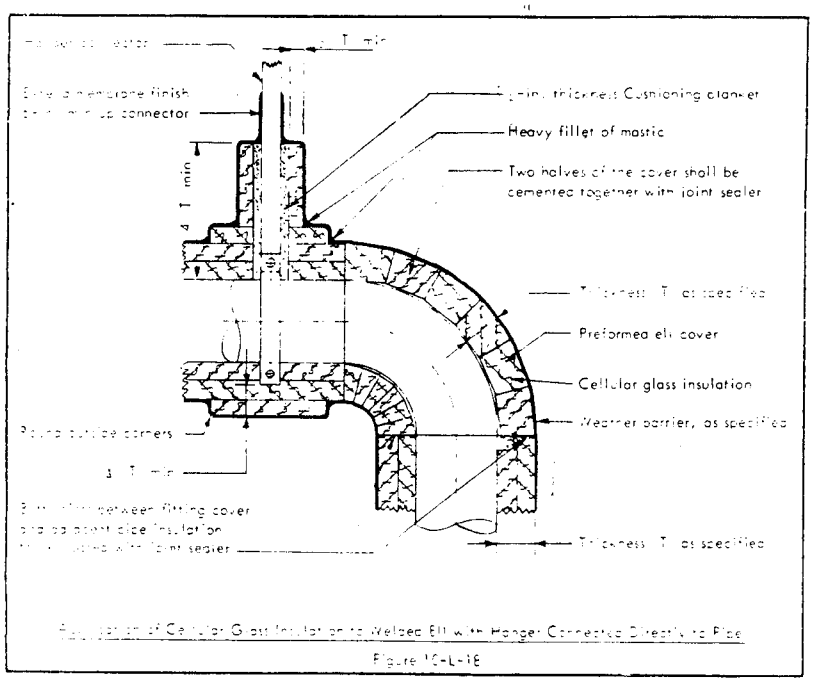
c. Use and application of strap and tape shall be as specified in Articles III.C and III.D of the GENERAL SPECIFICATIONS.

2. Supports and Hangers

a. On all applications, low temperature piping is supported on the outside of insulation surface in accordance with Owner's Standard P-62. Insulation shall be complete with weatherproof barrier applied before piping is placed in cradles. Standard P-62 is a guide to the maximum allowable spacing of cradles which may be supported on the outside of insulation.

b. Insulated cradles at the bottom of all vertical piping where the operating temperature is [illegible] or above 220°F, and where insulation is supported on the outside of insulated surfaces in accordance with Standard P-62, the insulation between cradle and pipe shall be the same [illegible] as the piping insulation.

c. Hangers attached directly to piping shall be insulated as shown in Figure 10-L-18.



Application of Cellular Glass Insulation to Welded Ell with Hanger Connected Directly to Pipe

Figure 10-L-18

SECTION B - APPLICATION - cont'd

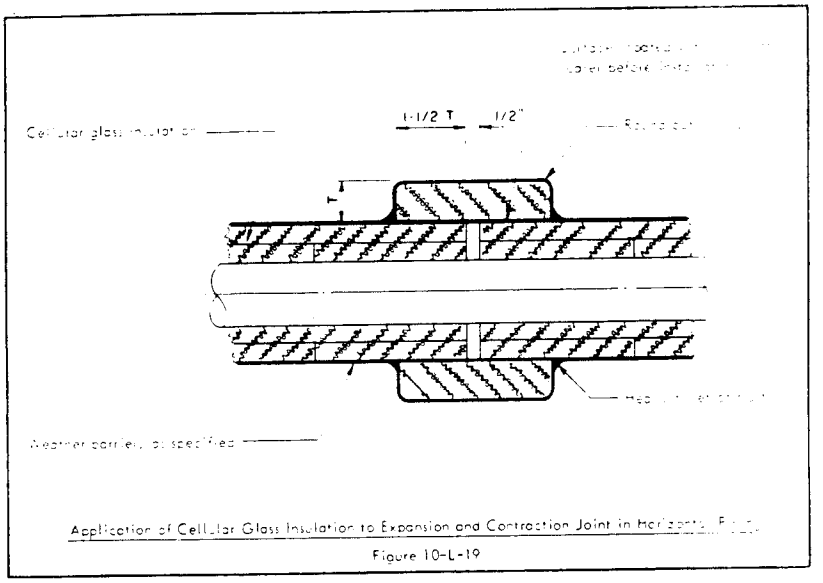
2 PIPING - cont'd

e Expansion and Contraction Joints

(1) Expansion and contraction joints shall be installed, as per Figure 10-L-19 or 10-L-20, in both horizontal and vertical straight run piping, at intervals as follows:

Up to 2-1/2 inches thick insulation - one for each 60 feet.
3 inches to 5 inches thick insulation - one for each 45 feet.
5-1/2 inches to 7-1/2 inches thick insulation - one for each 30 feet.

(2) Where flanged fittings or valves occur within these intervals, expansion and contraction shall be provided for in the flange cover, and expansion-contraction joints in the insulation will not be required



Application of Cellular Glass Insulation to Expansion and Contraction Joint in Horizontal Pipe

Figure 10-L-19

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STANDARD SPECIFICATIONS

UNION CARBIDE

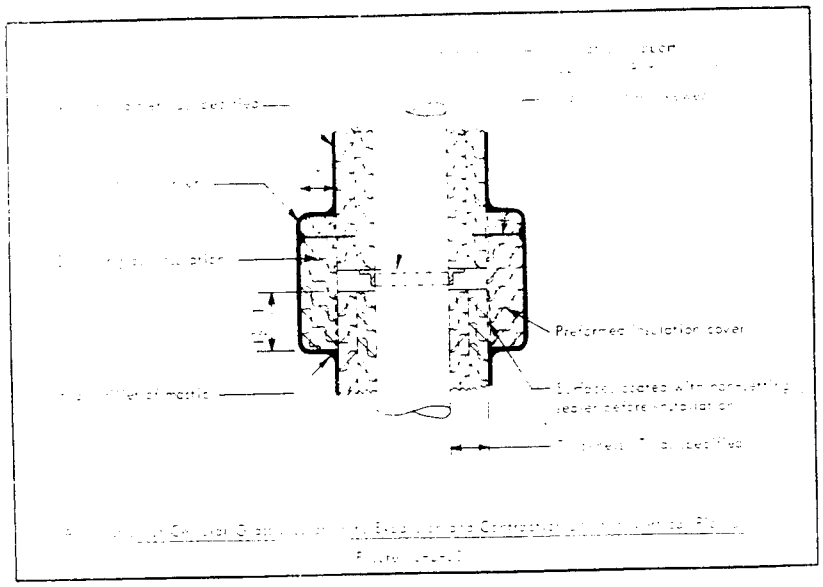
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SECTION B - APPLICATION - parts

[illegible] Thermal Insulation: Thermal fittings, where specified, shall be applied as specified in Article XIII of the GENERAL SPECIFICATIONS.

[illegible] Weather Barrier Coating: Weather-barrier coating shall be applied as specified in Article XIII of the GENERAL SPECIFICATIONS.



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THERMAL INSULATION APPLICATION SPECIFICATIONS

SCOPE

This specification describes the essential requirements for application of geodesically shaped cellular glass insulation segments for use on steel spheres normally operating at temperatures minus 40F to 150F.

Procedures described in the GENERAL SPECIFICATIONS are applicable to and constitute an integral part of this specification.

SECTION A - MATERIALS

INSULATION MATERIALS

Insulation shall be as specified in MATERIAL SEPCIFICATION NO. 10.

ACCESSORY MATERIALS

Accessory materials shall be as specified in MATERIALS SPECIFICATIONS article numbers as noted.

Nylon Strap	VII. A. 114	Fireproofing Insulation	Spec. No. 22
Crimp Clip for Nylon Strap	VII. A. 115	Mastic Caulking	VII. A. 45
Pipe Insulation Strap	VII. A. 13	Non Setting Sealer	VII. A. 83
Glass Tape Strap	VII. A. 14	Weather-Barrier Mastic (color as specified)	VII. B. 1. a
Stainless Steel Wire	VII. A. 17	Reinforcing Cloth	VII. B. 1. b.
Insulation Adhesive (two part)	VII. A. 105	Cushioning Material	VII. A. 2
Min. Asphalt Joint Sealer	VII. A. 43	Stainless Steel Wire	VII. A. 117
Water Sealer	VII. A. 116		

SECTION B - APPLICATION

EQUIPMENT - SPHERE

a. Insulation Supports. Sphere shall be provided with insulation supports as called for on drawings. The sphere shall be provided with three support rings, one to be added at equator, one to be located approximately 30° above the equator, and one to be located approximately 30° below equator. Other insulation supports, where required, shall be as specified in Article II of the GENERAL SPECIFICATIONS All insulation supports shall be provided by others.

b. Surface Preparation. Sphere body and legs shall be properly cleaned and coated with Dimetcote or approved equal as called for in UCC Coating Specifications. This shall be done by others. Care must be taken that the Dimetcote is fully cured prior to application of insulation.

c. Thickness Scheaule. Unless otherwise specified, insulation in excess of 2 1/2 inches total thickness shall be applied in multiple layers as specified in Article III. E. of the MATERIAL SPECIFICATIONS.

d. Sphere Body.

1) Cellular glass block insulation shall be shop fabricated, geodesically shaped, to fit the curvature of the sphere. Multiple layers of insulation, where required, shall be fabricated and applied so that butt joints of one layer do not coincide with that of the other.

2) Prior to application of insulation on bottom of sphere (up to first insulation support ring) nylon straps shall be installed from lower support ring down to bridle ring (made of twisted 14 gage stainless steel wire) at bottom etc. of sphere. These straps shall be installed on 12 inch centers on ring, drawn taut and secured with crimp clips.

3) Insulation adhesive shall be mixed in accordance with manufacturer's instructions in amounts that can be used within pot life of the material.

4) The surface of the cellular glass to be attached to the sphere shall be given a full coat of insulation adhesive. This coat shall be applied with a serrated trowel in sufficient quantity that when pressed to surface it will squeeze out around all edges.

5) Edges of cellular glass block shall be coated with joint vapor sealer so that when each adjacent segment is pressed into position it will form a completely vapor sealed joint with adjacent segments of insulation.

6) Strap (or straps) shall be pulled away from vessel then insulation inserted between strap and vessel, then strap shall be released to hold insulation in position, as shown in Figure 10-L SP-1. The straps facilitate installation and securement of segments until adhesive bond becomes effective.

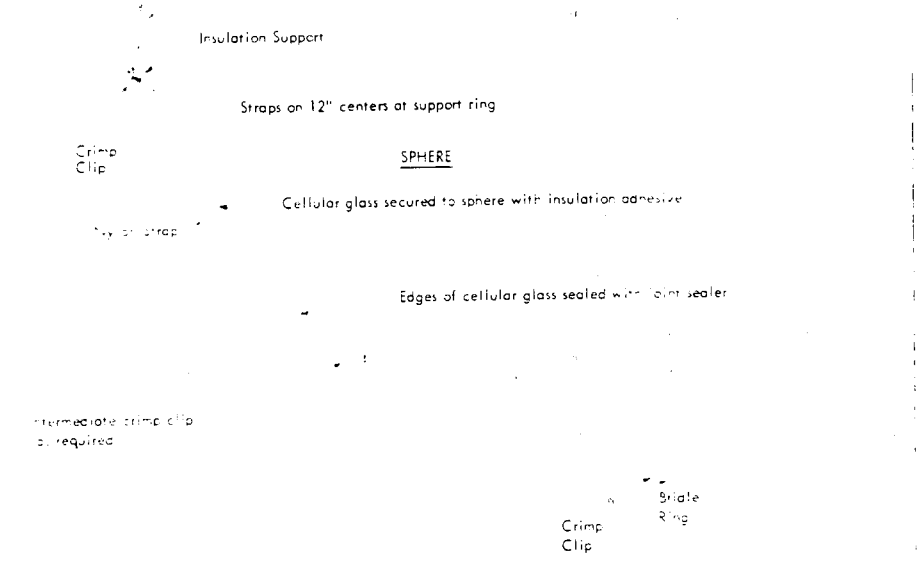
7) If a second layer of cellular glass is required, a second set of bands shall be installed on bottom of vessel and insulation applied in same manner as specified in (2), (3), (4), (5), and (6) above.

8) Application of cellular glass above first support ring shall be installed with adhesive in same manner as specified in (3), (4), (5), and (7) above.

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SECTION B - APPLICATION - Cont'd.

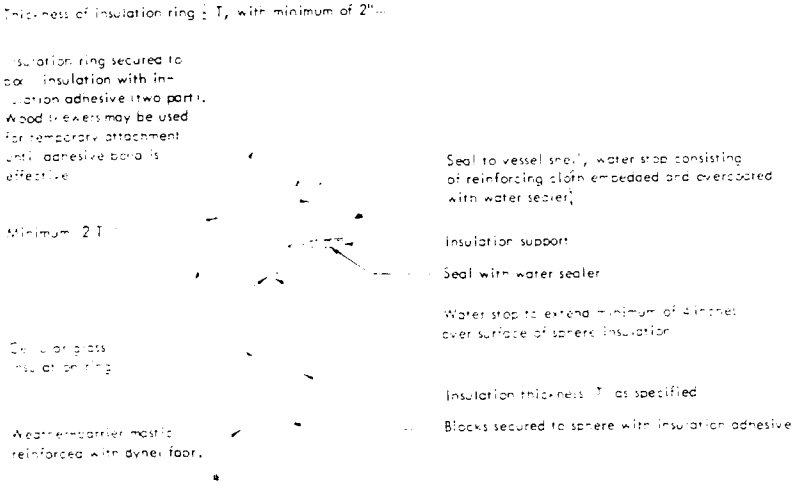
EQUIPMENT SPHERE - Cont'd



Attachment of Cellular Glass to Bottom of Sphere

Figure 10-L SP-1

5. After completion of application of cellular glass on area below each insulation support, a water stop shall be installed to the sphere over the support to outer surface of cellular glass. This water stop is shown in Figure No. 10-L SP-2



Insulation of Water Stop and Insulation Ring at Insulation Supports

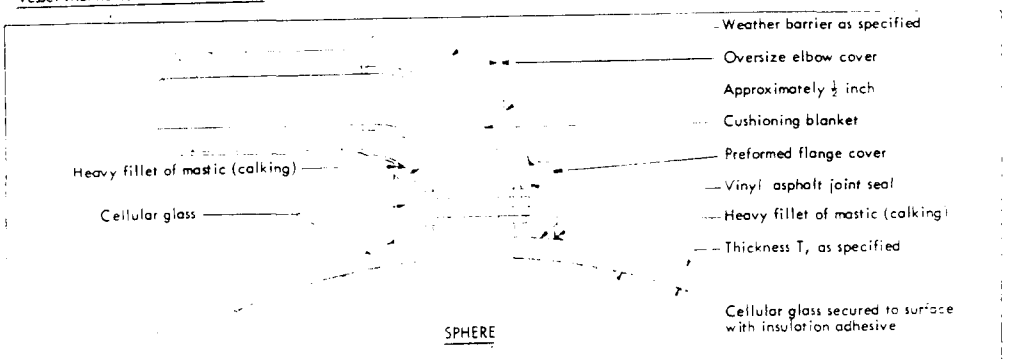
Figure No 10-L SP-2

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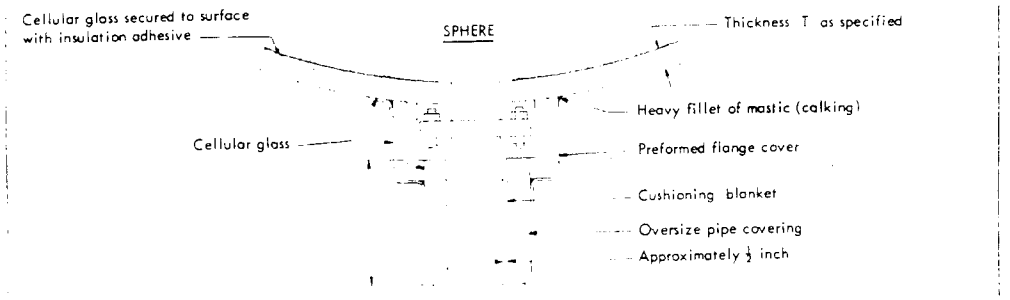
SECTION B - APPLICATION - Contd

1. EQUIPMENT SPHERE - Contd

e. Vessel Manholes and Line Nozzles. Vessel manholes and nozzles shall be insulated as shown in Figures 10-L SP-3, and 10-L SP-4.



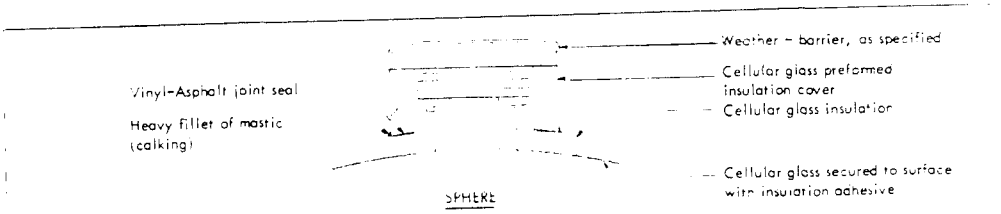
Nozzle Connected to Elbow



Nozzle Connected to Straight Pipe

Application of Cellular Glass to Line Nozzles on Spheres

Figure 10-L SP-3



Application of Celular Glass to Manholes and Blind Nozzles

Figure 10-L SP-4

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SECTION B - APPLICATION - Conta

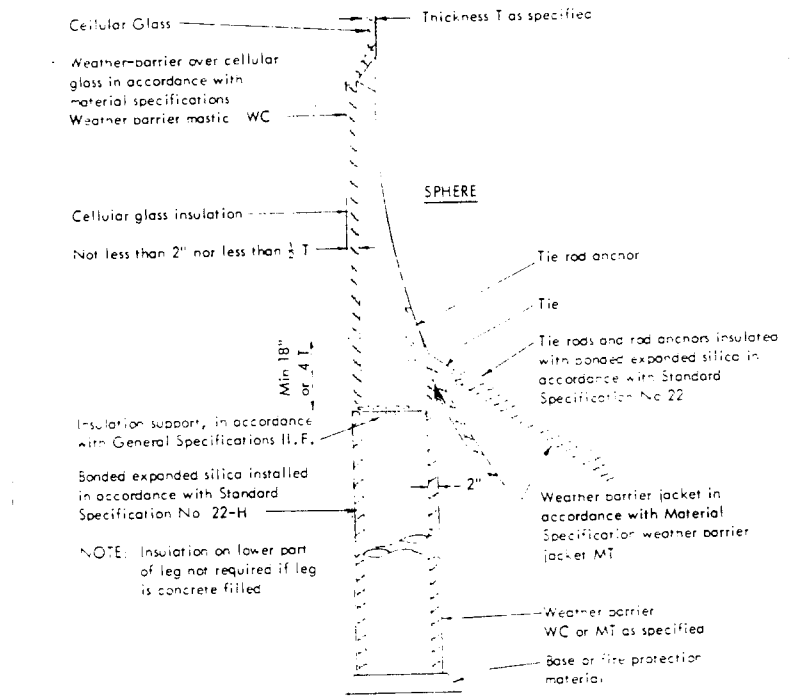
EQUIPMENT SPHERE - Conta

Vessel Legs.

(1) Concrete filled legs shall be insulated with cellular glass for a distance not less than four times the specified body insulation thickness, but not less than 18 inches, measured from junction of sphere with leg. Thickness over the leg shall not be less than one half that specified for sphere nor less than two inches in thickness.

(2) Legs not concrete filled shall be insulated with cellular glass insulation as specified in (1) above, and remainder of leg down to base or fire protection material shall be insulated with bonded expanded silica insulation 2 inches thick in accordance with STANDARD SPECIFICATION NO. 22H. Installation shall be as shown in Figure 10-L SP-5.

Tie Rods and Tie Rod Anchors. Tie rods and tie rod anchors shall be insulated with 2 inch thick bonded expanded silica in accordance with STANDARD SPECIFICATION NO. 22-H. Installation shall be as shown in Figure 10-L SP-5.



Application of Insulation on Sphere Legs and Tie Rod

Figure No 10-L SP-5

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SECTION B - APPLICATION - Conta

1. EQUIPMENT SPHERE - Conta

h. Weather-Barriers.

(1) Weather-barrier coating over insulation on sphere body and upper leg shall be as specified in MATERIAL SPECIFICATIONS VII.B.1.a. and shall be applied as specified in Article XIV.A. GENERAL SPECIFICATIONS.

(2) Weather-barrier jacket over the rod insulation shall be as specified in MATERIAL SPECIFICATION VII.B.3., Specification Designation "MT" and shall be applied as specified in Article XV.B of GENERAL SPECIFICATIONS.

(3) Insulation on support legs (where required) shall be weather-barrier protected by weather-barrier mastic or treated steel jackets as called for in (1) or (2) above.

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THERMAL INSULATION APPLICATION SPECIFICATIONS

CELLULAR GLASS
(Oxygen Service)

SCOPE

This specification describes the essential requirements for application of shaped cellular glass insulation for use on equipment and piping in oxygen service normally operating at temperatures below 70 F. It is applicable to both indoor and outdoor service.

Procedures described in the GENERAL SPECIFICATIONS are applicable to and constitute an integral part of this specification.

SECTION A - MATERIALS

1. INSULATION MATERIAL

Insulation shall be as specified in MATERIAL SPECIFICATION NO. 10

2. ACCESSORY MATERIALS

Accessory materials shall be as specified in the MATERIAL SPECIFICATIONS, article numbers as noted.

Cushioning Material for Equipment and Piping	VII. A. 1	Weather-Barrier Mastic (Color as Specified)	VII. B. [illegible]
Stainless Steel Wire	VII. A. 17	Reinforcing Cloth	VII. B. [illegible]
Equipment Insulation Strap	VII. A. 11	Fabricating Cement	VII. A. 34
Pipe Insulation Strap	VII. A. 13	Adhesive Cement	VII. A. 47
Clips for Equipment Strap	VII. A. 12	Joint Sealer	Vimasco Lax-Seal F or approved equal
Clips for Pipe Strap	VII. A. 14	Neoprene	1/16 inch thick, U. S. Rubber No. M-889 Hercules No. 765-N, or approved equal
Strap Anchor Clip	VII. A. 24		
Pipe Insulation Support	As shown in Figure 10-OX-16	Stainless Steel Skewers	VII. A. 21
Anti-Abrasive Coating	VII. A. 39	Welding Pins	VII. A. 19

SECTION B - APPLICATION

1. EQUIPMENT

a. Insulation Supports. Equipment shall be provided with insulation supports as specified in Article II of the GENERAL SPECIFICATIONS.

b. Thickness Schedule. Unless otherwise specified, insulation in excess of 2-1/2 inches total thickness shall be applied in multiple layers as specified in Article III, E, of the MATERIAL SPECIFICATIONS.

c. Cushioning Blanket

(1) On vertical equipment, two layers of cushioning blanket shall be applied over the top head and compressed to 1-inch thickness, and one layer to the sides and bottom head and compressed to 1-1/2-inch thickness, before application of the cellular glass insulation. Blanket shall be secured in place with a minimum amount of stainless steel wire. Cellular glass insulation shall then be applied over the blanket in the manner described in this specification. Cushioning blanket shall not be considered as part of the specified insulation thickness.

(2) On horizontal equipment, one layer of cushioning blanket shall be applied over the entire surface and compressed to 1-1/2-inch thickness and secured in the same manner as that called for in Paragraph (1) above.

d. Cellular Glass

(1) Cellular glass block insulation for sides and bottom heads of vertical vessels shall be shop fabricated and fitted to allow a 1-1/2-inch space for cushioning blanket between block and vessel.

(2) Cellular glass block insulation for top heads of vertical vessels shall be fabricated and fitted to allow a 1-inch space for cushioning blanket between block and vessel.

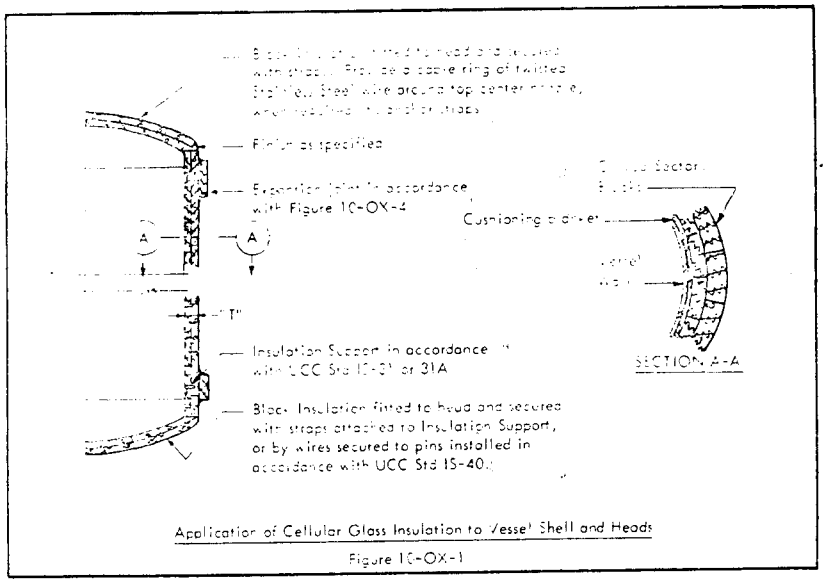
(3) Block insulation shall be applied over cushioning blanket on all equipment with all joints tightly butted. Multiple layers shall be applied so that joints of one layer do not coincide with those of any other layer.

(4) All butt edges and ends of insulation fabricated for inner layer or layers shall be given a smooth brush or spray coat of anti-abrasive coating and allowed to dry for a minimum of 1-2 hour, but preferably 2 hours, before application of insulation to equipment.

(5) All butt edges and ends of outermost layer (or single layer) of formed insulation shall be sealed with a buttered coat of the specified joint sealer. Joint sealer shall be of sufficient thickness to provide proper adhesion, seal, and cushion between the individual pieces of insulation as they are laid in place as shown in Figure 10-OX-1.

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EQUIPMENT - cont'd



Application of Cellular Glass Insulation to Vessel Shell and Heads

Figure 10-OX-1

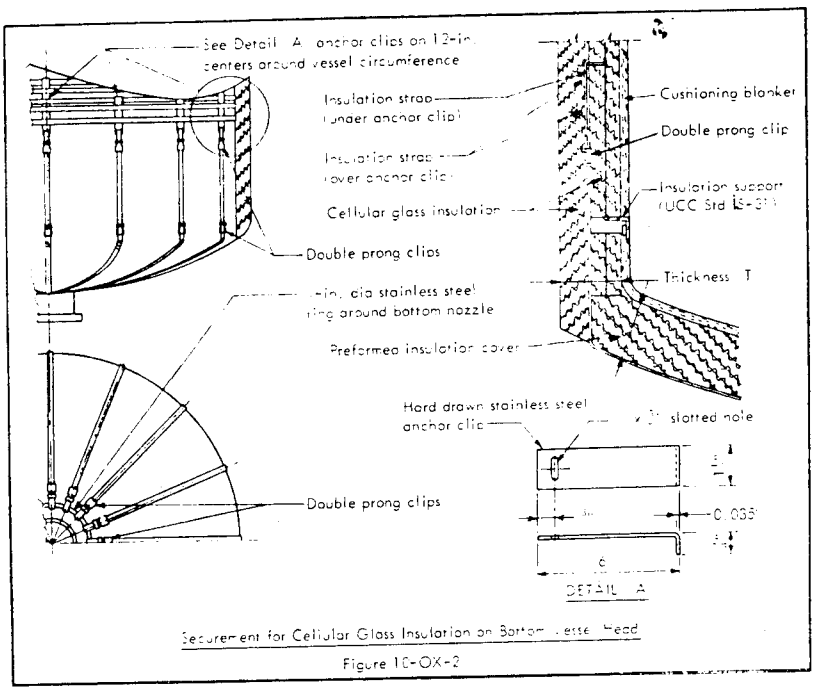
Equipment

1. Where contour of vessel permits firm and effective attachment, all layers of cellular glass insulation shall be secured in place with stainless steel insulation straps. Where required, insulation straps shall be attached to strap anchor angles in accordance with Owner's Standards 15-31, 15-30, and 15-42 as applicable to irregular surfaces. Where use of straps is impracticable, shall be secured with stainless steel wire attached to welding pins, drawn taut, and ends twisted together and pressed into insulation.

2. Inner layer or layers of cellular glass insulation on bottom heads of vertical equipment, or heads of horizontal equipment, shall be laid in place with stainless steel insulation straps secured to insulation supports, as shown in Owner's Standards 15-31, 15-30, and 15-42. Outer layer of cellular glass insulation on bottom heads of vertical equipment or heads of horizontal equipment shall be secured with insulation straps, as shown in Figure 10-OX-2.

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EQUIPMENT - cont'd



Securement for Cellular Glass Insulation on Bottom Vessel Head

Figure 10-OX-2

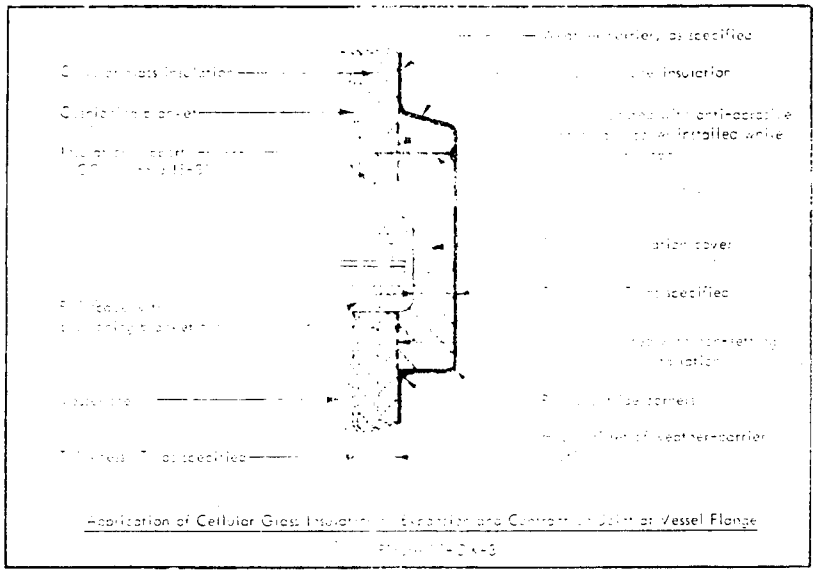
Flat Surfaces. Block shall be applied to flat surfaces in the same manner as previously specified for curved surfaces.

Expansion-Contraction Joints

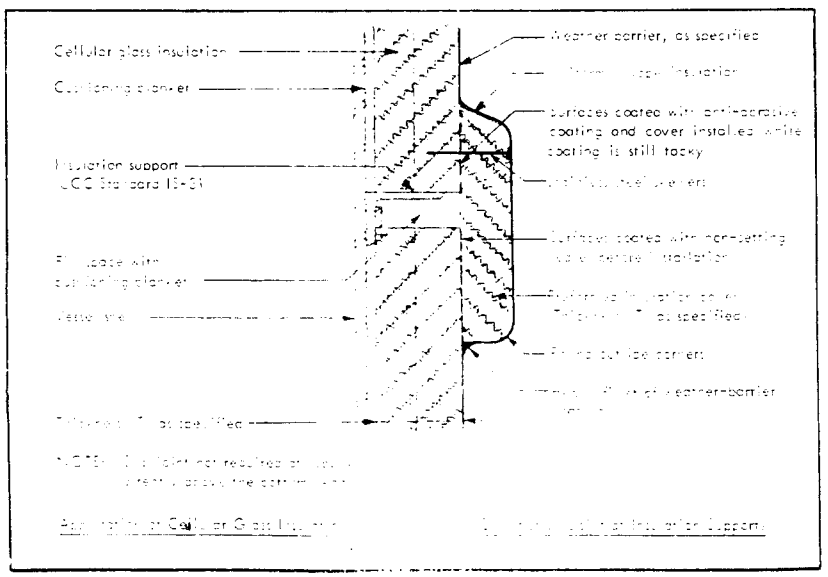
.1 Expansion-contraction joints, constructed as shown in Figure 10-OX-3, shall be provided at vessel flanges. Where movement is likely to occur, anti-abrasive coating shall be applied to surfaces of insulation, as shown, to provide proper slip joint.

.2 Longitudinal expansion and contraction of vessels shall be provided for by installing expansion-contraction joints at the insulation support, as shown in Figure 10-OX-4. Where more than one thickness of insulation is specified for a vessel, an insulation support shall be installed at the junction of two different thicknesses, and insulated in a manner similar to that shown in Figure 10-OX-4.

.3 Cushioning blanket shall be packed around nozzles and projections where they extend through the insulation, as shown in Figure 10-OX-5. Where movement is likely to occur, anti-abrasive coating shall be applied to surfaces of insulation to provide proper slip joint.



Application of Cellular Glass Insulation, Expansion and Contraction Joint at Vessel Flange

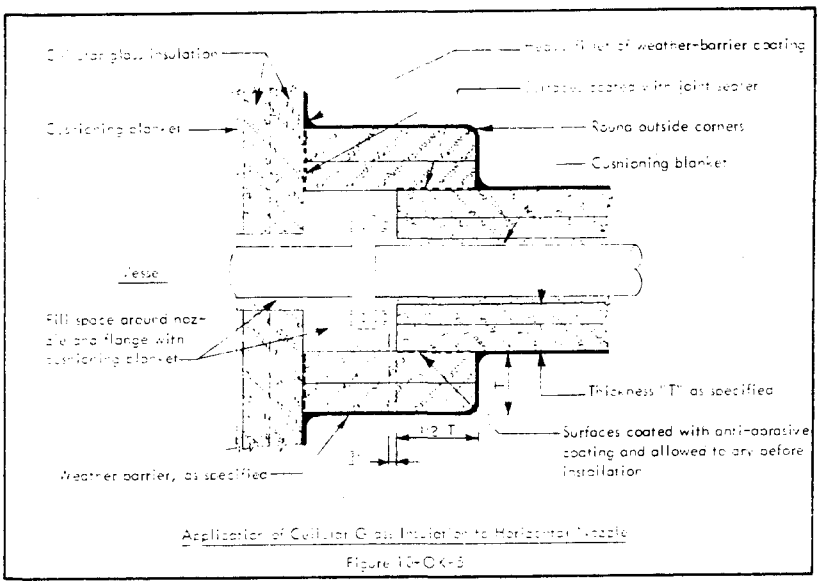


Application of Cellular Glass Insulation

Typical Insulation Support

SECTION 5 - APPLICATION - cont'd

EQUIPMENT - cont'd



Application of Cellulosic Glass Insulation to Horizontal Nozzle

Figure 10-OX-5

Movement Expansion Joints - Corrugated metal pipe expansion joints in piping systems, fittings as equipment items shall be insulated as specified in Section 10-OX-4. A slip joint shall be provided at both ends of the corrugated item when horizontal. Insulation shall be applied with overlapping 18 inches long. Sheet metal cover over the pipe insulation at each end of the expansion joint shall be applied with the right end of the pipe covering. The sleeve shall be secured with a strap at one end only. Outside the slip joint surfaces. The inner shall overlap sheet shall overlap 2 x T plus 1 inch over the sleeve at each end and be secured with one strap around the middle. The outer sheet sheet and insulation cover shall extend 2 x T over each end of the slip joint and be secured with straps as required. The longitudinal and circumferential seams shall be a minimum of 2 inches apart at the strap joints. Weather-barrier mastic shall be applied to the ends of the insulation cover and sealed to bare metal jackets. In the pipeline location planned to accommodate the inner jacket clearance shall be provided for expansion and [illegible]

Where expansion joints are not required, the slip joint at the top shall be omitted and the expansion joint cover secured to the [illegible]

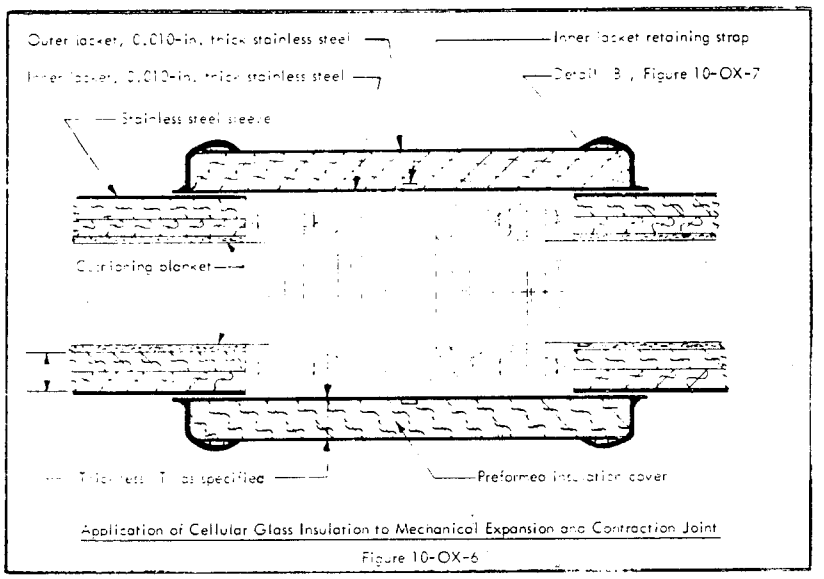
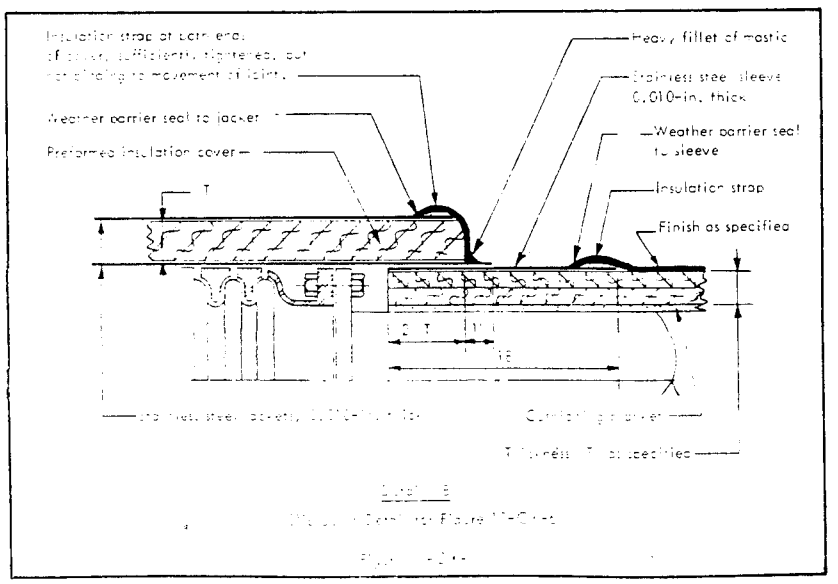


Figure 10-OX-6



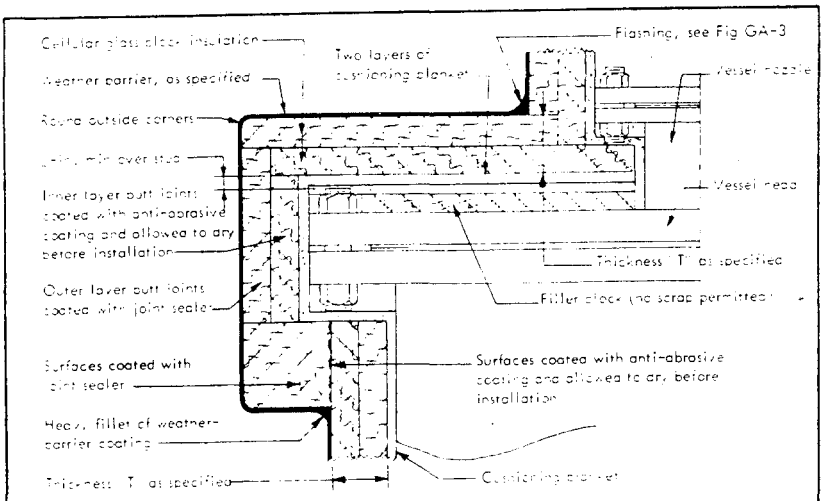
SECTION B - APPLICATION - cont'd

EQUIPMENT - cont'd

Flat Heads

1. Insulation on top of flat heads of vertical equipment shall be applied in the same manner as previously described in this specification. Water pockets shall be eliminated and proper drainage provided as shown in Figure 10-C.

2. All top nozzles on insulated equipment shall be provided with flashing as shown in Figure GA-3 of the GENERAL SPECIFICATIONS.



Application of Cellular Glass Insulation to Flat Equipment Heads

Figure 10-OX-8

Legs and Skirts

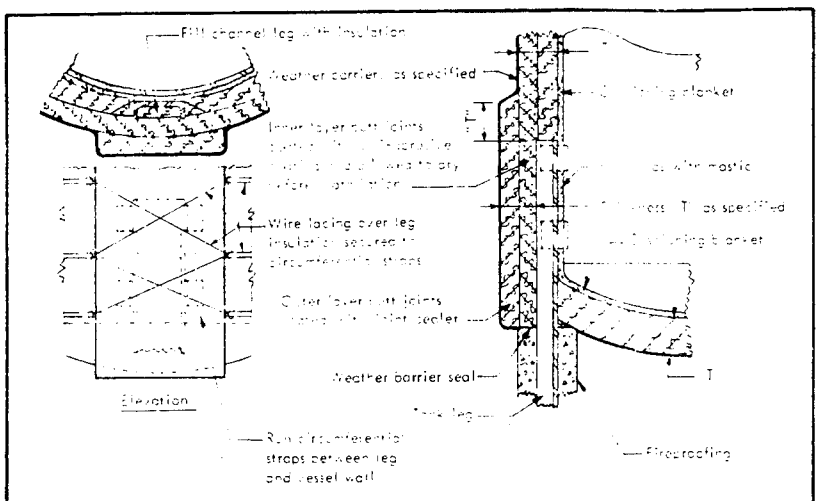
1. Concrete-filled structural tubing legs shall be insulated for a distance not less than 4 times the specified insulation thickness, measured from the junction of the vessel with the leg. Thickness over the leg shall be not less than 1/2 that specified for shell or head.

2. Channel legs shall be insulated with block which shall extend over channel flanges and down channel legs to the junction with structural material, or a distance of four times the insulation thickness, but not less than 24 inches. Thickness shall be as specified for shell or head but not less than 2 inches. Bands shall be applied firmly, approximately [illegible] apart.

3. Equipment openings between channel flanges shall be filled with block, cemented in place with adhesive cement. Surface of filler material shall be level with leg. Leg insulation shall be coated with weather-barrier coating. Installation shall be as shown in Figure 10-C Ref.

SECTION B - APPLICATION - cont'd

EQUIPMENT - cont'd



Application of Cellular Glass Insulation to Equipment Leg

Figure 10-OX-9

Vessel Skirts - Skirts supporting vertical equipment shall be insulated inside and outside. Insulation shall extend downward, from junction of vessel shell with insulated bottom head, a distance of not less than four times the thickness of insulation, but never less than 1 foot. Thickness of insulation over skirt shall be as specified for body of vessel, but never less than 2 inches. Insulating material shall be secured to inside or outside skirt as well. Support for inside skirt insulation, and bottom head insulation, shall be in accordance with Owner's Standard 15-42. Installation shall be as shown in Figure 10-OX-10.

Equipment Supports

1. Where equipment is supported on saddles, vessel insulation shall extend over saddles as shown in Figure 10-OX-11.

2. Where equipment is supported by structural steel members, insulation shall extend not less than four times the specified insulation thickness in each direction, measured from junction of vessel with insulated support lug. Thickness of insulation over steel supports shall be not less than 2 inches specified for body of vessel. Thickness of insulation over support lugs shall be the same as that of body insulation. Installation shall be as shown in Figure 10-OX-12.

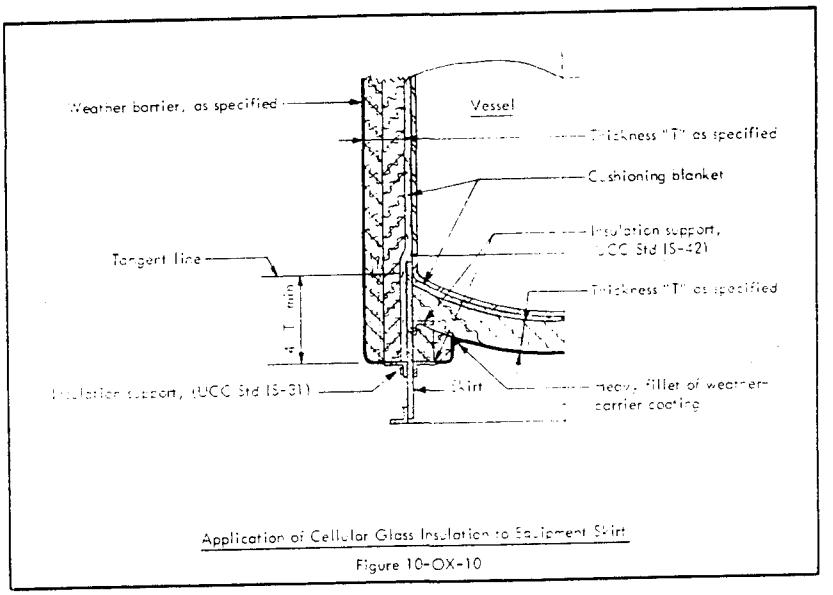
Vapor Barrier

1. Vapor barrier requirements shall be as specified in Article XI, B of the GENERAL SPECIFICATIONS.

2. Where specification requires all service [illegible] shall be applied as specified in Article XI, B of the GENERAL SPECIFICATIONS, the vapor barrier shall be indicated on the data sheet by adding the letter V to the specification designation, thus: 10-OXV.

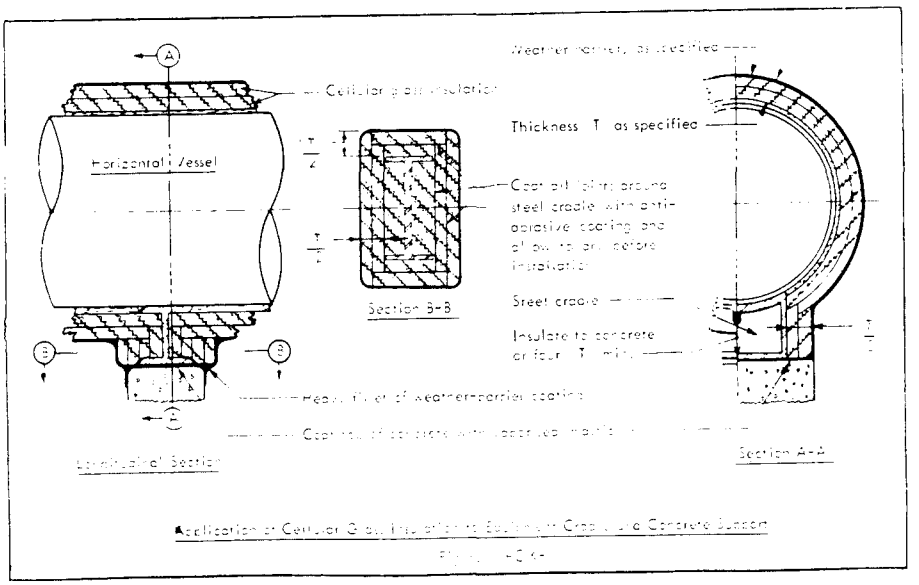
3. [illegible] termination of insulation.

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Application of Cellular Glass Insulation to Equipment Skirt

Figure 10-OX-10

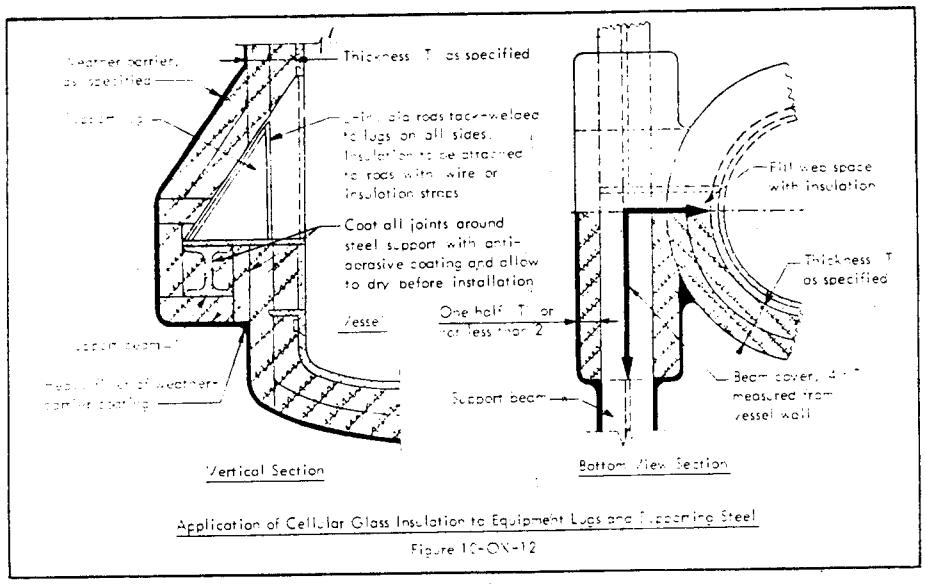


Application of Cellular Glass Insulation to Equipment Cradle on Concrete Support

Figure 10-OX-11

SECTION B - APPLICATION - cont'd

EQUIPMENT - cont'd



Application of Cellular Glass Insulation to Equipment Lugs and Supporting Steel

Figure 10-0X-12

Pipe Insulation

Pipe insulation shall be applied and secured as specified in Article III of the GENERAL SPECIFICATIONS.

Insulation in excess of 2-1/2" total thickness shall be applied in multiple layers as specified in Article III, E of the MATERIAL SPECIFICATIONS.

Pipe insulation shall be applied in a staggered position, in accordance with Figure GA-1 and GA-2 of the GENERAL SPECIFICATIONS.

Piping shall have an aluminum cushioning blanket secured with stainless steel wire and compressed to approximately 1/2 thickness of the cellular glass insulation. Cushioning material shall not be considered as part of insulation thickness.

Vapor barrier mastic, on the first layer insulation, and outer layer of multiple layer applications, shall be buttered into the joints of the units and shall be drawn together when insulation is applied so that only a very thin, vapor-tight mastic joint remains between units.

Insulation shall be installed in all pipe hangers, guides and anchors, to eliminate voids. Voids between insulation and hangers shall be filled with mastic and insulating cement as specified in the insulation. Any rounded corners on the insulation shall be trimmed to provide flat surfaces

SECTION B - APPLICATION - cont'd

2. PIPING - cont'd

a. Pipe Insulation - cont'd

(2) Butt edges and ends of all inner layers of insulation shall be given a smooth brush or spray coat of anti-abrasive coating and allowed to dry for a minimum of 1/2 hour, but preferably 2 hours, before application. Care shall be exercised to obtain a thin, even coat of sufficient thickness only to cover and fill the cut cells of the insulation.

(3) When scheduled for installations where severe vibration is expected, entire surface area shall be coated with anti-abrasive coating as specified in Item 2.a.(2) of this section.

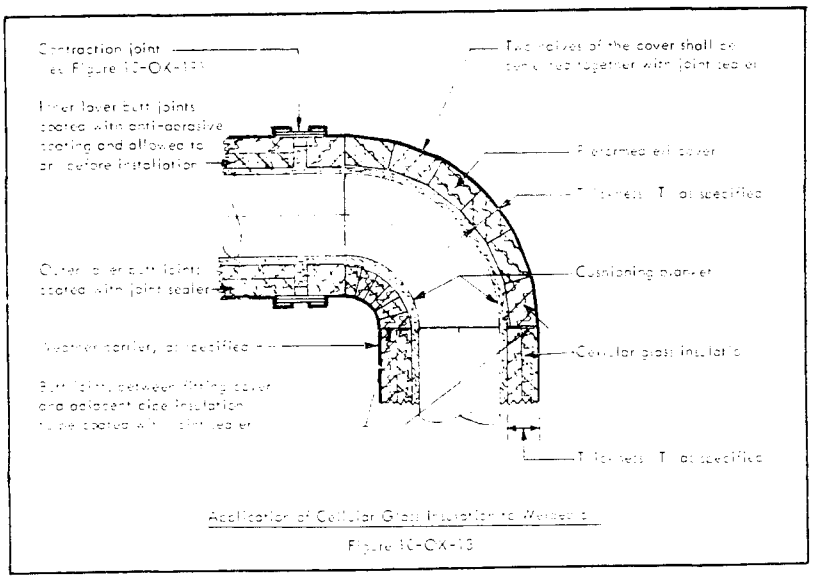
c. Fitting, Flange, and Valve Covers

1) Welding fitting covers shall be fabricated to an inside diameter 1 inch greater than the outside diameter of the welded fitting to allow for [illegible]

2) Fitting, flange, and valve covers shall be prefabricated in accordance with ASTM Recommended Practice C 450, latest revision.

3) [illegible] shall be packed and filled around valve stem and packing gland area with joint sealer, to eliminate water pockets.

4) Completing of hood assemblies shall be done with fabricating cement. In all cases the joints shall be as thin as possible, with just sufficient cement to obtain good adhesion and complete closure. In no case will wide cement joints, [illegible] voids and holes plugged with cement be permitted.



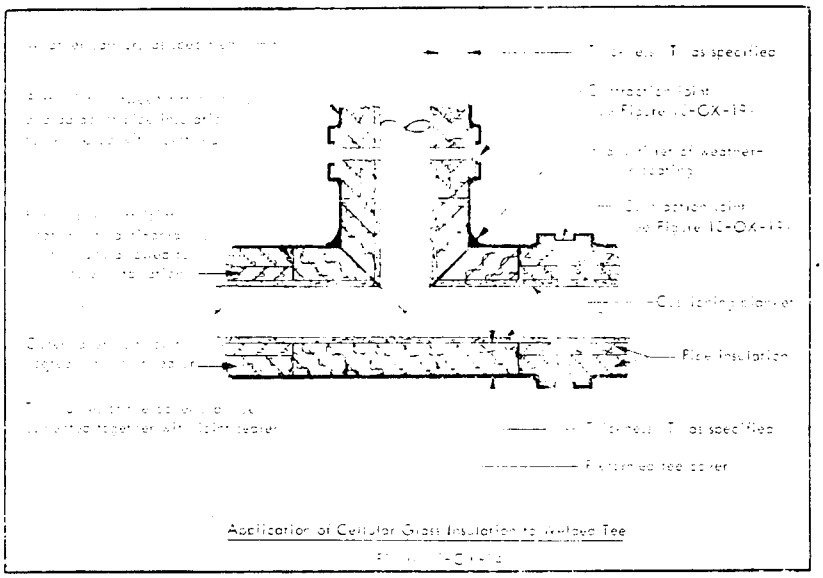
Application of Cellular Glass Insulation to Welded E

Figure 10-OX-13

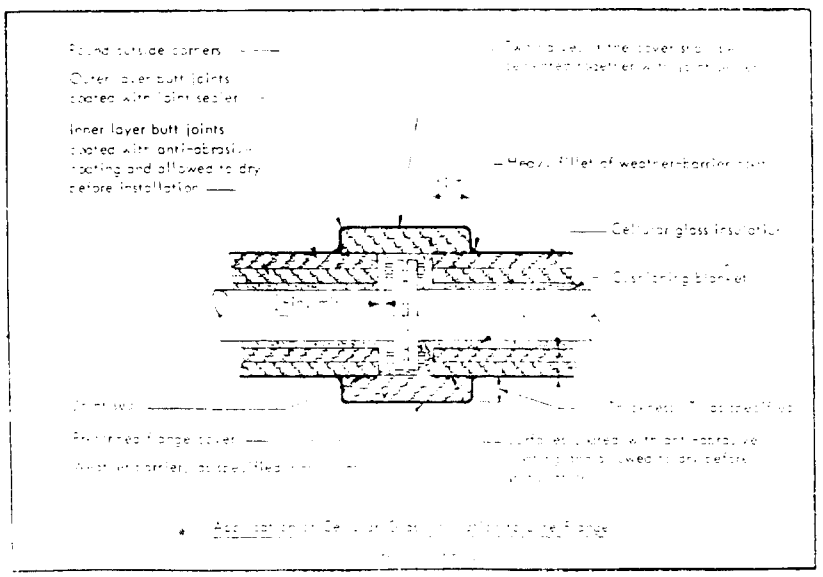
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SECTION B - APPLICATION

1. PIPING - Cont'd

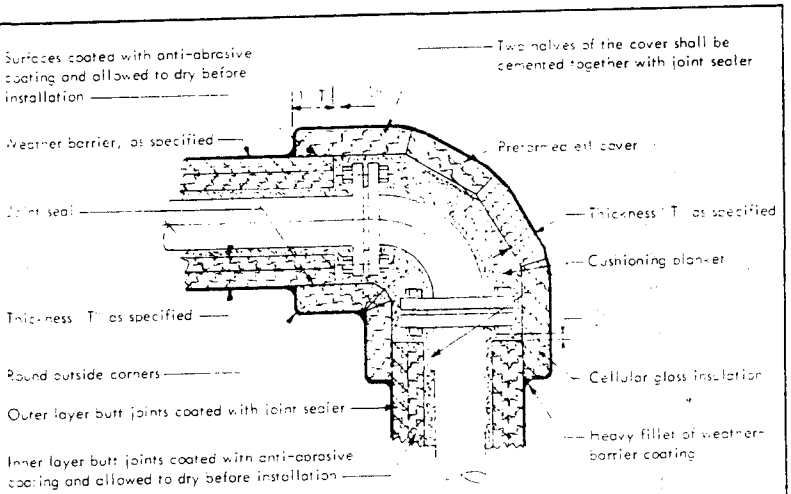


Application of Cellular Glass Insulation to Welded Tee



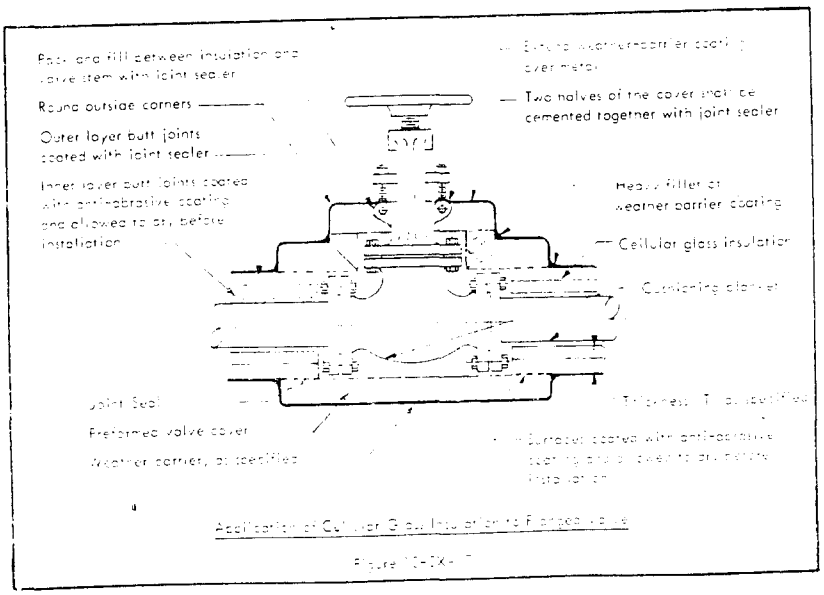
SECTION B - APPLICATION - contd

2. PIPING - contd



Application of Cellular Glass Insulation to Flanged Ell

Figure 10-OX-16



Application of Cellular Glass Insulation to Flanged Valve

Figure 10-OX-17

SECTION B - APPLICATION - contd

PIPING - contd

Sealing Plate

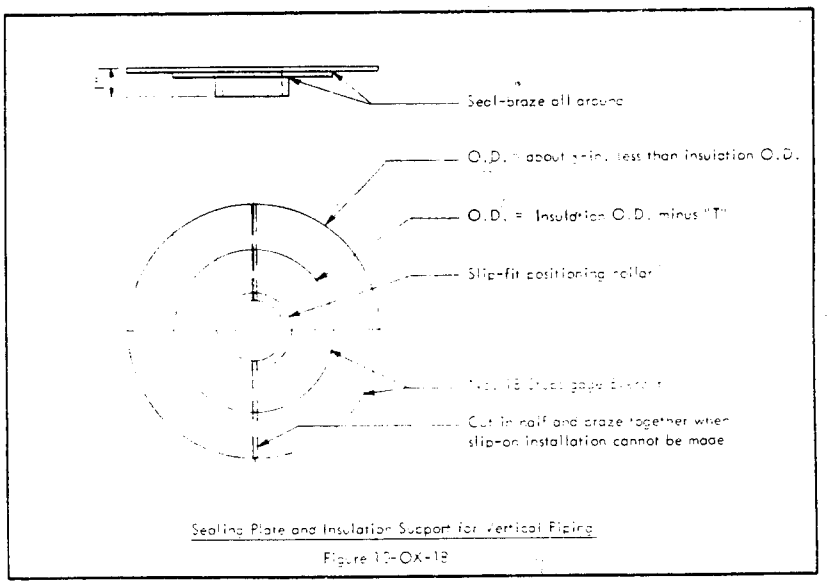
1. This plate, shown in Figure 10-OX-18, shall be used wherever insulation is terminated. A typical installation is shown in Figure 10-OX-22.

2. This plate shall also be used at expansion joints in vertical runs to carry the weight of the insulation, as shown in Figure 10-OX-20.

Expansion and Contraction Joints

1. Expansion and contraction joints shall be installed as shown in Figures 10-OX-19 and 10-OX-20, in both horizontal and vertical straight runs of piping, at 30-foot intervals.

2. [illegible] expansion and contraction joints shall be installed so that each run of pipe shall have at least one joint in it, as shown in Figures 10-OX-21 and 10-OX-22.

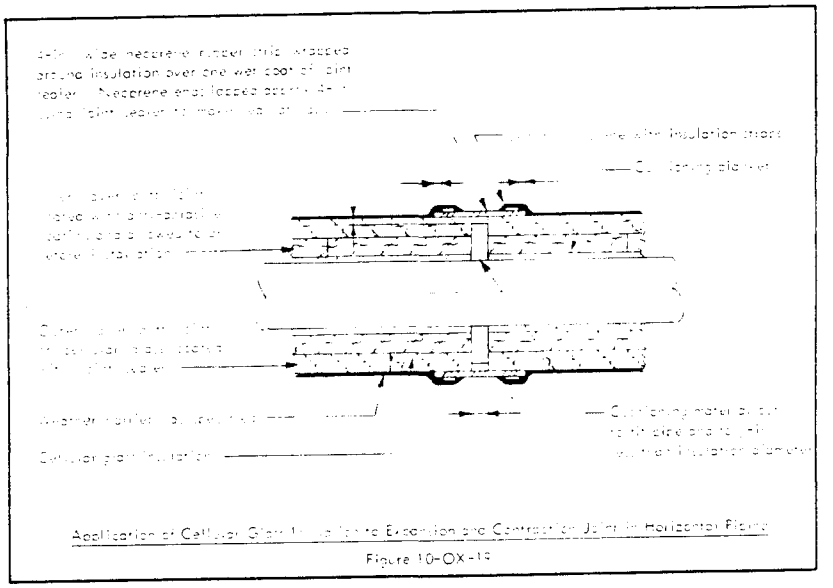


Sealing Plate and Insulation Support for Vertical Piping
Figure 10-OX-18

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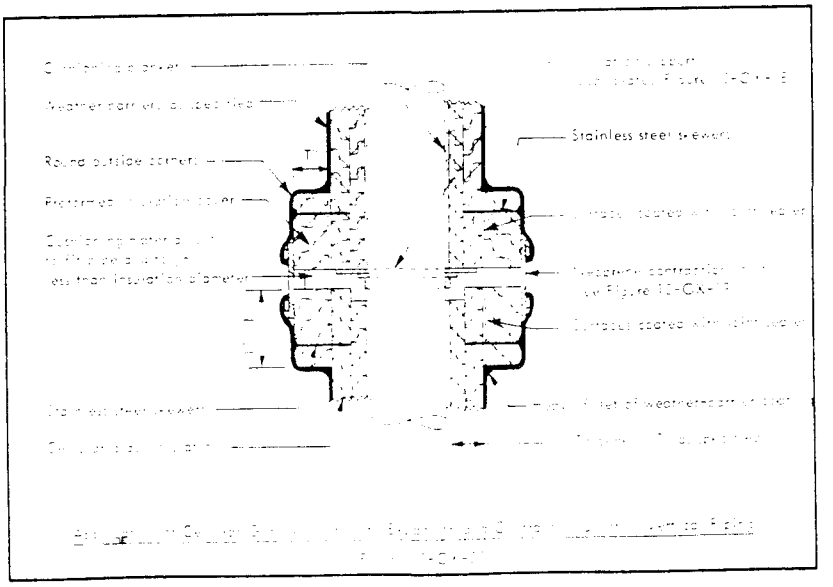
SECTION B - APPLICATION - cont'd

2. PIPING - cont'd



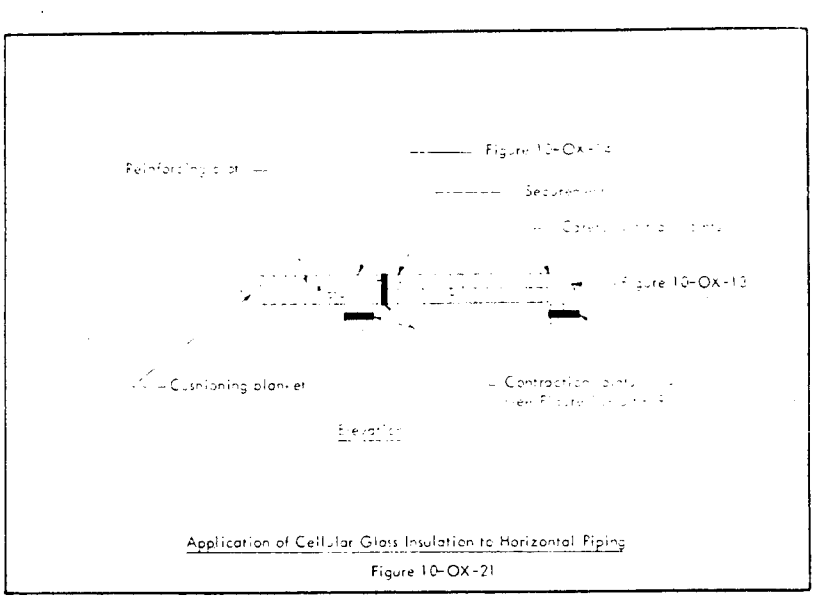
Application of Calliper Glass Insulation to Expansion and Contraction Joints in Horizontal Piping

Figure 10-OX-15

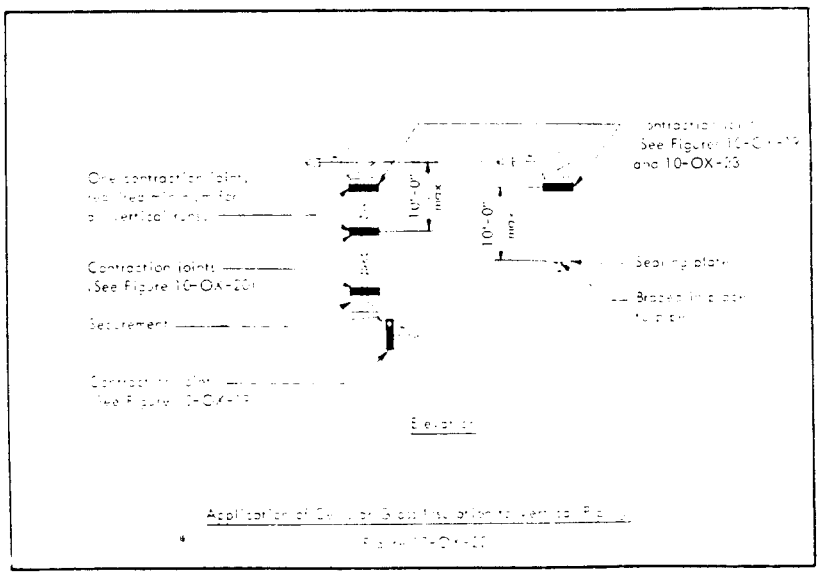


SECTION B - APPLICATION - cont'd

PIPING - cont'd



Application of Cellular Glass Insulation to Horizontal Piping
Figure 10-OX-21



SECTION B - APPLICATION - cont'd

2. PIPING - cont'd.

a. Securement

(1) All outer layers of cellular glass pipe insulation 4-1/2 inches and larger in outside diameter shall be secured with insulation strap.

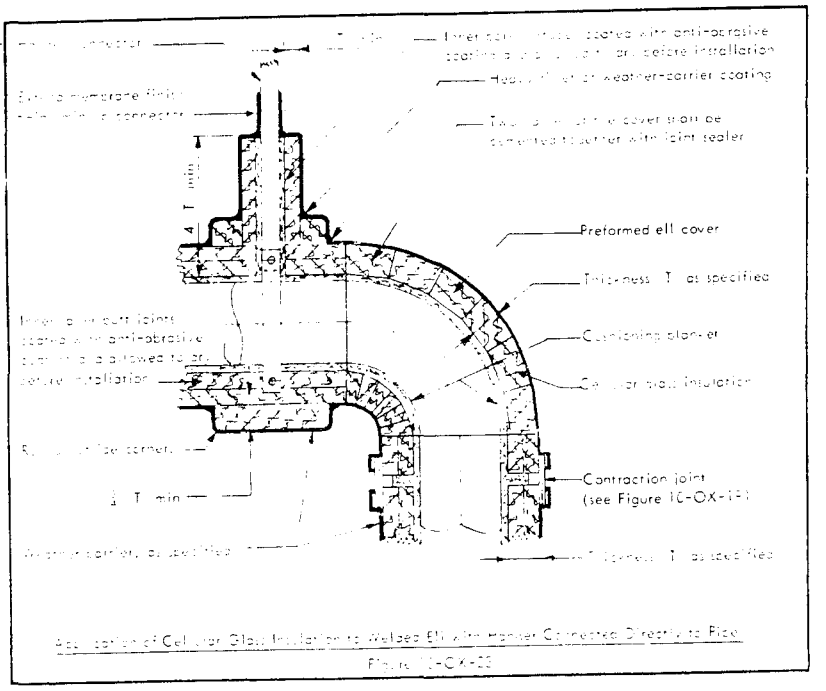
(2) All inner layers and outer layers less than 4-1/2 inches in outside diameter shall be secured with stainless steel wire.

(3) Use and location of strap and wire shall be as specified in Articles III.C and III.D of the GENERAL SPECIFICATIONS.

b. Supports and Hangers

(1) Where hot service, low temperature piping is supported on the outside of insulation as listed, in accordance with Owner's Standard P-80, insert or insulation complete with weather-barrier coating is placed in steel cradle. Standard P-82 is a guide to the maximum horizontal spacing of pipe which may be supported on the outside of insulation.

(2) Hanger assembly at location of piping shall be insulated as shown in Figure 10-OX-2.



Application of Cellular Glass Insulation to Welded Ell with Hanger Connected Directly to Pipe

Figure 10-OX-2

c. Traced Installations. Traced lines, where specified, shall be installed and insulated as specified in Article XIII of the GENERAL SPECIFICATIONS.

d. Weather Barrier

(1) Weather-barrier coating shall be applied as specified in Article XI.A.3 of the GENERAL SPECIFICATIONS.

(2) Weather barrier of stainless steel jacketing, [illegible] shall be as specified in Article X.A.3 of the GENERAL SPECIFICATIONS. This [illegible] by the addition of the [illegible] and [illegible] as shown on Figure 10-OX-[illegible].

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THERMAL INSULATION APPLICATION SPECIFICATION

RIGID URETHANE FOAM

SCOPE

This specification describes the essential requirements for application of shaped rigid urethane foam insulation for use on equipment, piping and auxiliaries normally operating at temperatures above 50 F up to and including 250 F. It is applicable to both indoor and outdoor service.

The suffix letters (or letter), 12-HSS, indicates that this specification shall be used for stainless steel equipment and piping.

Applicable portions of the GENERAL SPECIFICATIONS are applicable to and constitute an integral part of this specification.

SECTION A - MATERIALS

1. INSULATION MATERIAL

   Rigid urethane foam shall be as specified in MATERIAL SPECIFICATION NO. 12.

2. ACCESSORY MATERIAL

   Accessory materials shall be as specified in the MATERIAL SPECIFICATIONS, article numbers as noted.

Insulating Cement	VII.A.6	Strapping Tape	VII.A.23
Pipe Insulation Support	VII.A.9	Contact Adhesive (Standard)	VII.A.65
Equipment Insulation Strap	VII.A.11	Contact Adhesive (High Temperature)	VII.A.66
Clips for Equipment Strap	VII.A.12	Glass Wool Metal Mesh Blanket	VII.A.93
Stainless Steel Wire	VII.A.17	PVA Finish Coating and Lagging Adhesive	VII.A.94
Welding Pins	VII.A.19	Glass Reinforcing Cloth	VII.A.113
Stainless Steel Pins	VII.A.20	Weather Barrier Mastic (Color as Specified)	VII.B.1.a
Welding Pin Insulation Fasteners	VII.A.22	Reinforcing Cloth	VII.B.1.b
Cork-Filled Polyvinyl Acetate Mastic	Material Specification No. 40-J		

SECTION B - APPLICATION

1. EQUIPMENT

   a. Insulation Supports. Equipment shall be provided with insulation supports as specified in Article II of the GENERAL SPECIFICATIONS.

   b. Curved Surfaces.

      1) On cylindrical vessels, the rigid urethane curved segmental insulation blocks shall be preformed to fit the diameter of the vessel to which they are applied. Typical installation is shown in Figure 12-H-1.

      2) Curved segmental insulation blocks shall be installed on the cylindrical section of the vessel with staggered end joints as shown in Figure 12-H-2.

      3) Rigid urethane insulation for vessel heads shall be shop fabricated to fit the contour of the head.

   c. Flat Surfaces. Rigid urethane block insulation shall be applied to flat surfaces in staggered position with all joints tightly butted.

   d. Flanges. Manhole flanges, piping flanges and vessel flanges shall be insulated with preformed covers unless otherwise specified.

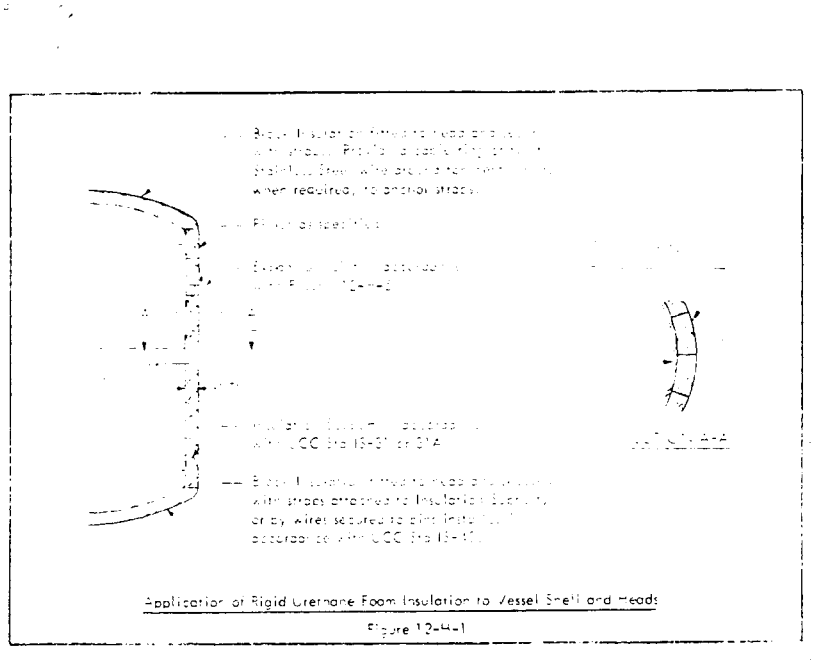
   e. Instrument

      1) Curved Surfaces.

         a) Where contour of vessel permits, insulation shall be secured with stainless steel insulation straps. Where required, insulation straps shall be attached to strap anchor angles in accordance with Owner's Standard 15-31. Insulation applied to irregular surfaces where the use of straps is impracticable, shall be secured with stainless steel wire attached to welding pins, drawn taut, ends twisted together and pressed into the insulation. Typical installation is shown in Figure 12-H-1.

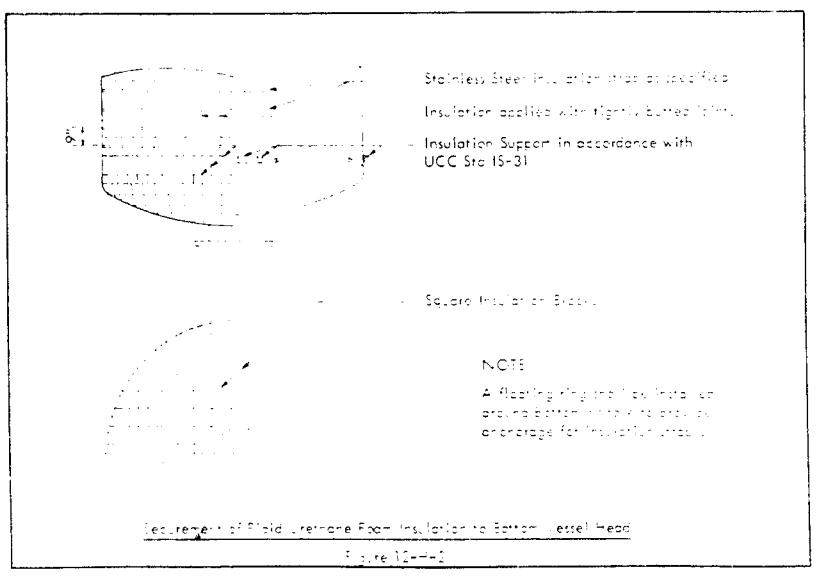
         b) Preformed segmental insulation blocks on bottom heads of vertical equipment or heads of horizontal equipment shall be held in place with stainless steel insulation straps secured to insulation supports as shown in Owner's Standard 15-31, 15-36, and 15-42. Insulation on heads of large diameter vessels (over 12 ft. OD), where use of straps is impracticable, shall be secured by wire attached to welding pins in accordance with Owner's Standard 15-42.

SECTION B - APPLICATION - cont'd



Application of Rigid Urethane Foam Insulation to Vessel Shell and Heads

Figure 12-H-1



Application of Rigid Urethane Foam Insulation to Bottom Vessel Head

Figure 12-H-2

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SECTION 6 - APPLICATION - cont'd

A. EQUIPMENT - cont'd

B. Insulation - cont'd

2. Flat surfaces

a. Block insulation applied to flat surfaces for operating temperatures below 180 F shall be secured to the surface with contact adhesive. Carbon steel surfaces shall be sand blasted and coated with a zinc silicate inorganic coating, in accordance with Union Carbide Design and Construction Coatings' Manual prior to the application of insulation. Aluminum, copper, stainless steel and galvanized steel equipment shall be cleaned of all dirt, grease, oil and other contaminates prior to the application of insulation.

b. Standard contact adhesive shall be used on surfaces for operating temperatures up to 180 F, whereas high temperature contact adhesive shall be used if operating temperature is above 180 F but less than 180 F. Standard or high temperature contact adhesive, as required, shall be applied over the entire surface to be insulated, and to the inner surface of the insulation, sufficiently in advance of application to allow the adhesive to dry to a non-tacky state. At temperatures from 32 F to 40 F, the drying time is approximately twice that at temperatures above 40 F. Boards shall be pressed into place with care not to trap air between the insulation and surface.

c. At operating temperatures exceed 180 F, rigid urethane insulation shall be secured with welding pin fasteners and pin clips. Insulation boards shall be a minimum of five attachments per board, as shown in Figure 12-H-5.

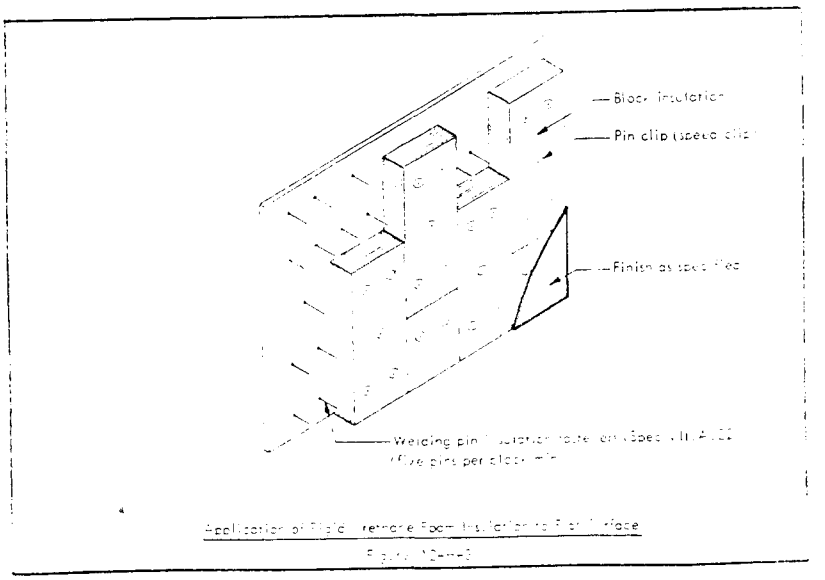
d. Pin clips shall be pressed tight to the insulation and pins to be cut off flush with the pin clip face. Any sharp protection shall be covered with asbestos-filled polyvinyl acetate mastic as called for in MATERIAL SPECIFICATION NO. 40-J.

C. Expansion joints

1. Where vessel flanges are insulated, expansion joints constructed as shown in Figure 12-H-4 shall be provided.

2. Longitudinal expansion of vessels shall be provided for by installing insulation expansion joints at insulation supports as shown in Figure 12-H-3.

3. Expansion joints in flat surfaces, such as ducts, shall be insulated with flexible blanket insulation. Five-pound density metal mesh blanket of double the specified thickness shall be applied to expansion joints and compressed to specified thickness so as to obtain minimum five-pound density. Typical installation is shown in Figure 12-H-6.



Application of Rigid Urethane Foam Insulation to Flat Surface

Figure 12-H-5

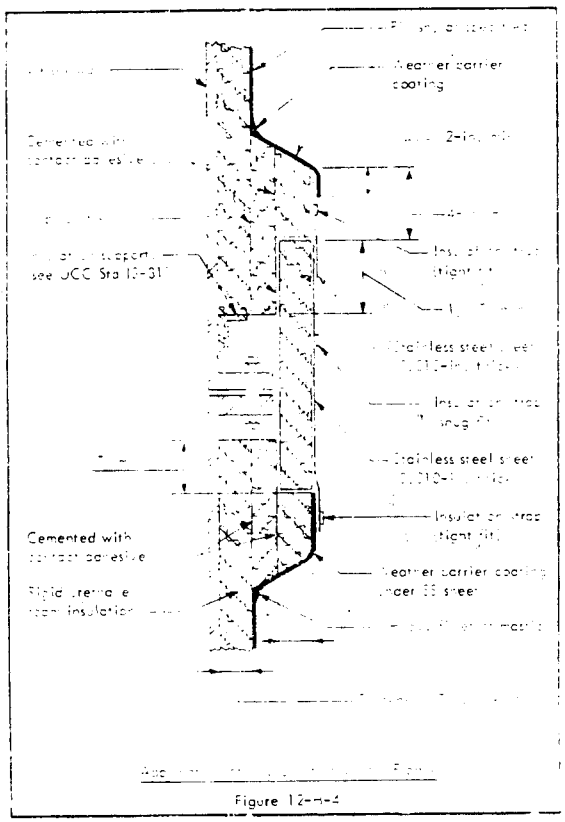
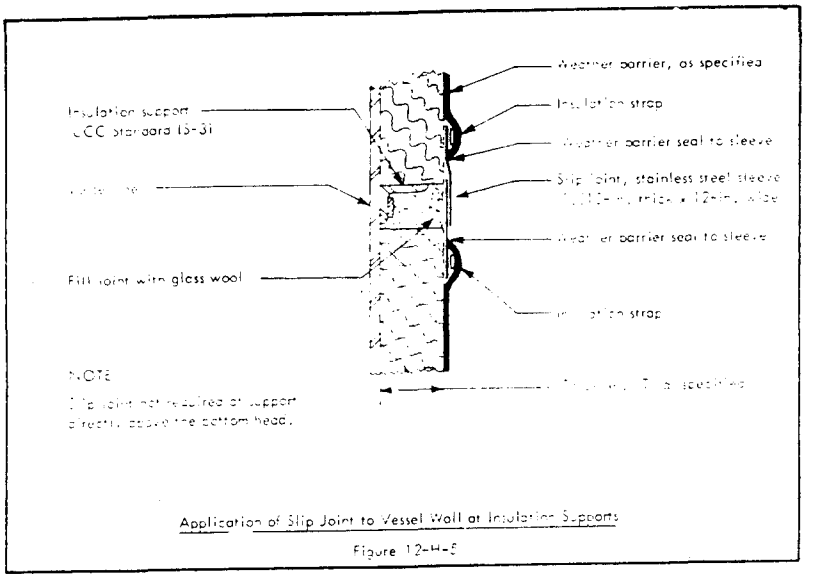

Weather barrier coating
Cemented with contact adhesive
see UCC Std 13-31
Stainless steel sheet
Insulation strap
tight fit
Stainless steel sheet
Insulation strap
tight fit
Weather barrier coating under SS sheet
Cemented with contact adhesive

Figure 12-H-4

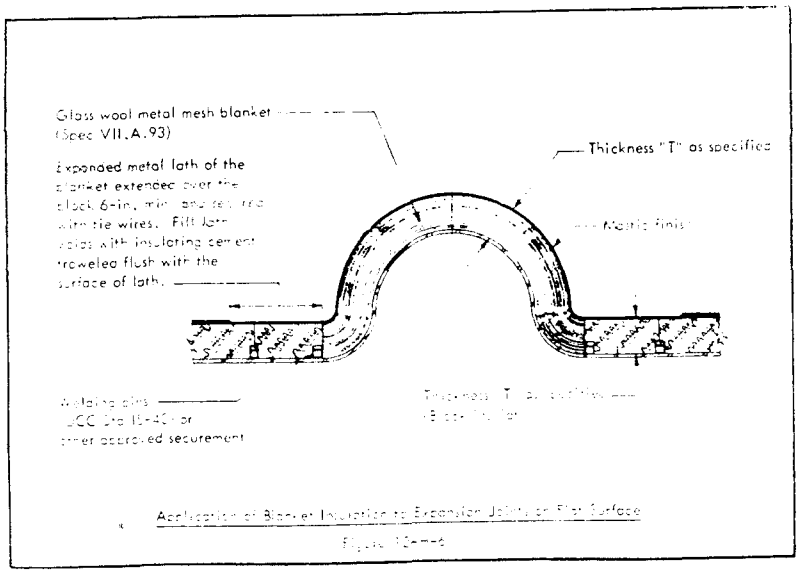
SECTION B - APPLICATION - cont'd

EQUIPMENT - cont'd



Application of Slip Joint to Vessel Wall at Insulation Supports

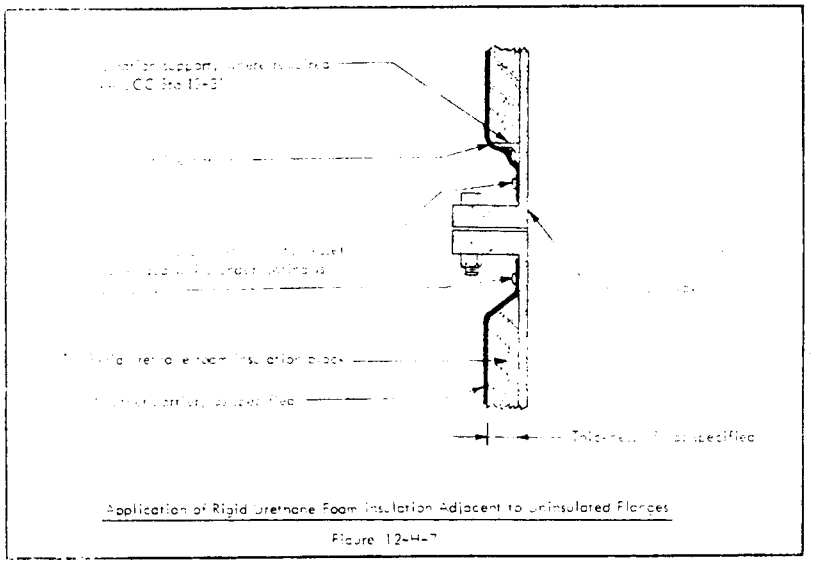
Figure 12-H-5



Application of Blanket Insulation to Expansion Joints on Flat Surface

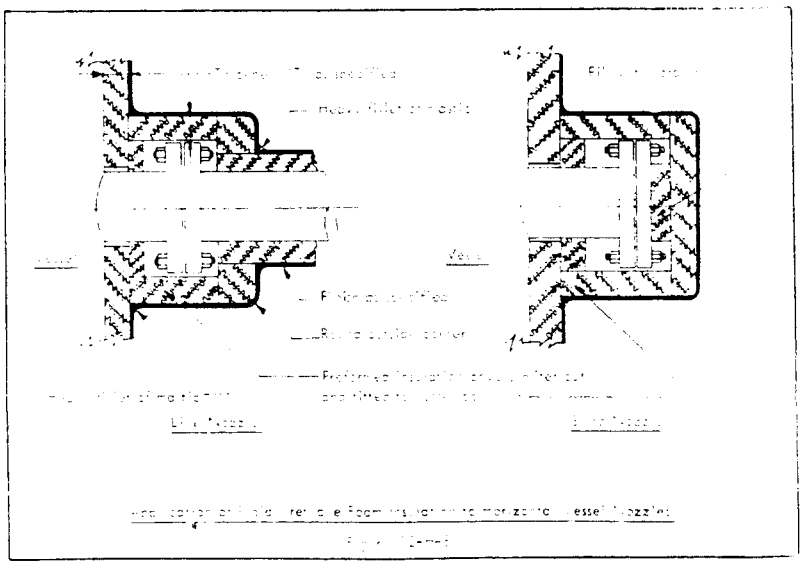
Figure 12-H-6

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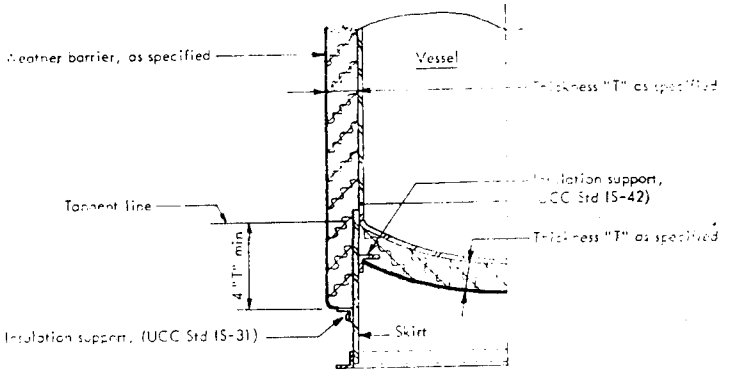
Application of Rigid Urethane Foam Insulation Adjacent to Uninsulated Flanges

Figure 12-H-7



SECTION B - APPLICATION - cont'd

1. EQUIPMENT - cont'd



Application of Rigid Urethane Foam Insulation to Equipment Skirt

Figure 12-H-9

c. Traced Installation. Tracing and insulation on traced equipment shall be installed as specified in Article XIII of the GENERAL SPECIFICATIONS.

d. Surface Finish. When insulation of the specified thickness has been applied, all small cracks and depressions shall be filled with permanently pliable, non-asphaltic mastic flush with the surface.

e. Weather-Barrier or Exterior Finish. Equipment - Weather Barrier. Weather-barrier coating materials and application shall be as specified in Articles XIV.A and XIV.B of the GENERAL SPECIFICATIONS.

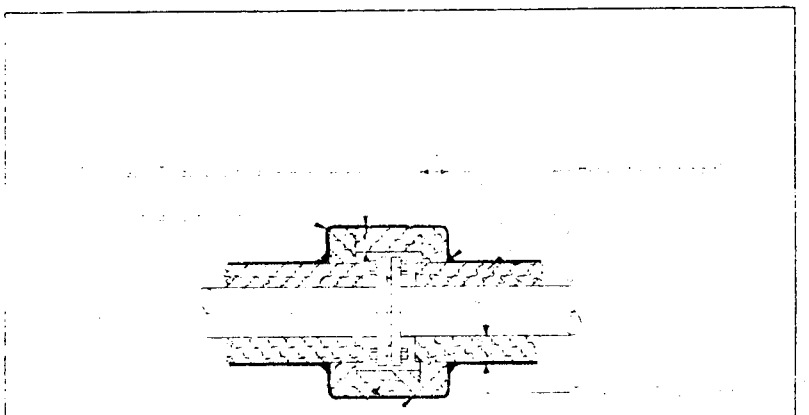
2. PIPING

a. Pipe Insulation.

1. Pipe insulation shall be applied to piping in staggered position in accordance with Figures GA-1 and GA-2 of the GENERAL SPECIFICATIONS.

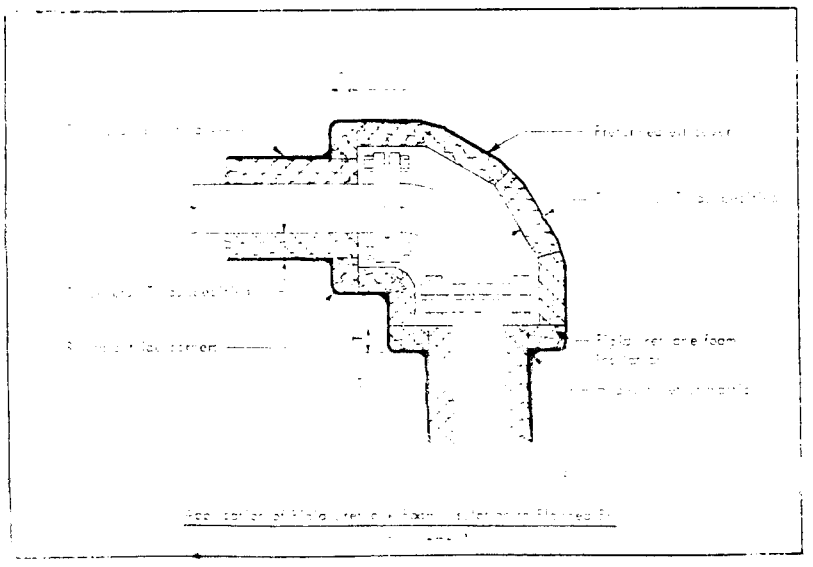
2. Insulation shall be applied with all joints tightly butted to eliminate voids. Large voids shall not be filled with mastic, but shall be eliminated by resetting and fitting insulation. Any rounded corners on the insulation to be butted shall be trued before application.

3. Pipe insulation shall be secured in place with strapping tape spaced as shown in Figure GA-1 of the GENERAL SPECIFICATIONS.



Application of Rigid Urethane Foam Insulation to Line Flange

Figure 12-H-10



SECTION B - APPLICATION - cont'd

2. PIPING - cont'd

a. Fittings, Flanges and Valve Covers.

1) Fittings, flanges and valves in one inch NPS and smaller piping shall be insulated with [illegible] cement. Fittings above one inch up to three inch NPS may be insulated with field fabricated or shop preformed covers.

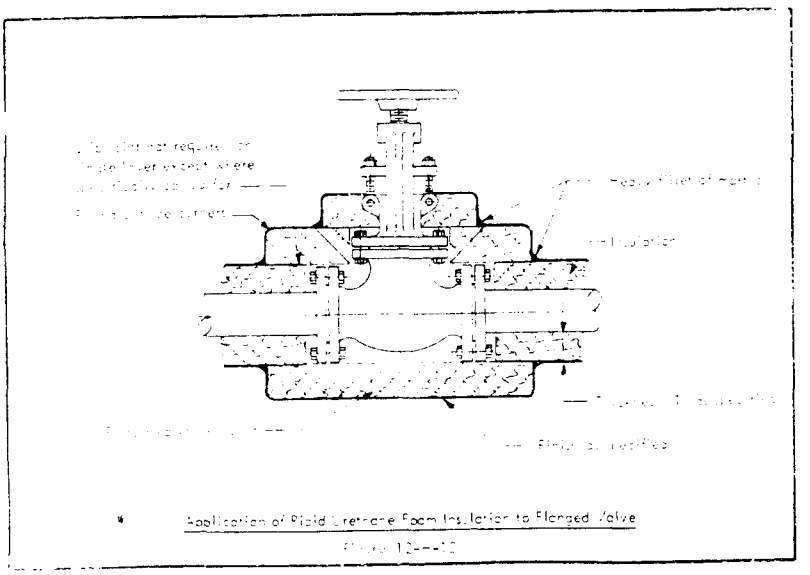
2) With exception of ball and plug valves, all fittings over three inch NPS shall be insulated with covers prefabricated in accordance with ASTM Recommended Practice C-450, latest revision. Installation of typical covers are shown in Figures 12-H-10, 12-H-11, and 12-H-12.

3) Ball and plug valve covers shall be field fabricated of proper sized pipe covering.

4) All valves shall be packed and filled around valve stem and packing gland assembly with heat resistant sealer to eliminate water pockets.

5) Special welded carbon steel or stainless steel flanged fittings shall not be insulated with [illegible] cement. These shall be insulated with [illegible]. The insulating cement shall be used with [illegible] covering stainless steel [illegible] cement.

6) Connecting flange assemblies shall be done with contact adhesive.

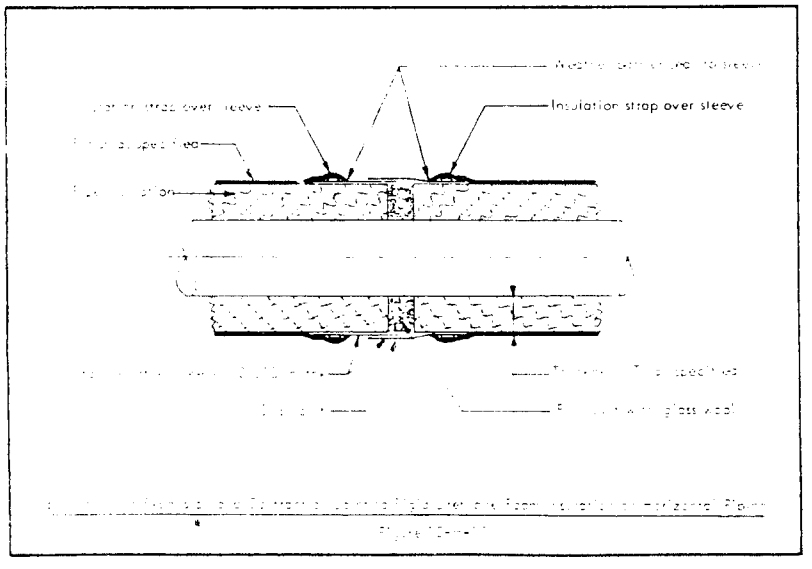


Application of Rigid Urethane Foam Insulation to Flanged Valve

Figure 12-H-12

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SECTION B - APPLICATION - cont'd



THERMAL INSULATION APPLICATION SPECIFICATIONS

PREFORMED FLEXIBLE PLASTIC FOAM

SCOPE

These specifications cover the essential requirements for application of preformed flexible plastic foam insulation for use on equipment, piping, and duct work handling or operating at temperatures from 32 F up to and including 180 F. It is applicable to both indoor and outdoor service.

SECTION A - MATERIALS

INSULATION MATERIAL

Insulation shall be as specified in MATERIAL SPECIFICATION 14.

ACCESSORY MATERIALS

All accessory materials shall be as specified in the MATERIAL SPECIFICATIONS, article numbers as listed:

Contact Adhesive, Standard	VII.A.65
Contact Adhesive, High Temperature	VII.A.66
Vapor Barrier Coating	VII.A.67
Finish Coating	VII.A.68
Vapor Barrier Coating, Fire Retardant, as specified	VII.A.69
Tape	VII.A.89
Vapor-Barrier or Metric Jacket as specified	VII.B.1.a

SECTION B - APPLICATION

1. SURFACE PREPARATION

a. Outer surfaces of carbon steel equipment and ductwork shall be sandblasted and coated with zinc silicate inorganic coating, in accordance with the Union Carbide Corporation Design and Construction Coatings Manual, prior to application of insulation.

b. Outer surfaces of aluminum, copper, or galvanized steel equipment and ductwork shall be cleaned of all dirt, grease, oil, and other contaminants prior to application of insulation.

2. TEMPERATURE LIMITATIONS

a. Insulation shall not be applied at ambient temperatures above 32 F.

b. Temperature limitations of contact adhesives are as follows:

1. Standard, 150 F
2. High Temperature, 180 F

3. APPLICATION PROCEDURES

a. Size of Sheets. Sheets of preformed flexible plastic foam insulation for vessels and ductwork shall be cut slightly oversize so that they must be compressed to fit for a butt joint.

b. Contact Adhesives. Standard or high temperature contact adhesive, as required, shall be applied over the entire surface to be insulated, as well as to the [illegible] side of insulation, sufficiently in advance of installation of sheet to allow the adhesive to dry to a nontacky state. At temperatures from 32 F to 40 F the drying time is much longer than at temperatures above 40 F.

c. Equipment

1. Begin application at bottom of vessel so that it overlaps the edges of the previously installed sheet, or sheets, by 1 8 inch. While rolling the sheet into place, start applying it at the center to the surface of the vessel, then work outward to avoid trapping air between the insulation and the surface. Compress the insulation into place to achieve a tight joint, then spread the joint and, by means of a small brush, apply sufficient adhesive to the joint edges to form a fillet. Press sheets and joints firmly into place with a small hand roller.

2. Where a double layer of insulation is required, the outer surface of the inner layer and the inner surface of the outer layer shall be coated with standard contact adhesive and the adhesive allowed to dry as specified in Subsection b above. The outer layer shall then be applied in the manner specified in Paragraph 1 above, in staggered joint construction.

3. [illegible] insulation termination shall be sealed with flexible sealer.

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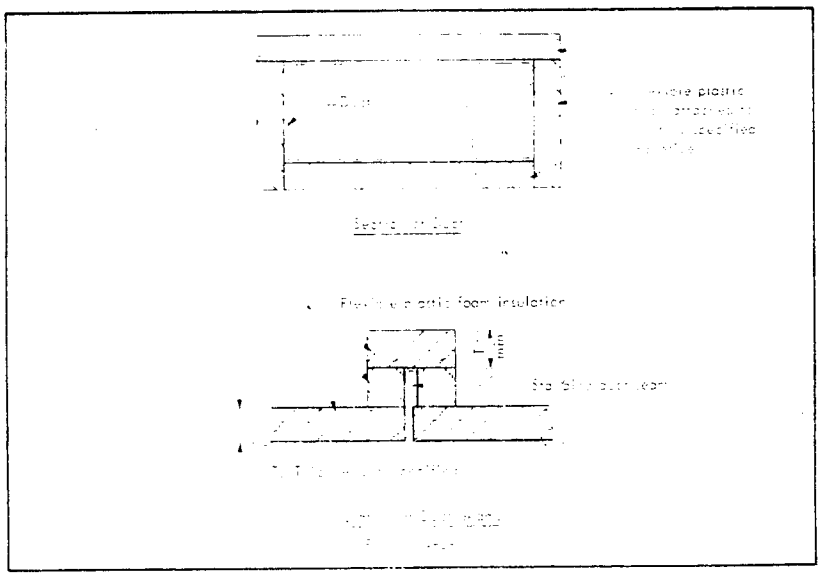
SECTION 3 - APPLICATION - cont'd

APPLICATION PROCEDURE - cont'd

[illegible]

1. Circular ducts shall be insulated with a continuous sheet about the duct perimeter with the seam on the bottom of horizontal ducts and on the [illegible] of vertical ducts. Application shall be as specified for [illegible] ducts.

2. Insulation for ducts and rectangular duct shall be applied first to the bottom surface, nearly filling the width of the duct. The side and top insulation shall overlap the insulation extending from the bottom, shall cover the edges of the bottom insulation. Insulation shall then be applied to the side surfaces of the duct, and shall extend over the bottom edges of the insulation on the sides. Application shall be as specified for [illegible] ducts. Insulation over reinforcing duct liner shall be of the same thickness as that applied to the surfaces. Details are shown in the following figure.



[illegible]

1. Cylindrical [illegible] Insulation

a. [illegible] insulation shall be applied [illegible] and shall extend [illegible] to completely seal off all insulation over the ends of the [illegible] insulation. Ends shall be closed with [illegible] to prevent moisture from entering the insulation.

b. Flexible insulation shall be [illegible] from the [illegible] and clamp it in the position during erection. After [illegible] the [illegible] and bands, the [illegible] shall be [illegible].

2. [illegible] Cylindrical Insulation

a. [illegible] shall be applied [illegible] and shall extend [illegible] to completely seal off all insulation over the ends of the [illegible] insulation. Ends shall be closed with [illegible] to prevent moisture from entering the insulation.

b. [illegible] shall be applied [illegible] and shall extend [illegible] to completely seal off all insulation over the ends of the [illegible] insulation. Ends shall be closed with [illegible] to prevent moisture from entering the insulation.

c. Flexible insulation shall be [illegible] from the [illegible] and clamp it in the position during erection. After [illegible] the [illegible] and bands, the [illegible] shall be [illegible].

3. [illegible] Cylindrical Insulation

a. [illegible] shall be applied [illegible] and shall extend [illegible] to completely seal off all insulation over the ends of the [illegible] insulation. Ends shall be closed with [illegible] to prevent moisture from entering the insulation.

b. [illegible] shall be applied [illegible] and shall extend [illegible] to completely seal off all insulation over the ends of the [illegible] insulation. Ends shall be closed with [illegible] to prevent moisture from entering the insulation.

c. Flexible insulation shall be [illegible] from the [illegible] and clamp it in the position during erection. After [illegible] the [illegible] and bands, the [illegible] shall be [illegible].

SECTION B - APPLICATION - cont'd

B. APPLICATION PROCEDURES - cont'd

1. Piping - cont'd

f. Supports and Hangers

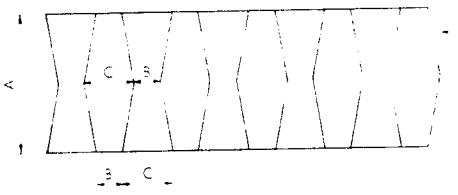
(2) Where horizontal piping is supported on the surface of the insulation, by means of [illegible] shown on Owner's Standard P-82, rigid plastic foam closed cell insulation shall be installed between the cradle and the pipe. This insulation shall be of sufficient length to extend beyond both ends of the cradle. Seams shall be adhered with standard contact adhesive as specified in Paragraph (2), [illegible] except that two coats of adhesive shall be applied to the seam surfaces. The first coat shall be allowed to dry to touch before the second coat is applied.

g. Where hangers are attached directly to the pipe, the pipe projecting through the [illegible] shall be insulated for a distance of [illegible]

i. Fitting, Flange and Valve Covers

(1) Fitting, flange, and valve covers which can be produced from pipe insulation shall be prefabricated in accordance with ASTM Recommended Practice C 450, latest revision, using contact adhesive for fabricating the joints.

(2) Fitting, flange, and valve covers for piping larger than 8-inch NPS shall be formed from sheet insulation cut and formed to fit, and adhered to the fittings with contact adhesive. Dimensions for cutting sheet insulation for [illegible] degree long and short radius elbows are shown in Figure 14-J-2.



Dimension A is a variable measure of the elbow's [illegible]

TABLE FOR DIMENSIONS B AND C

Nominal Pipe Size	Number of Segments	Long Radius 90° ELL B, In.	Long Radius 90° ELL C, In.	Short Rad. 90° ELL B, In.	Short Rad. 90° ELL C, In.
6	3	2-5 32	5-21 32	29 32	4-1 16
	4	1-19 32	4-1 4	1 2	3-5 16
8	3	2-21 32	6-27, 32	1-5 32	5-13, 32
	4	2	5-5 32	13 16	3-27 32
	5	1-6 16	3-7 16	5 16	2-19 32
	6	13 16	2-5 16	13 32	1-31 32
8	5	1-13 16	4-1 2	13 16	3-13 32
	6	13 16	2-5 16	13 32	2-13 32
10	5	2-11 32	5-19 32	1-1 16	4-1 4
	6	1-3 4	4-3 32	13 16	3-3 16
12	5	2-27 32	6-13 32	1-3 4	5-1 16
	6	2-3 32	4-21 32	1	3-3 16
16	5	3	6-13 32	1-29 32	6-1 2
	6	2-13 32	5-5 32	1-13 32	4-27 32
18	5	3-13 32	7-3 16	2-5 32	5-1 4
	6	2-11 16	5-13 16	1-13 32	3-7 16
20	5	3-3 4	8	2-13 32	6-1 16
	6	3	6-13 32	1-13 16	4-1 16
24	5	3-13 16	9-1 32	2-13 32	6-21 32
	6	3-21 32	7-13 16	2-13 16	4-1 4

[illegible] Flexible Foamed Plastic Sheet

Figure 14-J-2

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SECTION 3 - APPLICATION - contd

APPLICATION PROCEDURES - contd

A. Piping - contd

B. Fitting, Flange, and Valve Covers - contd

3. Seams of fitting covers and joints between fitting covers and pipe insulation shall either be adhered with contact adhesive as specified in Paragraph (2) above of this subsection, or sealed with two layers of tape.

4. Exposed edges of cut insulation, lines of termination, and irregular surfaces shall be coated and protected from vapor with flexible sealer.

C. FINISH AND WEATHER BARRIERS

1. Concealed Piping and Ductwork. Concealed piping and ductwork in buildings shall neither be finished nor protected with weather barrier.

2. Equipment, Piping, and Ductwork Indoors - Exposed to View

a. Equipment shall be finished with two coats of vinyl finish (color as specified).

b. Piping and ductwork exposed where they are subject to mechanical abuse or washing down with water shall be finished with two coats of vinyl finish (color as specified).

c. Piping and ductwork exposed to view shall be finished with two coats of PVA finish coating (color as specified).

3. Outdoor Equipment, Piping and Ductwork. All equipment, piping, and ductwork located outdoors shall be protected with weather-barrier mastic finish coat as specified in GENERAL SPECIFICATIONS, Article XI/.A and B.

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THERMAL INSULATION APPLICATION SPECIFICATIONS

PREFORMED FIBROUS GLASS

High Density (Over 10 lb per cu ft

SCOPE

This specification describes the essential requirements for application of preformed fibrous glass insulation for use on equipment and piping normally operating at temperatures from 70 F up to and including 750 F. It is applicable to both indoor and outdoor service.

Procedures described in the GENERAL SPECIFICATIONS are applicable to and constitute an integral part of this specification.

SECTION A - MATERIALS

1. INSULATION MATERIAL

Insulation material shall be as specified in MATERIAL SPECIFICATION 15.

2. ACCESSORY MATERIALS

Accessory materials shall be as specified in the MATERIAL SPECIFICATIONS, article numbers as listed.

Reinforcing Blanket	VII.A. 1	Pin Clips	VII.A. 23
Insulating Cement	VII.A. 6	Heat-Resistant Sealer	VII.A. 25
Pipe Insulation Screen	VII.A. 9	Mastic	VII.A. 26
Expansion Sleeves	VII.A.10	Glass Cloth Jacket	VII.A. 27
Equipment Insulation Strap	VII.A.11	High Temperature Fabricating Cement	VII.A. 28
Clips for Equipment Straps	VII.A.12	Bonding Adhesive	VII.A. 29
Pipe Insulation Strap	VII.A.13	Glass Wool Metal Mesh Blanket	VII.A. 30
Clips for Pipe Straps	VII.A.14	PVA Finish Coating and Lagging Adhesive	VII.A. 31
Stainless Steel Wire	VII.A.17	Weather-Barrier Mastic (color as specified)	VII.B. 1
Welding Pins	VII.A.19	Reinforcing Cloth	VII.B. 2
Stainless Steel Pins	VII.A.20	Stainless Steel Weather Barrier (Designation MI	VII.B.2
Stainless Steel Fasteners	VII.A.21	Treated Steel Weather Barrier (Designation MT	VII.B.3
Welding Pin Insulation Fasteners	VII.A.22		

SECTION B - APPLICATION

1. EQUIPMENT

a. Insulation Supports. Equipment shall be provided with insulation supports as specified in Part II of the GENERAL SPECIFICATIONS.

b. Thickness Exceeding. Unless otherwise specified, insulation in excess of three inches total thickness shall be applied in multiple layers as specified in Article III.B of the MATERIAL SPECIFICATIONS.

c. Curved Surfaces

(1) On cylindrical equipment larger than 30 inches in diameter, preformed fibrous glass block insulation shall be shop fabricated to curved segments to fit vessel surface, and applied to vessel sides in staggered position.

(2) On cylindrical equipment 30 inches and smaller in diameter, preformed fibrous glass pipe insulation, of the size required to fit the vessel, may be applied in rings. See Part 2, Piping, of this section.

(3) Preformed fibrous glass block insulation for vessel heads shall be shop fabricated to fit the contour of the head.

(4) Block insulation shall be applied with all joints tight, butted. Multiple layers shall be applied so that the butt joints of one layer do not coincide with those of any other layer.

d. Flat Surfaces

(1) Block insulation shall be applied to flat surfaces in staggered position with all joints tight, butted. Multiple layers shall be applied so that no butt joints of the layer do not coincide with those of any other layer.

(2) Voids and fastener depressions in insulation shall be pointed up with insulating cement troweled flush with the surface.

e. Flanges. Manhole flanges, piping flanges, and vessel flanges shall be insulated unless otherwise specified.

f. Insulation

(1) Curved Surfaces

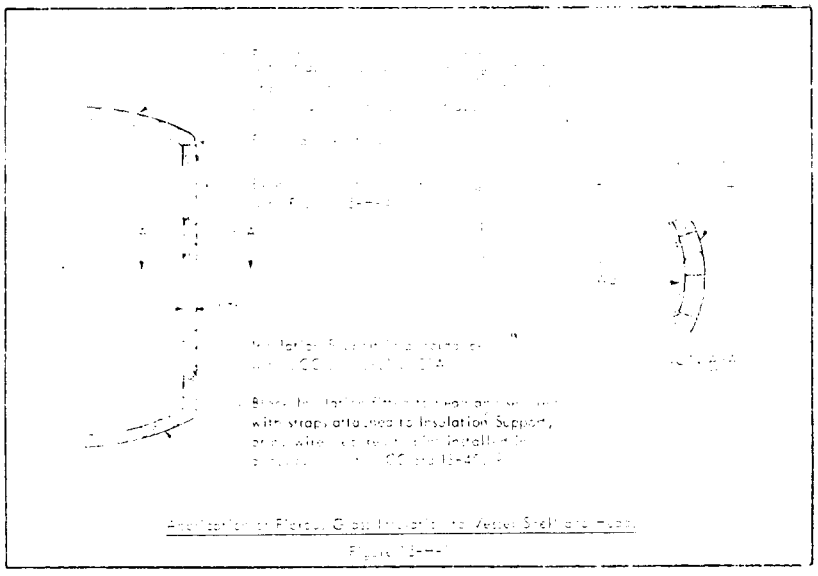
(a) Upon erection of vessel, with final and effective attachment, all layers of preformed fibrous glass insulation shall be secured in place with equipment insulation straps. Where required, insulation straps shall be attached to strap anchor angles in accordance with Owner's

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SECTION B - APPLICATION - cont'd

[illegible]

Insulation applied to irregular surfaces, where use of strap is impracticable, shall be secured with stainless steel wire [illegible] stainless steel, drawn taut, and ends twisted together and pressed into insulation. Typical installation is shown in Figure 15-H-1.



Application of Flexible Glass Insulation to Vessel Shell and Heads
Figure 15-H-1

[illegible] insulation on bottom heads of vertical equipment or heads of horizontal equipment shall be held in place with [illegible] insulation straps secured to insulation supports as shown in Owner's Standards 15-31, 15-3c, and 15-42. Insulation on heads of [illegible] diameter vessels over 12'-0" OD, where use of strap is impracticable, shall be secured by wire attached to welding pins in accordance with Owner's Standard 15-40 and as shown in Figure 15-H-2.

[illegible]

A layer of preformed fibrous glass insulation shall be secured with welding pin insulation fasteners and pin clips, spaced so as to provide [illegible] attachments per square, as shown in Figure 15-H-3.

Pins shall be pressed into insulation sufficiently to allow pins to be cut off below insulation surface.

Insulation Supports. A support shall be provided at each insulation support except the bottom support on vertical vessels and at each insulation support on horizontal vessels. Typical installation is shown in Figure 15-H-4.

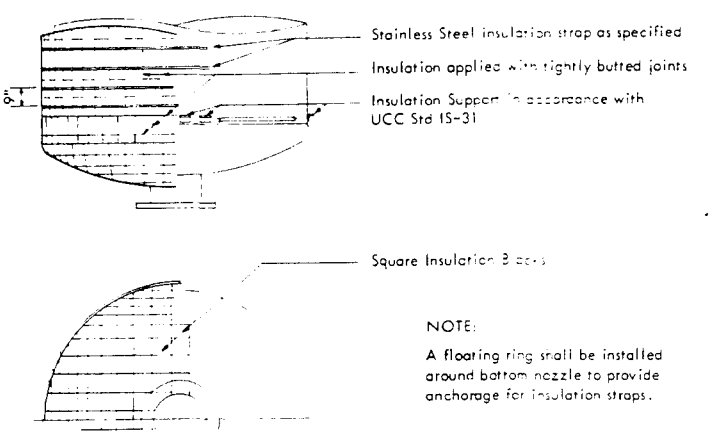
Expansion Joints. Expansion joints in structures or cylindrical vessels shall be insulated with flexible blanket insulation. Preformed pipe insulation of equivalent thickness shall be applied to expansion joints and compressed to specified thickness so as to obtain maximum [illegible] as shown in Figure 15-H-5.

Mechanical Expansion Joints. Corrugated mechanical expansion joints in piping usually listed as equipment items shall be insulated as shown in [illegible] Insulation shall be provided by applying an 18-inch long sleeve of 0.010-inch thick stainless steel over the pipe insulation [illegible] pipe insulation with the butt end of the pipe covering. The sleeve shall be secured with strap at one end only, [illegible] sleeve. It shall be of 0.010-inch thickness for pipe sizes up to 10" and of 0.015-inch thickness for pipe sizes 12" and larger. The sleeve shall extend over the metal jacket and shall be placed so as to shed water. Weather-barrier mastic shall be applied over the sleeve and on the pipe insulation at each end and shall be placed so as to shed water. Weather-barrier mastic shall overlap the [illegible] insulation.

[illegible] the expansion joint cover and the expansion joint cover secured fastened to the

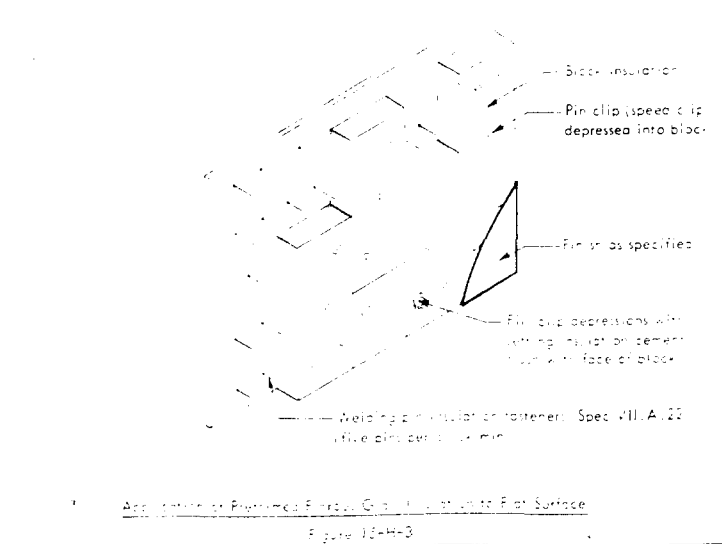
SECTION B - APPLICATION - cont'd

1. EQUIPMENT - cont'd



Securement of Fibrous Glass Insulation to Bottom Vessel Head

Figure 15-H-2



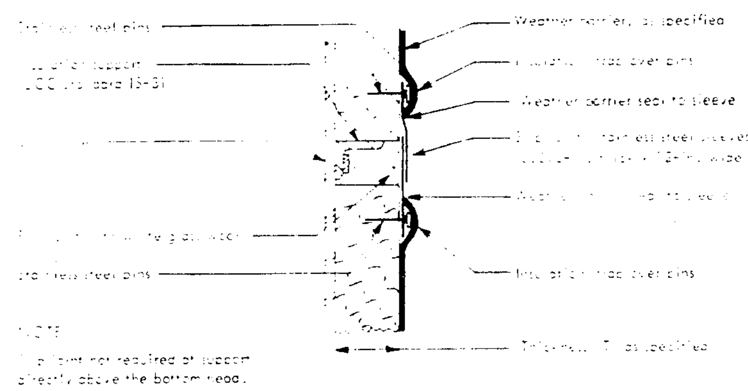
Application of Pinned Fibrous Glass Insulation to Flat Surface

Figure 15-H-3

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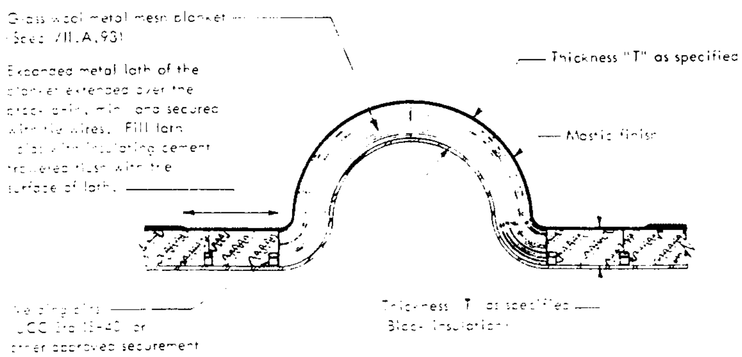
SECTION 3 - APPLICATION - contd

EQUIPMENT - contd



Application of Slip Joint to Vessel Wall at Insulation Support

Figure 15-H-4

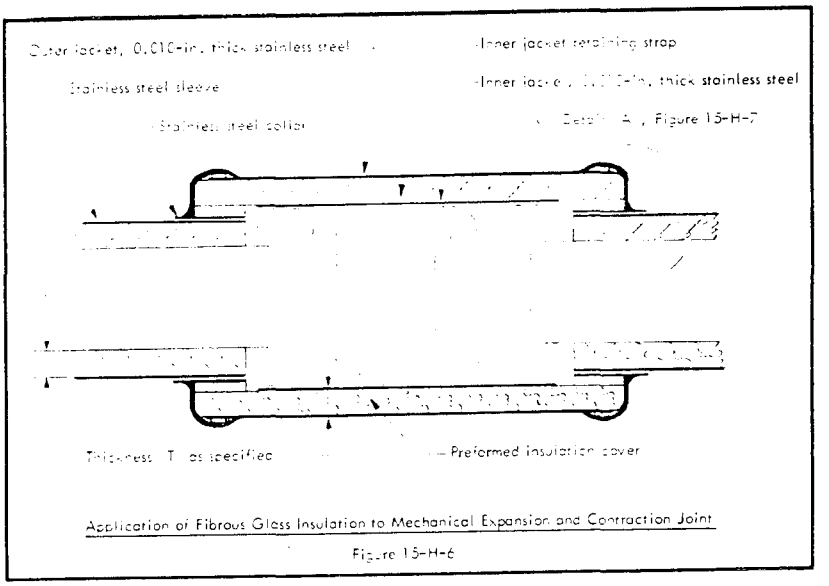


Application of Blanket Insulation to Expansion Joints on Flat Surface

Figure 15-H-5

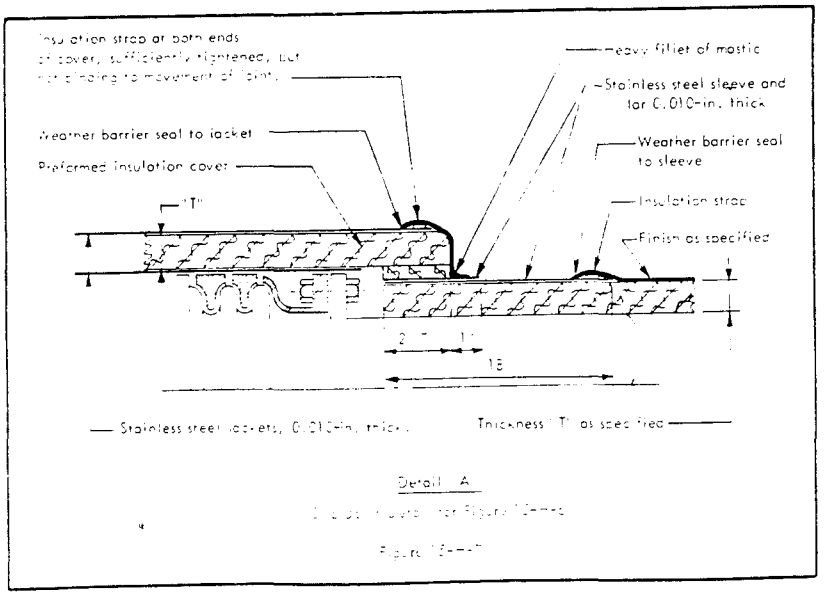
SECTION 3 - APPLICATION - cont'd

3.1 EQUIPMENT - cont'd



Application of Fibrous Glass Insulation to Mechanical Expansion and Contraction Joint

Figure 15-H-6



Detail A

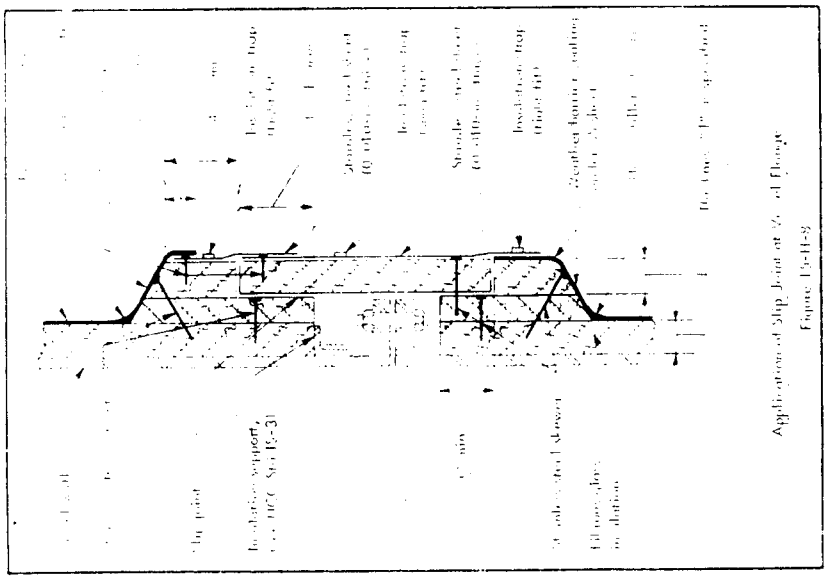
[illegible] for Figure [illegible]

Figure [illegible]

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SECTION 6 - APPLICATION - [illegible]

[illegible] of profile specifies, all [illegible] shall be insulated with preformed fibrous glass block insulation and the [illegible] stainless steel bands. All [illegible] shall be provided with a [illegible] above vessel flange. Assembly [illegible] sheet metal [illegible] weathertight [illegible]. Typical installation is shown in [illegible].



[illegible] vessel flanges are [illegible] outdoors and uninsulated, the reinforcing cloth of the weather barrier on the adjacent [illegible] shall be metal or wood [illegible] with heat resistant sealer and bonded with sealer is still tacky. A [illegible] applied over the reinforcing cloth and securement. Typical installation is [illegible] Figure 15-H-5.

[illegible] with [illegible] as detailed in Figure 15-H-10.

[illegible] shall be insulated as specified in Article V.C of the GENERAL SPECIFICATIONS.

[illegible] insulated with glass which shall extend over [illegible] flanges and down channel legs to fireproofing. Insulation shall be [illegible] for ease of [illegible].

[illegible] shall be insulated [illegible] between [illegible] flanges and over channel [illegible] Insulation shall be as shown in Figure 15-H-11.

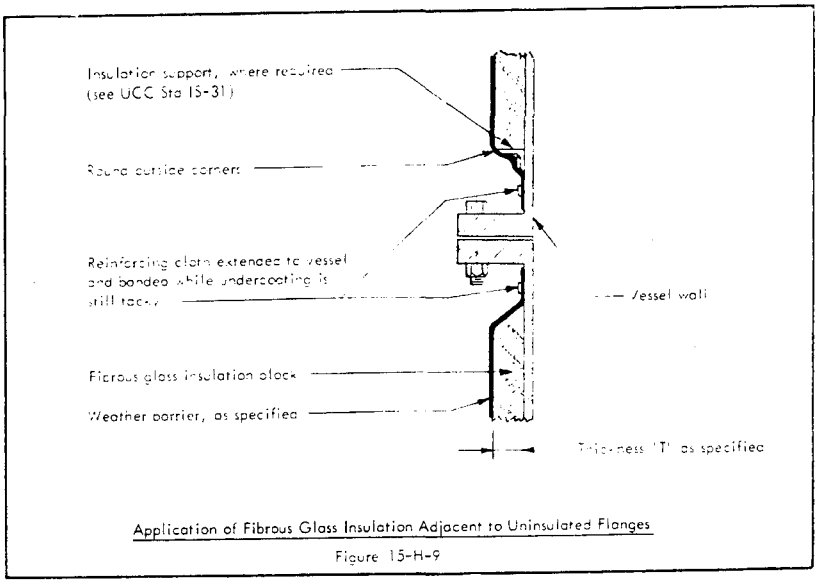
[illegible] shall be insulated [illegible] insulation shall extend outward from junction of [illegible] specified, entire surface of [illegible] specified, [illegible] heater. Where specified, entire surface of [illegible] shall be insulated [illegible] provided for bottom head [illegible] Figure 15-H-12.

[illegible] as specified in Article XIII of the GENERAL SPECIFICATIONS.

[illegible] and openings shall be filled with insulating cement

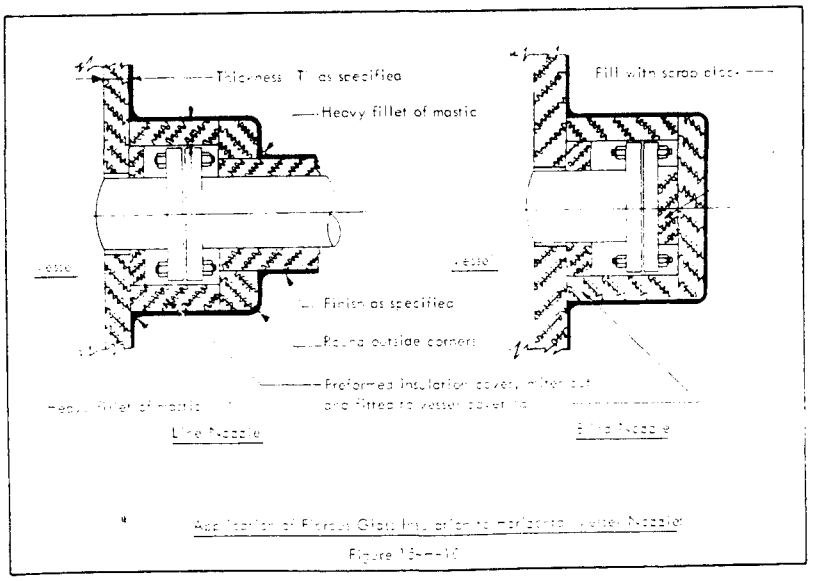
SECTION 3 - APPLICATION - cont'd

3. EQUIPMENT - cont'd



Application of Fibrous Glass Insulation Adjacent to Uninsulated Flanges

Figure 15-H-9



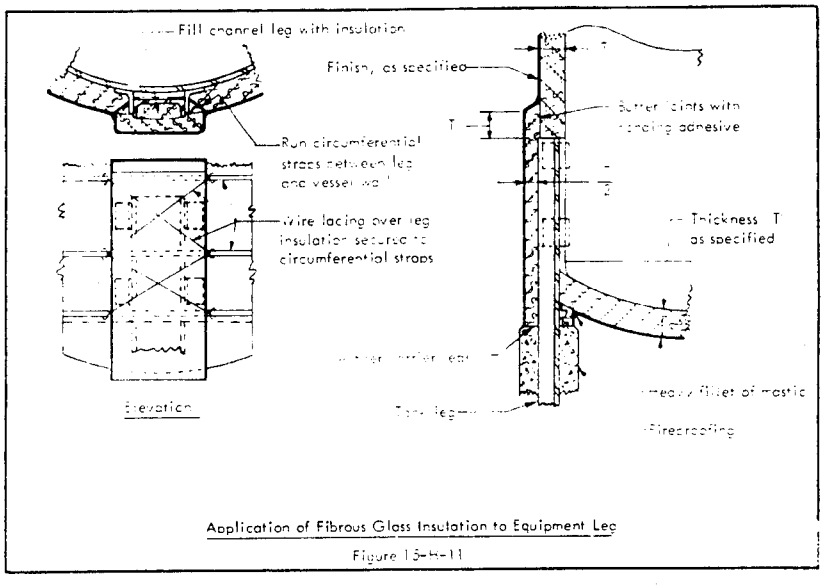
Application of Fibrous Glass Insulation Adjacent to Refractory Lined Nozzle

Figure 15-H-10

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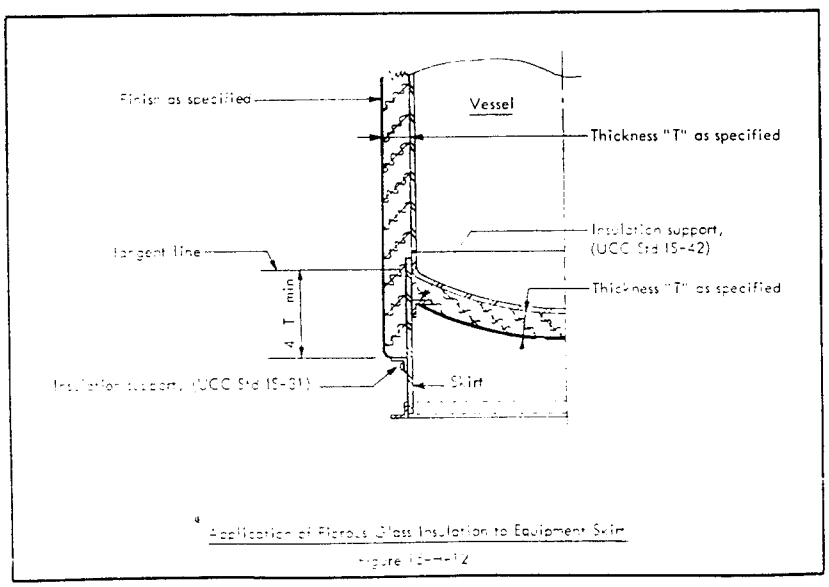
SECTION B - APPLICATION - contd

EQUIPMENT - contd



Application of Fibrous Glass Insulation to Equipment Leg

Figure 15-H-11



Application of Fibrous Glass Insulation to Equipment Skirt

Figure 15-H-12

SECTION B - APPLICATION - cont'd

1. EQUIPMENT - cont'd

B. Weather Barrier and Jacketing

(1) Outdoor Equipment

(a) Cylindrical Equipment. Weather-barrier coating or jacket shall be applied as specified in Articles XIV.B and XV.B, respectively, of the GENERAL SPECIFICATIONS.

(c) Flat Surfaces and Heads of Equipment. Weather-barrier coating shall be applied as specified in Article XIV.B of the GENERAL SPECIFICATIONS.

(2) Indoor Equipment. The specified glass cloth jacket shall be adhered with uniform tautness to the surface of the insulation with adequate adhesive. All joints shall be overlapped a minimum of two inches. After adhesive has dried, the entire surface shall be coated with P/A [illegible] specified color as specified to present a uniform color and surface texture.

2. PIPING

A. Pipe Insulation

(1) Pipe insulation shall be supported and secured as specified in Part III of the GENERAL SPECIFICATIONS.

(2) Insulation in excess of 3 inches total thickness shall be applied in multiple layers as specified in Article III.E of the MATERIAL SPECIFICATIONS.

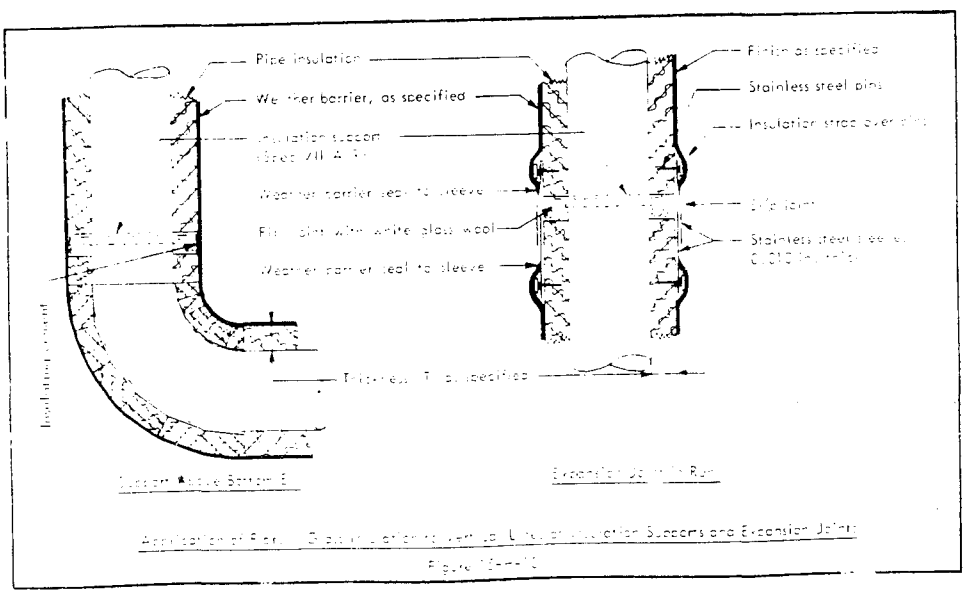
(3) Pipe insulation shall be applied to piping in staggered position in accordance with Figure GA-1 and GA-2 of the GENERAL SPECIFICATIONS.

(4) Insulation shall be applied with all joints tightly butted and fitted to eliminate voids. Large voids shall not be filled with weather-barrier mastic, but eliminated by either refitting or replacing insulation. Any rounded corners on the insulation surfaces to be butted shall be trued prior to application.

B. Vertical Pipe

(1) Insulation on 4-inch NPS and larger pipe extending more than 15 feet above bottom elbow shall be supported by a pipe insulation support located directly above the elbow. Typical installation is shown in Figure 15-H-13. A pipe insulation support shall also be installed above each pair of flanges or flanged valve in vertical pipe.

(2) When pipe extends more than 15 feet above pipe insulation supports located directly above elbows, flanges or flanged valves, additional supports shall be installed on approximately 15-foot centers to provide for installation of an expansion joint as shown in Figure 15-H-13.



Application of Pipe Insulation Weather Barrier, Insulation Supports and Expansion Joints

Figure 15-H-13

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SECTION B - APPLICATION - contd

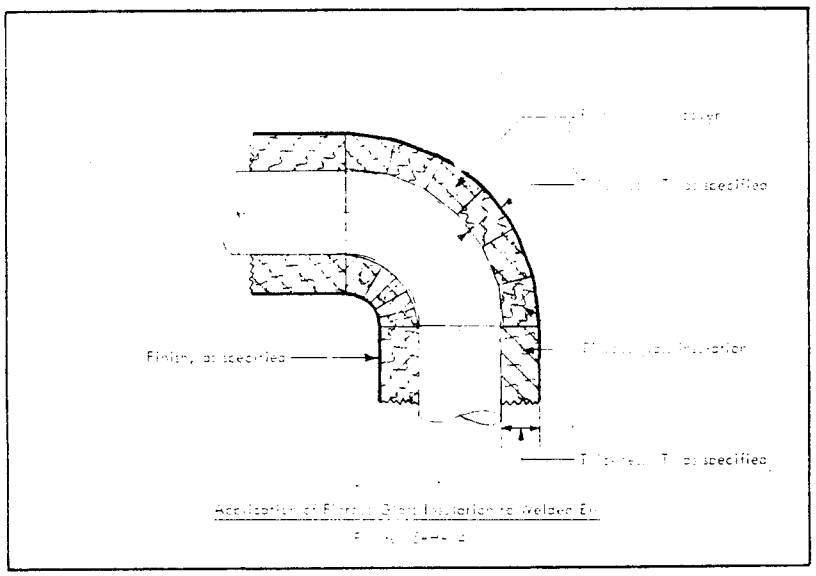
PART D - contd

Fittings, Flanges, and Valve Covers

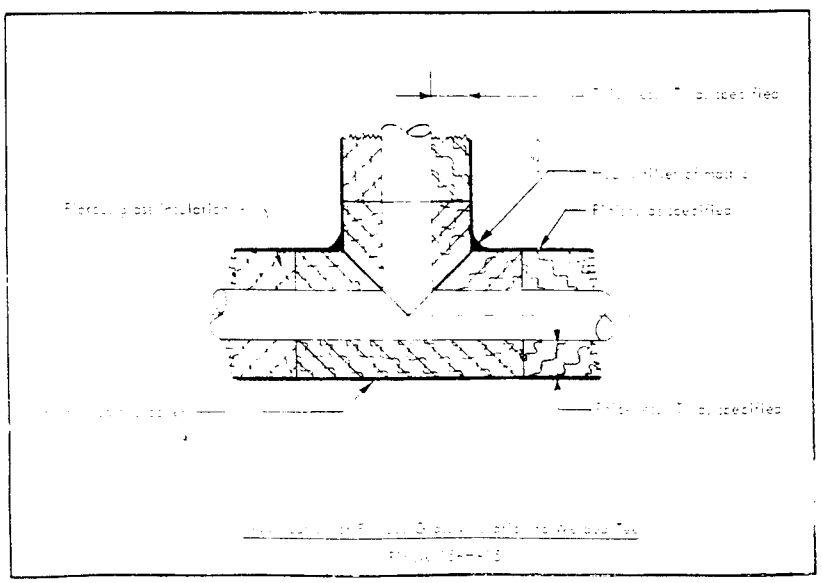
A. Fittings, flanges, and valves in one-inch NPS and smaller piping shall be insulated with insulating cement.

B. With exception of gate and plug valves, all fittings, flanges, and valves over three-inch NPS shall be insulated with covers prefabricated in accordance with ASTM Recommended Practice C 450, latest revision.

C. Gate and plug valve covers shall be field fabricated of proper sized pipe covering.



Application of Fitting Insulation to Welded Fitting



Union Carbide trial exhibit UC-4586: W. G. Hammar Transmittal Memoranda and Union Carbide Thermal Insulati…
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SECTION B - APPLICATION - contd

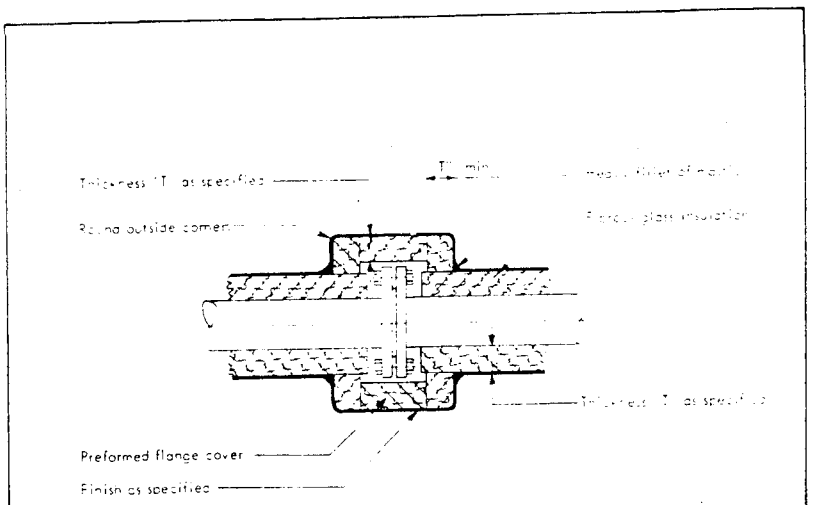
2. PIPING - contd

c. Fitting, Flange, and Valve Covers - contd

4) Screwed and welded fitting covers for three-inch IPS and smaller piping may be field fabricated

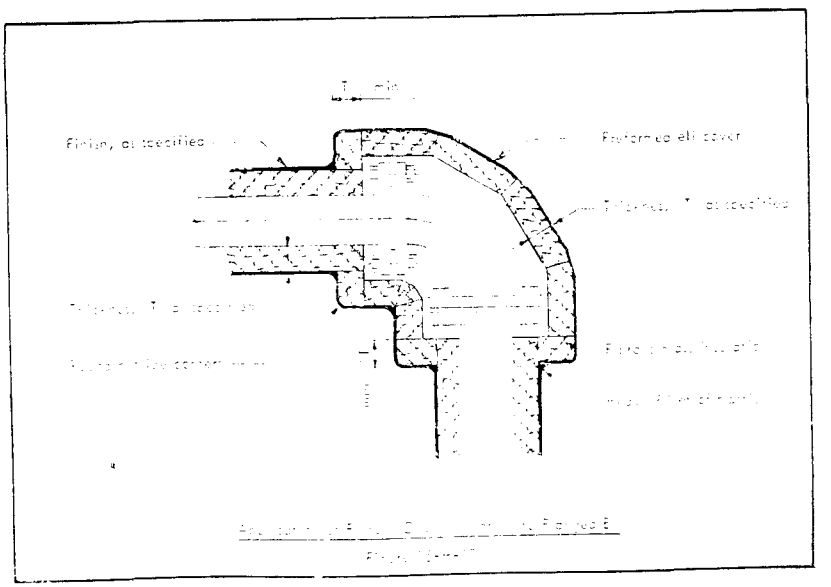
5) All valves shall be packed and filled around valve stem and packing gland assembly with [illegible] water-resistant sealer to eliminate water pockets

6) Cementing of shop assemblies shall be done with fabricating cement. In all cases the joints shall be as thin as possible with just sufficient cement to obtain good adhesion and complete closure. In no case will wide cement joints, or voids and holes plugged with cement, be permitted



Application of Fiberglass Insulation to Line Flange

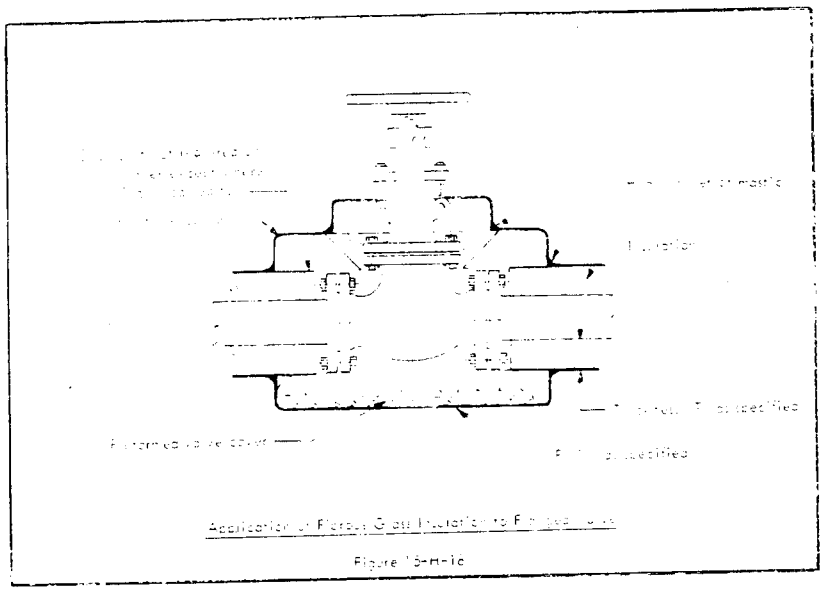
Figure 15-H-16



SECTION B - APPLICATION - contd

[illegible] - contd

[illegible] Figures and Tables Cover - contd

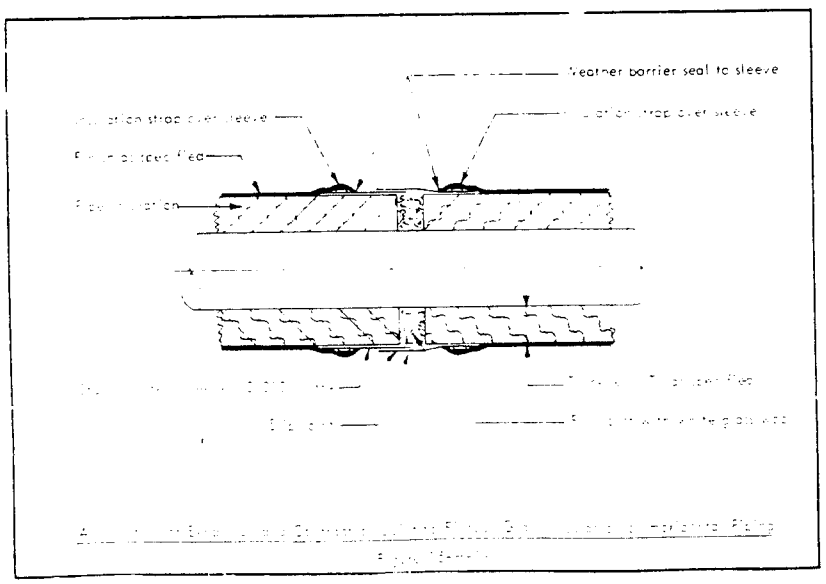


Application of Fiberglass Insulation to Flanged Joints

Figure 15-H-1c

[illegible] Expansion and Contraction Joints

[illegible] Expansion and contraction joints shall be provided in the insulation on 4-inch NPS and larger horizontal piping. An expansion and contraction joint shall be installed in each 21 feet of straight pipe not interrupted by flanges, valves, or fittings, and insulated with multiple layer insulation [illegible] 42 feet insulated with single layer insulation. Typical installation is shown in Figure 15-H-1d. Where flanged fittings or valves occur [illegible] intervals, expansion and contraction shall be provided for in the flange cover, and expansion and contraction joints in the pipe insulation shall be required.



[illegible]

SECTION B - APPLICATION - cont'd

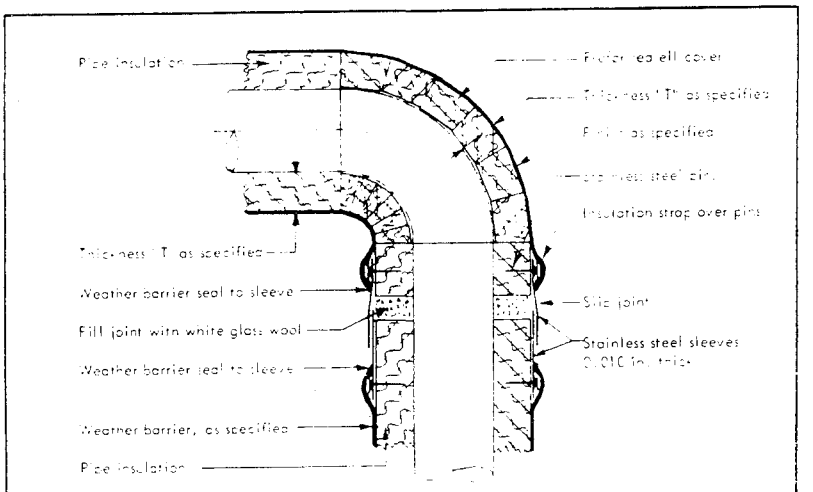
C. PIPING - cont'd

a. Expansion and Contraction Joints - cont'd

(2) If an expansion or contraction crack occurs after a line has been put in service, the crack shall be filled with white glass wool, and an expansion and contraction joint shall be installed at that location.

(3) Expansion slip joints shall be installed at the insulation support in vertical piping as shown in Figure 15-H-13.

(4) Expansion joints shall also be provided at the junction of fitting covers and pipe insulation located at the tops of risers where riser expansion is flow-limiting and the size is 4-inch NPS and larger. Typical installation is shown in Figure 15-H-20.



Application of Fiberglas Pipe Insulation to Weld End Elbow with Slip Joint at Top of Vertical Line

Figure 15-H-20

e. Traced Installations. Tracing and insulation on traced lines shall be installed as specified in Article XIII of the GENERAL SPECIFICATIONS.

f. Surface Finish. When insulation of the specified thickness has been applied, all small cracks and depressions shall be filled with finishing cement and troweled flush with the surface.

g. Weather Barrier and Jacketing

(1) Outdoor Piping. Weather-barrier coating or jacket, whichever is called for, shall be applied as specified in Articles XIII.B and XIII.C, respectively, of the GENERAL SPECIFICATIONS. Mastic weather barrier shall be used unless metal jacket is called for at the start.

(a) Weather barrier consisting of stainless steel jacketing, where required, shall be called for by the addition of the letter M to the specification designation, thus 15-HM.

(b) Weather barrier consisting of treated steel jacketing, where required, shall be called for by the addition of the letters MT to the specification designation, thus 15-HMT.

(2) Indoor Piping

(a) Fiberglas pipe insulation jacket shall be covered with uniform coating to the surface of the insulation with bonding adhesive. After this coating has been applied, the entire surface shall be coated with P.V.A. finish coating, color as specified, to present a uniform color and surface texture.

(b) Flanges, and valve covers shall be coated with weather-barrier coating as specified in Article XIII.B of the GENERAL SPECIFICATIONS.

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THERMAL INSULATION APPLICATION SPECIFICATIONS

PREFORMED FIBROUS GLASS

High Density (over 10 lb per cu ft)

SCOPE

This specification describes the essential requirements for application of preformed fibrous glass insulation for use on equipment and piping normally operating at temperatures from minus 20 F up to and including 100 F. It is applicable to both indoor and outdoor service.

Procedures described in the GENERAL SPECIFICATIONS are applicable to and constitute an integral part of this specification.

SECTION A - MATERIALS

A. INSULATION MATERIAL

The preformed fibrous glass insulation shall be as specified in MATERIAL SPECIFICATION 15-[illegible].

B. ACCESSORY MATERIALS

All accessory materials shall be as specified in the MATERIAL SPECIFICATIONS, article numbers as listed:

Glass Cloth Jacket	VII.A.[illegible]	White Vapor-Barrier Adhesive	VII.A.[illegible]
Insulating Cement	VII.A.[illegible]	Laminated Vapor-Barrier Jacket	VII.A.[illegible]
Pipe Insulation Support	VII.A.[illegible]	Curved Wood Block Insulation Supports	VII.A.[illegible]
Expansion Sleeve	VII.A.10	Non-Setting Sealer	VII.A.[illegible]
Equipment Insulation Strap	VII.A.11	Bonding Adhesive	VII.A.[illegible]
Cleats for Equipment Strap	VII.A.12	Low Temperature Fabricating Cement	VII.A.[illegible]
Pipe Insulation Strap	VII.A.13	Vapor Seal Mastic	VII.A.[illegible]
Cleats for Pipe Strap	VII.A.14	Jacket Bonding Cement	VII.A.[illegible]
Stainless Steel Wire	VII.A.15	Vapor Seal Lap Cement	VII.A.[illegible]
Welding Pins	VII.A.16	PVA Finish Coating and Lagging Adhesive	VII.A.[illegible]
Welding Pin Insulation Fasteners	VII.A.22	Reinforcing Cloth	VII.A.[illegible]
Pin Caps	VII.A.23	Weather-Barrier Mastic (color as specified)	VII.A.[illegible]
Fire-Retardant Vapor-Barrier Jacket and Butt Joint Strips	VII.A.[illegible]		

SECTION B - APPLICATION

A. EQUIPMENT

a. Insulation Supports. Equipment shall be provided with insulation supports as specified in Article II of the GENERAL SPECIFICATIONS.

b. Insulation Thickness. Unless otherwise specified, insulation in excess of 2 inches total thickness shall be applied in multiple layers as specified in Article III.B of the MATERIAL SPECIFICATIONS.

c. Curved Surfaces.

(1) On cylindrical equipment larger than 30 inches in diameter preformed fibrous glass block insulation shall be shop fabricated to curved segments to the thickness specified, and applied to vessel heads in staggered position.

2. On cylindrical equipment 30 inches and smaller in diameter preformed fibrous glass block insulation of the size required to fit the vessel heads shall be applied. See item B, Piping, of this section.

3. Preformed fibrous glass block insulation for vessel heads shall be shop fabricated to fit the contour of the head.

4. Block insulation shall be applied with all joints tight, butted. Multiple layers shall be applied so that the butt joints of each layer are staggered with those of any other layer.

d. Flat Surfaces.

1. Block insulation shall be applied to flat surfaces in staggered position with all joints tight, butted. Multiple layers shall be applied so that butt joints of each layer do not coincide with those of any other layer.

2. Voids and fastener depressions in insulation shall be pointed up with insulating cement and troweled flush with the surface.

e. Equipment

1. Head Surfaces

Insulation shall be applied to heads of vessels with firm and effective engagement of the layers of preformed fibrous glass insulation and shall be secured in place with [illegible] metal straps. Where required, insulation straps shall be attached to straps and/or angles in accordance with Owner's Standards [illegible]. Insulation applied to irregular surfaces, where use of straps is impracticable, shall be secured with stainless steel wire attached to pins [illegible] pins, drawn taut, and ends twisted together and pressed into insulation. Typical installation is shown in Figure 15-L-1.

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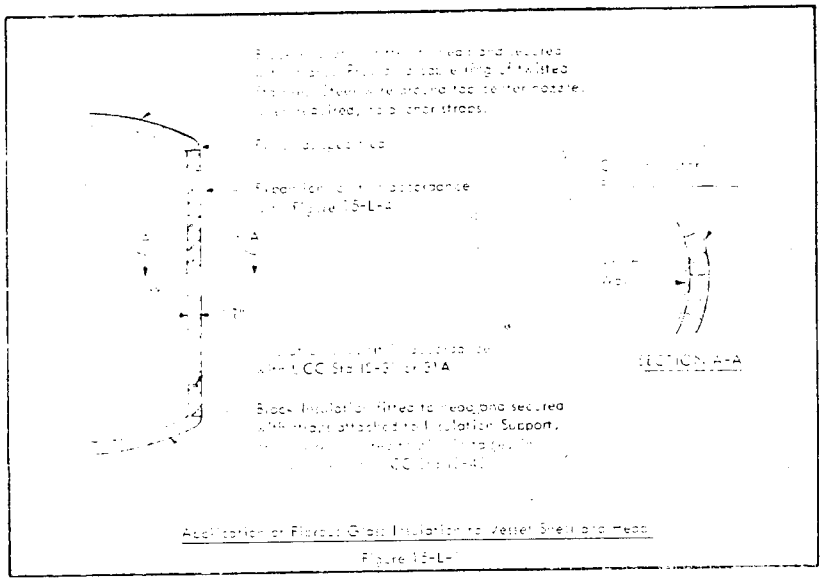
SECTION B - APPLICATION - cont'd

B.2. EQUIPMENT - cont'd

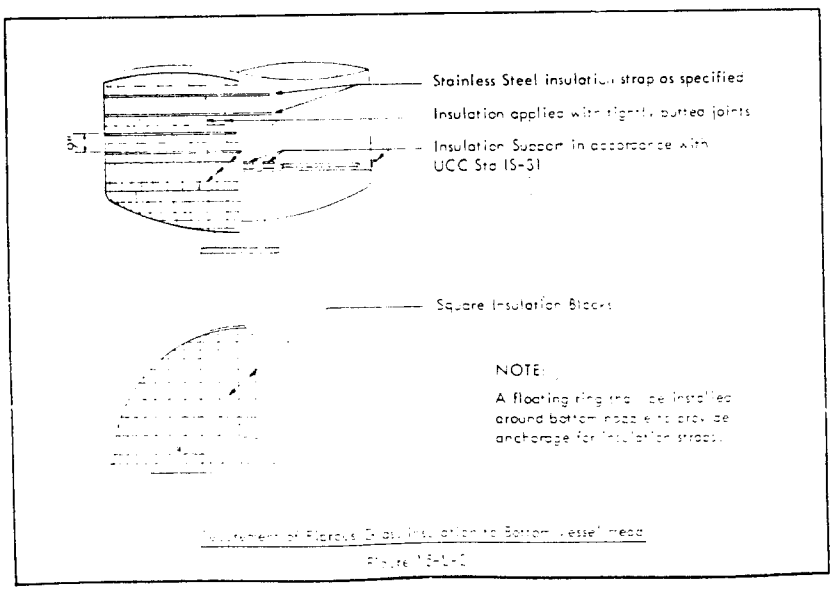
B.2.a. Instrument - cont'd

B.2.a.(1) Curved surfaces - cont'd

c. Preformed fibrous glass insulation on bottom heads of vertical equipment or heads of horizontal equipment shall be held in place with stainless steel insulation straps secured to insulation supports as shown in Owner's Standards 15-31, 15-36, and 15-42. Insulation in heads of large diameter vessels (over 12'-0" OD) where use of straps is impracticable shall be secured by wire attached to welding pins in accordance with Owner's Standard 15-40 and as shown in Figure 15-L-2.



Application of Fibrous Glass Insulation to Vessel Shell and Head
Figure 15-L-1



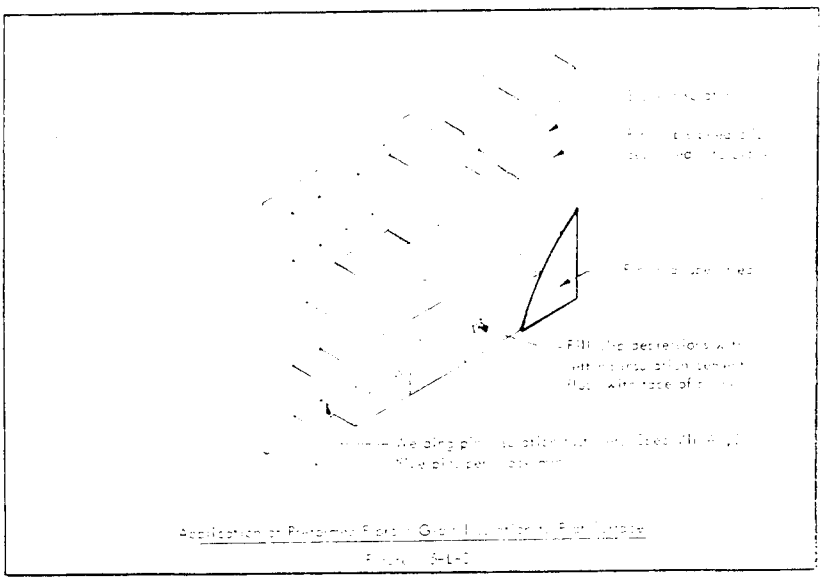
Attachment of Fibrous Glass Insulation to Bottom Vessel Head
Figure 15-L-2

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SECTION 5 - APPLICATION - cont'd

b. Anchors of preformed fibrous glass insulation shall be secured with welding pin insulation fasteners and pin clips, spaced as [illegible] minimum of five attachments per block, as shown in Figure 15-L-3.

[illegible] be pressed into insulation sufficient to allow pins to be cut off as [illegible] outer surface.



Application of Preformed Fibrous Glass Insulation on Flat Surfaces
Figure 15-L-3

[illegible] A slip joint shall be provided at each insulation support except the bottom support on vertical vessels and at each [illegible] support on horizontal vessels. Typical installation is shown in Figure 15-L-4.

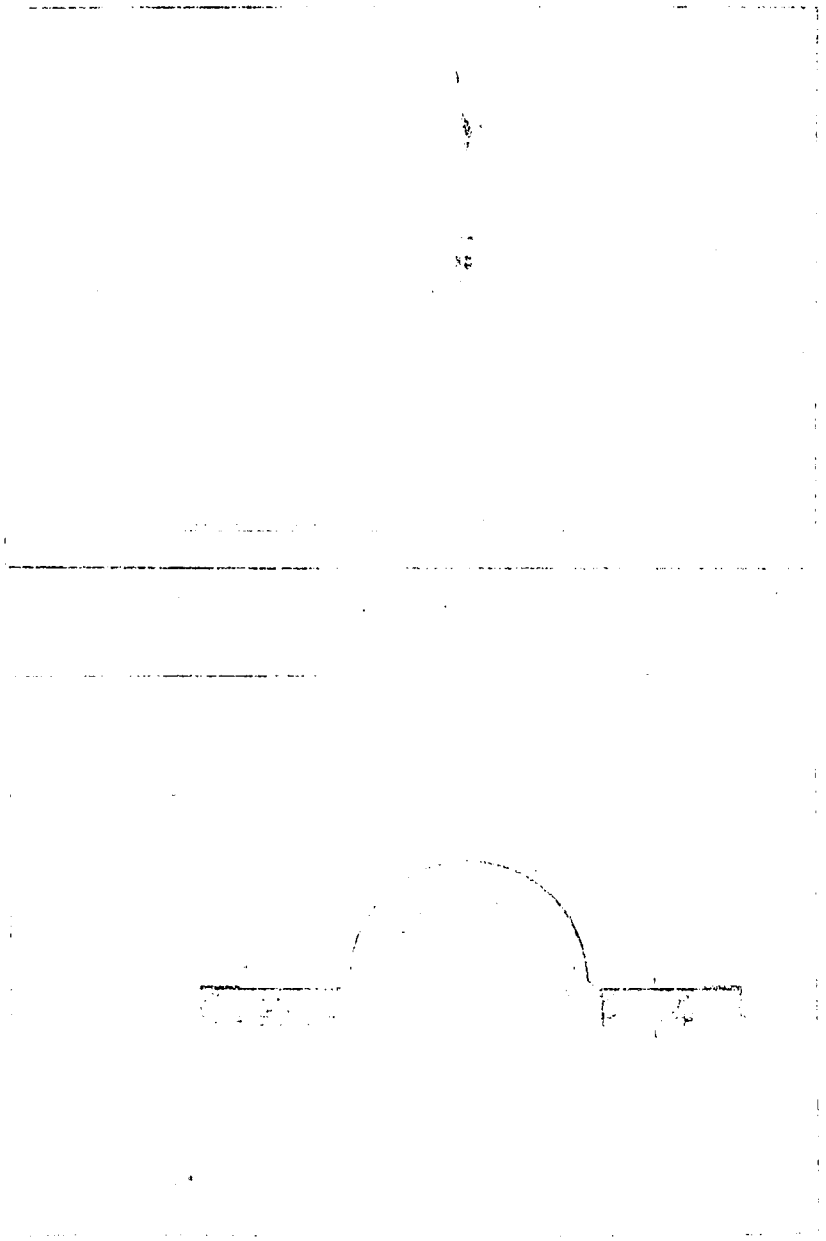
[illegible] Expansion joints in insulation on flat surfaces of vessels shall be insulated with preformed glass insulation. [illegible] specified thickness shall be applied to expansion joint and compressed to specified thickness to allow [illegible] insulation as shown in Figure 15-L-2.

[illegible] Corrugated mechanical expansion joint in piping [illegible] shall be insulated with [illegible] A slip joint shall be provided, according to [illegible] at each stainless steel [illegible] joint, placed flush with the butt end of the pipe covering. The sleeve shall be secured with [illegible] joint cover. A collar band of [illegible] stainless steel of sufficient length to embed one [illegible] be applied over the sleeve and held in place by the expansion joint cover [illegible] [illegible] joint cover and secured to the collar band. [illegible]

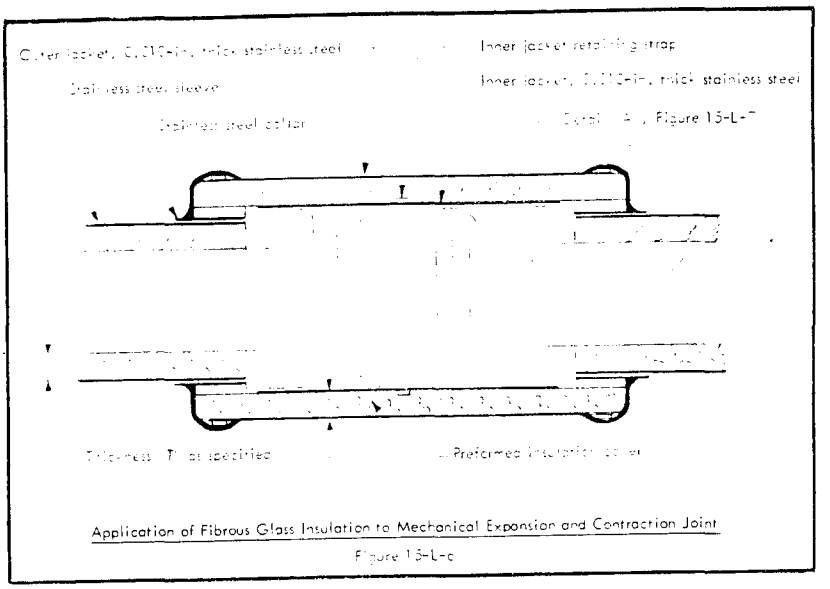
[illegible] vertical, in piping [illegible] joint at the top shall be omitted and the expansion joint covering [illegible]

[illegible] Unless otherwise specified, all [illegible] flanges shall be insulated with preformed fibrous glass [illegible] stainless steel jacket. An insulation support [illegible] immediately above [illegible] flanges. Allowance [illegible] slip joint allowing movement between insulation and [illegible] jacket. Typical installation is shown in Figure [illegible]

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Application of Fibrous Glass Insulation to Mechanical Expansion and Contraction Joint

Figure 15-L-6

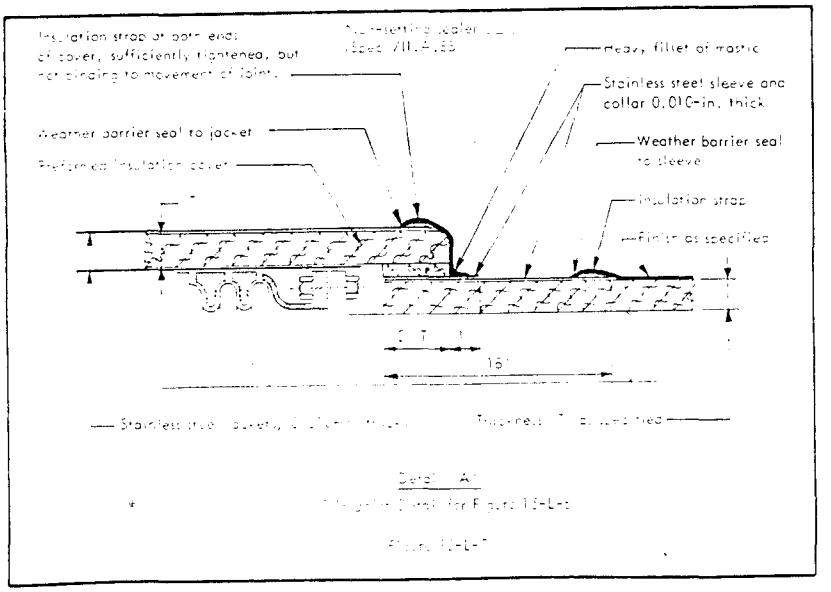
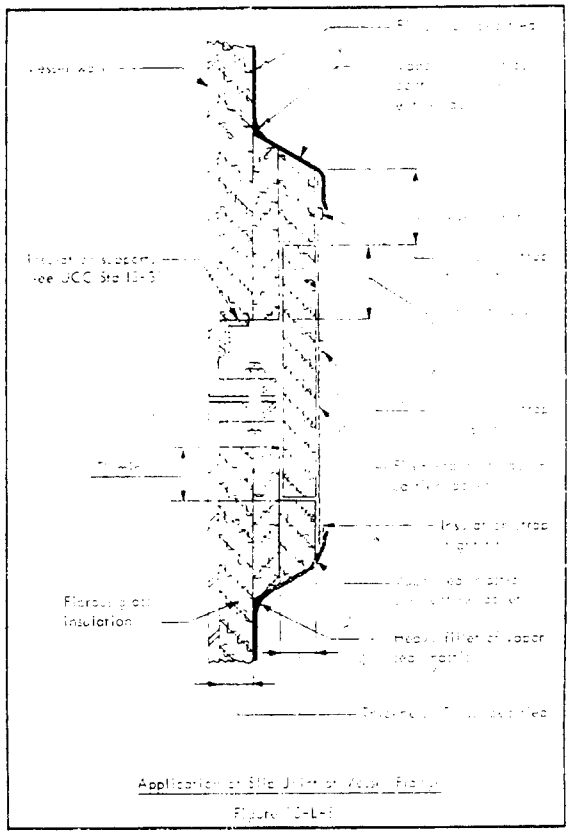


Figure 15-L-7

SECTION 3 - APPLICATION

EQUIPMENT - cont'd



Application at Side Joint of Vessel Flange
Figure 15-L-11

Insulated Vessel Flanges. Where vessel flanges are specifically noted to be left uninsulated, the reinforcing cloth of the vessel insulation shall be extended to metal of vessel body, coated with vapor seal mastic and banded while sealer is still tacky. A second layer of sealer and fabric may be applied over the reinforcing cloth and securement. This application is shown in Figure 15-L-11.

Vessel Nozzles. Unless otherwise specified, all vessel nozzles shall be insulated as shown in Figure 15-L-12.

Vessel Legs

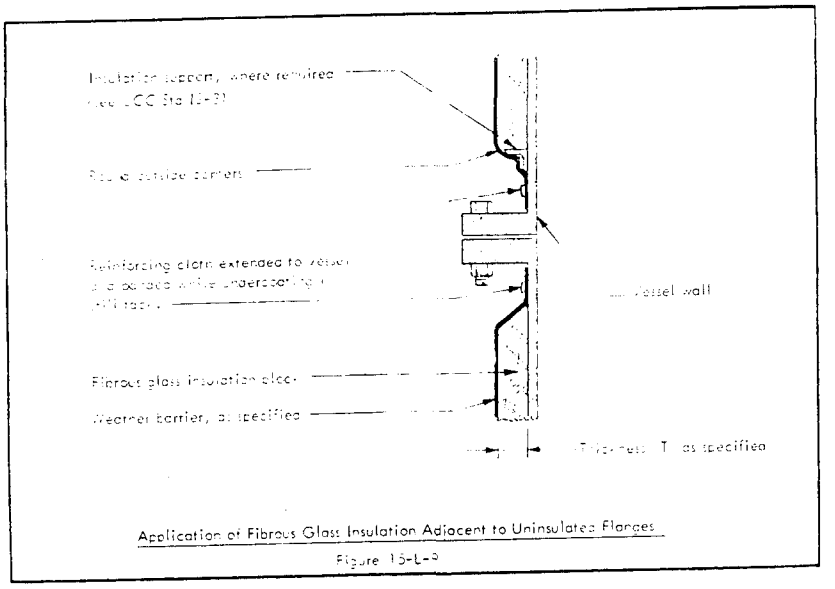
Concrete-filled structural tubing legs shall be insulated for a distance not less than 4 times the specified insulation thickness from the junction of the vessel with the leg. Thickness over the leg shall be not less than 1/2 that specified for body of vessel.

Channel legs shall be insulated with block which shall extend over channel flanges and across channel legs (Reference Figure 15-L-13) to a thickness not less than that specified for body of vessel.

Insulated flat plate legs shall be insulated with block cemented to plate with vapor seal adhesive. Insulation shall be as shown in Figure 15-L-14.

Vessel Supports. Saddle supports shall be insulated as specified for body of vessel. Insulation shall be as shown in Figure 15-L-15.

SECTION B - APPLICATION - cont'd



Application of Fibrous Glass Insulation Adjacent to Uninsulated Flanges

Figure 15-L-9

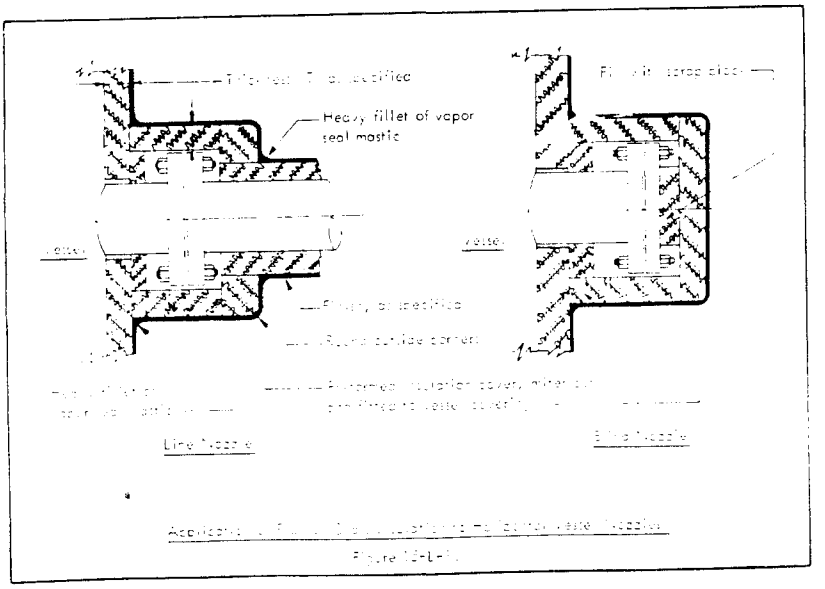
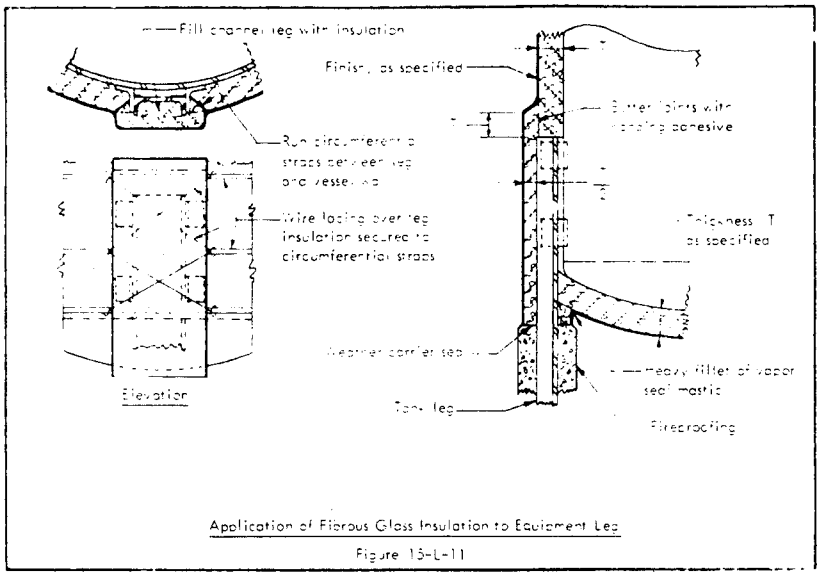


Figure 15-L-[illegible]

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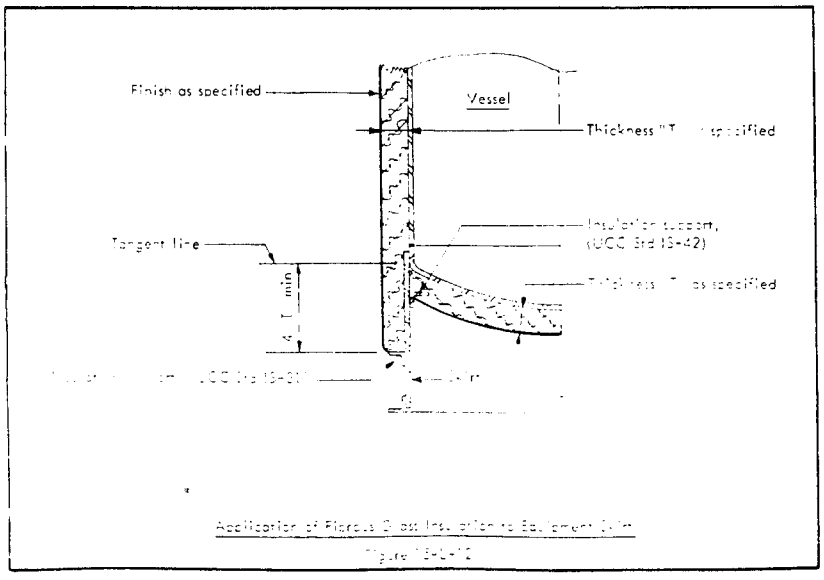
SECTION B - APPLICATION - cont'd

EQUIPMENT - cont'd



Application of Fibrous Glass Insulation to Equipment Leg

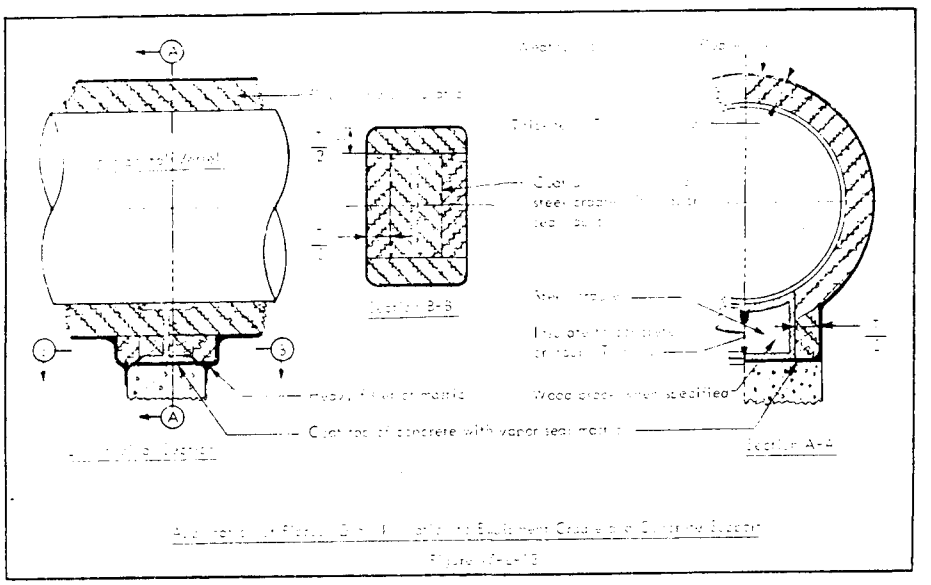
Figure 15-L-11

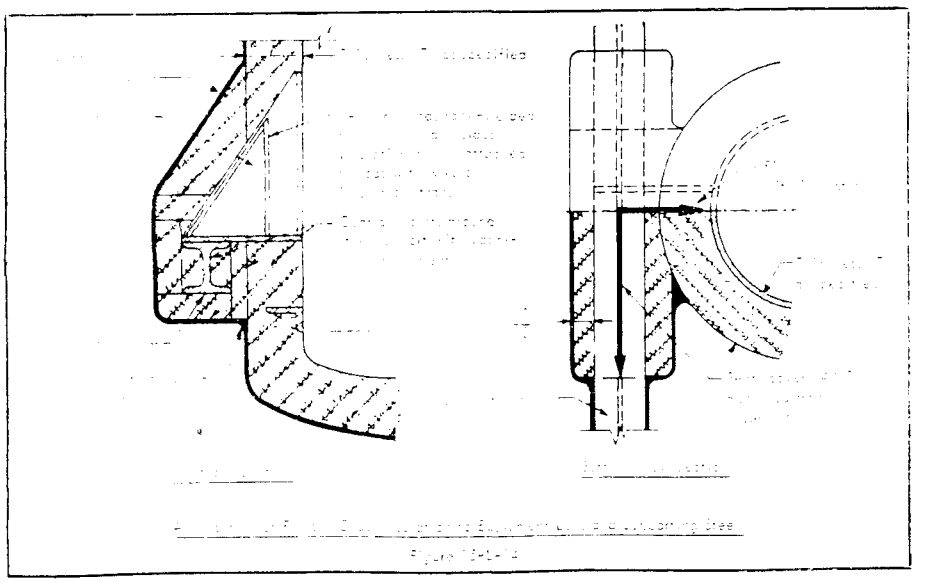


Application of Fibrous Glass Insulation to Equipment (Vert.

Figure 15-L-12

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Section B-B
Section A-A



SECTION B - APPLICATION - [illegible]

[illegible] shall be applied to the surface of each layer of cylindrical insulation [illegible] with insulation cement and troweled [illegible] the surface prior to application of fire-retardant vapor-barrier jackets or vapor seal mastic.

2. Fire-retardant vapor-barrier jacket shall be installed smooth, over each layer of cylindrical insulation, using jacket sealing cement to attach [illegible] of jackets. Edges shall be overlapped a minimum of two inches and sealed to form a completely tight envelope. Circumferential [illegible] of fire-retarded vapor-barrier butt joint strips centered on and wrapped tightly around joints.

[illegible] of irregular surfaces, where use of jackets is impracticable, shall be coated with vapor seal mastic [illegible] to the light. Care shall be taken to form a complete seal between the surface of the material being [illegible]

[illegible] Article XII, B, 1 of the GENERAL SPECIFICATIONS.

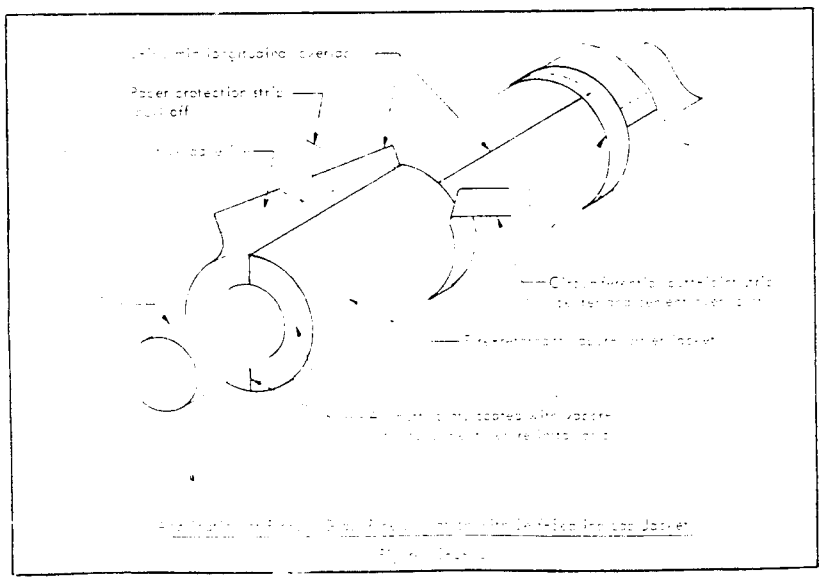
[illegible] shall be applied and secured as specified in Article III of the GENERAL SPECIFICATIONS.

[illegible] shall be applied in multiple layers as specified in Article III, B of the MATERIAL SPECIFICATIONS.

1. Piping insulated with factory-applied fire-retardant vapor-barrier jacket as described in MATERIAL SPECIFICATIONS [illegible] insulation shall be applied without compressing the jacket. The insulation shall be secured and sealed by means of the self-sealing longitudinal [illegible] with fire-retardant vapor-barrier butt joint strips centered on and wrapped tightly around joints. [illegible] Figure 15-L-1.

2. Piping insulated with factory-applied fire-retardant vapor-barrier jacket shall be applied to piping in accordance with [illegible] GA-1 and GA-2 of the GENERAL SPECIFICATIONS. Insulation shall be applied with all joints tightly butted and [illegible] shall not be filled with vapor-barrier mastic, but eliminated by either refitting or replacing insulation. [illegible] insulation surfaces to be butted shall be trued before application.

[illegible] of insulation without jacket, and butt ends and edges of insulation without jacket, shall be given a smooth finish of [illegible] [illegible] application.



Union Carbide trial exhibit UC-4586: W. G. Hammar Transmittal Memoranda and Union Carbide Thermal Insulati…
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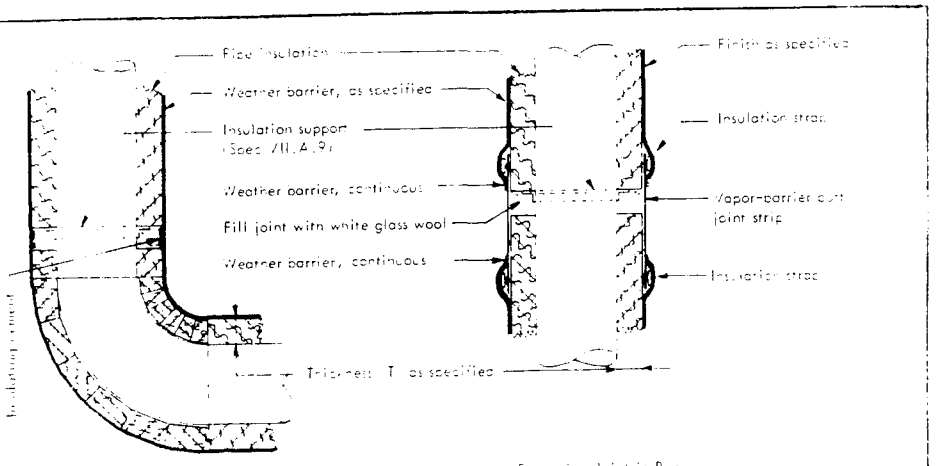
SECTION B - APPLICATION - cont'd

C. PIPING - cont'd

1. Vertical Pipe

a. Insulation on 4-inch NPS and larger pipe extending more than 15 feet above bottom elbow shall be supported by a pipe insulation support located directly above the bottom elbow. Typical installation is shown in Figure 15-L-1b. A pipe insulation support shall also be installed above each pair of flanges or flanged valve in vertical pipe.

b. When pipe extends more than 15 feet above pipe insulation supports located directly above elbows, flanges or flanged valves, additional supports shall be installed on approximately 15-foot centers to provide for installation of expansion joint as shown in Figure 15-L-1b.



Application of Fibrous Glass Insulation to Vertical Lines at Insulation Supports and Expansion Joints

Figure 15-L-1b

Fittings, Flanges, and Valve Covers

1. All fittings, flanges, and valves in one-inch NPS and smaller piping shall be insulated with insulating cement.

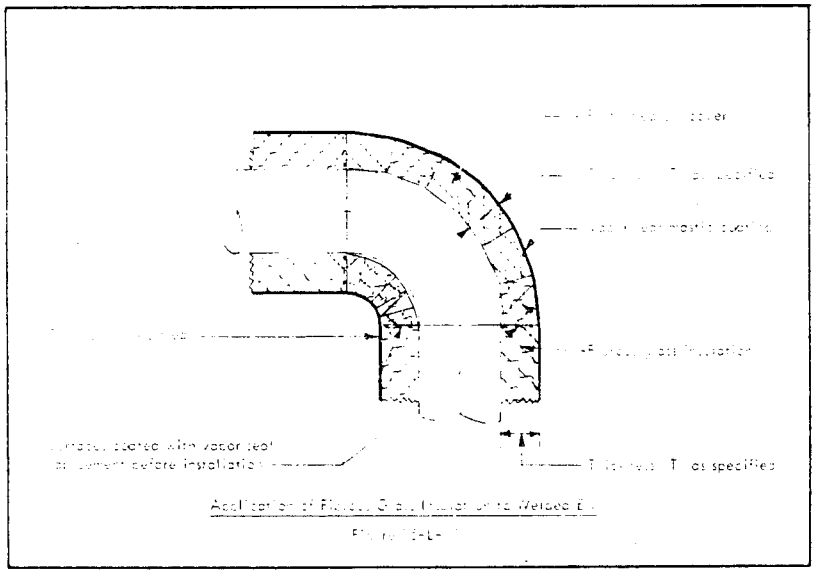
2. Fittings, flanges, and valve covers for piping larger than one-inch NPS shall be factory-molded or prefabricated in accordance with ASTM Designation C[illegible] (latest revision).

3. [illegible] to assembly shall be done with low-temperature fabricating cement. In all cases the joints shall be as thin as possible with sufficient cement to obtain good adhesion and complete closure. In no case will [illegible] cement joints or voids and holes plugged with cement be permitted.

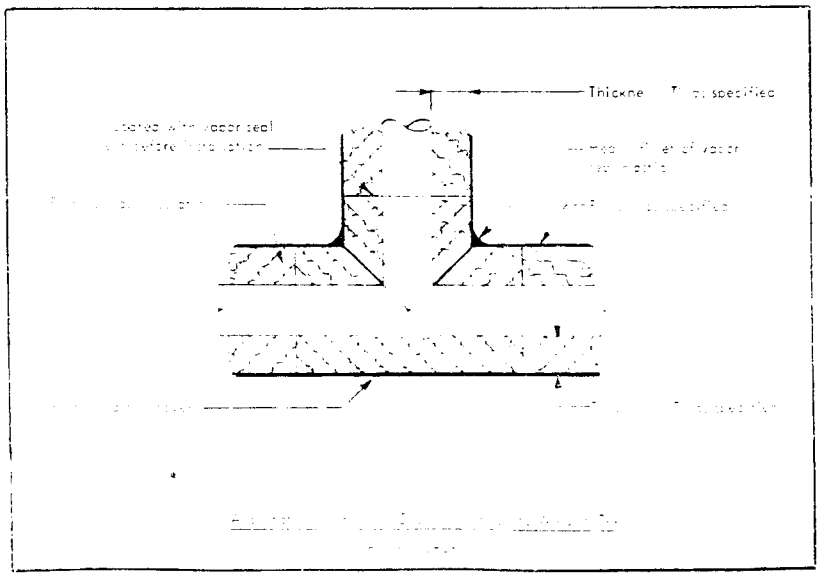
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[illegible] - cont'd

[illegible] and Valve Covers - cont'd

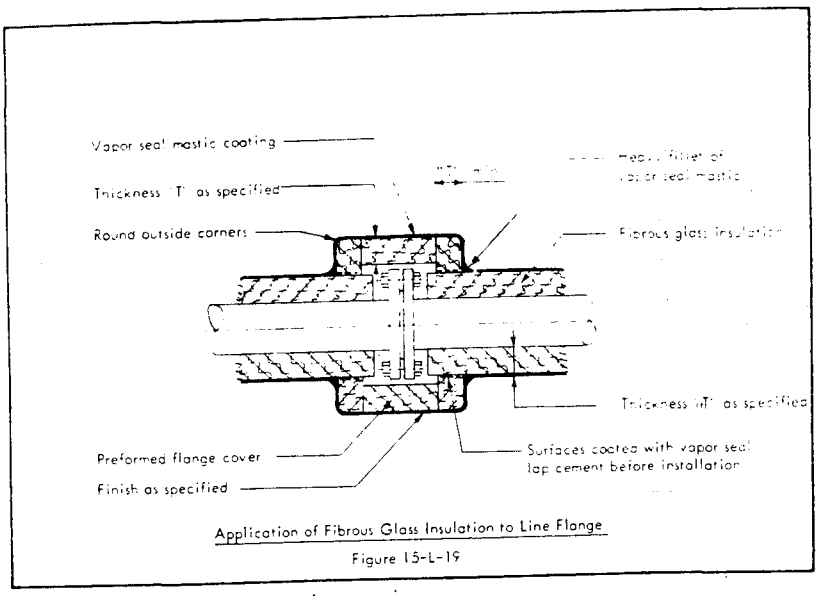


Application of Flexible Cellular Insulation to Welded Elbow



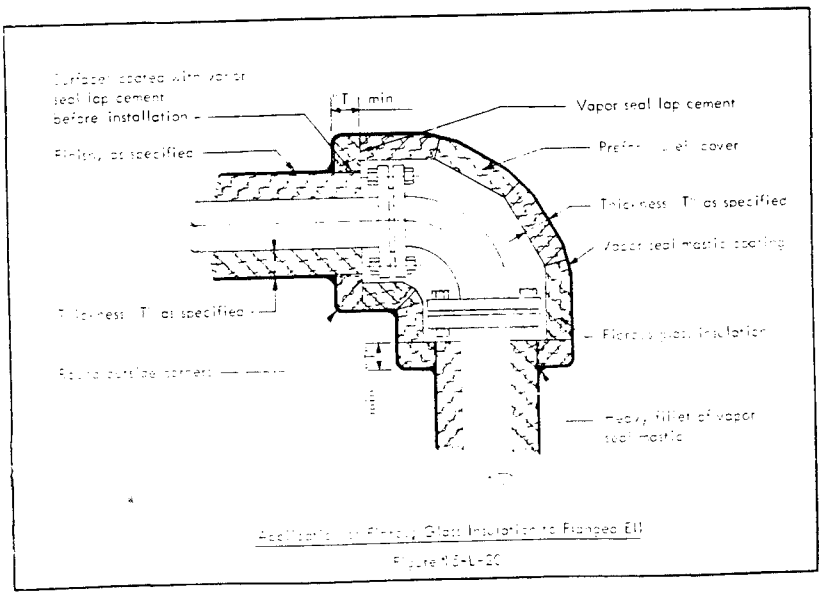
C. PIPING - cont'd

2. Fittings, Flanges, and Valve Covers - cont'd



Application of Fibrous Glass Insulation to Line Flange

Figure 15-L-19



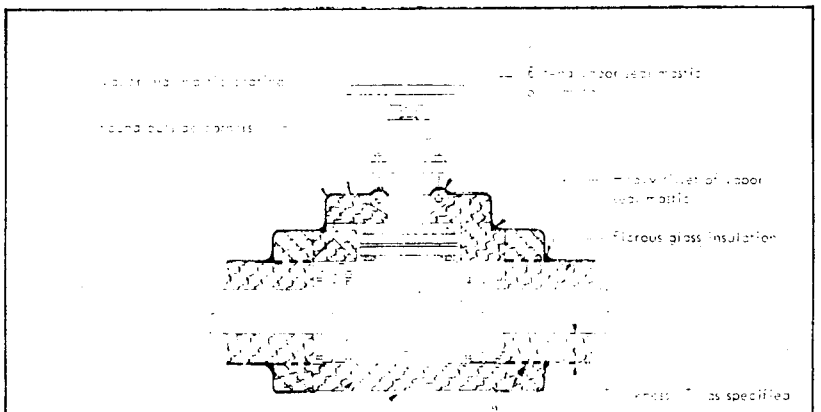
Application of Fibrous Glass Insulation to Flanged Ell

Figure 15-L-20

SECTION 3 - APPLICATION

[illegible]

Fiberglass Flanges, Bolts and Valves Covers - cont'd



Application of Fibrous Glass Insulation to Flanged Valve

Figure 15-L-01

Vapor Barrier

A. Small cracks and depressions in the surface of each layer of pipe insulation, of proper sizes from those with factory-applied fire-retardant vapor-barrier jackets, shall be filled with insulating cement and troweled flush with the surface before application of jacket.

B. Fire-retardant vapor-barrier jackets shall be installed on each layer of pipe insulation without factory-applied jackets. The jackets shall be applied smoothly, over the insulation surface and attached to it by means of jacket bonding cement. Edges shall be overlapped a minimum of [illegible] inches and sealed to form a completely tight envelope. Circumferential joints shall be sealed with fire-retardant vapor-barrier butt strips centered on and wrapped tightly around joints.

Surface Finish

Outdoor Pipe and Fittings

a. Weatherbarrier coating or jacket shall be applied as specified in Articles XI.A.3 and XI.B.3, respectively, of the GENERAL SPECIFICATIONS.

b. Fittings, flanges, bolts and valve covers shall be coated with vapor seal mastic applied to a minimum wet film thickness of [illegible] mils and covered with reinforcing cloth applied as specified in Article XI.A.3 of the GENERAL SPECIFICATIONS.

Indoor Pipe and Fittings

a. The outside [illegible] fire-retardant vapor-barrier jackets covering the pipe insulation shall be painted with PVA Primer specified in Section [illegible] as specified to present a uniform color and finish appearance.

b. Fittings, flanges, bolts and valve covers shall be coated as specified in Paragraph [illegible] above with PVA Primer specified in Section [illegible] as specified.

THERMAL INSULATION APPLICATION SPECIFICATIONS

PREFORMED FIBROUS GLASS

Low Density (Over 3 Lb Per Cu Ft)

SCOPE

This specification describes the essential requirements for application of preformed fibrous glass insulation for use on piping normally operating at temperatures above 70 F and up to and including 350 F. It is applicable to both indoor and outdoor service.

Procedures described in the GENERAL SPECIFICATIONS are applicable to and constitute an integral part of this specification.

SECTION A - MATERIALS

1. INSULATION MATERIAL

Insulation shall be as specified in MATERIAL SPECIFICATION 16.

2. ACCESSORY MATERIALS

Accessory materials shall be as specified in the MATERIAL SPECIFICATIONS, article numbers as noted.

Pipe Insulation Support	VII.A.6	Vapor Seal Lap Cement	VII.A.56
Strapping Tape	VII.A.33	PVA Finish Coating and Lagging Adhesive	VII.A.55
Fabricating Cement	VII.A.47	Weather-Barrier Mastic (color as specified)	VII.B.1
Fire-Retardant Vapor-Barrier Jacket and Butt Joint Strips	VII.A.72	Reinforcing Cloth	VII.B.13

SECTION B - APPLICATION

1. PIPING

a. Pipe Insulation

(1) Pipe insulation shall be supported and secured as specified in Article III of the GENERAL SPECIFICATIONS.

(2) Insulation in excess of 3 inches total thickness shall be applied in multiple layers as specified in Article III.B of the MATERIAL SPECIFICATIONS.

(3) Pipe insulation furnished with factory-applied fire-retardant vapor-barrier jacket, as described in MATERIAL SPECIFICATION 16, shall be installed on pipe without removing the jacket. The insulation shall be secured and sealed by means of the self-sealing longitudinal lap. Circumferential joints shall be sealed with fire-retardant vapor-barrier butt joint strips centered on and wrapped tightly around joints.

(4) Pipe insulation furnished without factory-applied fire-retardant vapor-barrier jacket shall be applied to piping in staggered position in accordance with Figures GA-1 and GA-2 of the GENERAL SPECIFICATIONS. Insulation shall be applied with all joints tightly butted and fitted to eliminate voids. Large voids shall not be filled with weather-barrier mastic, but eliminated by either refitting or replacing insulation. Any rounded corners on the insulation surfaces to be butted shall be trued before application.

(5) Butt ends of insulation with jacket, and butt ends and edges of insulation without jacket, shall be given a smooth brush or spray coat of vapor seal lap cement before application. Longitudinal joints and circumferential joints of insulation without jackets shall be sealed with vapor seal lap cement, and as specified in Paragraph (3) above.

(6) All pipe insulation larger than 12 inches OD shall have, in addition to the circumferential joint seal, a fire-retardant vapor-seal butt joint strip applied circumferentially in the center of each 3-foot section.

b. Fittings, Flanges, and Valve Covers

(1) With the exception of ball and plug valves, all fittings, flanges, and valves over three-inch NPS shall be insulated with covers preformed to conform in appearance with ASTM Recommended Practice C 450, latest revision.

(2) Ball and plug valve covers shall be field fabricated of proper sized pipe covering.

(3) Screwed and welded fitting covers for three-inch NPS and smaller piping may be field fabricated.

(4) The two halves of factory-molded covers shall be strapped together with strapping tape.

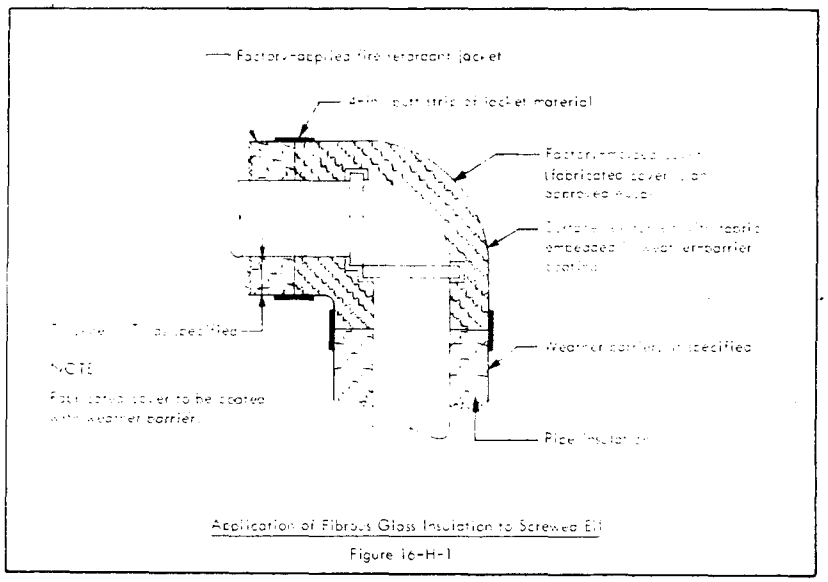
(5) The two halves of fabricated covers shall be cemented together with fabricating cement. In all cases the joints shall be as thin as possible, with just sufficient cement to obtain good adhesion and complete closure. In no case will wide cement joints, or voids and holes plugged with cement, be permitted.

(6) The insulation adjacent to covers for screwed fittings and valves shall be fitted tightly to the butt ends of the cover, and the joints sealed as specified in Item (5) of this section.

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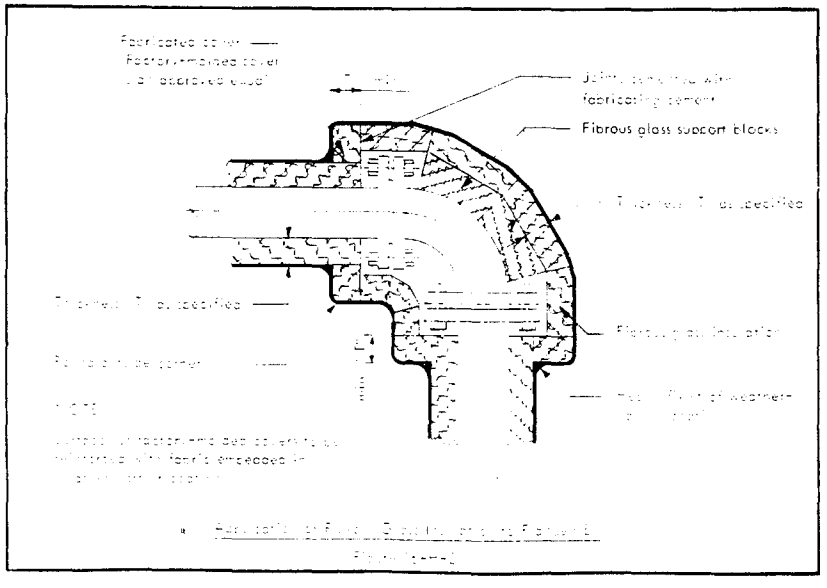
SECTION B - APPLICATION - cont'd

PIPING - cont'd



Application of Fibrous Glass Insulation to Screwed Fit

Figure 16-H-1



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SECTION B - APPLICATION - cont'd

2. SURFACE FINISH

a. Outdoor Piping. Weather-barrier coating or jacket shall be applied as specified in Article XIV.B and XV.B, respectively, of the GENERAL SPECIFICATIONS.

b. Indoor Piping

1) The surface of the fire-resistant vapor-barrier jackets covering the pipe insulation shall be coated with PVA finish coating and lagging adhesive (color as specified) to present a uniform color and surface texture.

2) The surfaces of pipe insulation without jackets and of fitting, flange, and valve covers shall be coated with weather-barrier mastic and reinforcing cloth, applied as specified in Article XIV.B of the GENERAL SPECIFICATIONS.

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THERMAL INSULATION APPLICATION SPECIFICATIONS

PREFORMED FIBROUS GLASS

Vapor Seal Rigid-Faced Insulation

SCOPE

These specifications set forth essential requirements for application of preformed fibrous glass vapor seal rigid-faced insulation for use on the exterior surfaces of heating, ventilating, and air conditioning ducts. It is applicable to both indoor and outdoor service.

SECTION A - MATERIALS

1. INSULATION MATERIAL

Insulation shall be in accordance with MATERIAL SPECIFICATION 17-RX.

2. ACCESSORY MATERIALS

All accessory materials shall be as specified in the MATERIAL SPECIFICATIONS, article numbers as listed.

Pin Fasteners	VII.A. 22	Outer Covering	VII.A. 2
Cap Washers	VII.A. 23	Joint Sealing Tape	VII.A. 5
Adhesive	VII.A. 75	Vapor-Barrier Mastic	VII.A.
Pressure Sensitive Joint Adhesive	VII.A. 77	Reinforcing Cloth	VII.A.
Fiberglass Insert Adhesive	VII.A.100		

SECTION B - APPLICATION

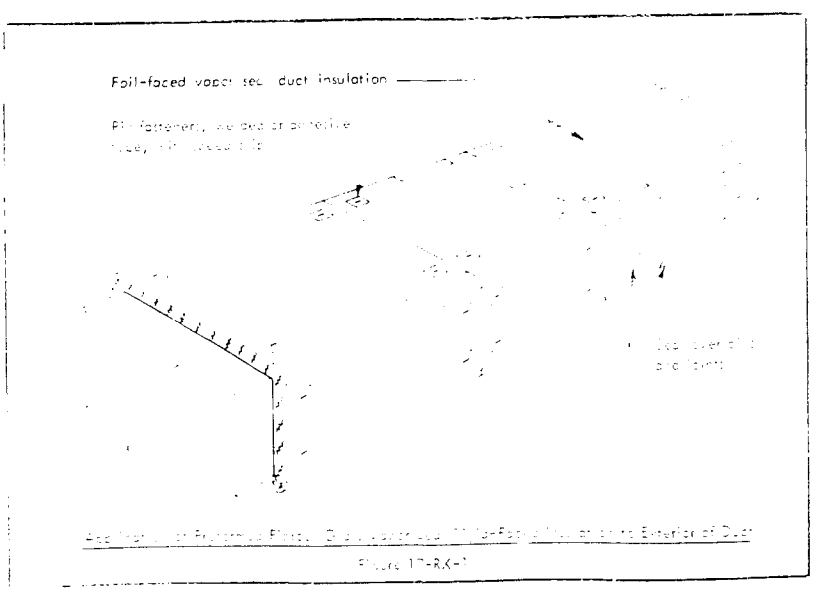
1. THICKNESS OF INSULATION

Thickness of insulation shall be as scheduled.

2. CONCEALED INDOOR DUCTS

a. Joints. Insulation shall be applied with all joints tightly butted.

b. Fasteners. Where welding is permitted, insulation shall be attached to duct with welding pins and pin caps. Where welding is prohibited, attachment shall be made with adhesive type pins and speed washers. Longitudinal spacing of pins shall be 12 to 18 inches. On sides 8 inches and over in width, one row of fasteners is required. On sides more than 8 inches one additional row is required for each multiple of 8 inches or fraction thereof. Pins shall be located 3 inches from outside of side or bottom. Typical installation is as shown in Figure 17-RX-1.



Application of Preformed Fibrous Glass Foil-Faced Vapor Seal to the Exterior of Duct

Figure 17-RX-1

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SECTION B - APPLICATION - contd

[illegible] - contd

[illegible]. All joints, cracks, punctures, and breaks shall be sealed with joint sealing tape to form a continuous vaportight envelope. The [illegible] shall be sealed vapor barrier with fire-resistant adhesive. Where pins project through insulation, holes shall be sealed [illegible]

[illegible]

[illegible] Joints, securement, and vapor barrier shall be as specified in Item 2 of this section.

[illegible]. Similar outer covering shall be adhered to the surface of the insulation on exposed [illegible] ducts with PVA finish coating and [illegible] applied PVA mastic as an adhesive. After the adhesive has dried, the outer covering shall be coated with this material, used [illegible] to color and surface texture.

[illegible]

[illegible] Joints, securement, and vapor barrier shall be as specified in Item 2 of this section.

[illegible]. Before application of weather barrier, all depressions in the surface of the insulation shall be filled with weather-barrier mastic [illegible]. Weather barrier shall then be applied as specified in Article XIV.B of the GENERAL SPECIFICATIONS.

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THERMAL INSULATION APPLICATION SPECIFICATIONS

PREFORMED FIBROUS GLASS

Coated Rigid Insulation

SCOPE

This specification describes the essential requirements for application of preformed fibrous glass coated rigid insulation for use on the interior surfaces of heating, ventilating, and air conditioning ducts.

SECTION A - MATERIALS

1. INSULATION MATERIAL

   The insulation shall be as specified in MATERIAL SPECIFICATION 17-RY.

2. ACCESSORY MATERIALS

   Accessory materials shall be as specified in the MATERIAL SPECIFICATIONS, article numbers as noted.

   Welding Pin Insulation Fasteners VII.A.22
   Pin Clips VII.A.23
   Adhesive Type Pins VII.A.75
   PVA Finish Coating and Lagging Adhesive . . . . . VII.A.[illegible]
   Fire-Resistant Adhesive . . . . . VII.A.[illegible]
   Fire-Resistant Caulking Mastic . . . . . VII.A.[illegible]

SECTION B - APPLICATION

1. THICKNESS OF INSULATION

   Thickness of insulation shall be as scheduled.

2. DUCTS HANDLING AIR UP TO 3000 FPM

   a. Before insulation is applied, welding pins and pin clips or adhesive pins and speed washers shall be installed on the interior top and side surfaces of the duct where the width and height of the duct exceed 12 inches and 24 inches, respectively. The maximum spacing of the pins shall be 16 inches on centers.

   b. Insulation shall be applied with all joints tightly butted, and shall be adhered to the interior surfaces of the duct with fire-resistant adhesive applied at a minimum coverage of 50 percent, and with welding pins and pin clips or adhesive pins and speed washers if required. The neoprene-coated side of the insulation shall face the air flow.

   c. All joints shall be caulked with fire-resistant caulking mastic.

3. DUCTS HANDLING AIR BETWEEN 3000 AND 4500 FPM

   Before application all edges of the insulation shall be given a heavy coat (1/8-inch thick) of fire-resistant caulking mastic. The purpose of the mastic is to prevent air from getting behind the insulation, or weakening the bond of the insulation to the metal surface. After the coating has been applied the insulation shall be installed as specified in Item 2 of this section, except that welding pins and pin clips or adhesive pins and speed washers shall be installed on all four sides of the duct.

   Insulation shall be applied as specified in Item 2 of this section. In addition, a light brush coat (100 sq ft per gallon) of PVA finish coating and lagging adhesive shall be applied to all interior surfaces of the insulation to reduce friction loss and improve absorption of low-frequency [illegible].

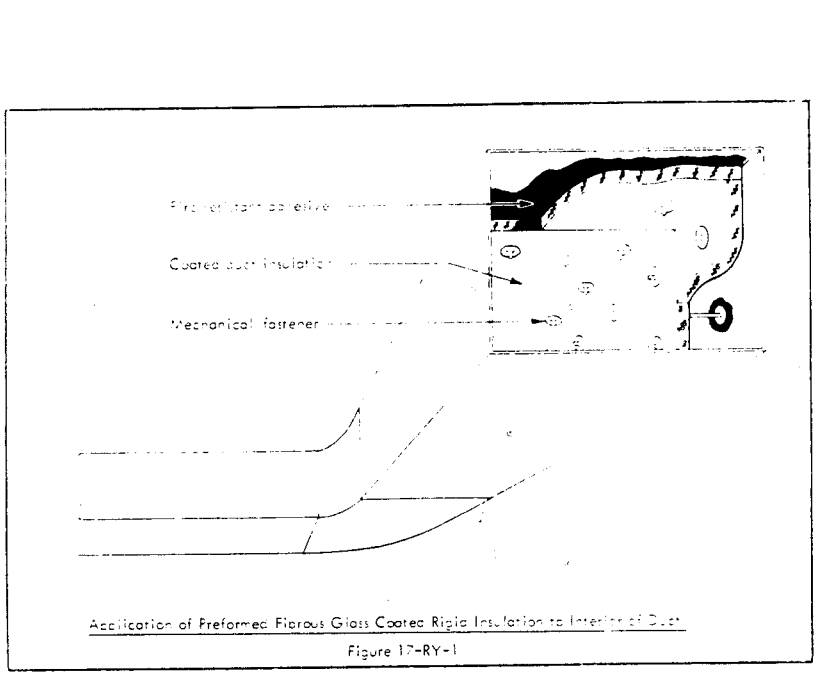
4. TYPICAL INSTALLATION

   Typical installation is shown in Figure 17-RY-1.

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SECTION B - APPLICATION - contd

1. TYPICAL INSTALLATION - contd



Application of Preformed Fibrous Glass Coated Rigid Insulation to Interior of Duct

Figure 17-RY-1

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THERMAL INSULATION APPLICATION SPECIFICATIONS

PREFORMED FIBROUS GLASS

Coated Rigid Insulation

SCOPE

This specification describes the essential requirements for application of preformed fibrous glass coated rigid insulation for use on the interior surfaces of heating, ventilating, and air conditioning ducts.

SECTION A - MATERIALS

1. INSULATION MATERIAL

The insulation material shall be as specified in MATERIAL SPECIFICATION 17-RY.

2. ACCESSORY MATERIALS

Accessory materials shall be as specified in the MATERIAL SPECIFICATIONS, article numbers as noted.

Metal Duct Insulation Fasteners	VII.A.22	PVA Finish Coating and Lagging Adhesive	VII.A.
Pin Clips	VII.A.23	Fire-Resistant Adhesive	VII.A.
Adhesive Type Pins	VII.A.25	Fire-Resistant Caulking Mastic	VII.A.

SECTION B - APPLICATION

1. THICKNESS OF INSULATION

Thickness of insulation shall be as scheduled.

2. DUCTS HANDLING AIR UP TO 3000 FPM

a. Before insulation is applied, welding pins and pin clips or adhesive pins and speed washers shall be installed on the interior top and side surfaces of the duct where the width and height of the duct exceed 12 inches and 24 inches, respectively. The maximum spacing of the pins shall be 16 inches on centers.

b. Insulation shall be applied with all joints tightly butted, and shall be adhered to the interior surfaces of the duct with fire-resistant adhesive applied in strips for a coverage of 30 percent, and with welding pins and pin clips or adhesive pins and speed washers if required. The neoprene-coated side of the insulation shall face the air flow.

c. All joints shall be sealed with fire-resistant caulking mastic.

3. DUCTS HANDLING AIR BETWEEN 3000 AND 4500 FPM

Before application of edges of the insulation shall be given a heavy coat (1/8-inch thick) of fire-resistant caulking mastic. The purpose of the mastic is to prevent air from getting behind the insulation, or weakening the bond of the insulation to the metal surface. After the coating has been applied, insulation shall be installed as specified in Item 2 of this section, except that welding pins and pin clips or adhesive pins and speed washers shall be installed on all four sides of the duct.

All joints shall be sealed as specified in Item 2 of this section. In addition, a light brush coat (100 sq ft per gallon) of PVA finish coating shall be applied to all interior surfaces of the insulation to reduce friction loss and improve absorption at low-frequency for noise.

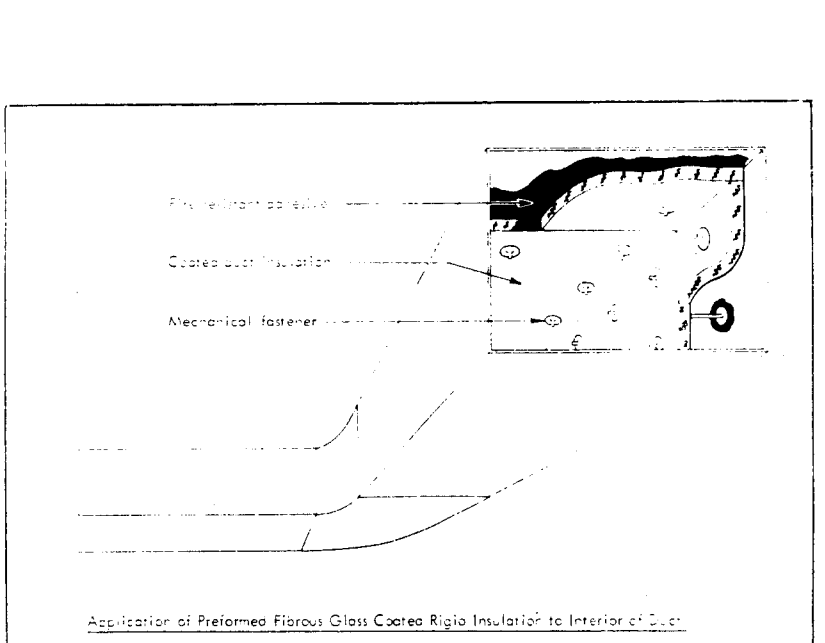
4. TYPICAL INSTALLATION

Typical installation is shown in Figure 17-RY-1.

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SECTION B - APPLICATION - contd

B. TYPICAL INSTALLATIONS - contd



Application of Preformed Fiberous Glass Coated Rigid Insulation to Interior of Duct

Figure 17-RY-1

THERMAL INSULATION APPLICATION SPECIFICATIONS

FIBROUS GLASS FLEXIBLE DUCT INSULATION

Faced With Fire-Retardant Vapor Barrier

SCOPE

This specification describes the essential requirements for application of fibrous glass flexible duct insulation faced with fire-retardant vapor barrier for use on the exterior surfaces of heating, ventilating, and air conditioning ducts that are in concealed indoor spaces.

SECTION A - MATERIALS

1. INSULATION MATERIAL

Insulation shall be as specified in MATERIAL SPECIFICATION 18-FX.

2. ACCESSORY MATERIALS

Accessory materials shall be as specified in the MATERIAL SPECIFICATIONS, article numbers as noted.

Fire-Resistant Adhesive VII.A.100
Joint Tape VII.A.104

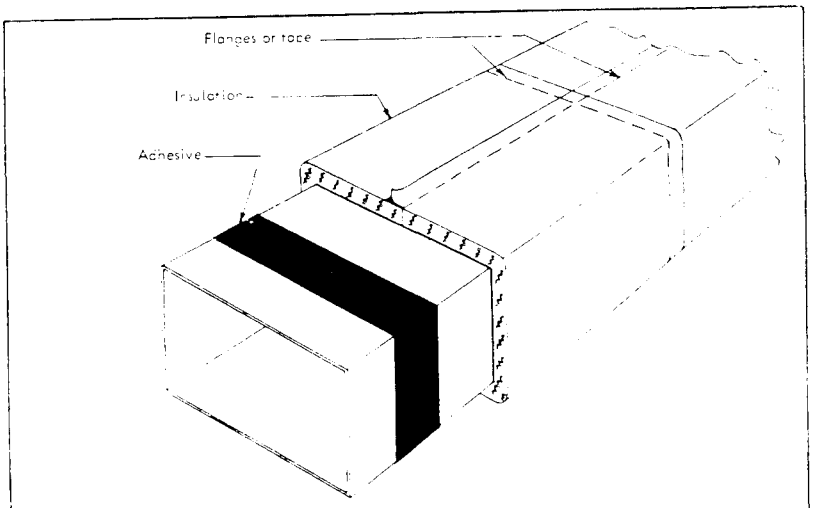
SECTION B - APPLICATION

1. THICKNESS OF INSULATION

Thickness of insulation shall be as scheduled.

2. DUCTS

Insulation shall be adhered to ducts with fire-resistant adhesive. All joints shall be tightly butted and sealed with joint tape or with 2-inch wide flanges of factory-applied vapor-barrier facing adhered to the insulation with fire-resistant adhesive. Typical installation is shown in Figure 18-FX-1.



Application of Fibrous Glass Flexible Duct Insulation to Exterior of Duct

Figure 18-FX-1

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THERMAL INSULATION APPLICATION SPECIFICATIONS

FIBROUS GLASS COATED FLEXIBLE DUCT LINER

ACOUSTICAL AND THERMAL INSULATION

SCOPE

This specification describes the essential requirements for application of fibrous glass coated flexible duct liner acoustical and thermal insulation for use on supply and return air ducts carrying conditioned and warm air respectively.

SECTION A - MATERIALS

1. INSULATION MATERIAL

[illegible] as specified in MATERIAL SPECIFICATION 18-FY.

2. ACCESSORY MATERIALS

Accessory materials shall be as specified in the MATERIAL SPECIFICATIONS, article numbers as follows:

Weld-On Fasteners	VIII.A.20
Pin Clips	VIII.A.25
Grip Nails	VIII.A.75
Fire-Resistant Adhesive	VIII.A.100

SECTION B - APPLICATION

1. DUCT CHARACTERISTICS

This specification describes application of insulation to 24-gage and heavier rectangular galvanized steel ducts.

2. THICKNESS OF INSULATION

Thickness of liner shall be as scheduled.

3. APPLICATION PROCEDURES

a. Forming. All ducts requiring insulation liner shall be insulated by carefully adhering the liner in a continuous piece to clean, flat metal sheet with fire-resistant adhesive and grip nails or welding pins. The liner and the metal shall be formed as a unit in the brake, with the coated side of the liner facing the air stream.

b. Methods of Attachment

1) Air Flow velocities from 0 to 1500 fpm

a) Before rolling the liner on the metal sheet from which the duct is to be formed, the leading edge of the liner shall be coated with fire-resistant adhesive. The liner shall be attached to the duct metal with grip nails, applied at each end three inches from the corner, then spaced at 4 inches, at a distance of 2 to 3 inches from the end of the duct. Grip nails shall also be applied at the center of the [illegible] using one nail for a width or height up to 10 inches, two nails for 10 inches to 22 inches, and three for 22 inches up to and including 34 inches, and one additional nail for a width or height up to 10 inches.

b) An alternative method of attachment is to adhere the liner to all interior duct surfaces with fire-resistant adhesive, applied at a rate of coverage of 50 percent, and use welded pins and pin clips as additional fastenings for the liner on the top of the duct when the width of the duct exceeds 12 inches, and on the sides when the height exceeds 24 inches. The pins shall be installed along the longitudinal center lines of the duct panels, starting 2 to 3 inches from the end of the duct and at a maximum spacing of 16 inches on center[illegible].

2) Air Flow velocities from 1500 to 4000 fpm

a) Fasten by right angle drive screws on the leading edges and 6 inches back under leading edges of the [illegible] to the duct.

b) Duct construction as specified in Paragraph 1 above.

3) Air Flow velocities from 4000 fpm through 6000 fpm

a) Duct construction, all edges of the duct [illegible] shall be given a heavy coat of 1/8-inch bead of fire-resistant adhesive.

b) [illegible] shall be applied with [illegible] pins and pin clips on 12-inch centers and fire-resistant adhesive applied at a rate of coverage of 50 percent.

SECTION B - APPLICATION - cont'd

[illegible] TYPICAL INSTALLATIONS

[illegible] of product [illegible] installation is shown in Figure 18-FY-1.

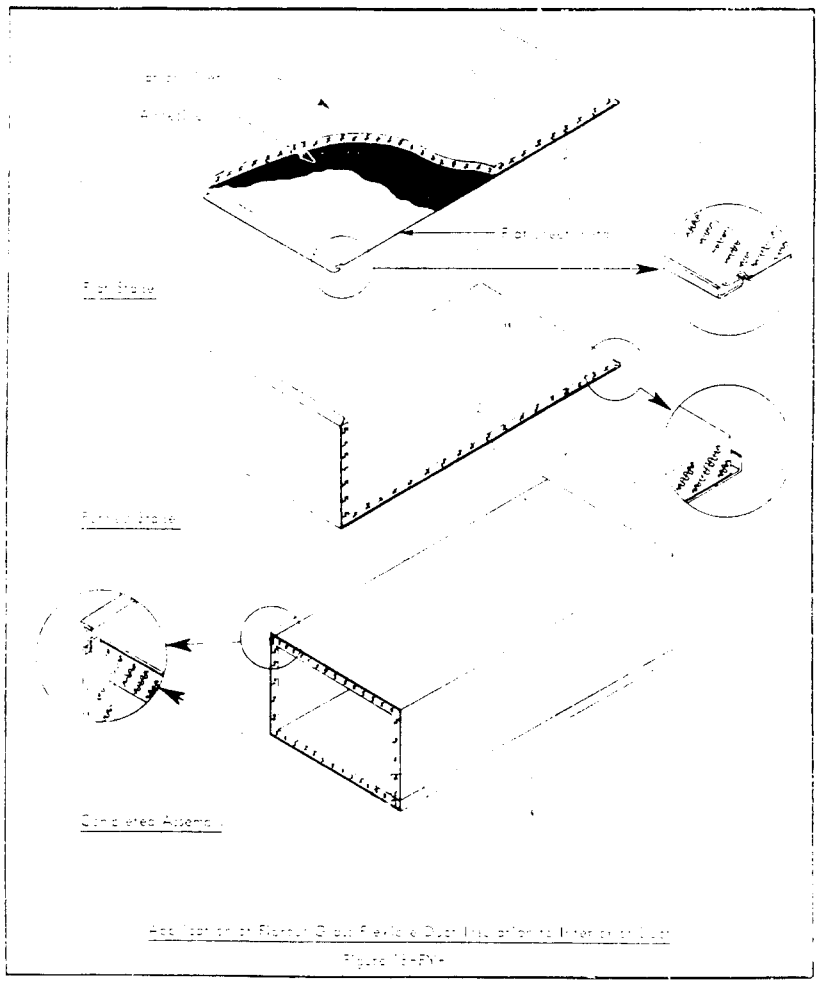


Figure 18-FY-1

THERMAL INSULATION APPLICATION SPECIFICATIONS
MINERAL WOOL INSULATION WITH INTEGRAL ALUMINUM FACING FOR VESSEL SIDE WALLS
EXPANDED SILICA BLOCK INSULATION FOR VESSEL ROOFS OR HEADS

SCOPE

This specification describes the essential requirements for application of mineral wool insulation with integral aluminum facing for use on side walls, and expanded silica block insulation for use on roofs or heads, of 12-foot OD and larger vertical storage tanks, normally operating at temperatures from 60 F up to and including 450 F. This specification covers vessels on which welding is or is not permitted.

Procedures described in the GENERAL SPECIFICATIONS are applicable to and constitute an integral part of this specification.

SECTION A - MATERIALS

1. INSULATION MATERIAL

a. Mineral Wool Batts with integral aluminum facing shall be as specified in MATERIAL SPECIFICATION 19.

b. Expanded Silica Block Insulation shall be as specified in MATERIAL SPECIFICATION 20.

2. ACCESSORY MATERIAL

Accessory materials shall be as specified in the MATERIAL SPECIFICATIONS, article numbers as noted.

Insulating Cement	VII.A.7	Studs*	VII.A.9
Equipment Insulation Straps	VII.A.11	Stud Nuts*	VII.A.9
Clips for Equipment Straps	VII.A.12	Sheet Metal Screws	VII.A.10
Expansion Springs or Bands	VII.A.15	Aluminum Flashing	VII.A.21
Clips for Expansion Springs or Bands	VII.A.16	High Temperature Fabricating Cement	VII.A.24
Stainless Steel Wire	VII.A.17	Mastic	VII.A.25
Welding Pins (alternative securement in place of welding pin insulation fasteners and pin clips)	VII.A.19	Lap Setting Sealer	VII.A.26
Welding Pin Insulation Fasteners	VII.A.22	Weather-Barrier Mastic	VII.B.1.a
Pin Clips	VII.A.23	Reinforcing Cloth	VII.B.1.a
Clips	VII.A.27	Cellular Glass Insulation - MATERIAL SPECIFICATION 10	

*When purchased insulation panels are ordered for welded installation, "S" clips and studs are furnished by the manufacturer of the panel.

SECTION B - PREPARATION AND APPLICATION

1. PREPARATION

a. Thickness of Insulation. The thickness of insulating panels to be installed on side walls and the thickness of the block insulation to be installed on roof or head shall be as shown on Insulation Schedule.

b. Insulation Supports and Securements

(1) Where welding to vessel is permitted, flat and cone head vessels shall have an angle or plate continuously welded to intersection of vessel shell and head to provide for insulation securement and water shed. This is shown in Figure 19-H-1.

(2) If cone insulation or side wall of vessel does not extend to base of vessel, an angle with an outstanding leg 2-inch greater in length than insulation to be supported shall be welded around vessel at level where panel insulation is to terminate.

(3) Securements for roof or head insulation shall be welding pins and clips or by securement pins welded to roof or heads. Where welding pins are used, a minimum of four pins and clips shall be installed to secure each block. Where securement pins are used, they shall be installed in accordance with Owner's Standard IS-40.

(4) Where welding to vessel is permitted, panels shall be secured to cylindrical section of vessel by studs, welded to vessel, that extend through factory-punched holes in aluminum facing, and secured in place with aluminum nuts and Hexcor washers. Dimensions of panels and stud arrangement shall be as shown in Figure 19-H-2.

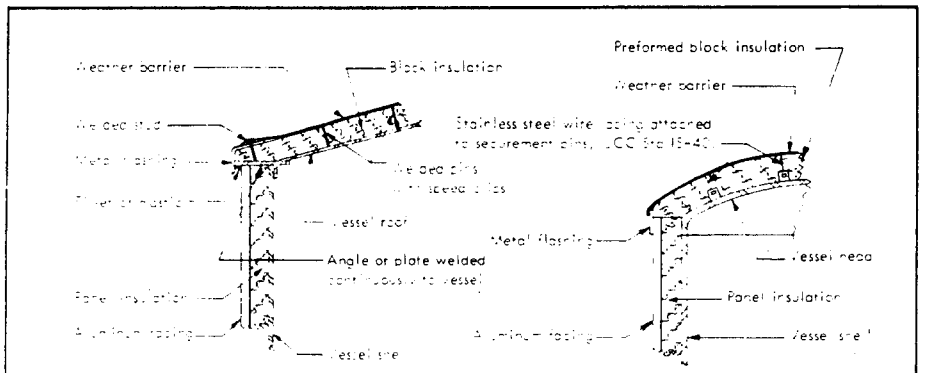
(5) Where welding to vessel is not permitted, insulation supports and attachments for insulation studs to secure head insulation, shall be installed in accordance with Owner's Standards IS-31, IS-31A, or IS-36.

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SECTION B - PREPARATION AND APPLICATION

PREPARATION - cont'd

1. [illegible] Supports and Securements - cont'd



Insulation Securement at Vessel Top and Sidewall Intersection (Welding permitted)

Figure 19-H-1

2. APPLICATION:

a. Side Walls

1) Where panels abut on vessel foundation, their bottom edges shall be cut to slope off foundation so that top edges of panels form a continuous horizontal line around circumference of vessel.

2) Arrangement of panels shall be as follows:

(a) Cuts for roof supports located at the same elevation may be simplified by arranging for horizontal lap to occur at this elevation so that top and bottom of panel may be cut to fit around nozzles.

(b) The vertical laps between panels shall be arranged where possible to fall on center line of nozzles which do not occur at the roof supports.

(c) Panels shall be installed with joints parallel to vertical axis of vessel.

3) Where vessel is on a low pad where level of rain or drainage water can reach bottom edge of panel, the first course insulation shall be [illegible] stripped from the bottom of the first course of panels to an elevation greater than the highest water level. [illegible] This amount of stripped-out fibrous insulation shall be replaced with granular glass insulation of equal thickness [illegible] the vessel.

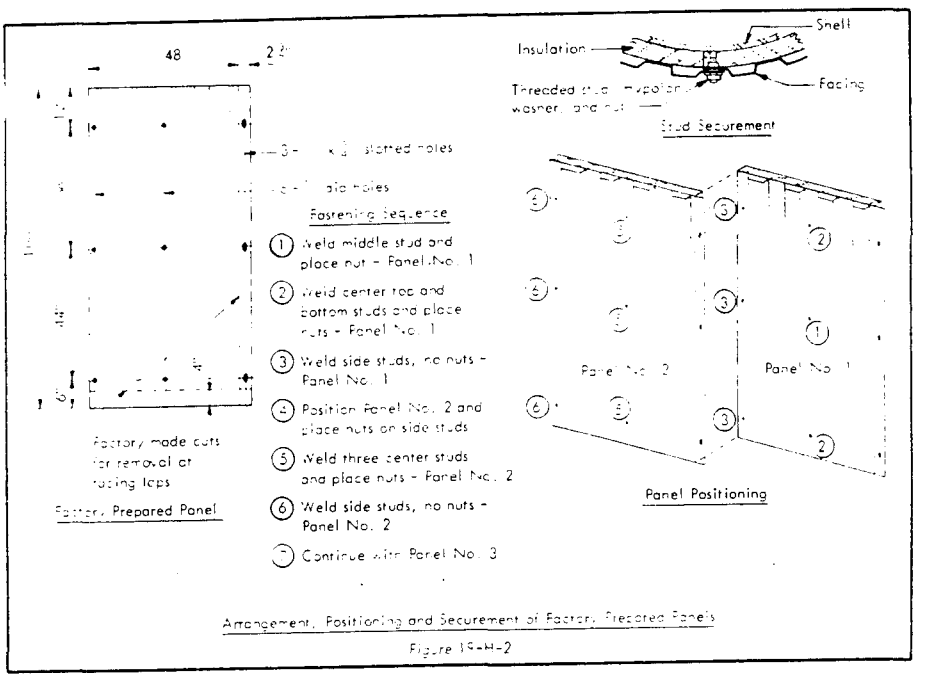
4) [illegible] shall be applied in accordance with the pattern [illegible] and arrangement [illegible] welded to the vessel and the panel held to the vessel by washers and nuts. After final paint coating, additional insulation shall be added to vessel and the panel fastened in position. Before overlapping edges of the first panel and the second panel are bolted together, 3.0 inches of insulation shall be removed from the overlapping panel. A piece of asphalt shall be placed between the overlapped aluminum sheet before bolting [illegible] together. [illegible] shall be cut to fit the top edge of the bottom course panels to support the next course of panels. [illegible] Adjustment [illegible] to provide for increase in thickness of insulation at the overlapping of the panel joints. A strip of insulation, [illegible] shall be removed from the bottom of the second course panel. The second course shall be lined up with edges of first course and bolted with stud bolts [illegible]. Care shall be taken that no studs go through both sheets of overlapped [illegible] panel. Overlapped joint of panels must be free of other contact so as to provide a true expansion joint. Fastening sequence and stud details are shown in Figure [illegible].

Union Carbide trial exhibit UC-4586: W. G. Hammar Transmittal Memoranda and Union Carbide Thermal Insulati…
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SECTION B - PREPARATION AND APPLICATION - cont'd

B. APPLICATION - cont'd

5. [illegible] Panels



Arrangement, Positioning and Securement of Factory Prepared Panels

Figure 19-H-2

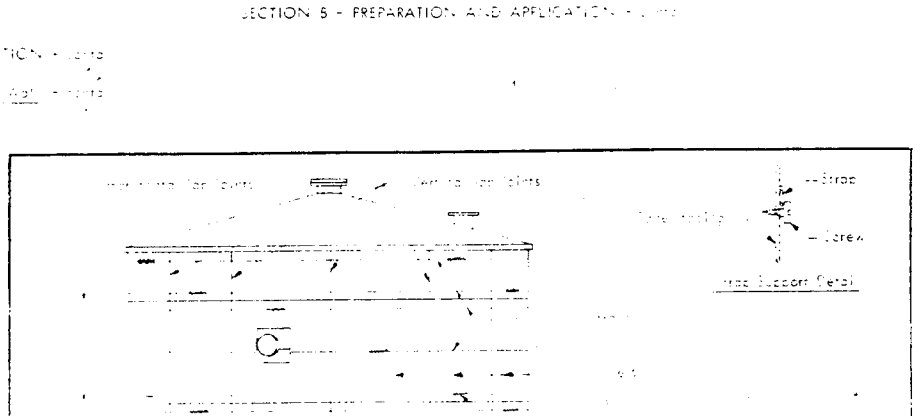
5. When panels are to be secured by strap, they shall be obtained without factory-punched holes for studs. First panel shall be positioned in place at called for in Paragraph (2) of this subsection. Insulation on overlapping edge of overlapping panels shall be removed and a bead of lap sealer placed between the overlapping faces. The panels shall be secured by straps on approximately 24-inch centers. Sheet metal screws shall be spaced at required intervals, below bands, installed with heads slightly protruding to prevent band from slipping downward. On vertical side wall panels, "S" clips shall be installed on approximately 24-inch centers along top edge. Two to four inches of insulation shall be removed from the bottom, depending on panel arrangement, and 2-3 inches from one side of each panel which is to be used on the second and following courses. This provides the overlap. The second course shall be positioned, with edges lined up with edges of the first course, over aluminum sheet supported by "S" clips. A band shall be installed at each horizontal overlap, positioned so as to ride behind front leg of the "S" clips. Bands at the intersection of the panel shall be installed as previously specified. The following courses shall be installed in identical manner. Tanks 12-feet to 20-feet in diameter shall have one expansion spring assembly installed in each band. Vessels over 20-feet shall have a spring assembly installed at approximately 30-foot intervals in each band (springs are four inches in length unstretched). Straps shall be tightened sufficiently to stretch each spring approximately three inches. The overlapped ribbed facing joint shall be held tightly together with sheet metal screws on approximately 24-inch centers. Care shall be taken that sheet metal screws do not fasten two courses of panels together at the expansion joint. "S" clips are free to slip to provide an expansion joint. Details are shown in Figure 19-H-3.

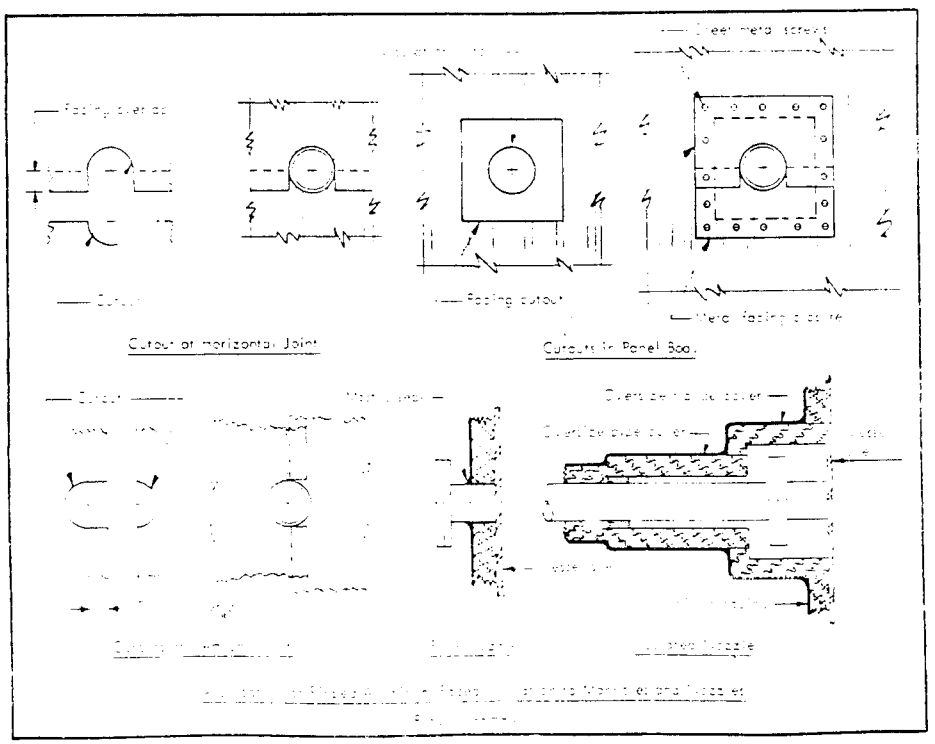
6. Wherever possible, cutouts for manholes and nozzles shall be located at the intersection of two panels. Where it is necessary to cut out a panel to fit over a manhole or nozzle, the opening shall be closed by one or two sections of panel cut to fit around the manhole or nozzle, then sealed to panel facing with lap sealer and secured in place with sheet metal screws. All cutouts shall be cut to fit around bare nozzles or the [illegible] cover of insulated nozzles or flanges. The junction shall be sealed with mastic. Details of application are shown in Figure 19-H-4.

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SECTION 5 - PREPARATION AND APPLICATION

APPLICATION - Cont'd





SECTION 9 - PREPARATION AND APPLICATION - cont'd

2. APPLICATION - cont'd

F. Roofs or Heads

1) The specified expanded silica block insulation shall be installed on roofs or heads.

2) Where welding is permitted, either rectangular securement pins or welding pins and pin clips may be used to attach the insulation blocks to the roof or head.

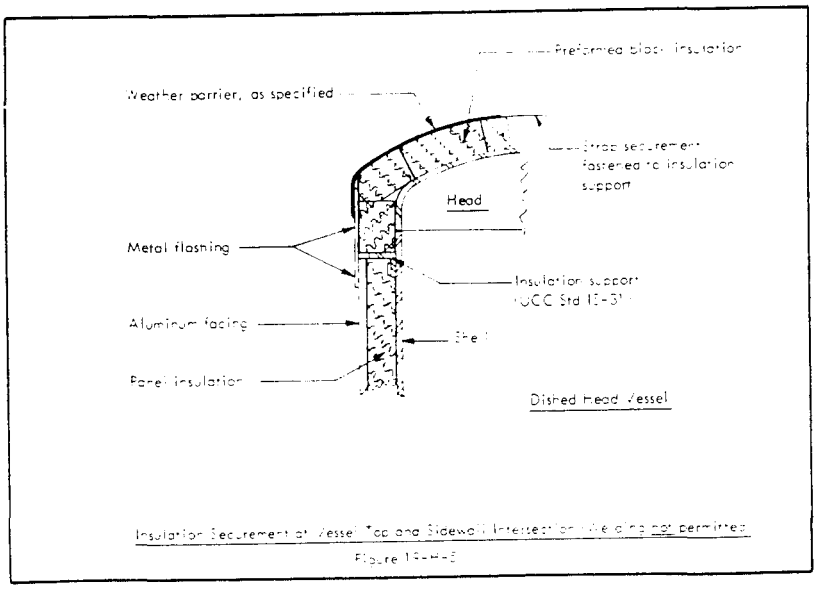
a) Where rectangular securement pins are used, they shall be welded to vessel roof or head in accordance with Owner's Standard IS-[illegible]. Stainless steel wires for lacing shall be passed through holes in rectangular pins. Blocks of insulation shall be installed in broken joint construction with all joints tightly buttec. Wires shall be pulled over block, cross laced, and ends twisted together, bent downward and embedded in the insulation. Holes and depressions caused by wire securement shall be pointed up with finishing cement and troweled to a smooth even surface.

b) Where welding pins are used, they shall be located so that a minimum of four pins impale each block, each pin located approximately two inches from each corner of the block. After insulation is impaled on pins, it shall be secured tightly to vessel by pin clips forced over the pins. Pins extending beyond pin clips shall be clipped off flush with surface. Depressions caused by clips pushed into insulation, and all [illegible] shall be pointed up with finishing cement and troweled to a smooth even surface.

3) Where welding is not permitted, the blocks shall be installed in broken joint construction with all joints tightly buttec, then secured by [illegible] insulation strap fastened to insulation supports installed in accordance with Owner's Standard IS-31 and IS-31A, and as shown on Figure [illegible].

4) Insulation cement shall be used only where necessary to fill unavoidable large voids in the insulation and, where necessary, to taper edges to provide the proper angle for water shed.

5) Small cracks and rounded edges of abutting blocks shall be pointed up with finishing cement troweled to a smooth even surface.



Insulation Securement at Vessel Top and Sidewall Intersect on Welding not permitted

Figure IS-H-3

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SECTION B - PREPARATION AND APPLICATION - cont'd

[illegible]

Flashing

Flashing for flat or cone roof vessels, as shown on Figure 19-H-1, shall be formed of aluminum sheet to fit the circumference and [illegible] thick. The drip leg shall extend a minimum of one inch below the shell angle or plate. It shall extend a minimum of six inches over the roof insulation. The flashing shall be impaled on welding pins, then secured with pin clips or laced to rectangular pins with stainless [illegible]. The joint of flashing with the underside of the shell angle or plate shall be caulked with mastic.

Metal flashing on dished head vessels shall be supported by "S" clips hooked over top of the aluminum panel jackets. The ends of flashing [illegible] lapped and joined together with sheet metal screws.

Vapor Barrier on Roof or Head - Mastic

The vapor barrier applied on cone or flat roof vessels shall extend over the top surface of the flashing.

The vapor barrier on top of dished head vessels shall extend down over the flashing a minimum of three inches.

The vapor barrier shall be applied as specified in Article XIV.B of the GENERAL SPECIFICATIONS.

Union Carbide trial exhibit UC-4586: W. G. Hammar Transmittal Memoranda and Union Carbide Thermal Insulati…
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THERMAL INSULATION APPLICATION SPECIFICATIONS

ALUMINUM FACED FIBROUS GLASS PANELS AND FIBROUS GLASS ROOF INSULATION

SCOPE

This specification describes the essential requirements for application of fibrous glass panels with integral aluminum facing for side walls and fibrous glass insulation for flat or cone-shaped roofs of vertical storage tanks twelve feet in diameter and larger normally operating at temperatures not lower than 65 F nor higher than 350 F, and on which field stud welding is permitted.

Procedures described in the GENERAL SPECIFICATIONS are applicable to and constitute an integral part of this specification.

SECTION A - MATERIALS

1. INSULATION MATERIALS

Insulation shall be as specified in MATERIAL SPECIFICATION 19.

2. ACCESSORY MATERIALS

Insulation Strap	VII.A.11	"S" Clips	VII.A.[illegible]
Strap Clips	VII.A.12	Battens	VII.A.126
Expansion Springs or Bands	VII.A.15	Studs	VII.A.[illegible]
Stainless Steel Wire	VII.A.17	Caps for Grooved Studs	VII.A.[illegible]
Welding Pin Insulation Fasteners	VII.A.22	Roof Tape	VII.A.[illegible]
Pin Clips	VII.A.23	Incombustible Adhesive	VII.A.[illegible]
Sheet Metal Screws	VII.A.32	Flashing	VII.A.31
Mastic	VII.A.45	Weather-Barrier Mastic	VII.B.[illegible]
Lap Sealer	VII.A.46	Reinforcing Cloth	VII.B.[illegible]

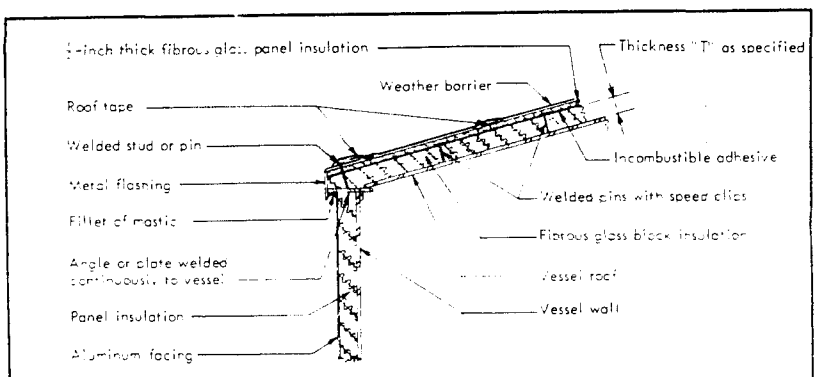
SECTION B - PREPARATION AND APPLICATION

1. PREPARATION

a. Thickness of Insulation. The thickness of insulating panels to be installed on the side walls and the thickness of the block insulation to be installed on roof shall be as shown on drawings or Insulation Schedule.

b. Insulation Supports and Securements. Vessels with flat or cone-shaped roofs shall have an angle or plate continuously welded to intersection of vessel roof and side wall to provide for insulation securement and water shed. Insulation securement for roof shall be pins welded to vessel roof located four inches from the edges and corners of the insulation, using not less than three pins on each of the sides and ends. Details are shown in Figure 19-J-1. Welded studs shall also be located on eight-inch centers, approximately two inches in from outer circumference of the edge of the top angle or plate, for securement of metal flashing.

If panel insulation on side wall of vessel does not extend to base of vessel, an angle with an outstanding leg 1 2-inch greater in length than the insulation thickness shall be welded around vessel at the level where panel insulation is to terminate.



Insulation Securement at Vessel Top and Sidewall Intersection

Figure 19-J-1

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SECTION B - PREPARATION AND APPLICATION - cont'd

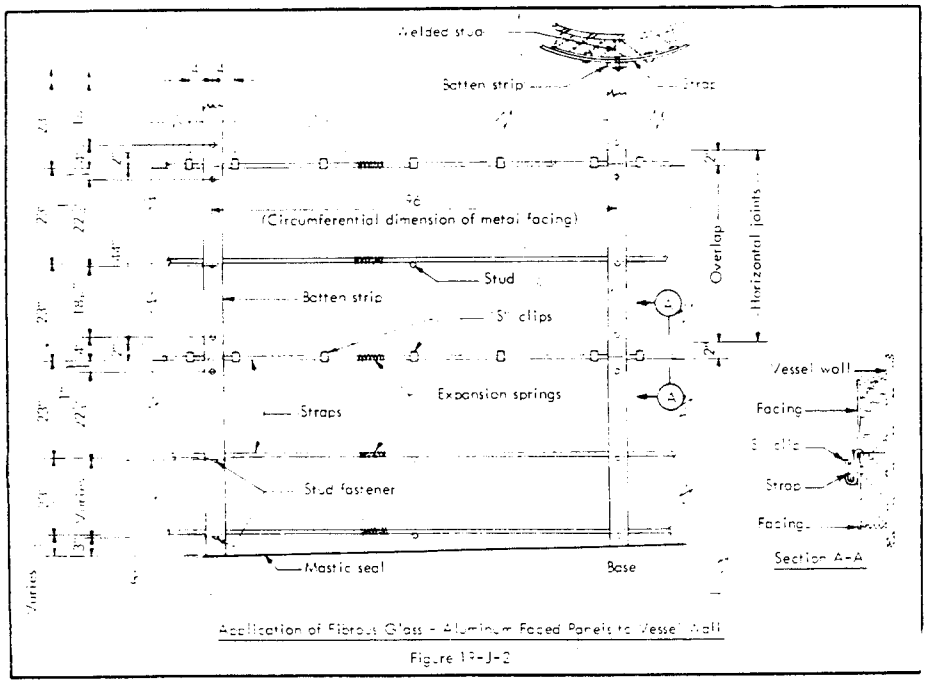
PREPARATION - contd

c. Layout for Wall Studs. Where panels about the vessel foundation, the bottom edge panel shall be cut to the slope of the foundation so that edges of first course of panels will form a continuous horizontal line around circumference of vessel, and vertical edges will be in lines parallel to axis of vessel. From these predetermined lines stud spacing shall be as follows:

Studs on side walls shall be in vertical rows, spaced to circumferential dimensions of 96 inches at the outer surface of aluminum facing. Vertical spacing shall be:

First Row - three inches above base or support angle
Again and Rows - as shown on Figure 19-J-2
Top Row - three inches from top.

Studs in knee area shall be in line with centers of largest number of nozzles that fall on edges or ends of panels. Details of stud spacing are shown on Figure 19-J-2.



Application of Fibrous Glass - Aluminum Faced Panels to Vessel Wall
Figure 19-J-2

APPLICATION

a. Side Walls

1. Begin application of panels at bottom course, laying insulated panels so that alternate rows of studs are between ends of panels and other rows are at panel joints. Butt ends of panels snugly but do not force panels out of line.

2. Where vessel is subject to rain or drainage water can reach bottom edge of panel, the fibrous glass insulation should be cut and removed from the first course of panels to an elevation greater than the highest expected water level. In no case shall this be less than nine inches. The removed fibrous glass insulation shall be replaced with suitable insulation of equal thickness cut to fit the diameter of the vessel.

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SECTION B - PREPARATION AND APPLICATION - contd

2. APPLICATION - contd

a. Side Walls - contd

(3) Impale first course panels on centerline studs, then secure with grooved caps or nuts, depending on type of stud used.

(4) Batten strips, over vertical joints of first course, shall be cut to be two inches less than height of top edge of first course panel, and shall be impaled over studs. After application of a bead of non-setting sealer on each edge of batten, it shall be positioned and secured with the stud caps or nuts.

(5) Install "S" Clips along top edge of first course of panels. A clip shall be placed four inches from each end, and three others shall be spaced equally from the end clips.

(6) Remove two inches of the fibrous glass (which is not adhered to the aluminum facing) from the bottom edge of each panel which is to be used for the second and successive courses. This provides for the two inches of facing overlap.

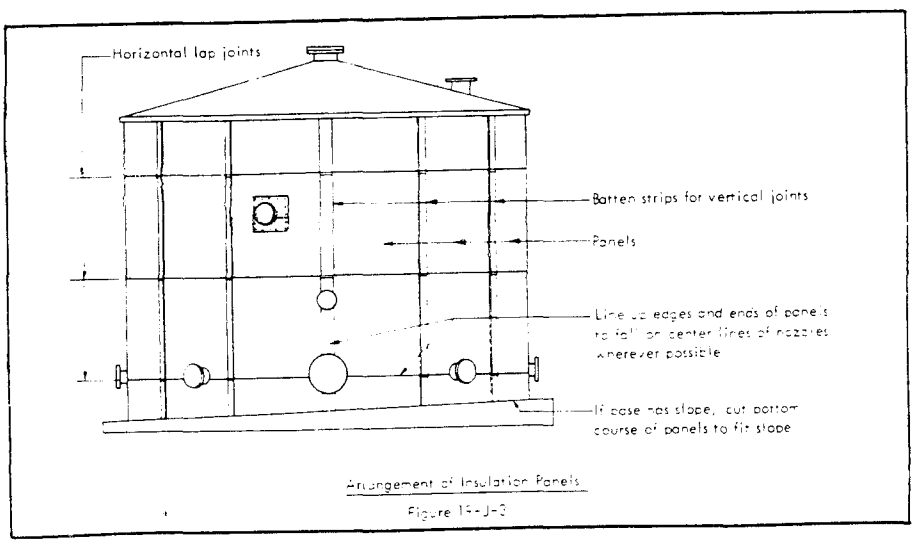
(7) Position second course, supported by "S" clips on top edge of first course, with ends of panels of the first course. Impale panels on studs at center, secure with cap or nut, then form around vessel so that ends are butted against studs at ends. After application of a bead of non-setting sealer at each end, position and impale batten to secure ends of adjacent panels to form watertight joint. Battens shall be secured in place with caps or nuts. Successive courses shall be installed in an identical manner.

(8) Insulation straps shall be installed on a vertical spacing as shown on Figure 19-J-2. Straps shall be installed to ride behind the front legs of "S" clips, and alternate spaced straps shall be positioned behind top edge of stud caps or nuts prior to final tightening of these caps or nuts.

(9) Vessels twelve feet to twenty feet in diameter shall have one expansion spring installed in each band. Vessels over twenty feet in diameter shall have an expansion spring installed at approximate 30-feet intervals in each band. Springs (four inches long unstressed) should be stretched approximately three inches when installed.

(10) Details of stud layout and panel installation are shown in Figure 19-J-2.

(11) Cutouts for manholes and nozzles shall, wherever possible, be located at the intersection of two panels as shown in Figure 19-J-3. Where it is necessary to cut out a panel to fit over a manhole or nozzle, the opening shall be closed up by one or two sections of panel cut to fit around the nozzle, then sealed to panel facing with non-setting sealer and secured in place with sheet metal screws. All cutouts shall be cut to fit around bare nozzles or the insulation cover of insulated nozzles or flanges. Junction shall be sealed with caulking mastic. Details of application are shown in Figure 19-J-4.



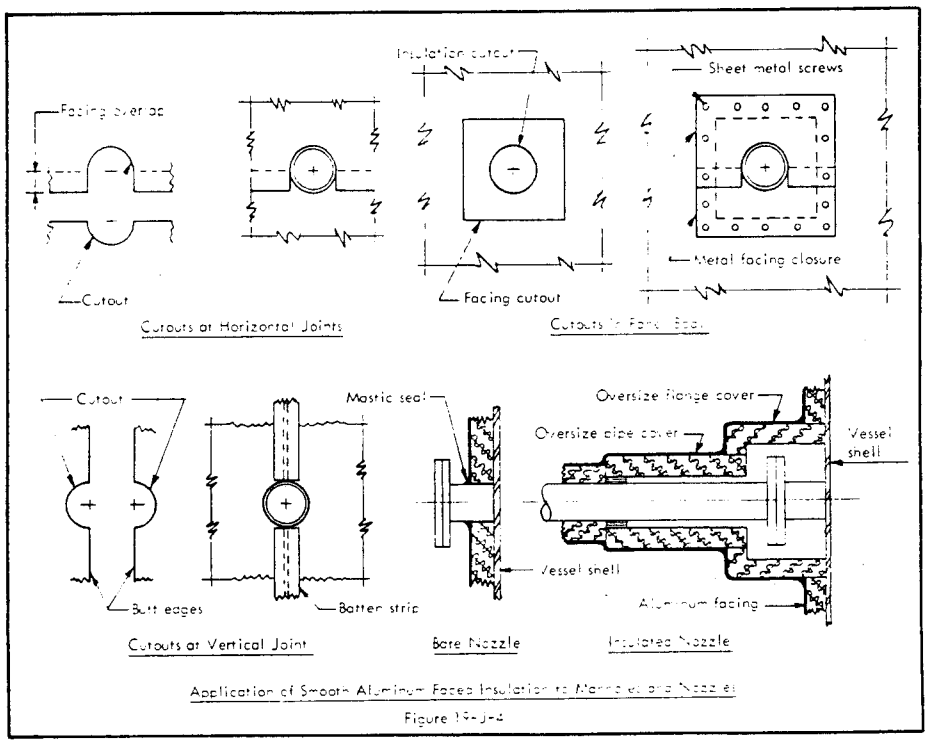
Arrangement of Insulation Panels

Figure 19-J-3

SECTION B - PREPARATION AND APPLICATION - cont'd

D. APPLICATION - cont'd

a. Side Walls - cont'd



Application of Smooth Aluminum Faced Insulation to Manhole and Nozzles

Figure 19-J-4

Roof

1. Roof insulation shall consist of two layers of fibrous glass roof insulation installed in broken joint construction.

2. Vessels with maximum operating temperature below 220 F shall be insulated with insulation roof panels as received. If vessel has a maximum temperature which exceeds 220 F the roof panels used on first layer shall have the wraparound weather barrier at edges of panels filleted into the board prior to installation.

3. The first layer of fibrous glass roof insulation shall be fully secured in place and shall be impaled on pins welded to the vessel roof. Pins shall be positioned as specified in Item 1(d) of this section so that a minimum of eight pins are used per 36 by 48-inch roof insulation panel. After insulation is impaled on pins it shall be secured tightly to vessel roof by pin clips forced on the welded pins.

4. The outer roof layer of 1 2-inch thick fibrous glass roof insulation shall be installed in broken joint construction by embedding it in a suitable adhesive spread over first layer of insulation at a uniform rate of 2½ gallons per 100 square feet. On roofs of small curvature it may be necessary to cut through the asphalt cap sheet in straight lines to allow insulation boards to lay to proper curvature. Joints shall be tightly butted and staggered in both directions.

5. Joints and cuts through asphalt cap sheet shall be covered with roofing tape embedded in asphalt spread over the joints and cuts at the rate of two gallons per 100 square feet. Tape end joints shall be lapped a minimum of [illegible]

SECTION B - PREPARATION AND APPLICATION - contd

2. APPLICATION - contd

c. Flashing

(1) Metal flashing as shown on Figure 19-J-1 shall be formed of aluminum sheet to fit circumference and curvature of roof. Drip leg shall extend a minimum of one inch below shell angle or plate. It shall extend a minimum of six inches over roof insulation.

(2) Impale flashing on studs then secure with grooved caps or nuts, depending on type of stud used.

(3) Junction of flashing with underside of shell angle or plate shall be caulked with caulking mastic.

(4) Tape embedded in adhesive shall be applied over junction of insulation and edge flashing.

d. Weather Barrier on Roof - Mastic

1. Weather barrier over roof insulation shall extend down over top surface of flashing.

2. Weather barrier shall be applied as specified in Article XIV.B of the GENERAL SPECIFICATIONS.

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THERMAL INSULATION APPLICATION SPECIFICATIONS

ASBESTOS FIBER

SCOPE

This specification describes the essential requirements for application of preformed asbestos fiber insulation for use on piping, including stainless steel, normally operating at temperatures from 70 F up to and including 1000 F. It is applicable to both indoor and outdoor service.

Procedures described in the GENERAL SPECIFICATIONS are applicable to and constitute an integral part of this specification.

SECTION A - MATERIALS

1 INSULATION

Insulation shall be as specified in MATERIAL SPECIFICATION 21.

2 ACCESSORY MATERIALS

Accessory materials shall be as specified in the MATERIAL SPECIFICATIONS, article numbers as noted.

White Glass Wool Blanket	VII.A. 1	High Temperature Fabricating Cement	VII.A.[illegible]
Insulating Cement	VII.A. 6	Heat-Resistant Sealer	VII.A.[illegible]
Pipe Insulation Support	VII.A. 9	Mastic	VII.A.[illegible]
Pipe Insulation Strap	VII.A.13	Weather-Barrier Mastic (color as specified)	VII.B.[illegible]
Clips for Pipe Strap	VII.A.14	Reinforcing Cloth	VII.B.[illegible]
Stainless Steel Wire	VII.A.17	Stainless Steel Weather-Barrier Jacket (Designation MA)	VII.B.[illegible]
Stainless Steel Pins	VII.A.20	Treated Steel Weather-Barrier Jacket (Designation MT)	VII.B.[illegible]

SECTION B - APPLICATION

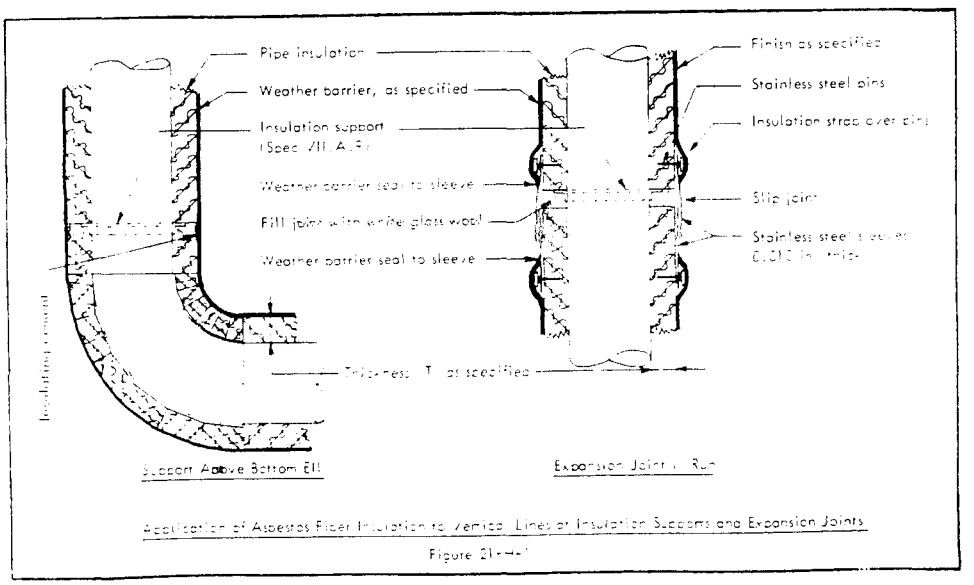
1 PIPE INSULATION

a. Pipe insulation shall be supported and secured as specified in Article II of the GENERAL SPECIFICATIONS.

b. Insulation in excess of 3 inches total thickness shall be applied in multiple layers as specified in Article III.E of the MATERIALS SPECIFICATIONS.

c. Pipe insulation shall be applied to piping in a staggered position in accordance with Figures GA-1 and GA-2 of the GENERAL SPECIFICATIONS.

d. Insulation shall be applied with all joints tightly butted and fitted, to eliminate voids. Large voids shall not be filled with weather-barrier mastic but eliminated by either refitting or replacing insulation. Any rounded corners on the insulation surfaces to be butted shall be trued before application.



Application of Asbestos Fiber Insulation to Vertical Lines at Insulation Supports and Expansion Joints

Figure 21-H-1

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SECTION B - APPLICATION - cont'd

1. PIPE INSULATION - cont'd

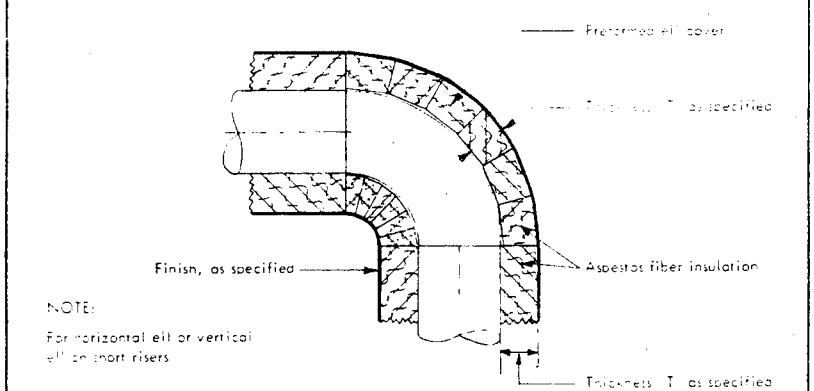
e. Factory-attached sheeting, where furnished, shall be removed from insulation before application.

f. Small cracks and depressions, where present, shall be pointed up with insulating cement and troweled flush with the surface of the insulation.

2. VERTICAL PIPE

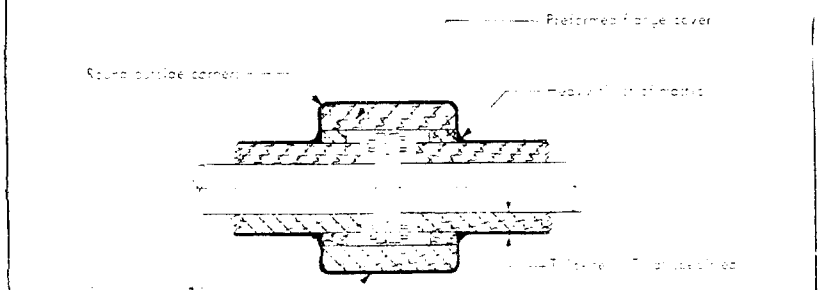
a. Insulation on 4-inch NPS and larger pipe extending more than 15 feet above bottom elbow, shall be supported by a pipe insulation support located directly above the elbow. Typical installation is shown in Figure 21-H-1. A pipe insulation support shall also be installed above each pair of flanges or flanged valve in vertical pipe.

b. When pipe extends more than 15 feet above pipe insulation supports located directly above elbows, flanges, or flanged valves, additional supports shall be installed on approximately 15-foot centers to provide for installation of an expansion joint as shown in Figure 21-H-1.



Application of Asbestos Fiber Insulation to Welded Ell

Figure 21-H-2



Application of Asbestos Fiber Insulation to Line Flange

Figure 21-H-3

SECTION B - APPLICATION - contd

3. FITTING, FLANGE, AND VALVE COVERS

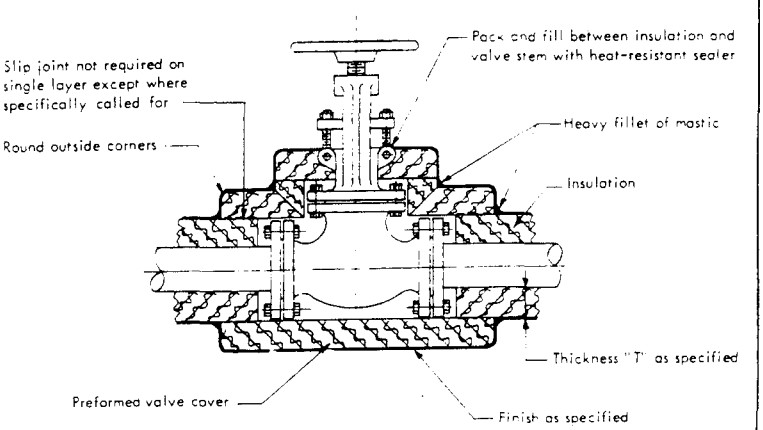
a. With exception of ball and plug valves, all fittings, flanges, and valves over three-inch NPS shall be insulated with covers prefabricated in accordance with ASTM Recommended Practice C 450, latest revision.

b. Ball and plug valve covers shall be field fabricated of proper sized pipe covering.

c. Screwed and welded fitting covers for three-inch NPS and smaller piping may be field fabricated.

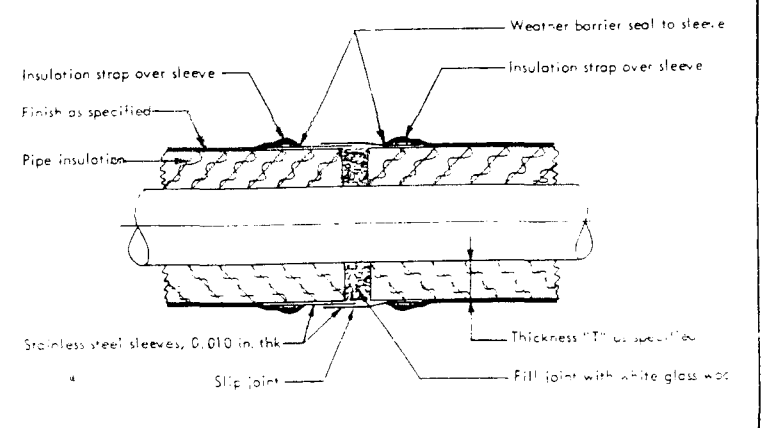
d. All valves shall be packed around valve stem and packing gland assembly with heat-resistant sealer to eliminate water pockets.

e. Cementing of shop assemblies shall be done with fabricating cement. In all cases the joints shall be as thin as possible with just sufficient cement to obtain good adhesion and complete closure. In no case will wide cement joints, or voids and holes plugged with cement, be permitted.



Application of Asbestos Fiber Insulation to Flanged Valve

Figure 21-H-4



Application of Expansion and Contraction Joint to Asbestos Fiber Insulation on Horizontal Piping

Figure 21-H-5

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SECTION B - APPLICATION - cont'd

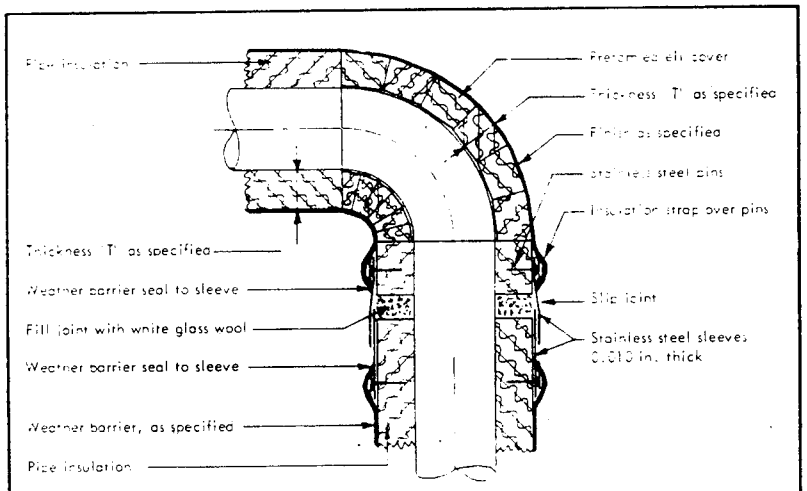
4. EXPANSION AND CONTRACTION JOINTS

a. Expansion and contraction joints shall be provided in the insulation on 4-inch NPS and larger horizontal piping. An expansion and contraction joint shall be installed in each 21 feet of straight pipe not interrupted by flanges, valves, or fittings, and insulated with multiple layer insulation; and in each 42 feet insulated with single layer insulation. Typical installation is shown in Figure 21-H-5. Where flanged fittings or valves occur within these intervals, expansion and contraction shall be provided for in the flange cover, and expansion and contraction joints in the insulation will not be required.

b. If an expansion or contraction crack occurs after a line has been put in service, the crack shall be filled with white glass wool, and an expansion and contraction joint installed at that location.

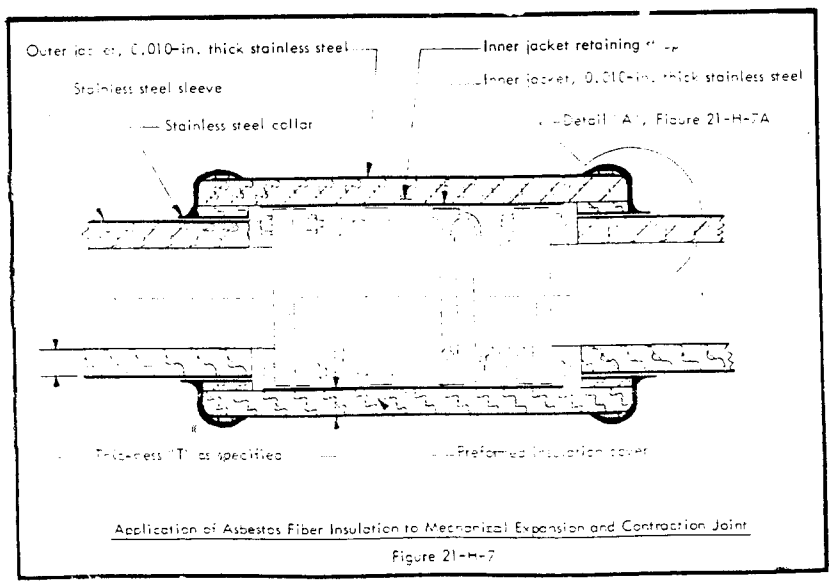
c. Expansion slip joints shall be installed at the insulation support in vertical piping, as shown in Figure 21-H-1.

d. Expansion slip joints shall also be provided at the junction of fitting covers and pipe insulation located at the tops of risers where riser exceeds 15 feet in height and size is 4-inch NPS and larger. Typical installation is shown in Figure 21-H-6.



Application of Asbestos Fiber Insulation to Welded Ell with Slip Joint at Top of Vertical Line

Figure 21-H-6



Application of Asbestos Fiber Insulation to Mechanical Expansion and Contraction Joint

Figure 21-H-7

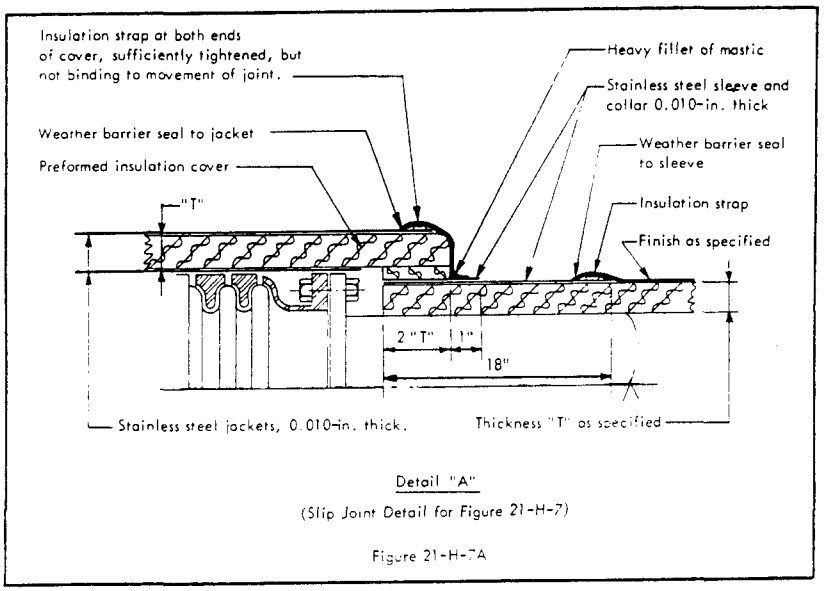
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SECTION B - APPLICATION - cont'd

5. MECHANICAL EXPANSION JOINTS

a. Corrugated mechanical expansion joints in piping (usually listed as equipment items) shall be insulated as shown in Figures 21-H-7 and 21-H-7A. A slip joint shall be provided by applying an 18-inch long sleeve of 0.010-inch thick stainless steel over the pipe insulation at each end of the expansion joint, flush with the butt end of the pipe covering. The sleeve shall be secured with strap at one end only, that farthest from the expansion joint cover. A collar band of 0.010-inch thick stainless steel, of sufficient width to project 1 inch beyond the expansion joint insulation cover, shall be applied over the sleeve and held in place by the expansion joint cover, which is then secured with insulation strap. The longitudinal laps of the stainless steel bands shall be a minimum of 2 inches, and shall be placed so as to shed water. Weather-barrier mastic shall be applied to the ends of the expansion joint cover and carried down and sealed to the collar band. Weather barrier mastic shall overlap the stainless steel weather jacket on the expansion joint cover.

b. Where expansion joints are installed vertically in piping, the slip joint at the top shall be omitted and the expansion joint cover securely fastened to the pipe covering.



Detail "A"
(Slip Joint Detail for Figure 21-H-7)

Figure 21-H-7A

6. TRACED INSTALLATIONS

Tracing and insulation of traced lines shall be installed as specified in Article XIII of the GENERAL SPECIFICATIONS.

7. WEATHER BARRIER

Weather-barrier coating or jacket, whichever is called for, shall be applied as specified in Articles XIV.B and XV.B, respectively, of the GENERAL SPECIFICATIONS. Mastic weather barrier shall be used unless metal jacket is called for as follows:

a. Weather barrier consisting of stainless steel jacketing, where required, shall be called for by the addition of the letter M to the specification designation, thus 21-HM or 21-HSSM.

b. Weather barrier consisting of treated steel jacketing, where required, shall be called for by the addition of the letters MT to the specification designation, thus 21-HMT or 21-HSSMT.

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THERMAL INSULATION APPLICATION SPECIFICATIONS

BONDED EXPANDED SILICA

SCOPE

This specification describes the essential requirements for application of preformed bonded and reinforced expanded silica (perlite) insulation for use on equipment and piping, including stainless steel, normally operating at temperatures from 70 F up to and including 1200 F.

Procedures described in the GENERAL SPECIFICATIONS are applicable to and constitute an integral part of this specification.

SECTION A - MATERIALS

1. INSULATION MATERIAL

Insulation material shall be as specified in MATERIAL SPECIFICATION NO. 22.

2. ACCESSORY MATERIALS

Accessory materials shall be as specified in the MATERIAL SPECIFICATIONS, article numbers as noted.

Cushioning Blanket	VII.A. 1	Stainless Steel Skewers	VII.A. 6
Mineral Wool Blanket (wire netting on both sides)	VII.A. 5	Welding Pin Insulation Fasteners	VII.A. 22
Insulating Cement	VII.A. 7	Pin Clips	VII.A. 23
Pipe Insulation Support	VII.A. 9	Fabricating Cement	VII.A. 24
Equipment Insulation Strap	VII.A.11	Heat-Resistant Sealer	VII.A. 25
Clips for Equipment Strap	VII.A.12	Mastic	VII.A. 26
Pipe Insulation Strap	VII.A.13	Mineral Wool Blanket (wire netting on one side, expanded metal lath on the other side)	VII.A. 28
Clips for Pipe Strap	VII.A.14	Weather-Barrier Mastic (color as specified)	VII.B. 1
Stainless Steel Wire	VII.A.17	Reinforcing Cloth	VII.B. 2
Wire Netting	VII.A.18	Stainless Steel Weather-Barrier Jacket (Designation MS)	VII.B. 3
Welding Pins	VII.A.19	Treated Steel Weather-Barrier Jacket (Designation MT)	VII.B. 5
Stainless Steel Pins	VII.A.20		

SECTION B - APPLICATION

1. EQUIPMENT

a. Insulation Supports. Equipment shall be provided with insulation supports as specified in Article II of the GENERAL SPECIFICATIONS.

b. Thickness Schedule. Unless otherwise specified, insulation in excess of 3 inches total thickness shall be applied in multiple layer construction, as specified in Article III.B of the MATERIAL SPECIFICATIONS.

c. Cushioning Blanket. On all equipment operating above 400 F or 8 feet and larger in diameter, a one-inch thick cushioning blanket shall be applied over the entire surface before application of the expanded silica insulation. On equipment operating up to 1000 F Cushioning Blanket VII. A. 1, shall be used, above 1000 F up to 1200 F, Blanket VII. A. 5 shall be used. The blanket shall not be compressed, and shall be secured in place with a minimum amount of stainless steel wire. Cushioning blanket shall not be considered as part of the specified insulation thickness.

d. Curved Surfaces. On all equipment, insulation block shall be properly cut in curved sectors and rectangular blocks, as required to fit vessel surfaces, with a 1-inch space allowed for cushioning blanket where used, and applied to vessel sides and heads in staggered position, with all joints tightly butted. Multiple layers shall be applied so that the butt joints of one layer do not coincide with those of any other layer. Typical installation is shown in Figure 22-H-1.

e. Flat Surfaces

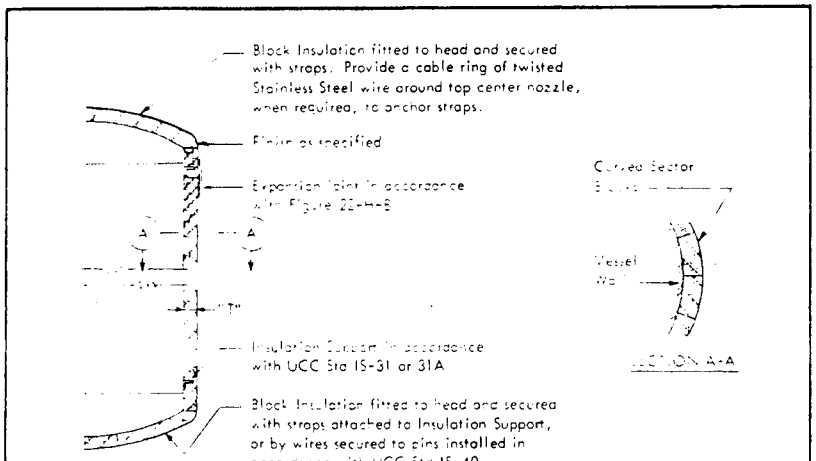
(1) Block insulation shall be applied to flat surfaces in staggered position with all joints tightly butted. It shall be secured with wire attached to welding pins as shown in Owner's Standard, IS-40 or other approved securement. On rectangular equipment, the welding pins or other approved securements, shall be placed on 12-inch centers, diamond pattern for top surfaces, on 18-inch centers, diamond pattern, for side surfaces and on 24-inch centers, diamond pattern for top surfaces. Where specified in the Insulation Schedule, block may be applied to flat surfaces with an approved adhesive.

(2) When specified thickness of insulation has been applied, wire netting shall be stretched tightly over block and secured with the wires or other approved securement. Entire surface shall be given a ½-inch thick, smooth and uniformly applied trowel coat of insulating cement. Typical installation is shown in Figure 22-H-2.

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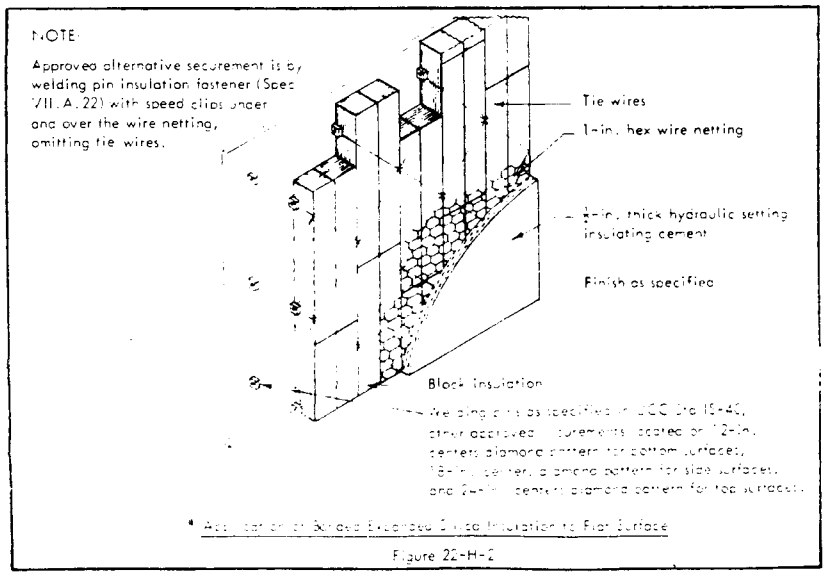
SECTION B - APPLICATION - contd

i EQUIPMENT - contd



Application of Bonded Expanded Silica Insulation to Vessel Shell and Heads

Figure 22-H-1



* Application of Bonded Expanded Silica Insulation to Flat Surface

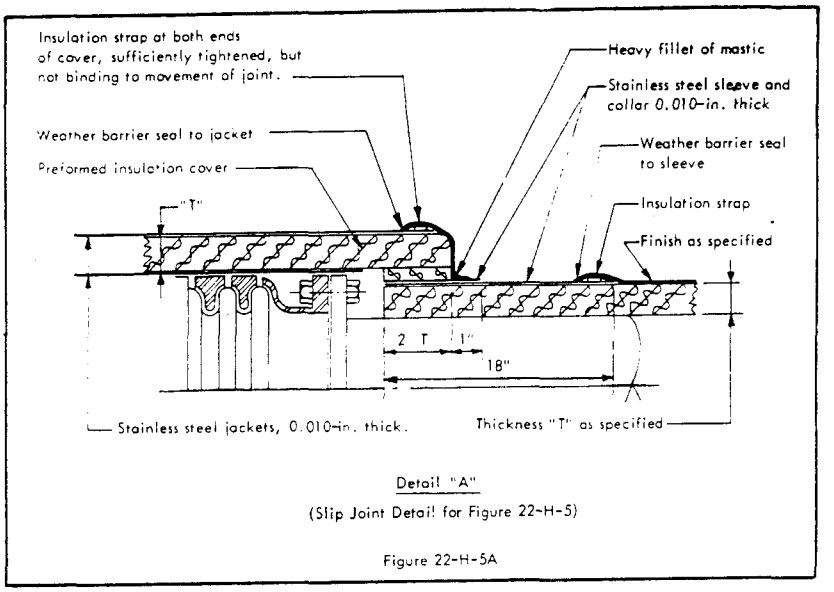
Figure 22-H-2

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SECTION B - APPLICATION - conta

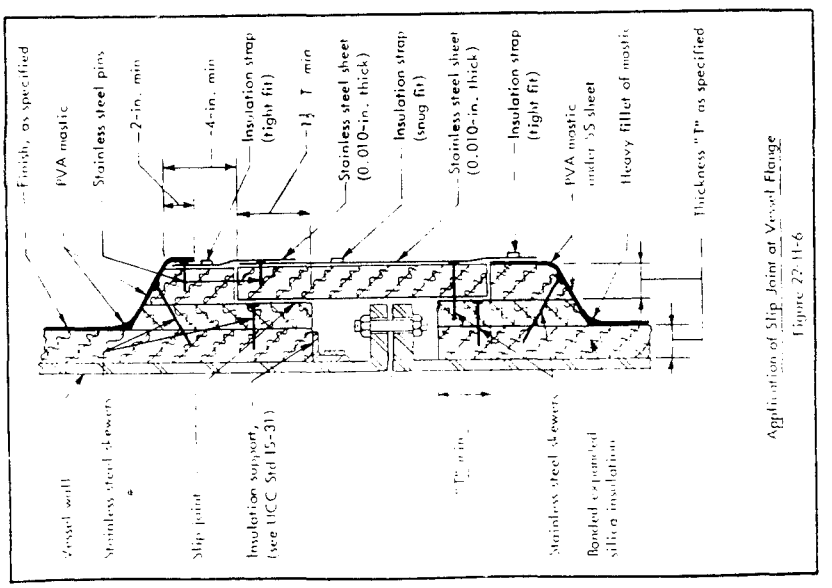
1. EQUIPMENT - conta

i. Insulated Vessel Flanges. Vessel flanges shall be insulated with preformed insulation assembly and weather protected by stainless steel jacket. An insulation support shall be provided immediately above vessel flange. Assembly shall be installed so as to provide slip joints which will allow movement of insulation and weather-barrier jacket. The top of projecting flange insulation shall be sloped to shed water. Typical installation is shown in Figure 22-H-6



Detail "A"
(Slip Joint Detail for Figure 22-H-5)

Figure 22-H-5A



Application of Slip Joint at Vessel Flange
Figure 22-H-6

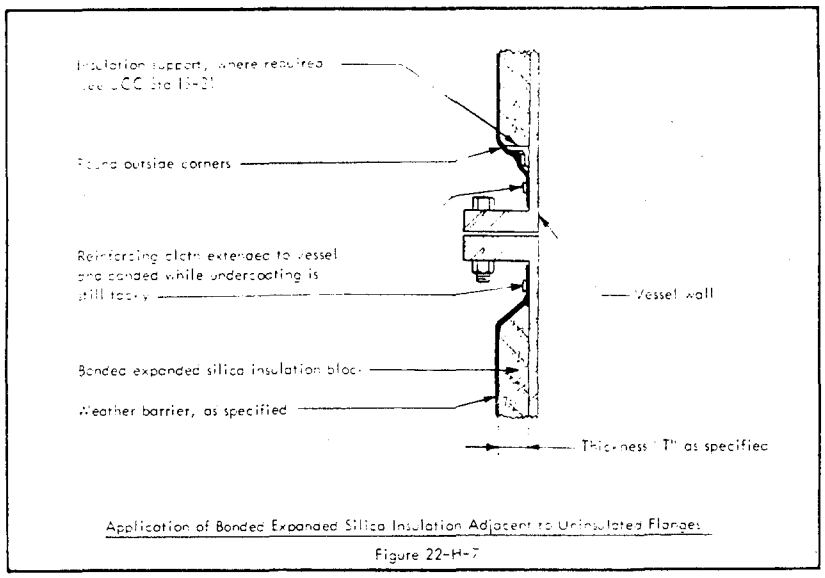
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SECTION B - APPLICATION - cont'd

EQUIPMENT - cont'd

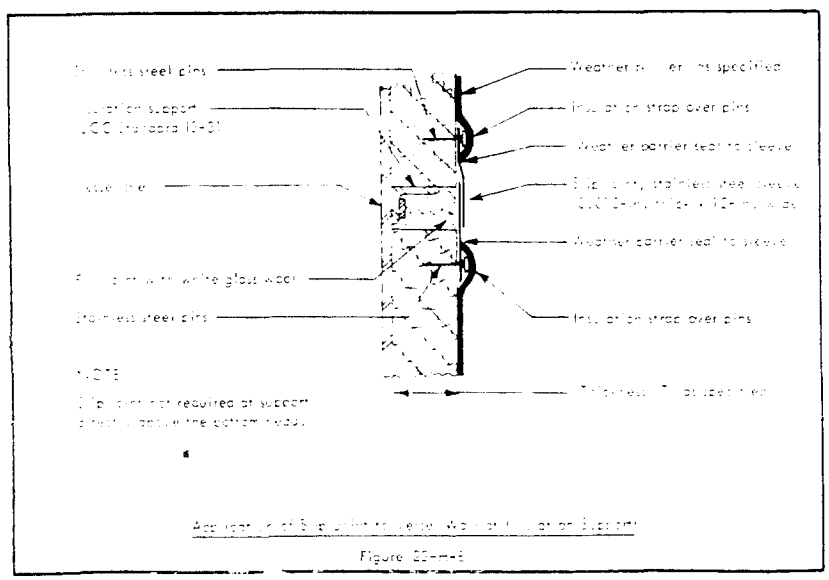
Uninsulated Vessel Flanges. Where vessel flanges are uninsulated, the reinforcing cloth of the weather barrier, on the adjacent vessel insulation, shall be extended to metal of vessel body, coated with weather-barrier coating, and bonded while coating is still tacky. A second application of weather-barrier coating shall then be applied over the reinforcing cloth and securement. Typical installation is shown in Figure 22-H-7.

Insulation Support. A slip joint shall be provided at each insulation support, except the bottom support, on vertical vessels, and at each insulation support without exception on horizontal vessels. Typical installation is shown in Figure 22-H-8.



Application of Bonded Expanded Silica Insulation Adjacent to Uninsulated Flanges

Figure 22-H-7



Application of Slip Joint at Insulation Support

Figure 22-H-8

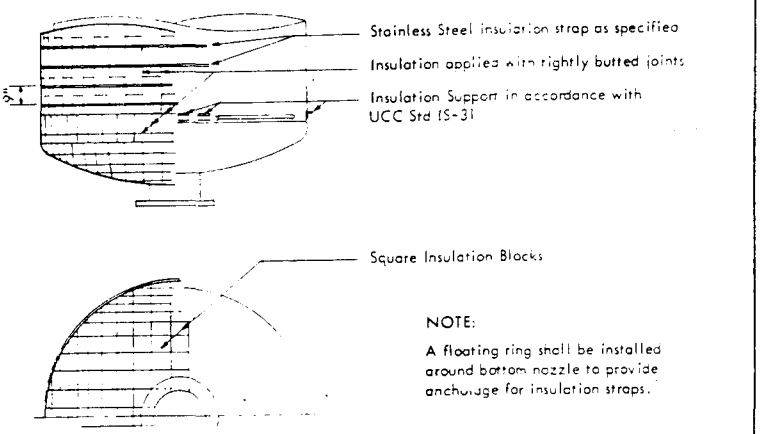
SECTION B - APPLICATION - cont'd

1. EQUIPMENT - cont'd

a. Securement

(1) All layers of insulation shall be secured with insulation strap where contour of vessel permits firm and effective attachment. Where required, insulation strap shall be attached to strap anchor angles as shown in Owner's Standard IS-31A. Insulation applied to irregular surfaces, where use of strap is impracticable, shall be secured with wire, fastened to welding pins, drawn taut, ends twisted and embedded in insulation.

(2) All layers of insulation on bottom heads of vertical equipment and heads of horizontal equipment shall be secured in place with wire attached to welding pins or with insulation strap attached to insulation support, as shown in Owner's Standards IS-31, IS-40, and Figure 22-H-3



Application of Bonded Expanded Silica Insulation to Bottom Vessel Head

Figure 22-H-3

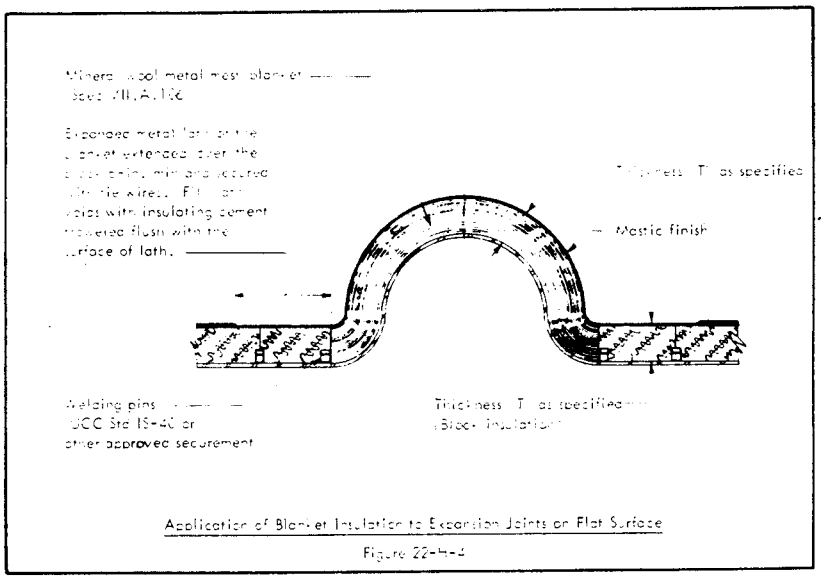
b. Flanges. Manhole flanges, piping flanges, and vessel flanges shall be insulated unless otherwise specified.

c. Expansion Joints

(1) Expansion joints in flat surfaces or cylindrical vessels shall be insulated with flexible blanket insulation. Typical joints are shown in Figure 22-H-4.

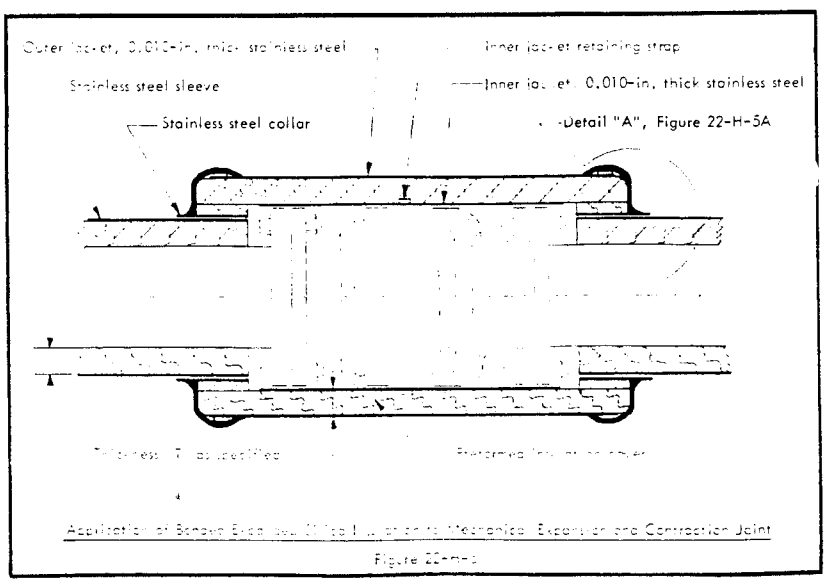
(2) Corrugated mechanical expansion joints in piping (usually listed as equipment items) shall be insulated as shown in Figures 22-H-5 and 22-H-5A. A slip joint shall be produced by applying an 18-inch long sleeve of 0.010-inch thick stainless steel over the pipe insulation at the weather end of the expansion joint, placed flush with the butt end of the pipe covering. The sleeve shall be secured with straps at the end of the high temperature insulation cover. A collar band of 0.010-inch thick stainless steel, of sufficient width to project 1-inch beyond the expansion joint insulation cover, shall be applied over the sleeve and held in place on the expansion joint cover which is then secured with a jacket or strap. The longitudinal laps of the stainless steel bands shall be a minimum of 2 inches and shall be placed so as to shed water. Weatherproof mastic shall be applied to the ends of the expansion joint cover and carried down and sealed to the collar band. Weatherproof mastic shall cover all of the stainless steel weather jacket of the expansion joint cover.

Where expansion joints are installed vertically in piping, the slip joint at the top shall be omitted and the expansion joint cover and pipe insulation terminated at the pipe covering.



Application of Blanket Insulation to Expansion Joints or Flat Surface

Figure 22-H-4



Application of Bonded Blanket Insulation to Mechanical Expansion and Connection Joint

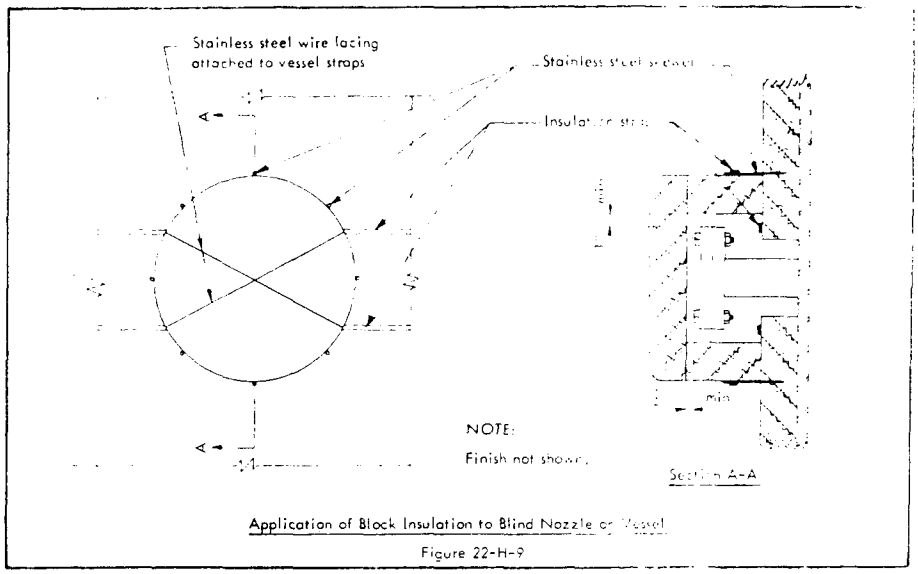
Figure 22-H-5

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SECTION B - APPLICATION - cont'd

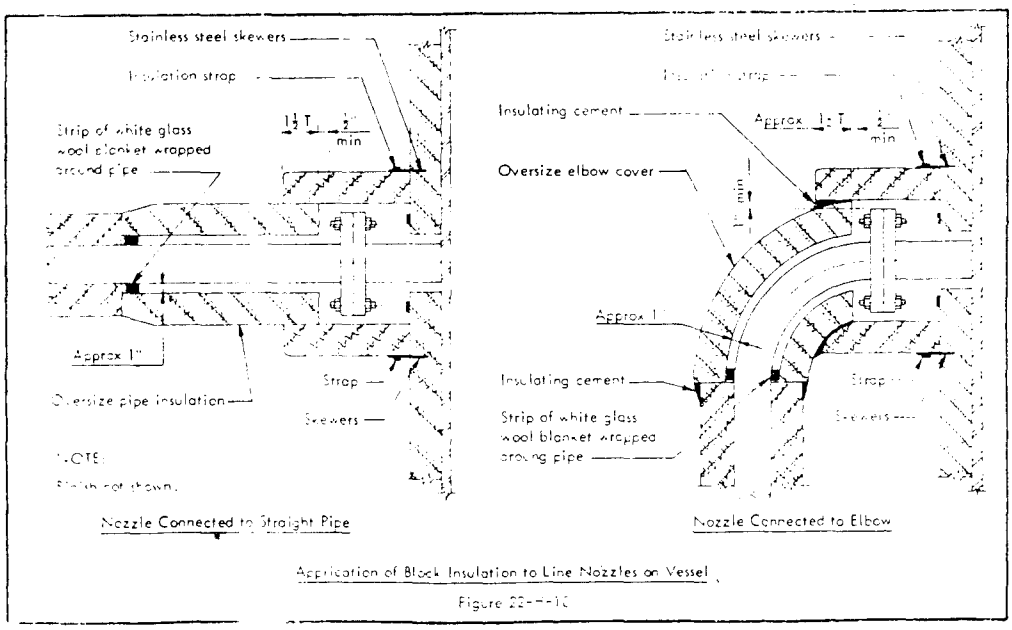
1. EQUIPMENT - contd

f. Vessel Nozzles. Vessel nozzles shall be insulated as shown in Figures 22-H-9 and 22-H-10



Application of Block Insulation to Blind Nozzle on Vessel

Figure 22-H-9



Application of Block Insulation to Line Nozzles on Vessel

Figure 22-H-10

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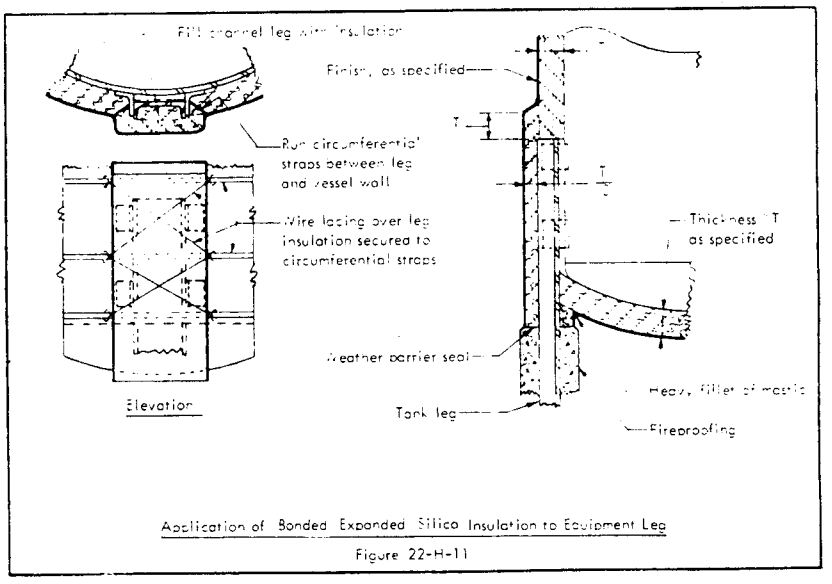
1. EQUIPMENT - cont'd

- Vessel Legs

1. Cylindrical leg structural tubing legs shall be insulated as specified in Article [illegible]C of the GENERAL SPECIFICATIONS.

2. Channel legs shall be insulated with block which shall extend over channel flange and down channel legs to fireproofing. Thickness shall be a minimum of one-half that specified for body of vessel.

3. Vessel insulation shall be butted firmly against tank leg flange. Re-entrant space between channel flanges and over channel flanges between legs insulation shall be filled with blocks. Installation shall be as shown in Figure 22-H-11.



Application of Bonded Expanded Silica Insulation to Equipment Leg

Figure 22-H-11

- Vessel Skirts. Skirts supporting vertical equipment shall have their outer surfaces insulated [illegible] unless otherwise specified [illegible] a minimum distance of skirt with bottom head, a minimum of four times the specified [illegible] but not less than 12 inches. If bottom of skirt is less than 12 inches [illegible]. Thickness and type as specified for body of vessel. The bottom head insulation shall be [illegible] accordance with Owner's Standard [illegible]. Installation shall be as shown in Figure 22-H-12.

- Traced Installations. Tracing and insulation on traced equipment shall be installed as specified in Article XIII of the GENERAL SPECIFICATIONS.

- Surface Finish. Where specified thickness of insulation has been applied, any small cracks or portions shall be pointed up with [illegible] and finished smooth to the shape of insulation.

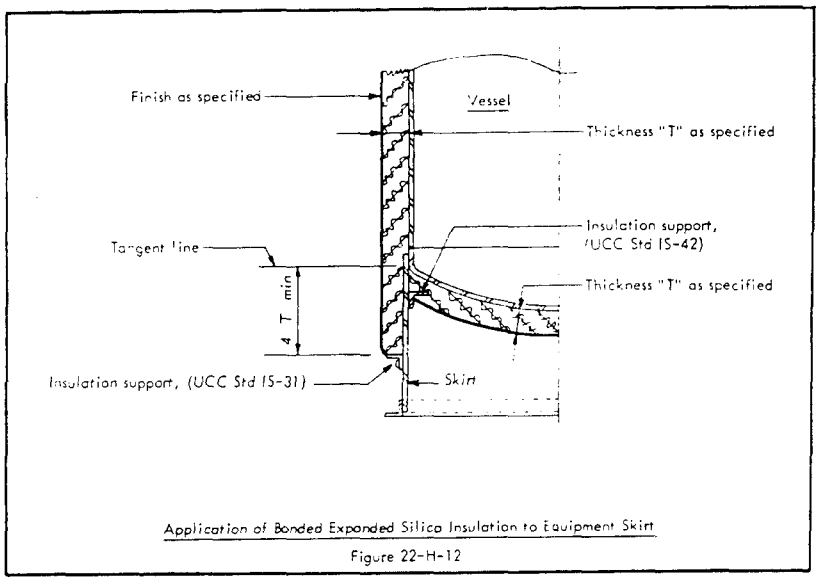
- Weather Barrier. Weather-barrier coating of jacket, whether [illegible] applied, shall be applied as specified in Articles A[illegible] and A[illegible], respectively, of the GENERAL SPECIFICATIONS. Mastic weather barrier shall be used unless metal barrier is called for as follows:

1. Weather barrier consisting of stainless steel jacketing, where required, shall be called for by the addition of the letter S to the specific weather designation, thus 22-HAS or 22-HSAS.

2. Weather barrier consisting of treated steel jacketing, where required, shall be called for by the addition of the letters AT to the specific weather designation, thus 22-HAT or 22-HSAT.

SECTION B - APPLICATION - cont'd

1 EQUIPMENT - cont'd



Application of Bonded Expanded Silica Insulation to Equipment Skirt

Figure 22-H-12

2 PIPING

a Pipe Insulation

(1) Insulation Supports. Pipe insulation shall be supported and secured as specified in Article III of the GENERAL SPECIFICATIONS.

(2) Thickness Schedule. Unless otherwise specified, insulation in excess of 3 inches total thickness shall be applied in multiple construction as specified in Article III.B of the MATERIAL SPECIFICATIONS.

(3) Vertical Pipe

(a) Insulation on 4-inch NPS pipe and larger, extending more than 15 feet above the bottom elbow, shall be supported by a pipe insulation support located directly above the elbow. Typical installation is shown in Figure 22-H-13. A pipe insulation support shall be installed above each pair of flanges or flanged valve in vertical pipe.

(b) When pipe extends more than 15 feet above pipe insulation support located directly above elbow, flanges or flanged valves, additional supports shall be installed on approximately 15-foot centers to provide for installation of expansion joint as shown in Figure 22-H-13.

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SECTION B - APPLICATION - cont'd

B. PIPING - cont'd

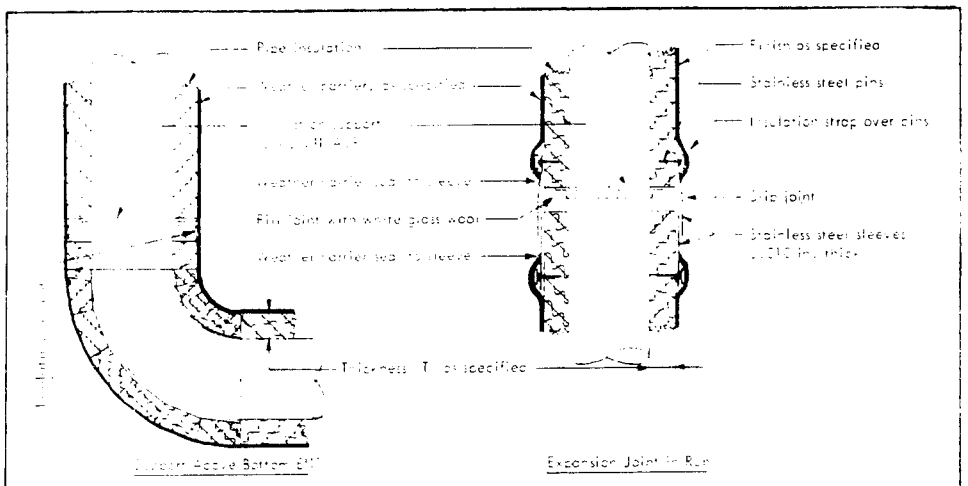


Figure 22-H-13

Figure 22-H-13

Fittings, Flanges and Valve Insulation

1. With the exception of ball and plug valves, all fittings, flanges, and valves over three-inch NPS shall be insulated with covers prefabricated to approximate the thickness of the adjoining pipe insulation.

2. Ball and plug valve covers shall be field fabricated of proper sized pipe covering.

3. Screwed and welded fitting covers for three-inch NPS and smaller piping may be field fabricated.

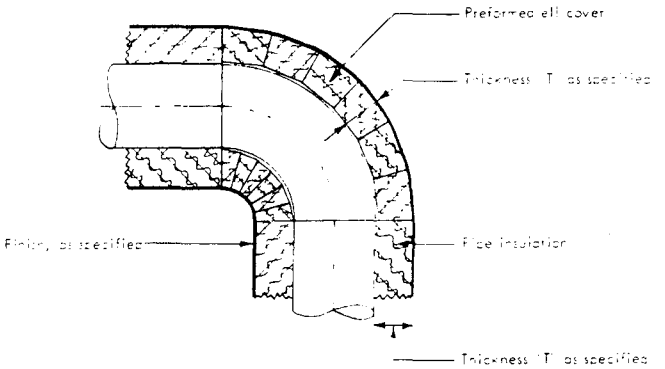
4. Fitting insulation shall be secured with wire or strap as required.

5. [illegible] Cement shall be applied in sufficient quantity to exclude pipe adhesion and complete the insulation. [illegible] Typical covers are shown in Figures 22-H-14, 22-H-15 and 22-H-16.

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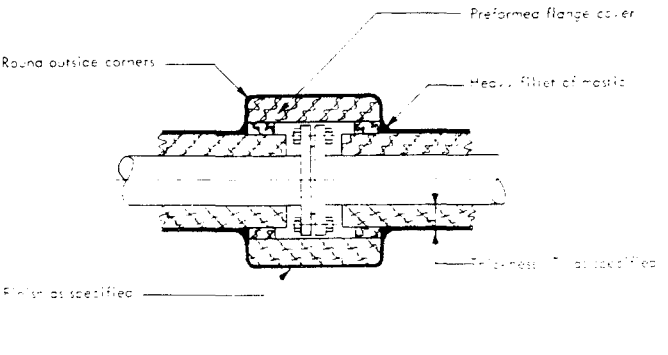
SECTION B - APPLICATION - cont'd

2. PIPING - cont'd



Application of Bonded Expanded Silica Insulation to Horizontal Welded Ell

Figure 22-H-14

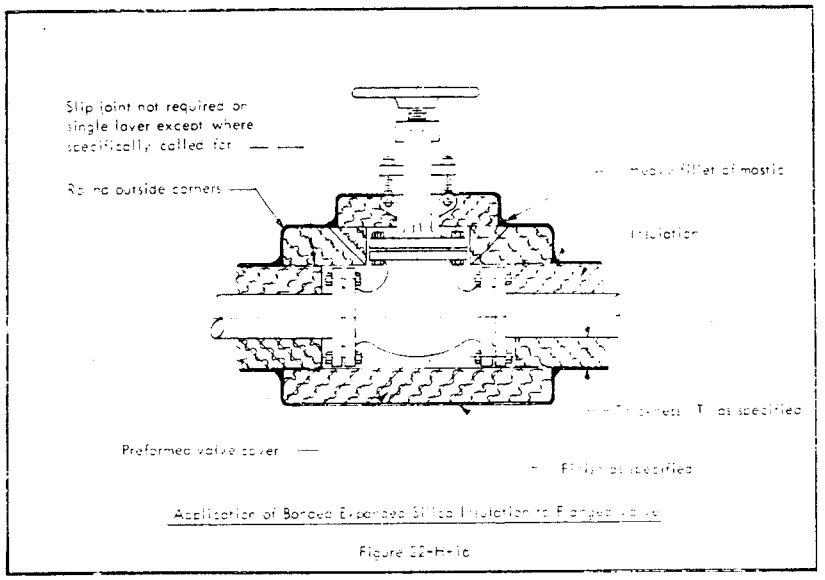


Application of Bonded Expanded Silica Insulation to Pipe Line Flange

Figure 22-H-15

SECTION B - APPLICATION - cont'd

2. PIPING - cont'd

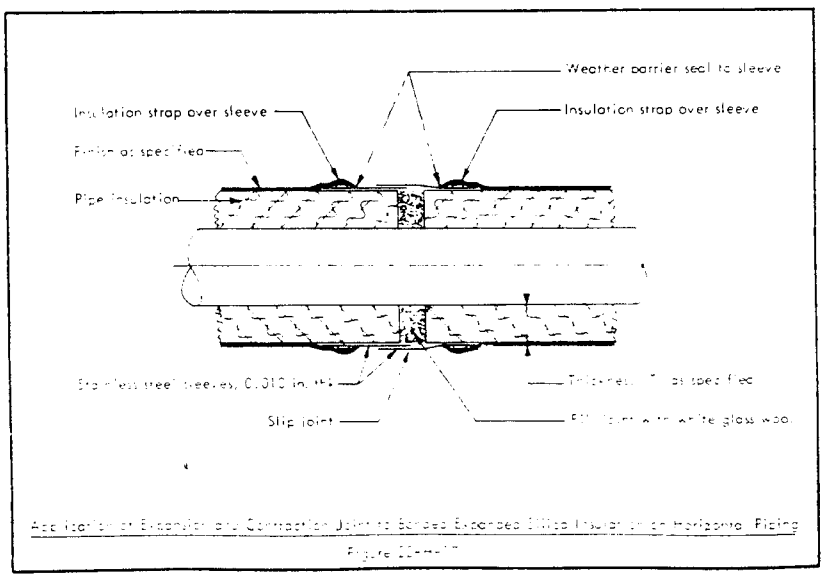


Application of Bonded Expanded Silica Insulation to Flanged Valve

Figure 22-H-1c

e. Expansion Joints

(1) Expansion slip joints shall be provided in the insulation for horizontal piping 4-inch NPS and larger. An expansion joint shall be installed in each 21 ft of straight piping not interrupted by flanges, valves, or fittings, and insulated with multiple layer insulation; and each 42 ft insulated with single layer insulation. Typical installation is shown in Figure 22-H-1f. If an expansion crack occurs after line is put in service, the crack shall be filled with white glass wool and an expansion joint shall be provided at that location.



Application of Expansion and Compaction Joint to Bonded Expanded Silica Insulation on Horizontal Piping

Figure 22-H-1f

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SECTION B - APPLICATION - contd

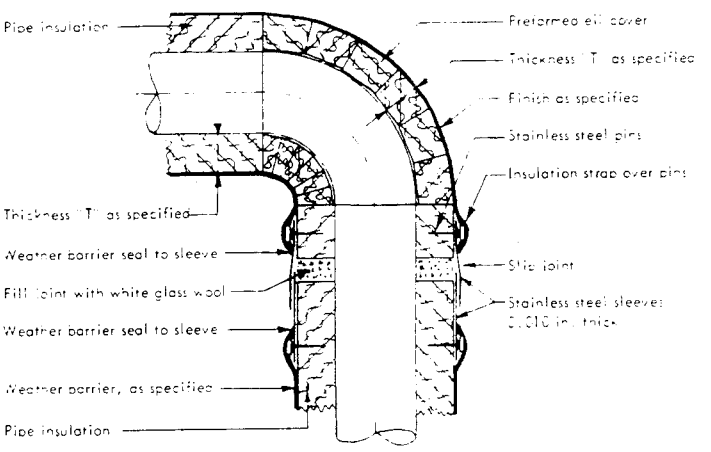
2. PIPING - contd.

c. Expansion Joints - contd.

(2) The expansion slip joints shall be installed at the insulation support in vertical piping as shown in Figure 22-H-13.

(3) Expansion slip joints shall be provided at junction of fitting covers and pipe insulation located at the tops of risers where riser exceeds 15 ft in height and pipe is 4-inch NPS or larger. Typical installation is shown in Figure 22-H-18.

(4) Where flanged fittings or valves occur within these intervals, expansion shall be provided for the flange cover, and expansion joints in the insulation will not be required.



Application of Bonded Expanded Insulation to Welded Ell with Slip Joint at Top of Vertical Line

Figure 22-H-18

e. Traced Installations. Tracing and insulation on traced lines shall be installed as specified in Article XIII of the GENERAL SPECIFICATIONS.

f. Surface Finish. Where present, small cracks and depressions shall be filled and smoothed with insulating cement before application of weather barrier.

g. Weather Barrier. Weatherbarrier coating and jackets, whichever is called for, shall be applied as specified in Articles XVI.B and XVII.B, respectively, of the GENERAL SPECIFICATIONS. Mastic weather barrier shall be used unless metal jacket is called for as follows:

1. Weather barrier consisting of stainless steel jacketing, where required, shall be called for by the addition of the letter M to the specification designation, thus 22-HM or 22-HSSM.

2. Weather barrier consisting of treated steel jacketing, where required, shall be called for by the addition of the letters MT to the specification designation, thus 22-HMT or 22-HSSMT.

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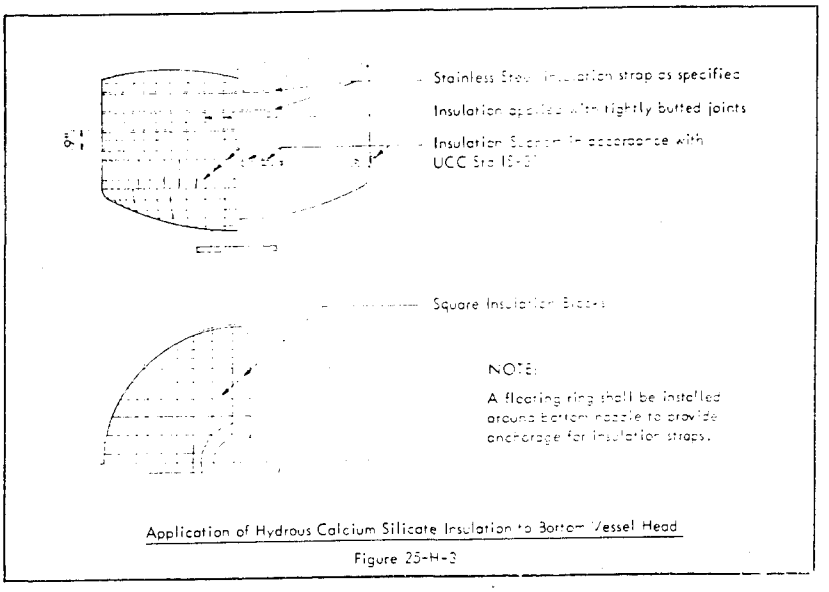
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SECTION B - APPLICATION - cont'd

1. EQUIPMENT - cont'd

f. Securement - contd

2) All layers of insulation on bottom heads of vertical equipment and heads of horizontal equipment shall be secured in place with wire attached to welding pins, or with insulation strap attached to insulation support as shown in Carbide Standards IS-31 and IS-40, and Figure 25-H-3.



Application of Hydrous Calcium Silicate Insulation to Bottom Vessel Head

Figure 25-H-3

g. Flanges. Manhole flanges, blind flanges, and vessel flanges shall be insulated unless otherwise specified.

h. Expansion Joints

1) Expansion joints in flat surfaces or cylindrical vessels shall be insulated with flexible blanket insulation. Typical installation is shown in Figure 25-H-4.

2) Corrugated mechanical expansion joints in piping (usually listed as equipment items) shall be insulated as shown in Figures 25-H-5 and 25-H-5A. A slip joint shall be provided at both ends of the corrugated item when horizontally installed in piping. Apply a stainless steel sleeve 18-inches long by 0.010-inch thick over the pipe insulation at each end of the expansion joint, placed flush with the butt end of the pipe insulation. The sleeve shall be secured with a strap at one end only, outside the slip joint surfaces. The inner stainless steel jacket shall extend 2 inches over the sleeves at each end and be secured with one strap around the middle. The outer stainless steel jacket and insulation cover shall extend 2 inches over each end of the slip joint and be secured with straps as required. The longitudinal laps of the stainless steel sheets shall be a minimum of 2 inches, placed so as to shed water. Weather-barrier mastic shall be applied to the ends of the insulation cover and sealed to asbestos metal jackets. If the pipe insulation diameter is less than the inner jacket diameter, the slip joint shall be made as shown in Figures 22-H-5 and 22-H-5A.

Where expansion joints are installed vertically in piping, the slip joint at the top shall be omitted and the expansion joint cover secured to the pipe covering.

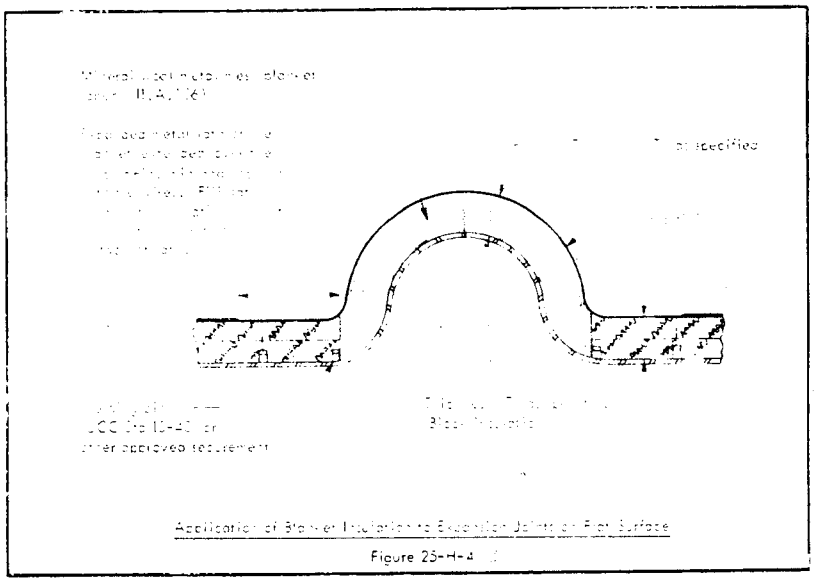
i. Insulated Vessel Flanges. Vessel flanges shall be insulated with preformed insulation assembly and weather protected with stainless steel jackets. A insulation support shall be provided immediately above vessel flange. Assembly shall be installed so as to provide slip joint which will allow movement of insulation and weather-barrier jacket. The top of protecting flange insulation shall be sloped to shed water. Typical installation is shown in Figure 25-H-6.

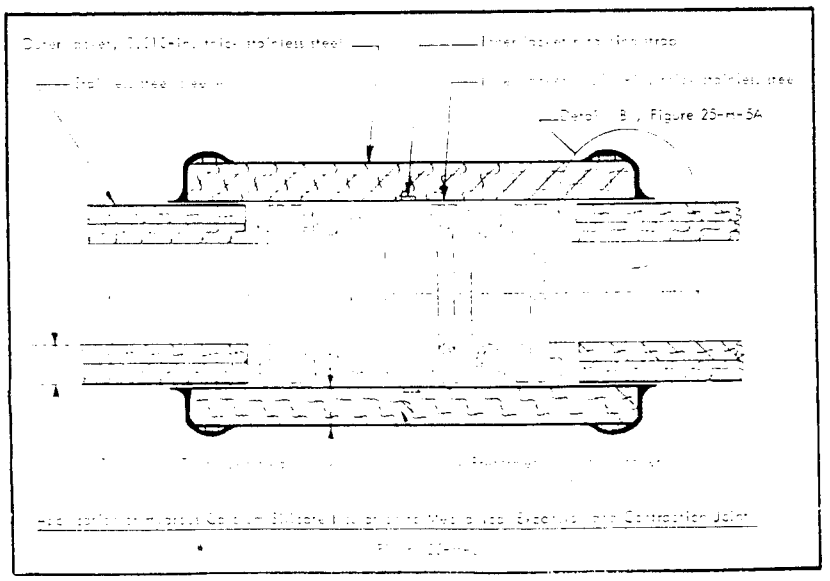
j. Insulation Support. A slip joint shall be provided at each insulation support, except the bottom support, on vertical vessels and at each insulation support without exception on horizontal vessels. Typical installation is shown in Figure 25-H-7.

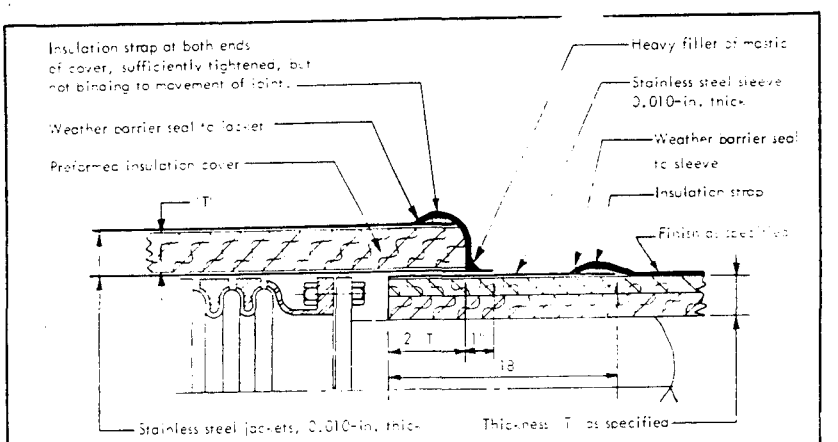
k. Vessel Nozzles. Vessel nozzles shall be insulated as shown in Figure 25-H-5 and 25-H-5.

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SECTION 5 - APPLICATION

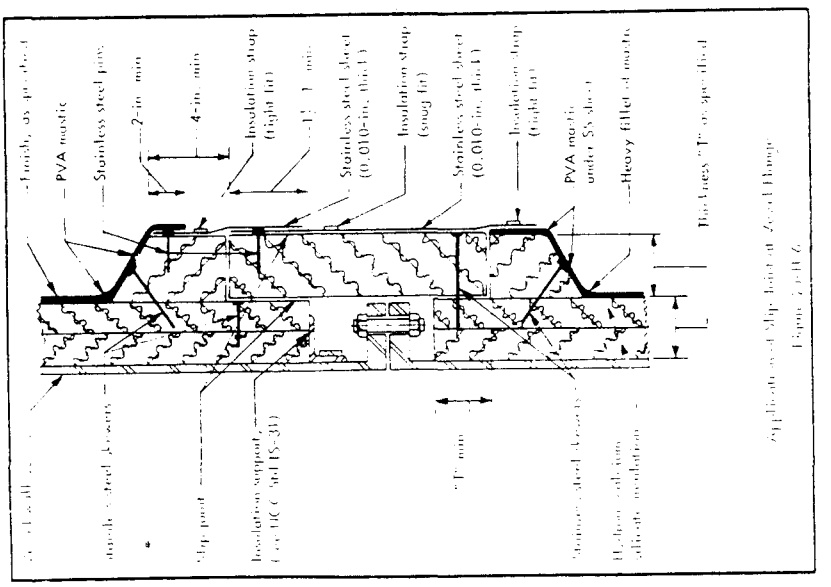




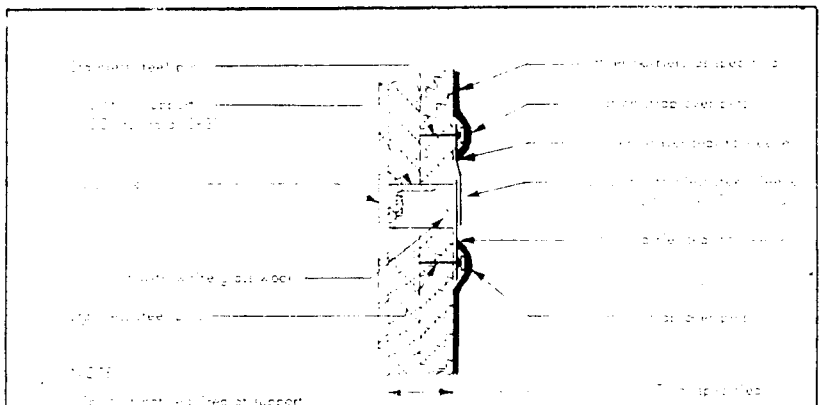


Detail "B"
(Slip Joint Detail for Figure 25-H-5

Figure 25-H-5A

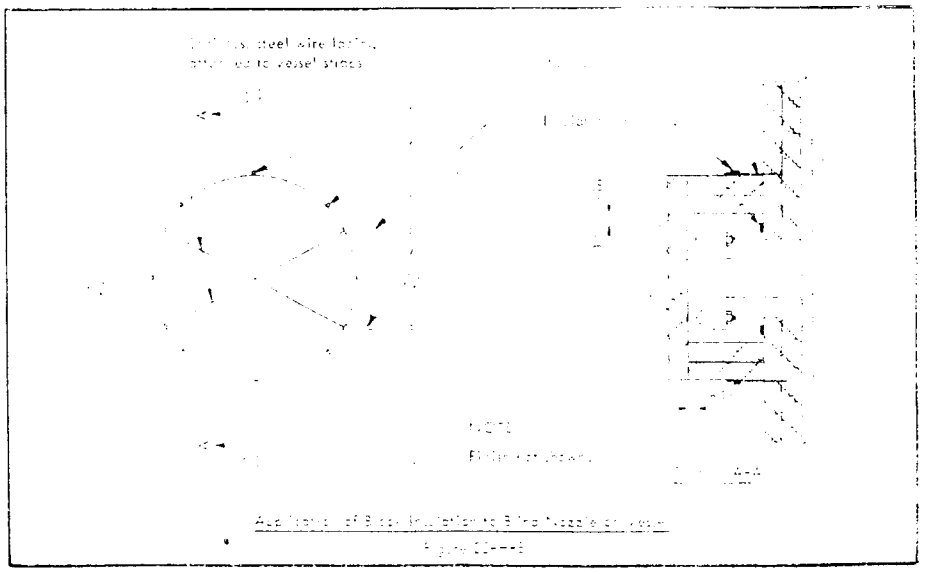


SECTION 3 - APPLICATION [illegible]



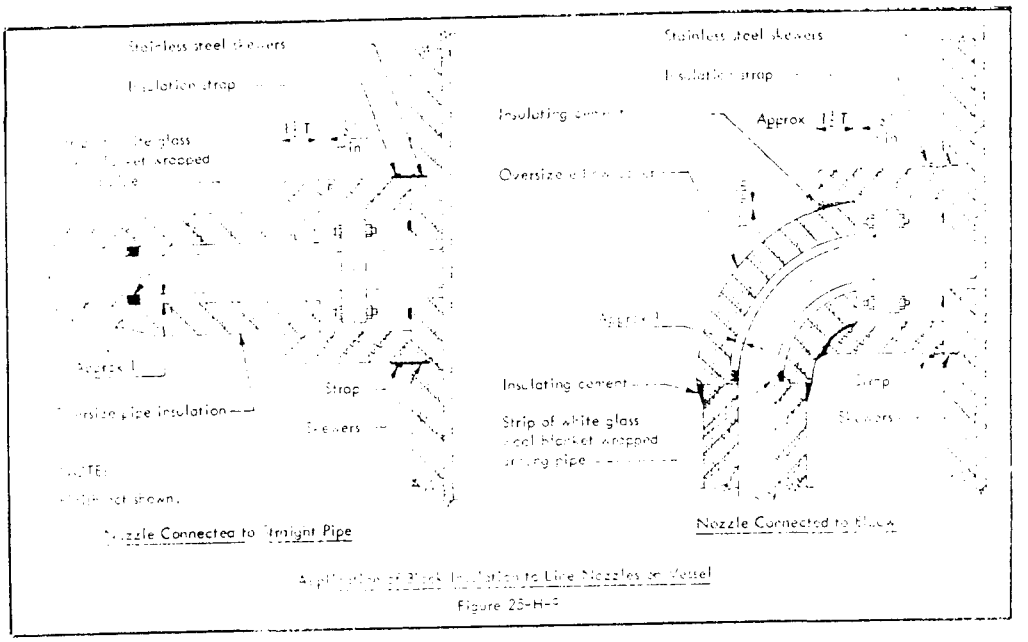
Application of Slip Joint to Vessel Wall at Insulation Support

Figure 25-H-7



SECTION B - APPLICATION - cont'd

1. EQUIPMENT - cont'd



Application of Block Insulation to Line Nozzles on Vessel
Figure 25-H-9

1. [illegible]

Concrete-filled structural tubing legs shall be insulated as specified in Article V.C of the GENERAL SPECIFICATIONS.

2. Channel legs shall be insulated with clos[illegible] for small extend over channel flanges and down channel legs to fireproofing. Thickness to a minimum of one-half that specified for body of vessel.

3. Vessel insulation shall be butted firmly against [illegible] leg flange. Reentrant space between channel flanges and over channel flanges between adjacent insulation shall be filled with [illegible]. Installation shall be as shown in Figure 25-H-10.

m. Vessel Skirts. Skirts supporting vertical equipment shall have their outer surfaces insulated. Unless otherwise specified, insulation shall extend downward from junction of skirt with bottom head, a minimum of four times the specified thickness, but not less than 12 inches, on the bottom head a distance of not less than 12 inches. Thickness shall be as specified for body of vessel. The bottom head insulation shall be supported in accordance with Owens-Illinois Standard 15-43 or 15-42. Installation shall be as shown in Figure 25-H-11.

n. Traced Installations. Tracing and insulation on traced equipment shall be installed as specified in Article XIII of the GENERAL SPECIFICATIONS.

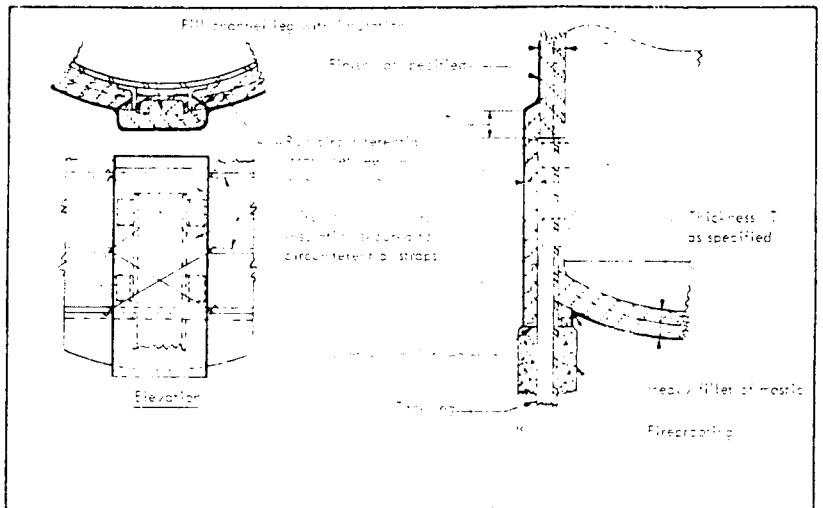
o. Surface Finish. When specified thickness of insulation has been applied, any small cracks or depressions shall be pointed up with insulation cement and finished flush with surface of insulation.

p. Weather Barrier. Weather-barrier mastic coating or jacket, whichever is called for, shall be applied as specified in Articles XI.B and XI.C, respectively, of the GENERAL SPECIFICATIONS. Mastic weather barrier shall be used unless metal jacket is called for as follows:

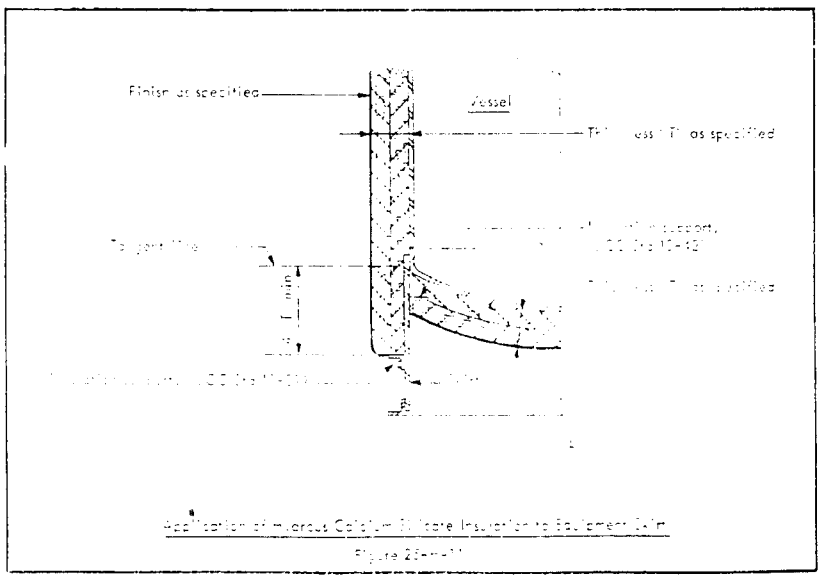
1. Weather barrier consisting of stainless steel jacketing, where required, shall be called for by the addition of the letter M to the specification designation, thus 25-HM.

2. Weather barrier consisting of [illegible] steel jacketing, where required, shall be called for by the addition of the letters MT to the specification designation, thus 25-HMT.

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Application of Hydrous Calcium Silicate Insulation to Equipment Leg



SECTION B - APPLICATION - cont'd

2. PIPING

a. Pipe Insulation

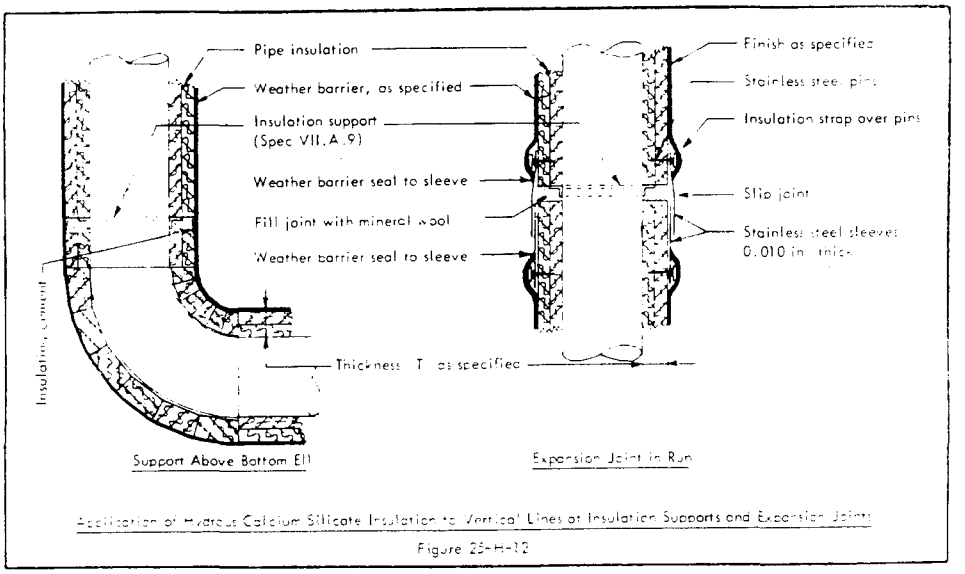
(1) Insulation Supports. Pipe insulation shall be supported and secured as specified in Article III of the GENERAL SPECIFICATIONS.

(2) Thickness Schedule. Unless otherwise specified, insulation in excess of three inches total thickness shall be applied in multiple layer construction as specified in Article III.B of the MATERIAL SPECIFICATIONS, except that outer layer shall be calcium silicate insulation per MATERIAL SPECIFICATION 23.

3 Vertical Pipe

(a) Insulation on 4-inch NPS pipe and larger extending more than 15 feet above the bottom elbow shall be supported by a pipe insulation support located directly above the elbow. Typical installation is shown in Figure 25-H-12. A pipe insulation support shall also be installed above each pair of flanges or flanged valve in vertical pipe.

(b) When pipe extends more than 15 feet above pipe insulation supports located directly above elbows, flanges or flanged valves, additional supports shall be installed on approximately 15-foot centers to provide for installation of expansion joint as shown in Figure 25-H-12.



Application of Hydrous Calcium Silicate Insulation to Vertical Lines at Insulation Supports and Expansion Joints

Figure 25-H-12

b. Fittings, Flanges, and Valve Covers

(1) Fittings, flanges, and valves shall be insulated with covers prefabricated in accordance with ASTM Recommended Practice C 450 (latest revision).

(2) [illegible] fittings shall be fitted and assembled with tight joints. Cementing of prefabricated assemblies shall be done with the least amount of cement. All joints shall be as thin as possible, with just sufficient cement to obtain good adhesion and complete closure. In no case shall excessive cement joints, or voids and holes plugged with cement, be permitted. Typical covers are shown in Figures 25-H-13, 25-H-14, and 25-H-15.

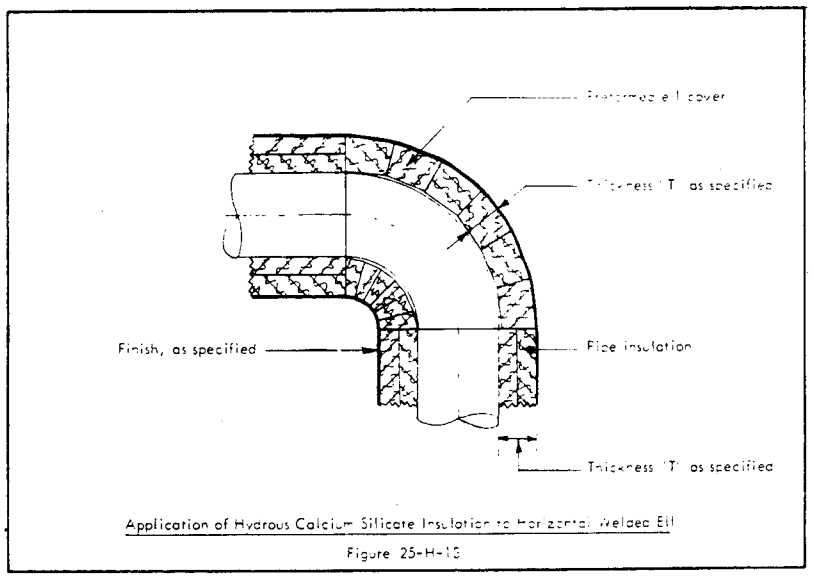
SECTION B - APPLICATION - contd

2. PIPING - contd

b. Fitting, Flange, and Valve Covers - contd

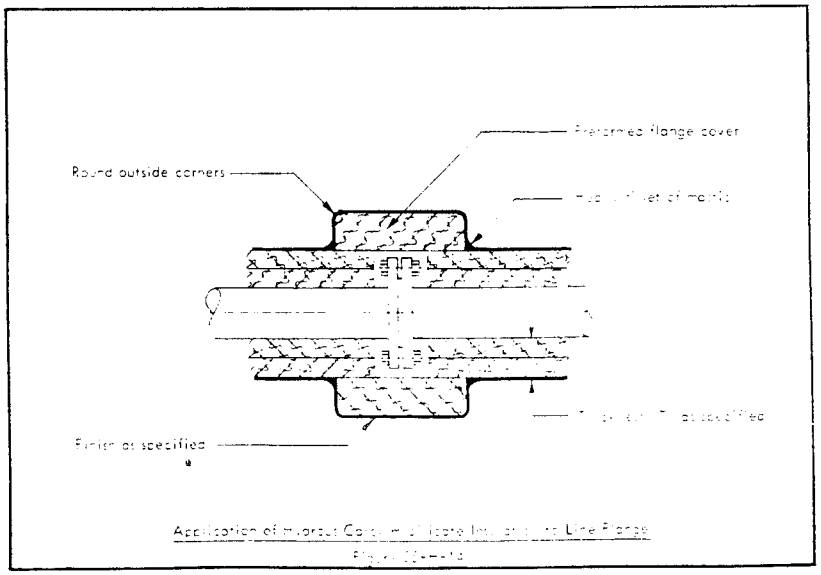
(4) Fitting insulation shall be secured with wire or strap as required.

(5) If any fracturing of insulation occurs due to pipe expansion, the break shall be repaired by covering it with a collar expansion flange cover.



Application of Hydrous Calcium Silicate Insulation to Horizontal Welded Ell

Figure 25-H-13



Application of Hydrous Calcium Silicate Insulation to Line Flange

Figure 25-H-14

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THERMAL INSULATION APPLICATION SPECIFICATIONS

SCOPE

This specification describes the essential requirements for application of geodesically shaped bonded expanded silica insulation for use on steel spheres normally operating at temperatures from 70F up to 500F.

Procedures described in the GENERAL SPECIFICATIONS are applicable to and constitute an integral part of this specification.

SECTION A - MATERIALS

1. INSULATION MATERIAL

Insulation shall be as specified in MATERIAL SPECIFICATION NO. 22.

2. ACCESSORY MATERIALS

Accessory materials shall be as specified in MATERIAL SPECIFICATIONS, article numbers as noted.

Equipment Insulation Strap	VII.A.11	Fabricating Cement	VII.A.38
Clips for Equipment Strap	VII.A.12	Heat Resistant Sealer	VII.A.42
Stainless Steel Wire	VII.A.17	Mastic (caulking)	VII.A.45
Insulating Cement	VII.A.7	Weather-Barrier Mastic	
Wire Netting	VII.A.18	(color as specified)	VII.B.1.a.
Welding Pin Insulation Fasteners	VII.A.22	Reinforcing Cloth	VII.B.1.b.
Pin Clips	VII.A.23	Treated Steel Weather-Barrier	
Stainless Steel Skewers	VII.A.21	Jacket (designation MT)	VII.B.3

SECTION B - APPLICATION

1. EQUIPMENT - SPHERE

a. Insulation Supports. Sphere shall be provided with insulation supports as called for on drawings. The sphere shall be provided with three insulation support rings. One support ring to be located at the equator, one to be located approximately 30° above the equator, and one to be located approximately 30° below the equator. Other insulation supports, where required, shall be as specified in Article II of the GENERAL SPECIFICATIONS. All insulation supports shall be provided by others.

b. Surface Preparation. Sphere body and legs shall be prepared as called for in Article I, GENERAL SPECIFICATIONS.

c. Thickness Schedule. Unless otherwise specified, insulation shall be single layer. Where insulation thickness greater than 3 inches is required, special engineering design is necessary.

d. Sphere Body

1. Expanded bonded silica insulation shall be shop fabricated or molded geodesically shaped to fit the design of the sphere.

2. Expanded bonded silica insulation shall be secured with welding pin insulation fasteners and pin clips, spaced so as to provide a minimum of four attachments per block.

3. Pin clips shall be pressed into insulation sufficiently to allow pins to be cut off below face of insulation. The clip depression shall be filled flush with face of block with mastic (caulking). Typical installation is shown in Figure 22-H SP-1.

4. After completion of application of bonded expanded silica insulation on area below each insulation support, a water stop shall be installed from the ring, over the exposed edge of the insulation and carried down over the outer surface of the insulation. This water stop is shown in Figure 22-H SP-2.

e. Vessel Manholes and Line Nozzles. Vessel manholes and nozzles shall be insulated as shown in Figures 22-H SP-3 and 22-H SP-4.

f. Vessel Legs

1. Concrete filled legs shall be insulated as specified in Article V.C.1 of the GENERAL SPECIFICATIONS.

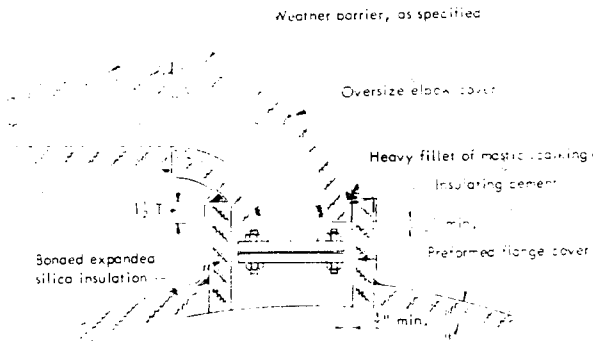
2. Legs not concrete filled, or not fire protected, shall be insulated with 2 inches of bonded expanded silica to base of fire protected part of leg. Insulation shall be installed in accordance with STANDARD SPECIFICATION NO. 22-H.

g. Tie Rods and Tie Rod Anchors. Tie rods and tie rod anchors shall be insulated with 2 inches of bonded expanded silica in accordance with STANDARD SPECIFICATION NO. 22-H.

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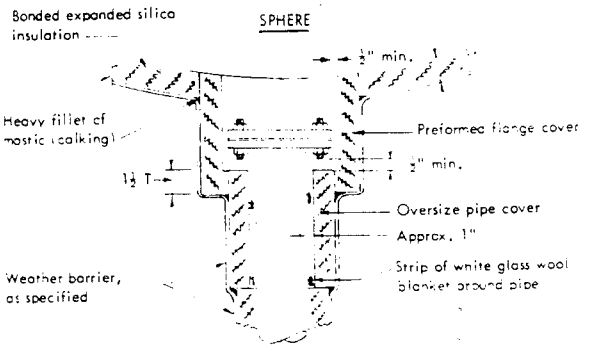
SECTION B - APPLICATION - Contd

g Tie Rods and Tie Rod Anchors - Contd



SPHERE

Nozzle Connected to Elbow

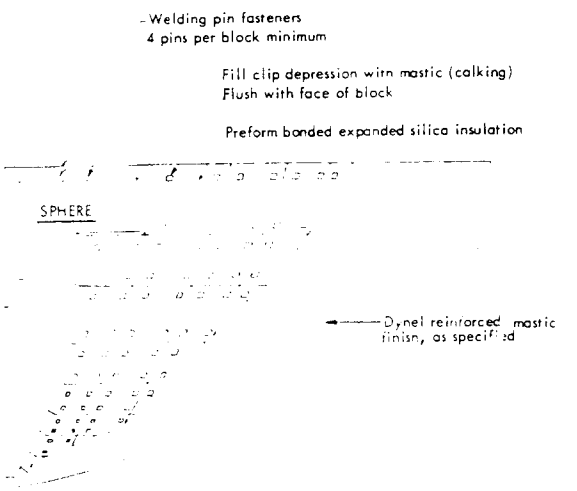


Nozzle Connected to Straight Pipe Application of Cellular Glass to Line Nozzles or Spheres

Figure 22-HSP-3

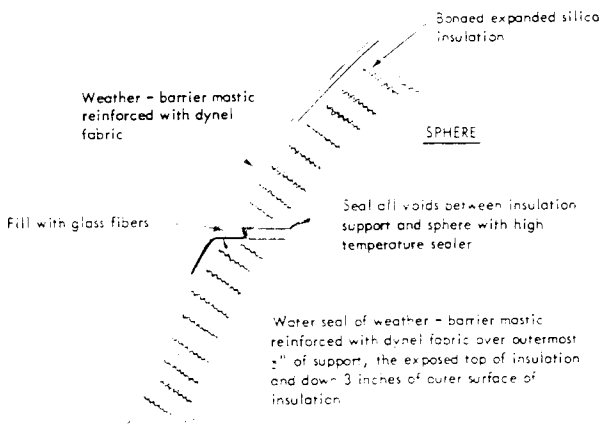
SECTION B - APPLICATION - Contd

g. Tie Rods and Tie Rod Anchors - Contd



Application of Preformed Bonded Expanded Silica Insulation to Sphere Body

Figure 22-H SP-1



Installation of Water Stop at Insulation Supports

Figure No 22-H SP-2

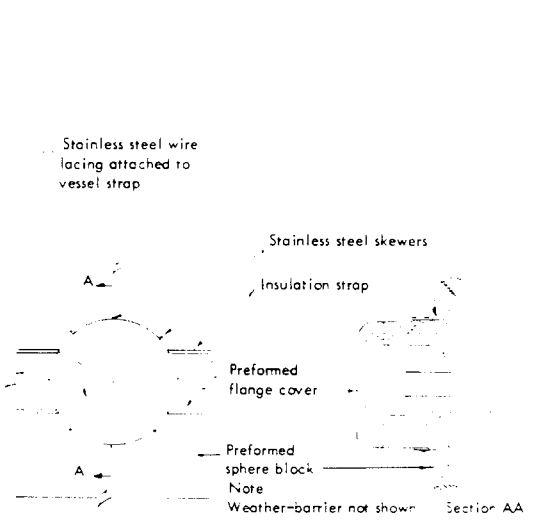
SECTION B - APPLICATION - Contd

Weather-Barriers

1) Weather-barrier coating over insulation on sphere body shall be as in MATERIAL SPECIFICATION VII.B.1.a., and shall be applied as specified in Article XIV.A. of GENERAL SPECIFICATIONS.

2) Weather-barrier jacket over the rod insulation shall be as specified in MATERIAL SPECIFICATION VII.B.3., Specification Designation "MT" and shall be applied as specified in Article XV.B. of GENERAL SPECIFICATIONS.

3) Insulation on support legs (where required) shall be weather protected by weather-barrier mastic or treated steel jackets as called for in (1) or (2) above.



Application of Bonded Expanded Silica Insulation to Blind Flange on Sphere

Figure 22-H SP-4

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THERMAL INSULATION APPLICATION SPECIFICATIONS

INHIBITED CALCIUM SILICATE

SCOPE

This specification describes the essential requirements for application of preformed inhibited calcium silicate insulation for use on equipment and piping, including stainless steel, normally operating at temperatures from 70 F up to and including 950 F.

Procedures described in the GENERAL SPECIFICATIONS are applicable to and constitute an integral part of this specification.

SECTION A - MATERIALS

1. INSULATION MATERIAL

Insulation material shall be as specified in MATERIAL SPECIFICATION 23.

2. ACCESSORY MATERIALS

Accessory materials shall be as specified in the MATERIAL SPECIFICATIONS, article numbers as noted.

Cushioning Blanket	VII.A. 1	Stainless Steel Skewers	VII.A. 15
Mineral Wool Blanket (wire netting on both sides)	VII.A. 5	Welding Pin Insulation Fasteners	VII.A. 16
Insulating Cement	VII.A. 7	Pin Clips	VII.A. 17
Pipe Insulation Support	VII.A. 9	Fabricating Cement	VII.A. 21
Equipment Insulation Strap	VII.A.11	Heat-Resistant Sealer	VII.A. 22
Clips for Equipment Strap	VII.A.12	Mastic	VII.A. 23
Pipe Insulation Strap	VII.A.13	Mineral Wool Blanket (wire netting on one side, expanded metal lath on the other side)	VII.A. 24
Clips for Pipe Strap	VII.A.14	Weather-Barrier Mastic (color as specified)	VII.B. 1
Stainless Steel Wire	VII.A.17	Reinforcing Cloth	VII.B. 2
Wire Netting	VII.A.18	Stainless Steel Weather-Barrier Jacket (Designation MA)	VII.B. 3
Welding Pins	VII.A.19	Treated Steel Weather-Barrier Jacket (Designation MTA)	VII.B. 3
Stainless Steel Pins	VII.A.20		

SECTION B - APPLICATION

1. EQUIPMENT

a. Insulation Supports. Equipment shall be provided with insulation supports as specified in Article II of the GENERAL SPECIFICATIONS.

b. Thickness Schedule. Unless otherwise specified, insulation in excess of three inches total thickness shall be applied in multiple layers of equal thickness as specified in Article III.B of the MATERIAL SPECIFICATIONS.

c. Cushioning Blanket. On all equipment operating above 400 F or 8 feet and larger in diameter, a one-inch thick white glass wool cushioning blanket shall be applied over the entire surface before application of the calcium silicate insulation. The blanket shall not be compressed and shall be secured in place with a minimum amount of stainless steel wire. Cushioning blanket shall not be considered as part of the specified insulation thickness.

d. Curved Surfaces. On all equipment insulation block shall be properly cut in curved sectors and rectangular blocks, as required, to fit vessel surfaces with a one-inch space allowed for cushioning blanket where used and applied to vessel sides and heads in staggered position with all joints tightly butted. Multiple layers shall be applied so that the butt joints of one layer do not coincide with those of any other layer. Typical installation is shown in Figure 23-HSS-1.

e. Flat Surfaces

1) Block insulation shall be applied to flat surfaces in staggered position with all joints tightly butted. It shall be secured with wire attached to welding pins as shown in Owner's Standard IS-40, or other approved securement. On rectangular equipment, the welding pins, or other approved securements, shall be placed on 12-inch centers, diamond pattern, for bottom surfaces, and on 24-inch centers, diamond pattern, for side surfaces and on 24-inch centers, diamond pattern, for top surfaces. Where specified in the Insulation Design Schedule, block may be applied to flat surfaces with an approved adhesive.

2) When specified thickness of insulation has been applied, wire netting shall be stretched tightly over block and secured with the wire to the approved securement. Entire surface shall be given a 1/2-inch thick, smooth and uniformly applied trowel coat of setting insulating cement. Typical installation is shown in Figure 23-HSS-2.

f. Securement

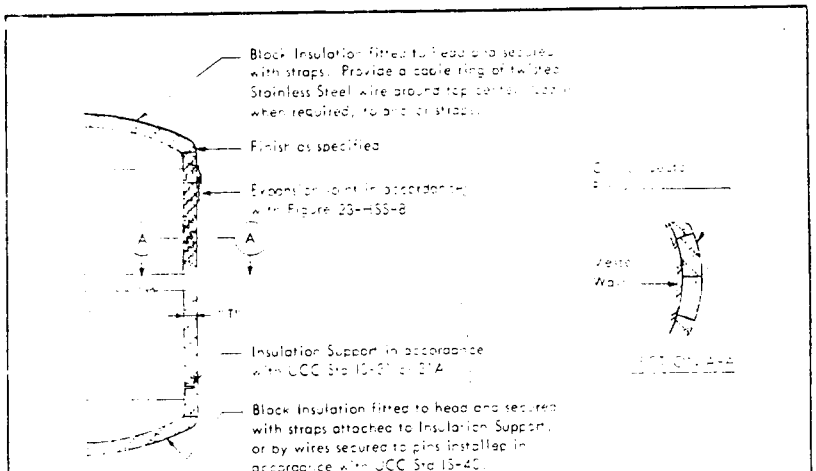
1) All layers of insulation shall be secured with insulation strap where contour of vessel permits firm and effective attachment. Insulation strap shall be attached to strap anchor angles as shown in Owner's Standard IS-31A. Insulation applied to irregular surfaces where use of strap is impracticable, shall be secured with wire fastened to welding pins, drawn taut, ends twisted and embedded in insulation.

2) All layers of insulation on bottom heads of vertical equipment and heads of horizontal equipment shall be secured in place with wire attached to welding pins or with insulation strap attached to insulation support as shown in Owner's Standard IS-31 and IS-40, and in Figure 23-HSS-3.

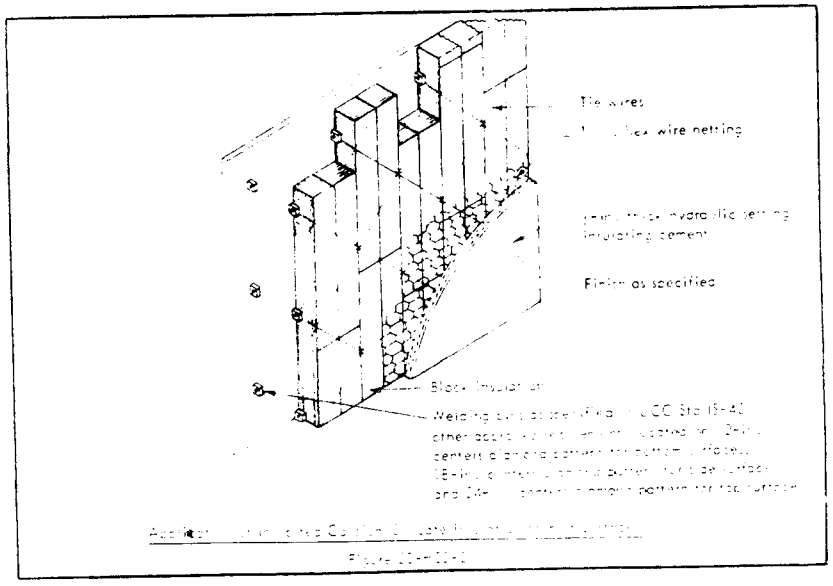
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SECTION B - APPLICATION - cont'd

1. EQUIPMENT - cont'd

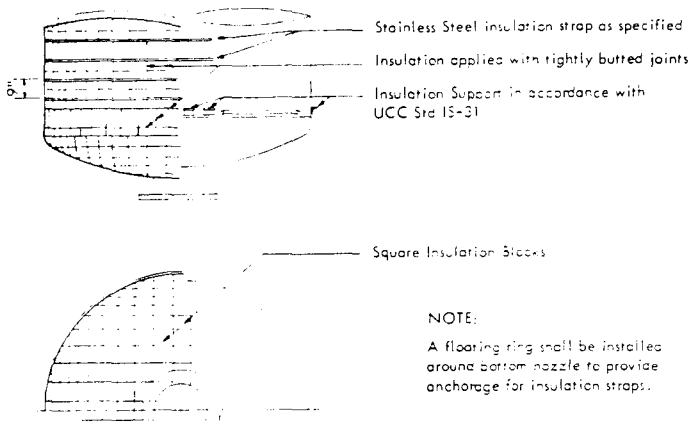


Application of Inhibited Calcium Silicate Insulation to Vessel Shells and Heads
Figure 23-HSS-1



Union Carbide trial exhibit UC-4586: W. G. Hammar Transmittal Memoranda and Union Carbide Thermal Insulati…
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1. EQUIPMENT - cont'd



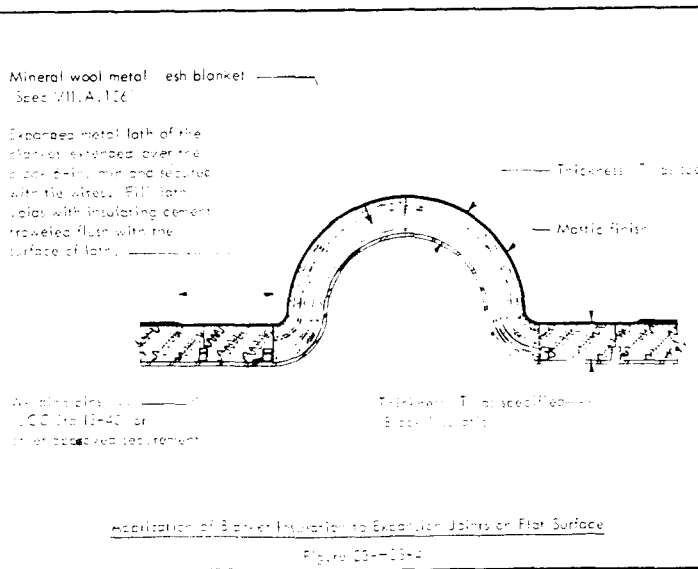
Application of Inhibited Calcium Silicate Insulation to Bottom Vessel Head

Figure 23-HSS-3

f. Flanges. Manhole flanges, blind flanges, and vessel flanges shall be insulated unless otherwise specified.

g. Expansion Joints

1. Expansion joints in flat surfaces or cylindrical vessels shall be insulated with flexible blanket insulation. Typical installation is shown in Figure 23-HSS-4.



Application of Blanket Insulation to Expansion Joints on Flat Surface

Figure 23-HSS-4

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SECTION B - APPLICATION [illegible]

EQUIPMENT [illegible]

Expansion Joint Covers

[illegible] specified [illegible] insulation shall be provided for [illegible] as shown in Figures 23-HSS-2 and [illegible] stainless steel over the pipe insulation at each [illegible] joints, placed flush with the butt end of the pipe covering. The sleeve shall be secured with strap at one end only, near [illegible] joint cover. A collar band of 0.010-in. thick stainless steel, [illegible] long to project one inch beyond the exp[illegible] joint cover shall be applied over the sleeve and held in place at the expansion joint cover which is then secured with insulation [illegible] ends of the stainless steel bands shall be a minimum of two inches, and shall be placed so as to shed water. Weather-barrier [illegible] shall be applied over the expansion joint cover and collar band. Weather-barrier mastic shall [illegible] at the expansion joint cover.

[illegible] Flanges and Valves

[illegible] shall be protected by stainless steel [illegible] shall be slip joint, which allow [illegible] as shown in Figure 23-HSS-[illegible].

[illegible] shall be finished at the joint by the application of [illegible] weather barrier or mastic on the adjacent insulation [illegible] shall be finished with weather barrier [illegible] as specified. A second application of weather barrier [illegible] as shown in Figure 23-HSS-[illegible].

[illegible] shall be insulated as specified [illegible] vertical mounts, and at each [illegible] as shown in Figure 23-HSS-[illegible].

Supports

[illegible] shall be insulated as shown in Figure 23-HSS-[illegible] and 23-HSS-[illegible].

Columns

[illegible] structural tubing legs shall be insulated as specified in Article 7.C of the GENERAL SPECIFICATIONS.

[illegible] longitudinally insulated with block which shall extend over channel flanges and down channel legs to fireproofing. Insulation shall be [illegible] as specified for beams or vessels.

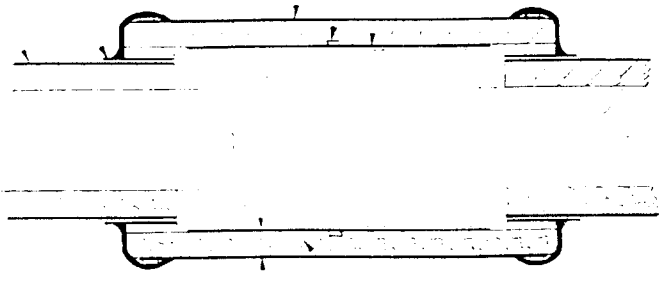
[illegible] shall be insulated, against tank leg fire jet. Reentrant space between channel flanges and over channel flanges shall be [illegible] with block. Installation shall be as shown in Figure 23-HSS-[illegible].

[illegible] Stainless steel sleeve

Inner basket, 0.010-in. thick stainless steel

Stainless steel collar

[illegible] Detail [illegible], Figure 23-HSS-2A



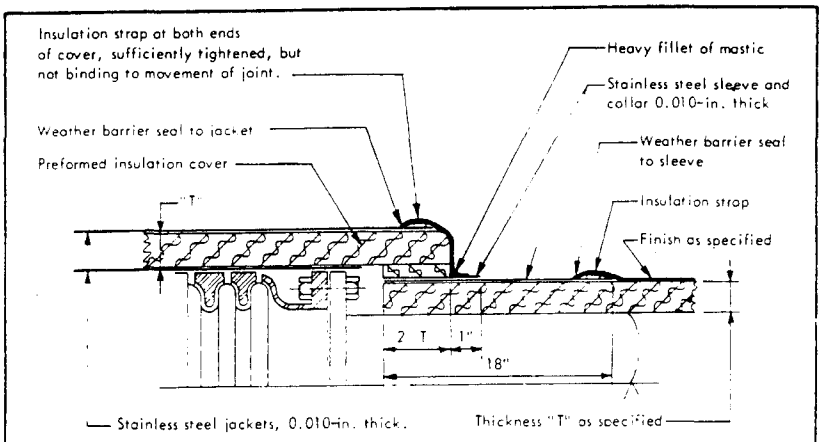
[illegible] as specified

Preformed [illegible] weather cover

[illegible]

SECTION B - APPLICATION - cont'd

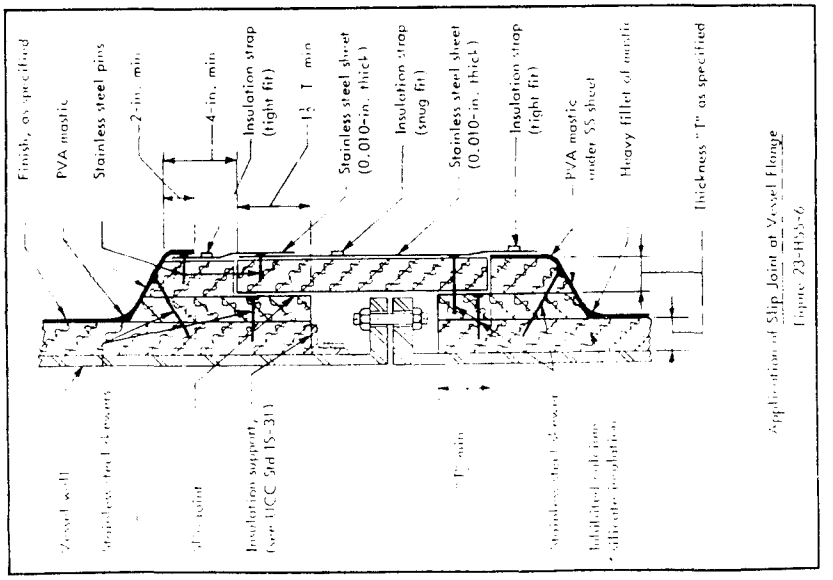
1. EQUIPMENT - cont'd



Detail "A"

(Slip Joint Detail for Figure 23-HSS-5)

Figure 23-HSS-5A

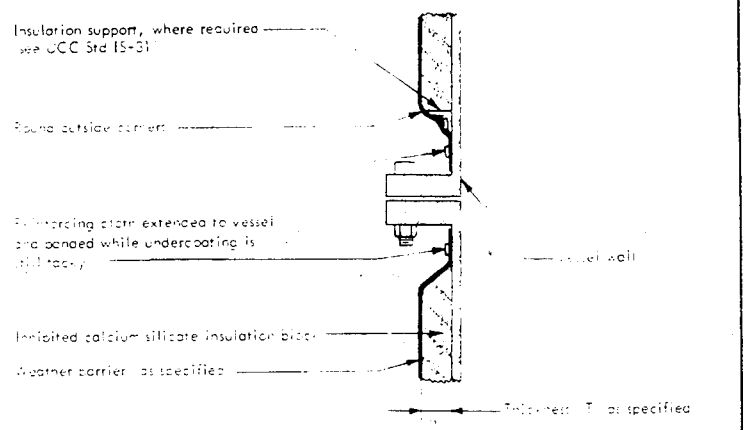


Application of Slip Joint at Vessel Flange
Figure 23-HSS-6

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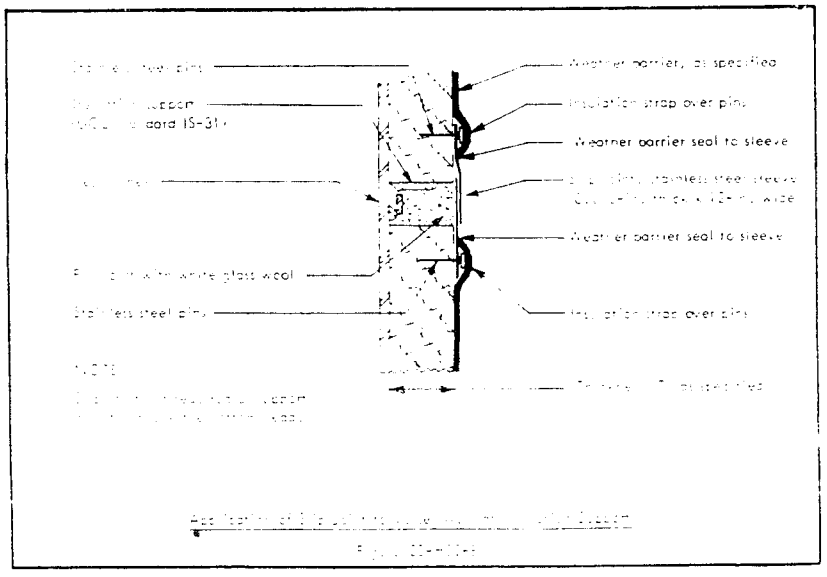
SECTION B - APPLICATION - cont'd

E. EQUIPMENT - cont'd



Application of Inhibited Calcium Silicate Insulation Adjacent to Uninsulated Flanges

Figure 23-HSS-7



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1. EQUIPMENT - cont'd

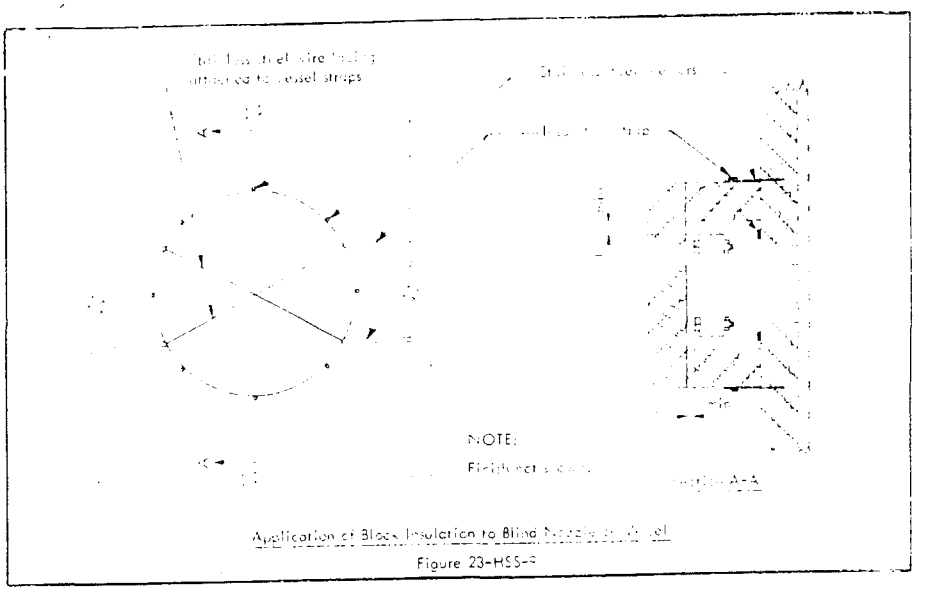


Figure 23-HSS-9

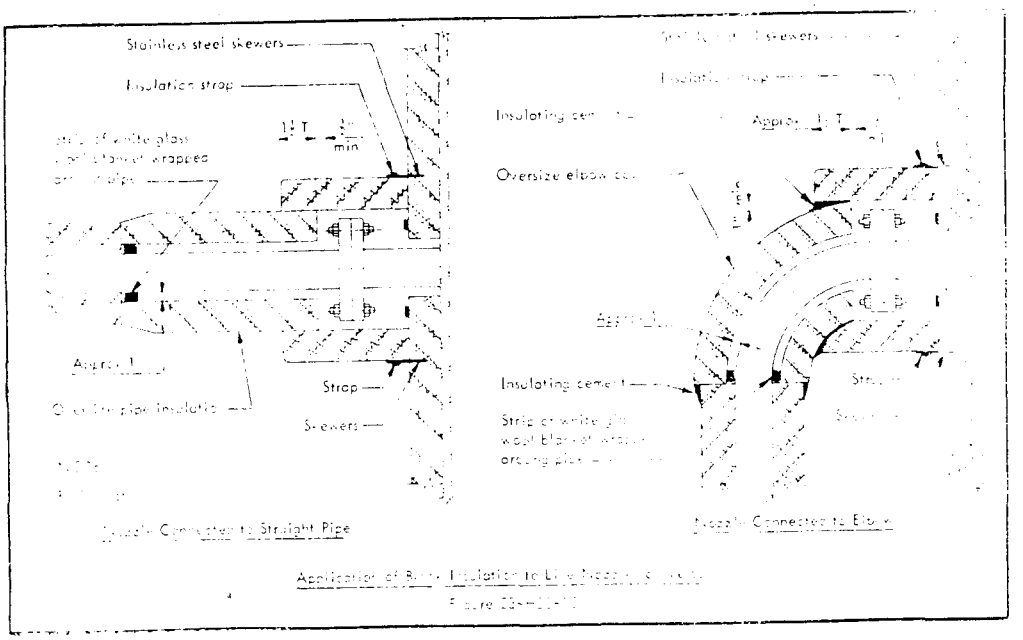
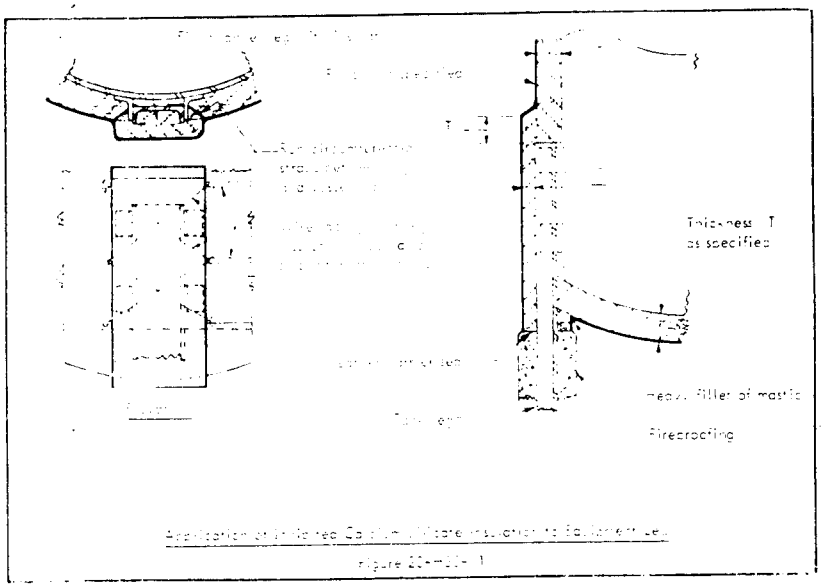


Figure 23-HSS-10

SECTION 8 - APPLICATION [illegible]

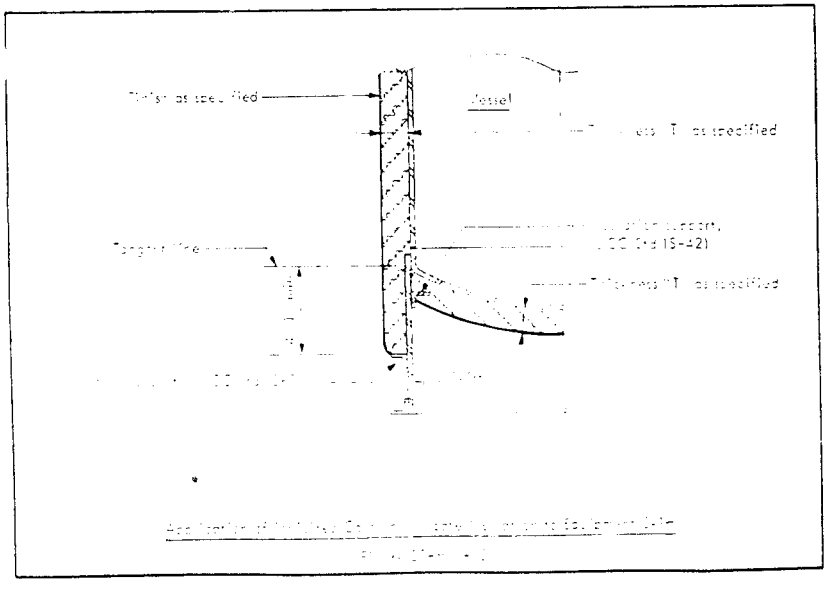
[illegible]



Application of Insulation Cement to Equipment Legs

Figure 23-H-HSS-1

[illegible] specified, insulation shall extend [illegible] than 12 inches, or as [illegible] from insulation shall be supported in accordance [illegible] Figure 23-H-HSS-2.



[illegible]

1. EQUIPMENT - cont'd

a. Traced Installations. Tracing and insulation on traced equipment shall be installed as specified in Article XIII of the GENERAL SPECIFICATIONS.

b. Surface Finish. When specified thickness of insulation has been applied, any small cracks or depressions shall be pointed up with insulation cement and troweled flush with surface of insulation.

c. Weather Barrier. Weather-barrier coating or jacket, whichever is called for, shall be applied as specified in Articles XI[illegible].B and X[illegible].B, respectively, of the GENERAL SPECIFICATIONS. Mastic weather barrier shall be used unless metal jacket is called for as follows:

1) Weather barrier consisting of stainless steel jacketing, where required, shall be called for by the addition of the letter M to specification number, thus 23-HM or 23-HSSM.

2) Weather barrier consisting of treated steel jacketing, where required, shall be called for by the addition of the letters MT to the specification designation, thus 23-HMT or 23-HSSMT.

2. PIPING

a. Pipe Insulation

1) Insulation Supports. Pipe insulation shall be supported and secured as specified in Article III of the GENERAL SPECIFICATIONS.

2) Thickness Schedule. Unless otherwise specified, insulation in excess of three inches in thickness shall be applied in multiple layers of equal thickness as specified in Article III.B of the MATERIAL SPECIFICATIONS.

3) Vertical Pipe

a) Insulation on 4-inch N.P.S. pipe and larger extending more than 15 feet above the nearest elbow shall be supported on a pipe insulation support located directly above the elbow. Typical installation is shown in Figure 23-HSS-13. A pipe insulation support shall also be installed above each pair of flanges or flanged valve in vertical pipe.

b) When pipe extends more than 15 feet above pipe insulation supports located directly above elbows, flanges or flanged valves, additional supports shall be installed on approximately 15-foot centers to provide for installation of expansion joint as shown in Figure 23-HSS-13.

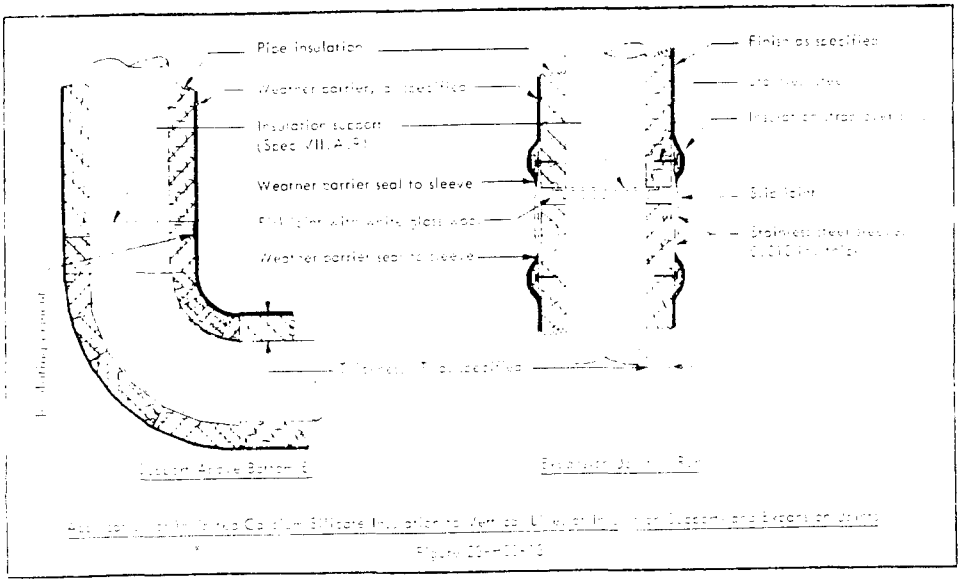


Figure 23-HSS-13

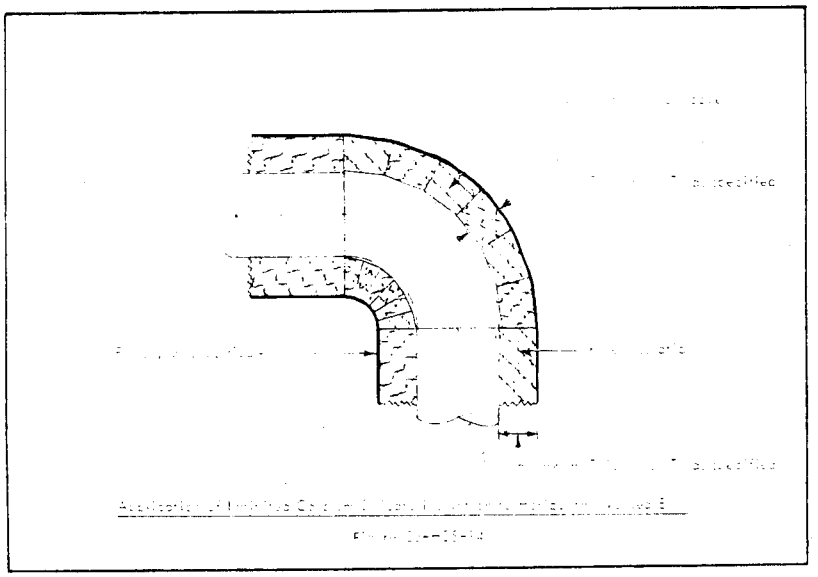
1. PIPING - ITEMS

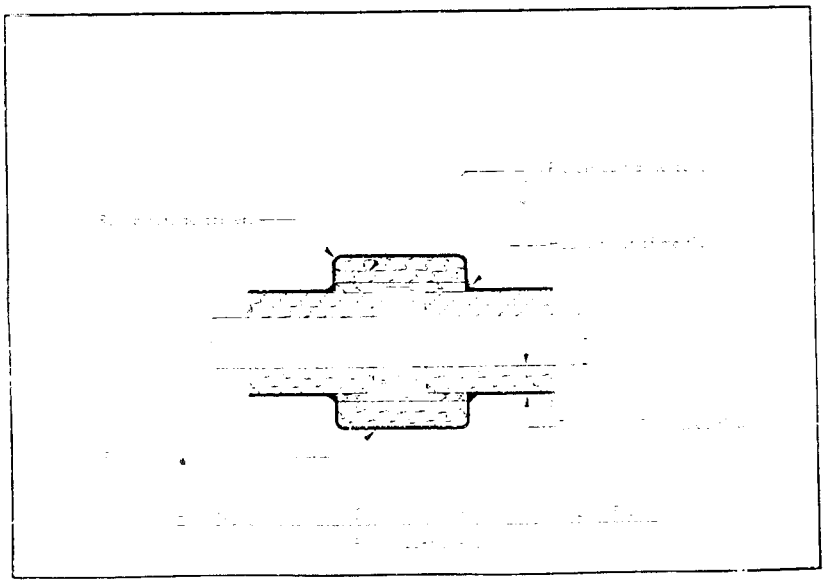
a. Fitting, Flange, and Valve Covers

(1) Insulate all pipe flanges, plug valves, all fittings, flanges, and valves over three-inch N.P.S. pipe size shall be insulated with covers prefabricated to the configuration of the Factory Mutual Practice 2-40N, Appendix "A".

(2) For pipe sizes over 8 inches covers shall be field fabricated of proper sized pipe covering.

(3) Only where removable fitting covers for three-inch N.P.S. and smaller piping may be field fabricated.





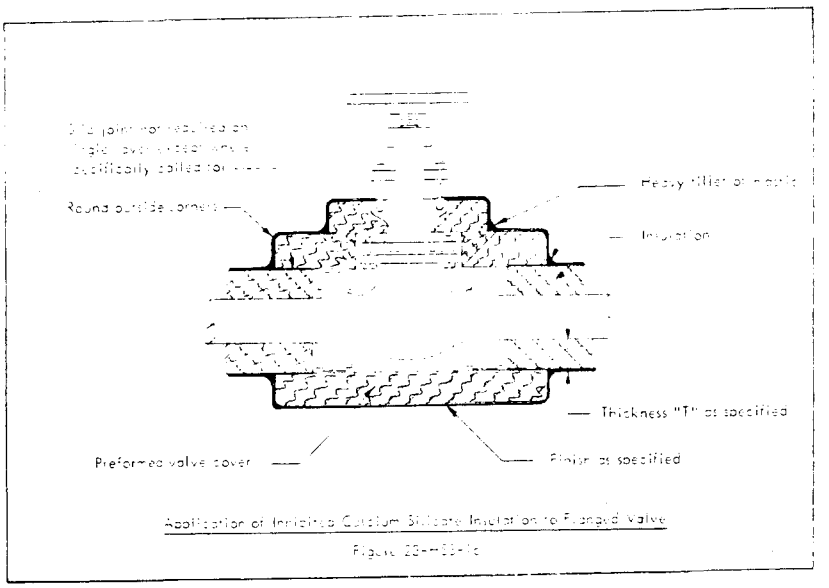
SECTION B - APPLICATION - cont'd

C. PIPING - cont'd

4. Fittings, Flanges and Valve Covers - cont'd

a. Fitting insulation shall be secured with wire or straps as required.

b. Insulation for all fittings shall be fitted and assembled with tight joints. Cementing of prefabricated assemblies shall be done with insulating cement. In all cases the joints shall be as thin as possible with just sufficient cement to provide good adhesion and complete closure. In no case will wide cement joints, or voids and holes plugged with cement, be permitted. Typical covers are shown in Figures 23-HSS-14, 23-HSS-15, and 23-HSS-16.



Application of Insulating Calcium Silicate Insulation to Flanged Valve

Figure 23-HSS-13

5. Expansion Joints

a. Expansion slip joints shall be provided in the insulation for horizontal piping 4-inch NPS and larger. An expansion joint shall be installed for each 21 feet of straight piping not interrupted by flanges, valves, or fittings, and insulated with multiple layer insulation, and each 42 feet insulated with single layer insulation. Typical installation is shown in Figure 23-HSS-17. If an expansion crack occurs after the insulation is in service, the crack shall be filled with white glass wool and an expansion joint shall be provided at that location.

b. Slip expansion joints shall be installed at the insulation support in vertical piping as shown in Figure 23-HSS-2.

c. Expansion joints shall be provided at junction of fitting covers and pipe insulation as required at the base of flanges, valves, and elbows. Slip joints shall be provided for pipe 4-inch NPS or larger, for multiple layer applications. Typical installation is shown in Figure 23-HSS-6.

d. Where flanged fittings or valves occur within these intervals, expansion shall be provided for in the flange cover, and expansion joints in the pipe will not be required.

6. Tracing and Insulation of Heated Piping. Tracing and insulation of heated piping shall be installed as specified in Article XIII of the GENERAL SPECIFICATIONS.

7. Piping Finish. Finish primers, shall coats and barrier coats shall be applied and maintained on insulating cement before application of finish coat.

8. Coat or Barrier. Weather barrier coating and adhesive. Wherever it is required, and where applied as specified in Article XVIII.B and XVIII.C of the GENERAL SPECIFICATIONS. Mastic weather barrier coating and glass cloth reinforcement shall be applied to all exposed

a. Weather barrier consisting of mastic coating and glass cloth reinforcement, where required, shall be applied after the application of the finish coat to the insulation as shown in Figure 23-HSS-7 or 23-HSS-10.

b. Weather barrier consisting of mastic coating and glass cloth reinforcement, where required, shall be applied after the application of the finish coat to the insulation as shown in Figure 23-HSS-7 or 23-HSS-10.

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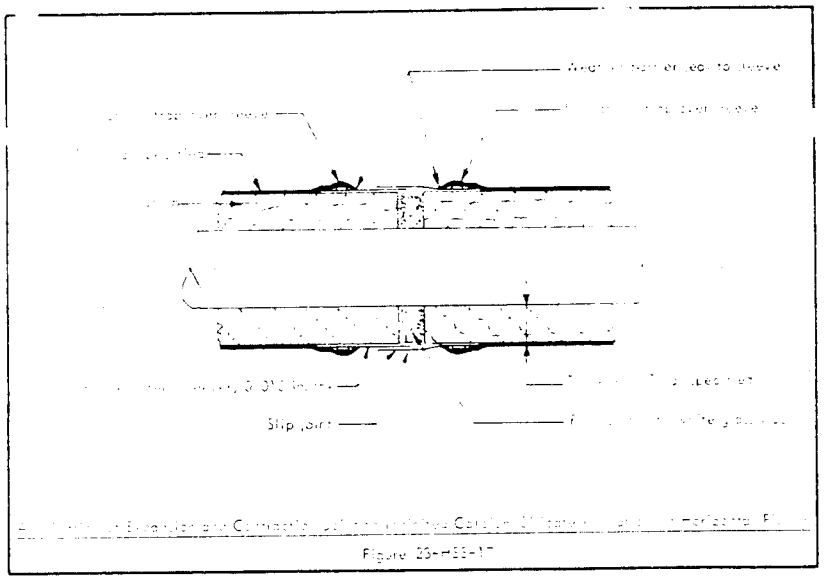
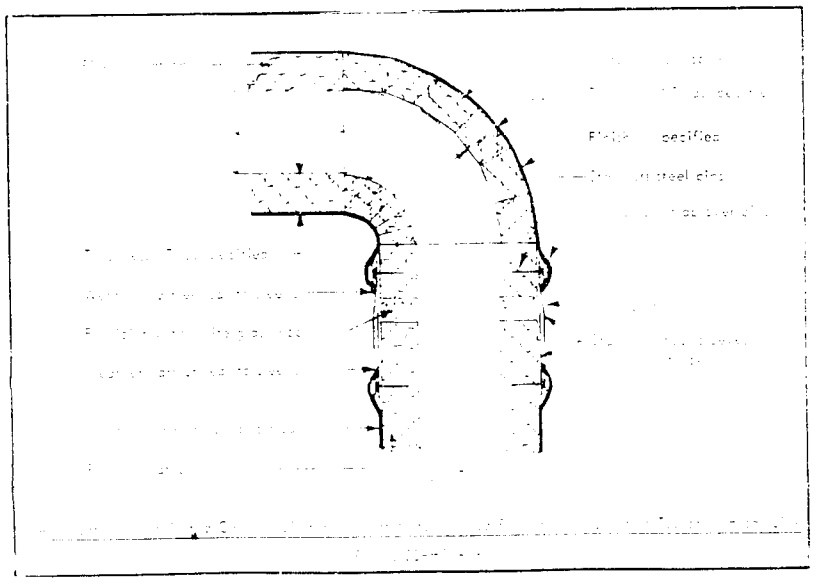


Figure 23-HSS-17



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THERMAL INSULATION APPLICATION SPECIFICATIONS

HYDROUS CALCIUM SILICATE IN COMBINATION WITH INHIBITED CALCIUM SILICATE

SCOPE

This specification describes the essential requirements for application of preformed hydrous calcium silicate insulation in combination with inhibited calcium silicate insulation for use on equipment and piping normally operating at temperatures from 750 F up to and including 1200 F.

Procedures described in the GENERAL SPECIFICATIONS are applicable to and constitute an integral part of this specification.

SECTION A - MATERIALS

1. INSULATION MATERIALS

Hydrous calcium silicate insulation and inhibited calcium silicate insulation shall be as specified in MATERIAL SPECIFICATIONS 25 and 23, respectively.

2. ACCESSORY MATERIALS

Accessory materials shall be as specified in the MATERIAL SPECIFICATIONS, article numbers as noted.

Mineral Wool Blanket (wire netting on both sides)	VII.A. 5	Stainless Steel Skewers	VII.A. 6
Insulating Cement	VII.A. 7	Welding Pin Insulation Fasteners	VII.A. 8
Pipe Insulation Support	VII.A. 9	Pin Clips	VII.A. 10
Equipment Insulation Strap	VII.A.11	Fabricating Cement	VII.A. 11
Clips for Equipment Strap	VII.A.12	Heat-Resistant Sealer	VII.A. 12
Pipe Insulation Strap	VII.A.13	Mastic	VII.A. 13
Clips for Pipe Strap	VII.A.14	Mineral Wool Blanket (wire netting on one side expanded metal lath on the other side)	VII.A.15a
Stainless Steel Wire	VII.A.17	Weather-Barrier Mastic (color as specified)	VII.B.1a
Wire Netting	VII.A.18	Reinforcing Cloth	VII.B.1b
Welding Pins	VII.A.19	Stainless Steel Weather-Barrier Jacket (Designation M)	VII.B.2
Stainless Steel Pins	VII.A.20	Treated Steel Weather-Barrier Jacket (Designation MT)	VII.B.3

SECTION B - APPLICATION

1. EQUIPMENT

a. Insulation Supports. Equipment shall be provided with insulation supports as specified in Article II of the GENERAL SPECIFICATIONS.

b. Thickness Schedule. Unless otherwise specified, insulation in excess of three inches total thickness shall be applied in multiple layer construction as specified in Article III.B of the MATERIAL SPECIFICATIONS, except that outer layer shall be calcium silicate insulation per MATERIAL SPECIFICATION 23.

c. Cushioning Blanket. On all equipment operating above 400 F or 8 feet and larger in diameter, a one-inch thick mineral wool cushioning blanket shall be applied over the entire surface before application of the hydrous calcium silicate insulation. The blanket shall not be compressed, and shall be secured in place with a minimum amount of stainless steel wire. Cushioning blanket shall not be considered as part of the specified insulation thickness.

d. Curved Surfaces. On all equipment, insulation block shall be properly cut in curved sectors and rectangular blocks, as required, to fit vessel surfaces with a one-inch space allowed for cushioning blanket where used and applied to vessel sides and heads in staggered position with all joints tightly butted. Multiple layers shall be applied so that the butt joints of one layer do not coincide with those of any other layer. Typical installation is shown in Figure 25-H-1.

e. Flat Surfaces

1) Block insulation shall be applied to flat surfaces in staggered position with all joints tightly butted. It shall be secured with wire attached to welding pins as shown in Owner's Standard, or other approved securement. On rectangular equipment the welding pins or other approved securement shall be placed on 12-inch centers, diamond pattern, for bottom surfaces, on 18-inch centers, diamond pattern, for side surfaces, and on 24-inch centers, diamond pattern, for top surfaces.

2) When specified thickness of insulation has been applied, wire netting shall be stretched tightly over block and secured with tie wires, or other approved securement. Entire surface shall be given a 1/2-inch thick, smooth and uniformly applied trowel coat of insulating cement. Typical installation is shown in Figure 25-H-2.

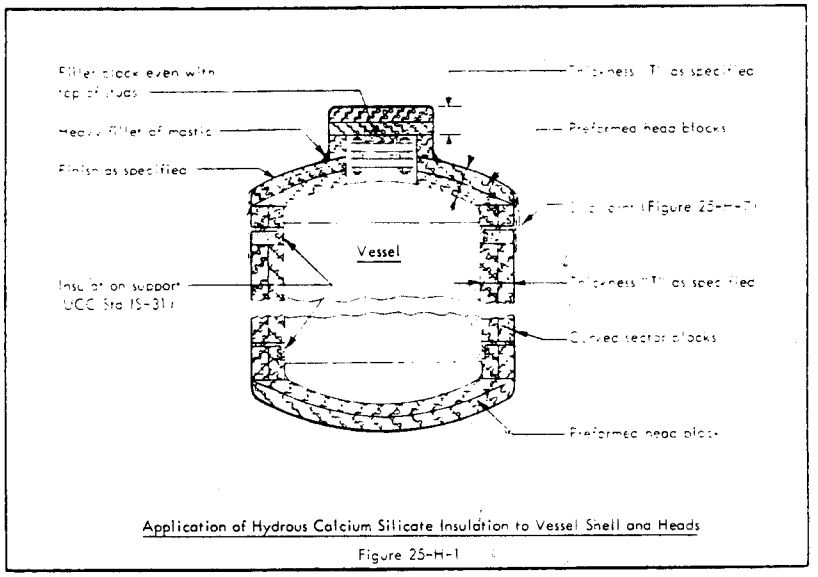
f. Securement

1) All pipe insulation shall be secured with insulation strap where contour of vessel permits firm and effective attachment. Where required, insulation strap shall be attached to strap anchor angles as shown in Owner's Standard IS-31A. Insulation applied to irregular surfaces, where use of strap is impracticable, shall be secured with wire fastened to welding pins, drawn taut, ends twisted and embedded in insulation.

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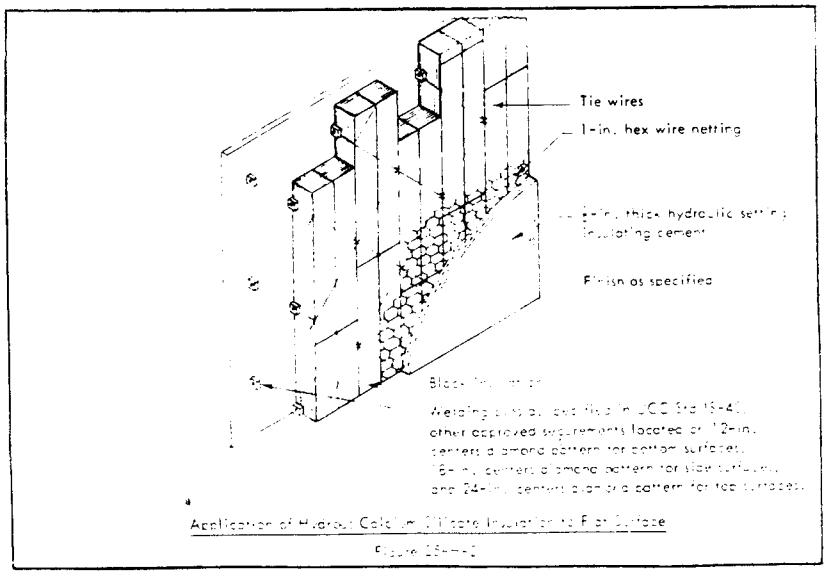
SECTION B - APPLICATION - cont'd

1. EQUIPMENT - cont'd



Application of Hydrous Calcium Silicate Insulation to Vessel Shell and Heads

Figure 25-H-1

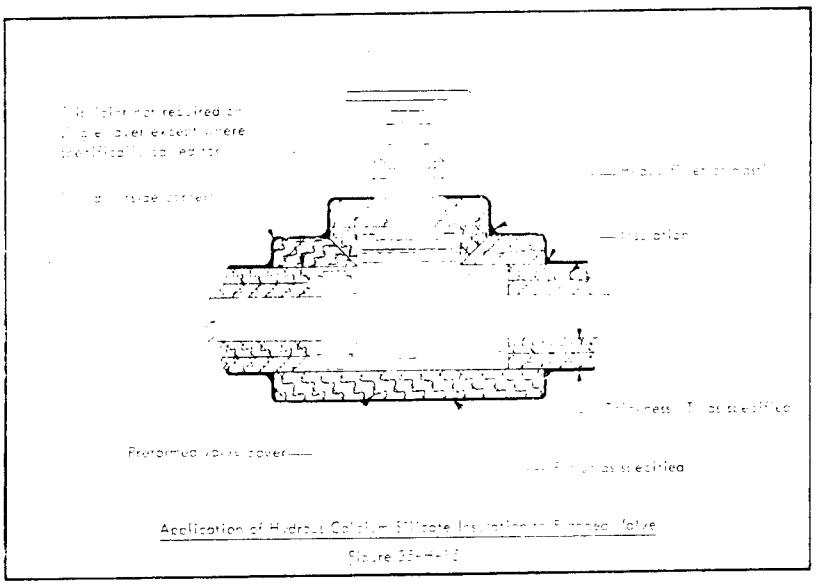


Application of Hydrous Calcium Silicate Insulation to Flat Surface

Figure 25-H-2

2. PIPING Items

a. Piping Flanges and Valve Covers - Items



Application of Hydrous Calcium Silicate Insulation on Flanged Valve

Figure 25-H-12

b. Expansion Joints

1) Expansion slip joints shall be provided in the insulation on hot piping at intervals not exceeding 100 feet on straight runs. An expansion joint shall be provided within 15 feet of each anchor. Where anchors are not required on straight runs of piping, such as between two elbows, expansion joints shall be provided at intervals not exceeding 100 feet. Expansion joints shall be provided in insulation applied on piping 4-inch NPS and larger with single layer insulation. Typical installation is shown in Figure 25-H-13. In all expansion joints except those around flanges, the space between the ends of the insulation shall be filled with white glass wool and an expansion joint shall be provided at this location.

2) The expansion slip joints shall be installed at the insulation support in vertical piping as shown in Figure 25-H-12.

3) Expansion slip joints shall be provided at the edge of flange covers and valve covers where the piping is 4-inch NPS and larger. Typical installation is shown in Figure 25-H-13.

4) Where flanged fittings or valves occur in hot lines, expansion joints shall be provided in the flange covers and insulation shall be applied as specified in Article XIII of the GENERAL SPECIFICATIONS.

c. Traced Installations. Tracing and insulation on traced lines shall be installed as specified in Article XIII of the GENERAL SPECIFICATIONS.

d. Jacket Finish. Where required, jacket, bands and expansion joints shall be finished and installed as specified in Article XIII of the GENERAL SPECIFICATIONS.

e. Weather Barrier. Weather-barrier coating and barrier, where it is called for, shall be applied as specified in Article XIII of the GENERAL SPECIFICATIONS. Where weather barrier is required, the word "weather" shall be added to the specification for the item.

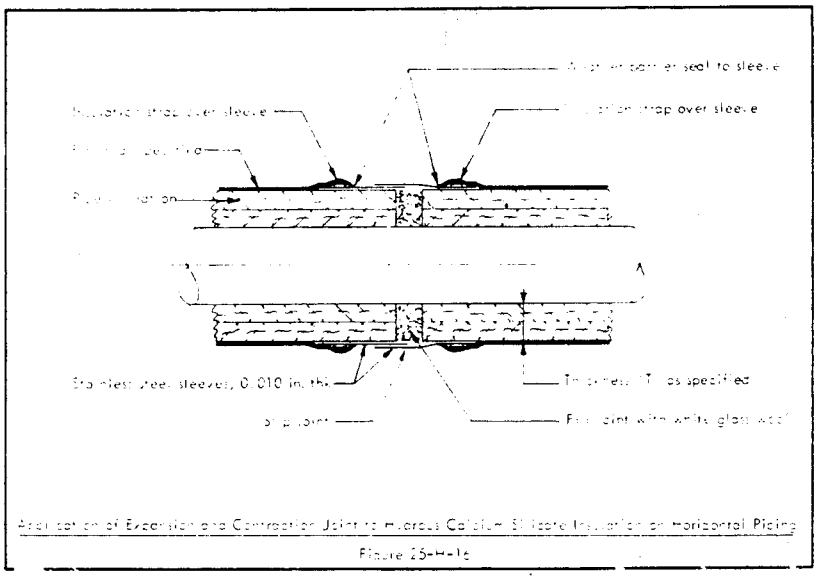
1) Weather barrier on cold piping of stainless steel jacketing, where required, shall be indicated by the addition of the letter W to the specification for the item. See Figure 25-H-12.

2) Weather barrier coating on insulated steel jacketing, where required, shall be indicated by the addition of the letters WT to the specification for the item. See Figure 25-H-12.

SECTION B - APPLICATION - cont'd

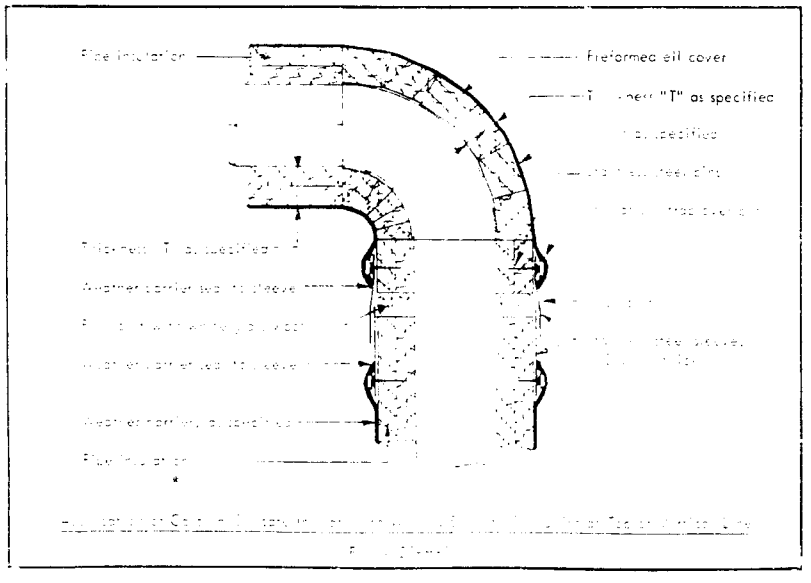
D. PIPING - cont'd

3. Expansion Joints - cont'd



Arrangement of Expansion and Contraction Joints in Hot or Cold Service Insulation on Horizontal Piping

Figure 25-H-16



THERMAL INSULATION APPLICATION SPECIFICATIONS

PREFABRICATED STAINLESS-CASED ALUMINUM

SCOPE

This specification sets forth the essential requirements for application of prefabricated stainless-cased aluminum reflective insulation for use on piping and equipment normally operating at temperatures from 33 F up to and including 1000 F.

Procedures described in the GENERAL SPECIFICATIONS are applicable to and constitute an integral part of this specification.

SECTION A - MATERIALS

1. INSULATION MATERIAL

   a. [illegible] shall be as specified in MATERIAL SPECIFICATION 31.

2. ACCESSORY MATERIALS (furnished by manufacturer)

   a. [illegible] Insulation Strap - 3/8-inch by 0.015-inch, Type 304, stainless steel.

   b. Stainless Steel Sheet Metal Screws (minimum Size No. 12).

   c. Snap-lock type fasteners.

SECTION B - APPLICATION

1. EQUIPMENT

   a. Insulation Supports. Equipment shall be provided with insulation supports as specified in Article II of the GENERAL SPECIFICATIONS.

   b. Thickness Schedule. Unless otherwise specified, insulation shall be applied in one layer.

   c. Curved Surfaces. Panels fabricated for curved surfaces shall be applied with edges closely abutting and with outer casing laps, or trim strips, arranged to shed water. Where required, panels shall be secured to each other with sheet metal screws through the casing laps, or trim strips, over joints to form a continuous envelope over the surface to be insulated, except at expansion joints, flanges, etc. Where required, panels shall be secured with insulation strap or special fasteners.

   d. Flat Surfaces. Panels fabricated for flat surfaces shall be applied in the same manner as specified for curved surfaces. Where the span of surface to be insulated exceeds 30 inches, panels shall be secured to the surface by a method approved by the Owner.

2. PIPING

   a. Pipe Insulation

      1) Insulation supports, where required, shall be provided by the Contractor.

      2) Unless otherwise specified, insulation shall be applied in one layer.

      3) Insulation shall be applied to piping with the flush separator end of each section inserted into overlapping end of abutting section. The extended longitudinal edges of each section shall be lapped over flush edges of abutting half-section so that all joints are tightly butted.

      4) Lapped edges of outer shell shall be placed so as to shed water.

   b. Fitting, Flange, Valve, and Pipe Bend Covers. Fittings, flanges, valves and bent piping shall be insulated in a manner similar to that for straight piping. The fitting covers shall be applied with telescoping joint connections to the adjacent pipe insulation. In cases where the covers adjoin other types of insulation, the covers shall be designed to overlap the dissimilar insulation.

   c. [illegible] Insulation shall be secured in place with insulation strap, snap-lock type fasteners or screws.

   d. General

      1) Care shall be taken in the application to prevent crushing or other abuse of the insulation, and to preserve the factory finish of the jacket.

      2) Wherever field cutting or fitting around supports, or [illegible] is required, care shall be exercised to insure good workmanship, and to avoid individual air chambers in the insulation.

      3) Where any element or piping is located outdoors, or where [illegible] openings in outer shell of the insulation and jacket shall be made to form a watertight seal.

      4) Provision shall be made in the assembly of the insulation for expansion and contraction of the surfaces insulated without damage to the insulation.

      5) Tracing and insulation on traced lines, where specified, shall be installed as specified in Article XIII of the GENERAL SPECIFICATIONS.

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THERMAL INSULATION APPLICATION SPECIFICATIONS

BONDED AND REINFORCED EXPANDED SILICA

SCOPE

This specification describes the essential requirements for application of preformed bonded and reinforced expanded silica (perlite) insulation for use on equipment and piping, including stainless steel, operating above 70 F and specified to be protected from fire exposure.

Procedures described in the GENERAL SPECIFICATIONS are applicable to and constitute an integral part of this specification, with exceptions as noted herein.

SECTION A - MATERIALS

A. INSULATION MATERIAL

Insulation shall be as specified in MATERIAL SPECIFICATION 22.

B. ATTACHED MATERIALS

Attached materials shall be as specified in the MATERIAL SPECIFICATIONS, article numbers as noted.

Cushioning Blanket	VII.A. 1	Stainless Steel Screws	VII.A. 21
Mineral Wool Blanket (wire netting on both sides)	VII.A. 5	Welding Pin Insulation Fasteners	VII.A. 22
Insulating Cement	VII.A. 7	Pin Clips	VII.A. 23
Pipe Insulation Support	VII.A. 9	Fabricating Cement	VII.A. 36
Equipment Insulation Strap	VII.A.11	Heat-Resistant Sealer	VII.A. 40
Clip for Equipment Strap	VII.A.12	Mastic	VII.A. 45
Pipe Insulation Strap	VII.A.13	Adhesive Type Pins	VII.A. 75
Clip for Pipe Strap	VII.A.14	Mineral Wool Blanket (wire netting on one side, expanded metal lath on the other side)	VII.A. 76
Stainless Steel Wire	VII.A.17	Weather-Barrier Mastic (color as specified)	VII.B. 1
Wire Netting	VII.A.18	Reinforcing Cloth	VII.B. 2
Welding Pins	VII.A.19	Stainless Steel Weather-Barrier Jacket (Designation MT)	VII.B.2
Stainless Steel Pins	VII.A.20	Treated Steel Weather-Barrier Jacket (Designation MT)	VII.B.3

SECTION B - APPLICATION

1. EQUIPMENT

a. Insulation Supports. Equipment shall be provided with insulation supports as specified in Article II of the GENERAL SPECIFICATIONS.

b. Thickness Schedule. Unless otherwise specified, insulation in excess of 3 inches total thickness shall be applied in multilayer construction as specified in Article III.B of the MATERIAL SPECIFICATIONS.

c. Cushioning Blanket. On all equipment operating above 400 F or 8 feet and larger in diameter a one-inch thick wool cushioning blanket shall be applied over the entire surface before application of the expanded silica insulation. On equipment operating up to 1000 F Cushioning Blanket VII. A. 1 shall be used, above 1000 F to 1200 F Blanket VII. A. 5 shall be used. The blanket shall not be compressed, and shall be held in place with a minimum amount of stainless steel wire. Cushioning blanket shall not be considered as part of the specified insulation thickness.

d. Curved Surfaces. On all equipment insulation block shall be properly cut in curved sectors and rectangular blocks, as required to fit vessel surfaces, with a one-inch space allowed for cushioning blanket where used, and applied to vessel sides and heads in staggered position with all joints tight, butted. Multiple layers shall be applied so that the butt joints of one layer do not coincide with those of any other layer. Typical installation is shown in Figure 32-H-1.

e. Flat Surfaces. Block insulation shall be applied to flat surfaces in staggered position with all joints tightly butted. It shall be secured with attached to welding pins as shown in Owner's Standard 15-40, or other approved securement. On rectangular equipment, the welding pins or other approved securements shall be placed on 12-inch centers, diamond pattern, for bottom surfaces on 18-inch centers, diamond pattern, for side surfaces and on 24-inch centers, diamond pattern for top surfaces. Typical installation is shown in Figure 32-H-2.

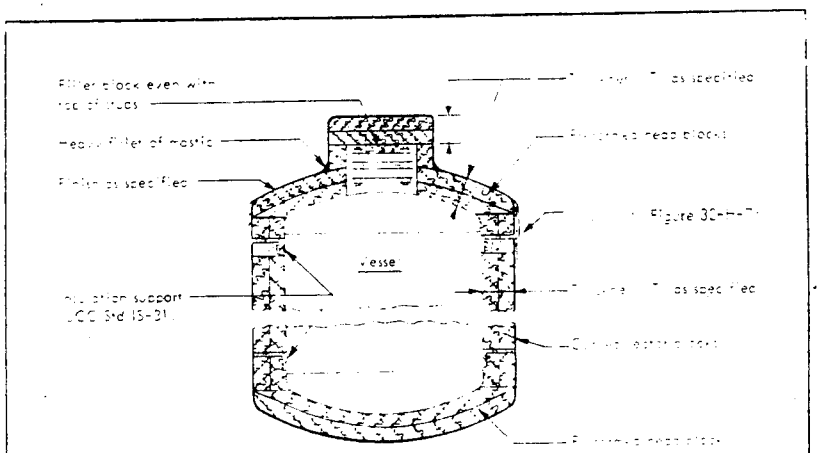
f. Securement

1. All layers of insulation shall be secured with insulation strap where contour of vessel permits firm and effective attachment. Circumferential insulation strap shall be attached to strap anchor angles as shown in Owner's Standard 15-31A. Insulation applied to irregular surfaces, where strap is impracticable, shall be secured with wire fastened to welding pins, drawn taut, ends twisted and embedded in insulation.

2. All layers of insulation on bottom heads of vertical equipment and heads of horizontal equipment shall be secured in place with wire attached to welding pins, or insulation strap attached to insulation support as shown in Owner's Standard 15-31 and 15-40 and in Figure 32-H-3.

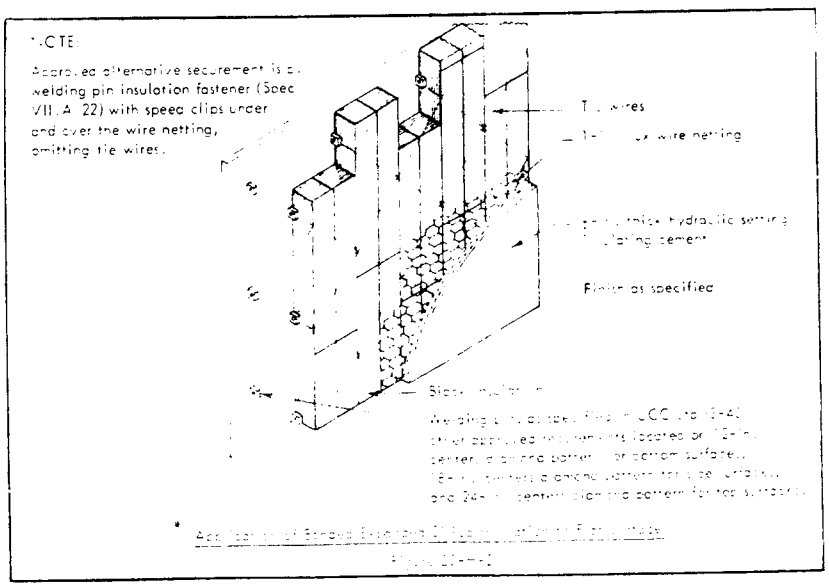
g. Flanges. Manhole flanges, blind flanges, and vessel flanges shall be insulated unless otherwise specified.

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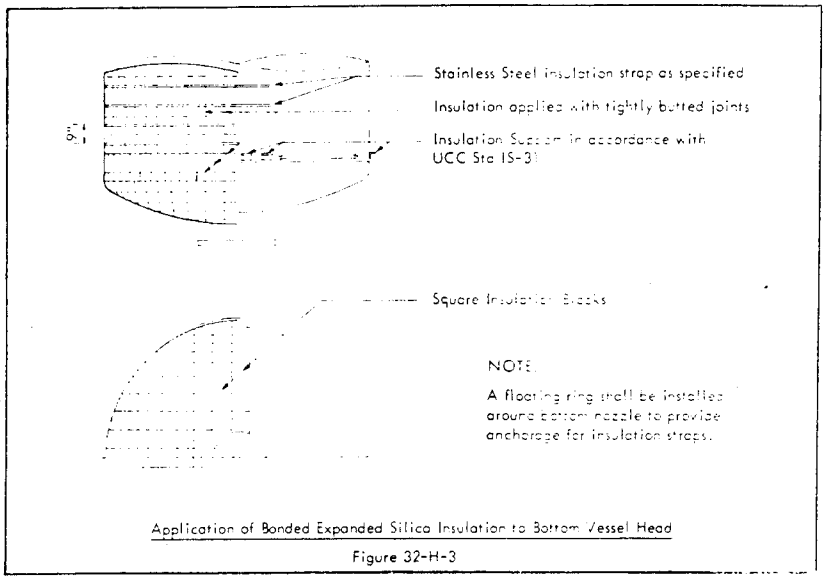


Application of Bonded Expanded Silica Insulation to Vessel Shell and Heads

Figure 32-H-1



B. EQUIPMENT - cont'd

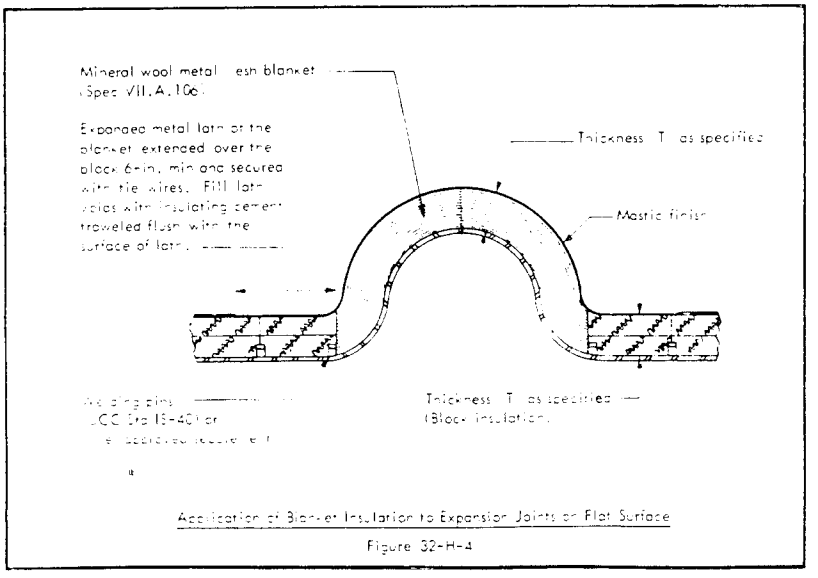


Application of Bonded Expanded Silica Insulation to Bottom Vessel Head

Figure 32-H-3

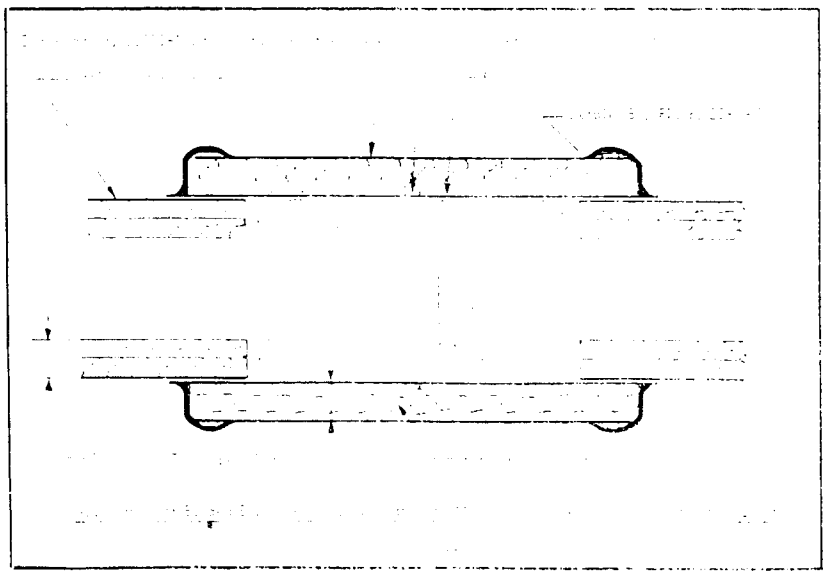
4. Expansion Joints

a. Expansion joints in flat surfaces or cylindrical vessels shall be insulated with flexible blanket insulation. Typical installation is shown in Figure 32-H-4.



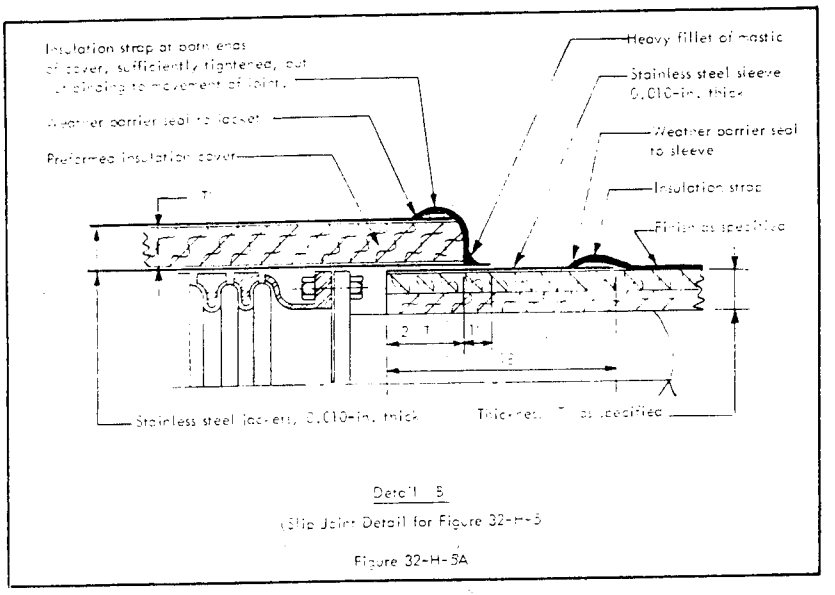
Application of Blanket Insulation to Expansion Joints on Flat Surface

Figure 32-H-4



Union Carbide trial exhibit UC-4586: W. G. Hammar Transmittal Memoranda and Union Carbide Thermal Insulati…
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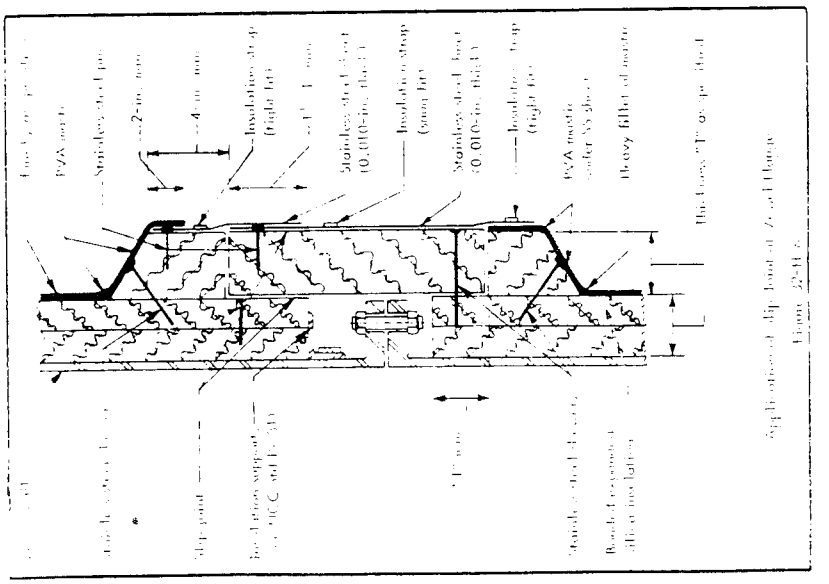
SECTION B - APPLICATION - cont'd

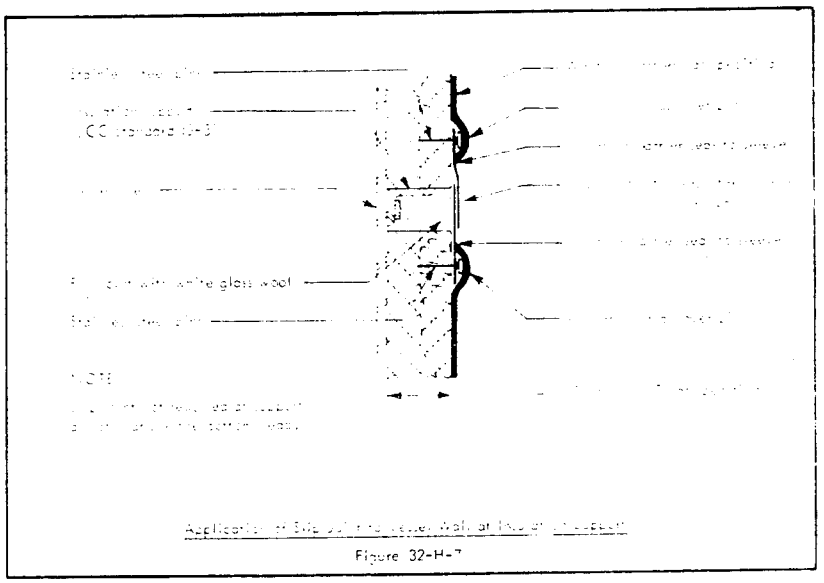


Detail B

(Slip Joint Detail for Figure 32-H-3

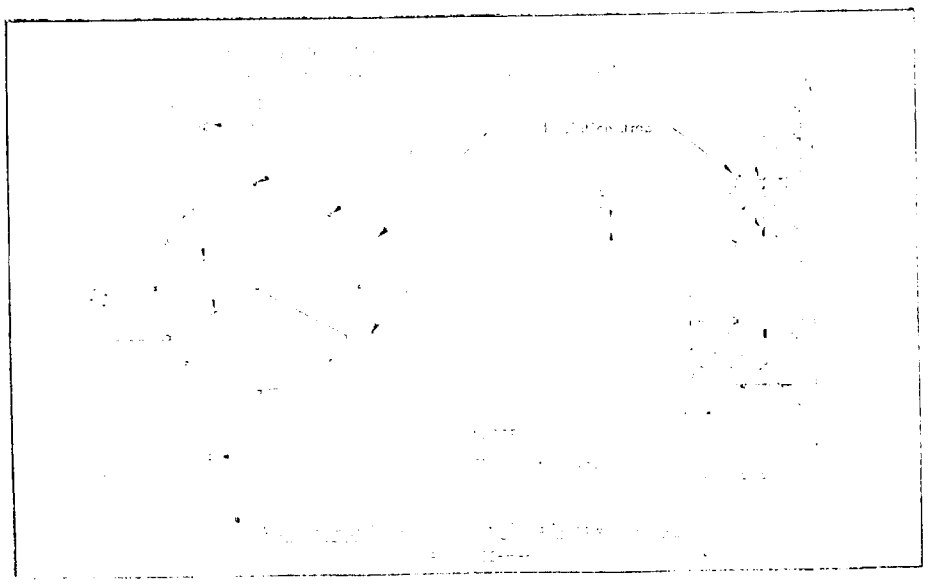
Figure 32-H-3A



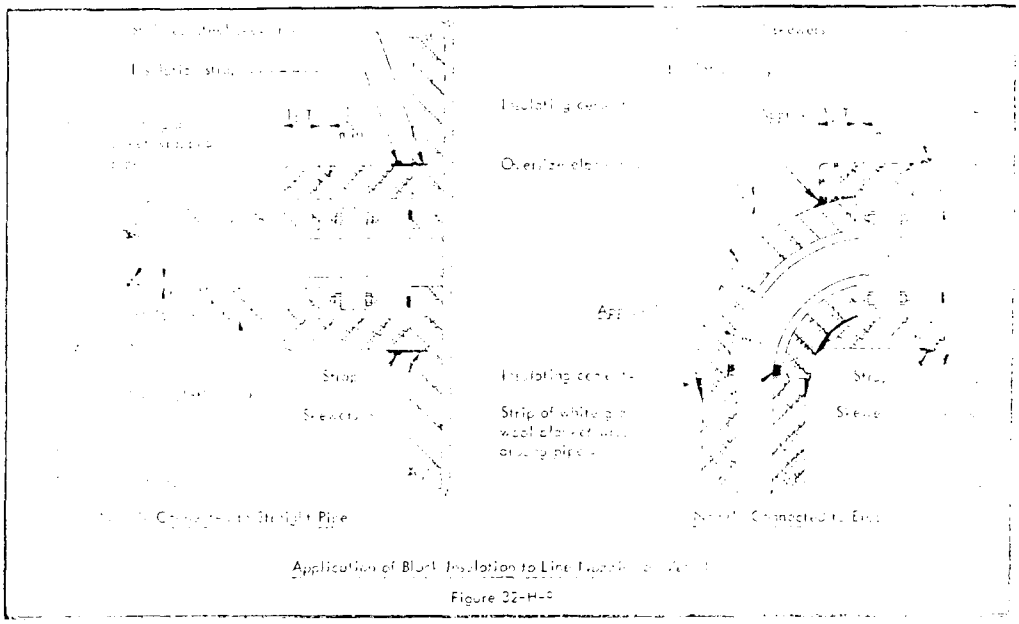


[illegible]

Figure 32-H-7

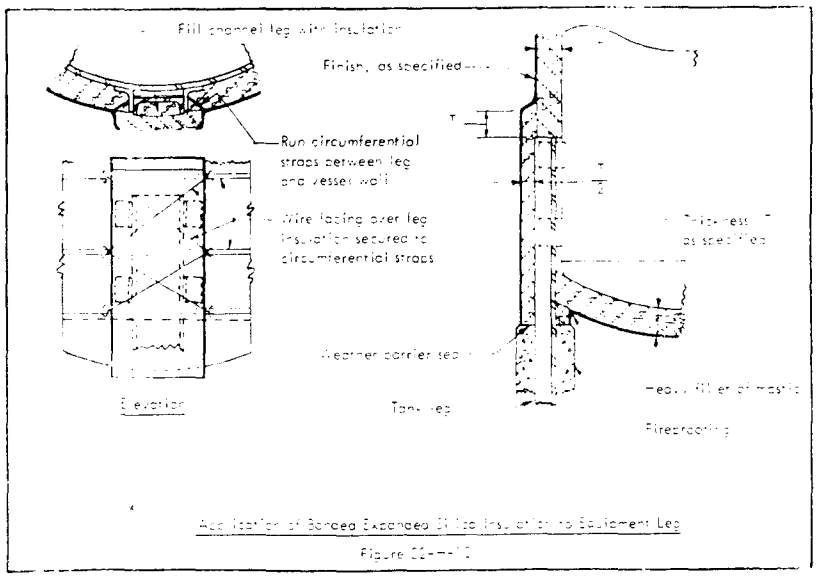


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Application of Blunt Insulation to Line

Figure 32-H-8



Application of Banded Expanded Blanket Insulation to Equipment Leg

Figure 32-H-10

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SECTION B - APPLICATION - cont'd

[illegible] All vertical equipment shall have their outer surfaces insulated [illegible] otherwise specified, insulation shall extend [illegible] from head to standard fireproofing or to foundation as shown in Figure [illegible].

[illegible] Tracing and insulation on traced equipment shall be installed as specified in Article XIII of the GENERAL SPECIFICATIONS.

[illegible] Where insulation has been applied, and where it is necessary [illegible] shall be painted as with insulation termination [illegible].

[illegible] Weatherproof coating or jacket, where required to be applied as specified in Articles XI.A.8 and XI.B, respectively, of the GENERAL SPECIFICATIONS, shall be applied [illegible] jacket.

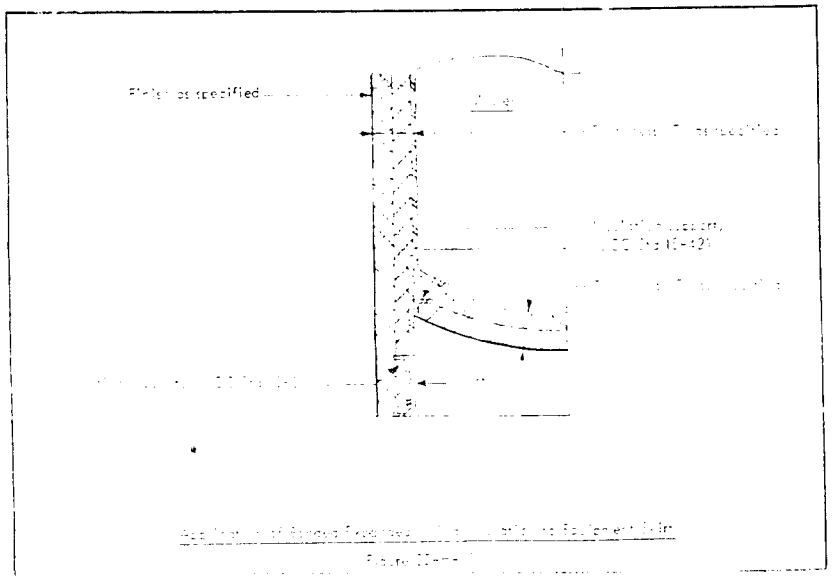
[illegible] Where [illegible] is called for [illegible] of the letter "T" [illegible].

[illegible]

[illegible] Pipe insulation shall be [illegible] as specified in Article [illegible] of the GENERAL SPECIFICATIONS.

[illegible] Unless otherwise specified, pipe insulation shall be applied in accordance with the table for outdoor [illegible] of the GENERAL SPECIFICATIONS.

Nominal Pipe Size	Total Conductive Thickness, Inches	Number of Layers	Thickness of Each Layer, Inches
[illegible]	1	-	1
[illegible]	1½	-	1½
[illegible]	2	-	2
[illegible]	3	-	3
[illegible]	4	2	2
[illegible]	5	2	2½
[illegible]	6	2	3
[illegible]	7	2	3½
[illegible]	8	2	4
[illegible]	9	3	3
[illegible]	10	3	3½
[illegible]	11	3	3½
[illegible]	12	3	4



[illegible]

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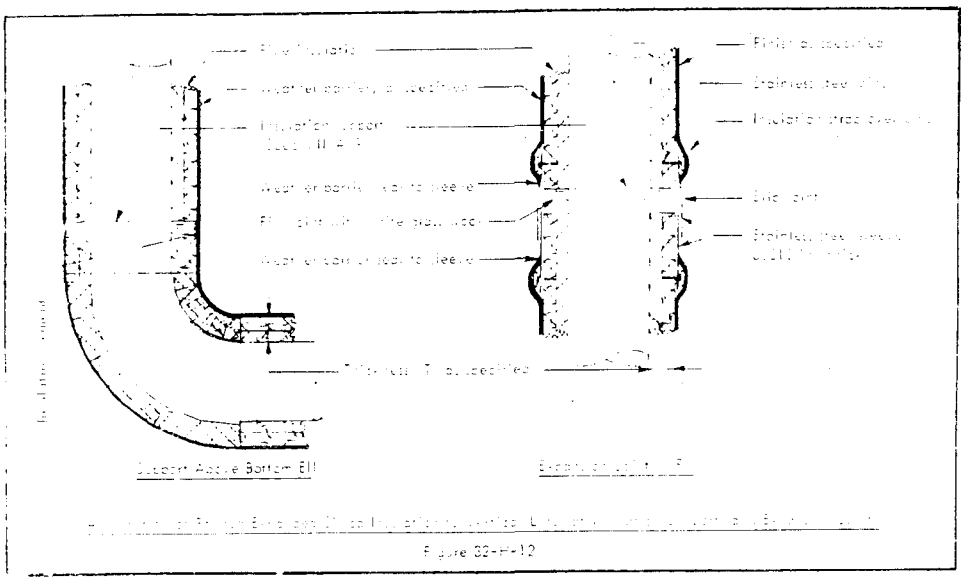


Figure 32-HF-12

SECTION B - APPLICATION - cont'd

2. PIPING - cont'd

e. Fittings, Flange, and Valve Covers

1) Fittings, flanges, and valves shall be insulated with covers prefabricated in accordance with ASTM Recommended Practice C 450 latest revision.

2) Cementing of shop fabricated assemblies shall be done with fabricating cement. In all cases the joints shall be as thin as possible with just sufficient cement to obtain good adhesion and complete closure. In no case will wide cement joints, or voids and holes plugged with cement, be permitted. Typical covers are shown in Figures 32-H-13, 32-H-14, and 32-H-15.

3) Fitting insulation shall be secured with wire or strap as required.

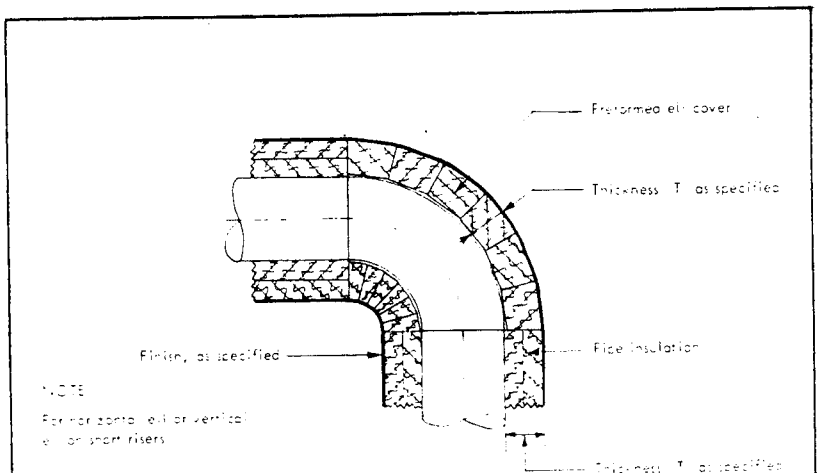
f. Expansion Joints

1) Expansion slip joints shall be provided in the insulation for horizontal piping 4-inch NPS and larger. An expansion joint shall be installed every 90 feet of straight piping not interrupted by flanges, valves, or fittings and insulated with multiple layer insulation, and every 45 feet insulated with single layer insulation. Typical installation is shown in Figure 32-H-16. If an expansion crack occurs after line is put in service, the crack shall be filled with white glass wool and an expansion joint shall be provided at that location.

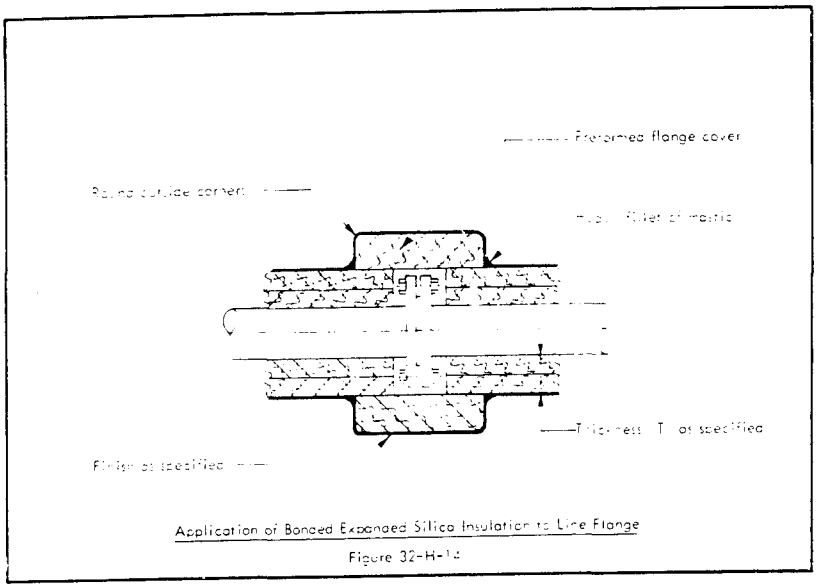
2) The expansion slip joints shall be installed at the insulation support in vertical piping as shown in Figure 32-H-12.

3) Expansion slip joints shall be provided at junction of fitting covers and pipe insulation located at the tops of risers where riser exceeds 10 feet in height and pipe is 4-inch NPS and larger. Typical installation is shown in Figure 32-H-17.

4) Where flanged fittings or valves occur within these intervals, expansion shall be provided for in the flange cover, and expansion slip joints in insulation will not be required.

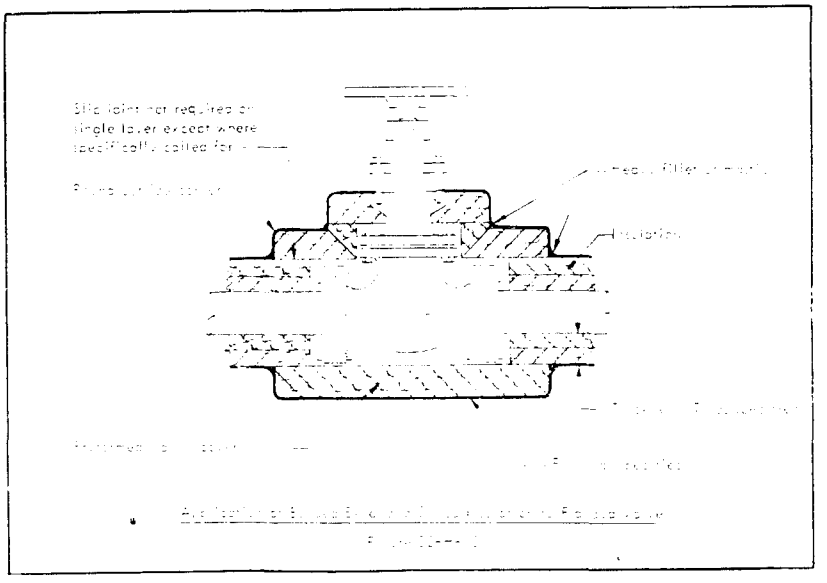


Application of Bonded Expanded Silica Insulation to Welded Elbow
Figure 32-H-13



Application of Bonded Expanded Silica Insulation to Line Flange

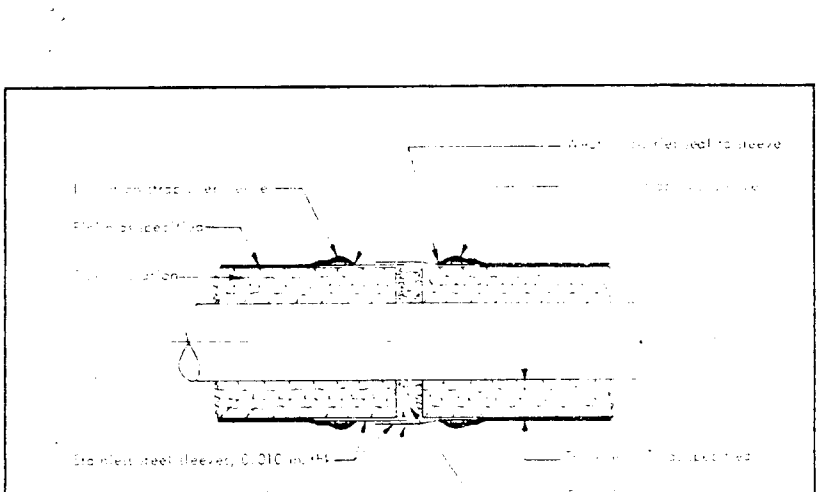
Figure 32-H-14



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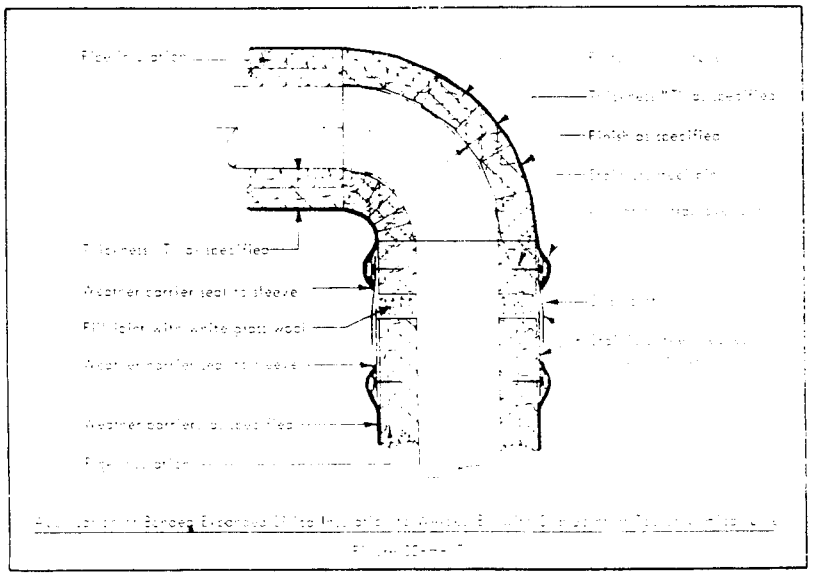
SECTION 3 - APPLICATION [illegible]

3.1 PIPING [illegible]



Application of Expansion and Contraction Joints in Bonded Expanded Silica Insulation on Horizontal Piping

Figure 32-H-16



SECTION B - APPLICATION - cont'd

3. PIPING - cont'd

a. Surface Finish

All voids, pockets and depressions, where present, shall be filled and smoothed with insulating cement.

2. Unless specifically noted, fittings, flanges and valves shall be given a skin coat of specified hard surface finishing cement before application of coatings.

b. Polyurethane Tubing in Conduit or Trough, Junction Boxes, and Copper Tubing

Unless specified in insulation schedule or instrumentation schedule, polyurethane shall be placed in metal conduit or trough and sealed. Conduit and troughs within a distance of 3 feet from the junction boxes shall be insulated for fire protection.

2. Unless otherwise specified, insulation shall be a minimum of 1½-inch thickness.

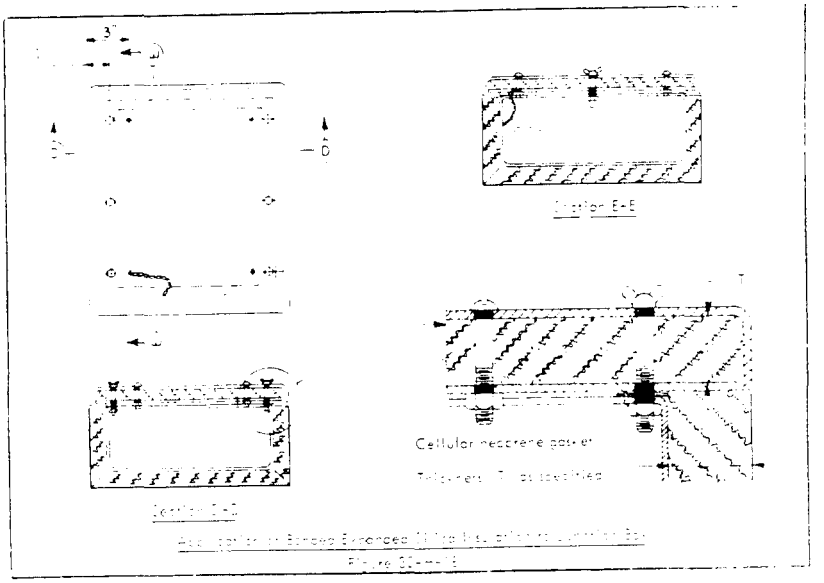
3. Polyurethane shall be poured to conduit, junction boxes and troughs in staggered operations where possible, and with all joints [illegible].

4. Polyurethane conduit and copper tubing shall be secured with stainless steel insulation straps.

5. Polyurethane junction boxes and troughs shall be secured with stainless steel wire and nylon nuts. If welding on junction boxes and troughs is unavoidable, stainless steel pins shall be used.

6. Polyurethane junction boxes and troughs shall be insulated separately from the remainder of covers. Typical installation is shown in Figures 32-HFP-8 and 32-HFP-9.

7. All aluminum conduit, trough, and junction boxes shall be coated as specified in the Union Carbide Corporation Design and Construction Standard Specifications.

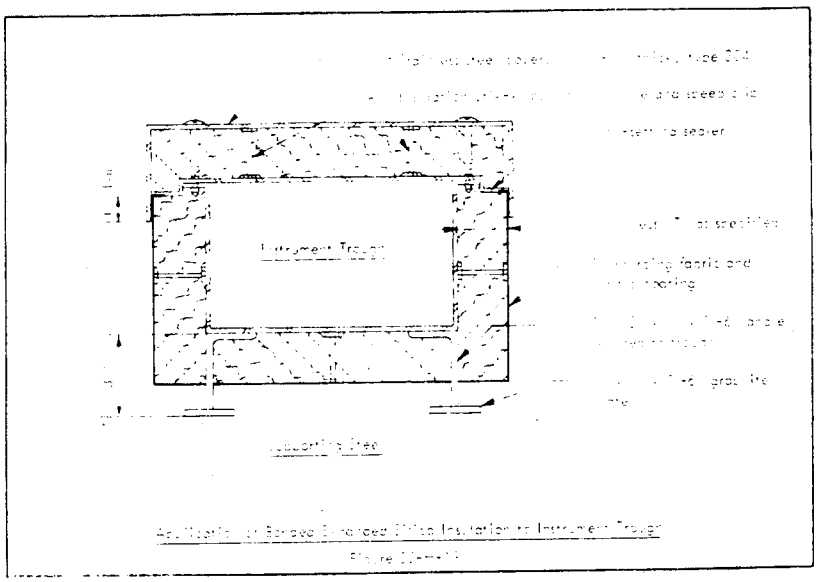


Pipe Support or Bracing Extended Through Insulation or Junction Box
Figure 32-HFP-8

SECTION [illegible] - APPLICATION - cont'd.

[illegible] Pipe - cont'd.

[illegible] Conduit or Trough - Junction Boxes - Sleeves - Supporting - cont'd.



Application of Sealed Finished Fiber Insulation to Instrument Trough

Figure [illegible]

Terminations. Finishing and insulation of treated lines at [illegible] shall be installed as specified in Article XIII of the GENERAL SPECIFICATIONS.

Weather Barrier. A weather-barrier coating or jacket, which must be called for [illegible] shall be applied as specified in Articles XI [illegible] and [illegible] of the GENERAL SPECIFICATIONS. Where weather-barrier coating is to be used [illegible] letter is added for specification [illegible].

A weather barrier consisting of stainless steel lagging, where required, shall be called for by the addition of the letter M to the specification designation, thus 32-HFPSM.

[illegible] weather barrier consisting of treated fiber lagging, where required, shall be called for by the addition of the letter MT to the specification designation, thus 32-HFPMT.

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THERMAL INSULATION APPLICATION SPECIFICATIONS

BONDED EXPANDED SILICA AND CELLULAR GLASS

SCOPE

This specification describes the essential requirements for application of bonded expanded silica and cellular glass insulation to low temperature equipment and piping, normally operating below 70 F, and specified to be protected from fire exposure.

The second designation, 32-LFPSS, indicates that this specification shall be used for stainless steel equipment and piping. However, Specification 32-LFPSS may also be subject to the use of accessory materials specified for stainless steel.

Procedures described in the GENERAL SPECIFICATIONS are applicable to and constitute an integral part of this specification.

SECTION A - MATERIALS

1. INSULATION

Bonded expanded silica insulation and cellular glass insulation shall be as specified in MATERIAL SPECIFICATIONS 22, and 10, respectively.

2. ACCESSORY MATERIALS

Accessory materials shall be as specified in the MATERIAL SPECIFICATIONS, article numbers as noted.

Specification 32-LFP

Cushioning Blanket	VII.A. 1	Fabricating Cement for Expanded Silica	VII.A. 38
Cushioning Glass Fiber Molded Pipe Insulation	VII.A. 4	Anti-Abrasive Coating	VII.A. 39
Equipment Insulation Strap	VII.A.11	Joint Sealer	VII.A. 40
Clips for Equipment Strap	VII.A.12	Lap Sealer	VII.A. 41
Pipe Insulation Strap	VII.A.13	Adhesive Cement	VII.A. 42
Clips for Pipe Strap	VII.A.14	Weather-Barrier Mastic (color as specified)	VII.B. 1
Stainless Steel Wire	VII.A.17	Reinforcing Cloth	VII.B. 2
Strapping Tape	VII.A.33	Stainless Steel Weather Barrier (Designation MS)	VII.B. 3
Fabricating Cement for Cellular Glass	VII.A.36	Treated Steel Weather Barrier (Designation MT)	VII.B. 4

Specification 32-LFPSS

Accessory materials for Specification 32-LFPSS are the same as those for Specification 32-LFP, with the following exceptions:

Cushioning Glass Fiber Molded Pipe Insulation . . . . VII.A. 3 instead of VII.A.4
Anti-Abrasive Coating and Joint Sealer . . . . . VII.A.40 instead of VII.A.39

SECTION B - APPLICATION

1. EQUIPMENT

a. Insulation Supports. Equipment shall be provided with insulation supports as specified in Article II of the GENERAL SPECIFICATIONS.

b. Thickness Schedule. Second layer, or inner layers, as specified in Article III.E of the MATERIAL SPECIFICATIONS, shall be required to be bonded cellular glass, but not less than 1½-inch thick. Outer layer shall be 1½-inch thick bonded expanded silica insulation.

c. Cushioning Blanket

1) On all equipment except stainless steel a ½-inch thick cushioning blanket shall be applied over the entire surface before the application of the cellular glass insulation. Blanket shall be held in place with a minimum amount of stainless steel wire. Cellular glass insulation shall then be applied over the blanket in the following manner. Cushioning blanket shall not be considered as part of the specified insulation thickness.

2) On all stainless steel equipment a one-inch thick white glass wool cushioning blanket shall be applied over the entire surface before insulation. Blanket thickness and secured in the same manner as that specified in Paragraph (1) above.

d. Curved Surfaces

1) Cellular glass insulation shall be shop fabricated into curved segments or rectangular blocks, as required, and fitted to allow a minimum joint for cushioning blanket between block and vessel. Block insulation shall be applied over cushioning material on all equipment with a joints staggered. Multiple layers of insulation shall be applied so that the butt joints of one layer do not coincide with those of any other layer.

2) All butt edges and ends of insulation fabricated for inner layer, or layers, shall be given a smooth brush or spray coat of the specified bonding cement and allowed to dry for a minimum of four hours before application of insulation to equipment.

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SECTION B - APPLICATION - cont'd

1. EQUIPMENT - cont'd

a. Curved Surfaces - cont'd

2) All butt edges and ends of outermost layer (or single layer) of cellular glass formed [illegible] shall be sealed with a buttered coat of joint sealer. This coating shall be only of sufficient thickness to provide proper adhesion, seal, and surface between the individual pieces of insulation. Typical installation is shown in Figure 32-LFP-1.

4) Banded expanded silica insulation shall be properly molded or cut into curved segments or rectangular blocks, as required, to fit the outside surface of the cellular glass insulation, and applied to insulated sides and heads of vessel in staggered position with all joints tightly butted.

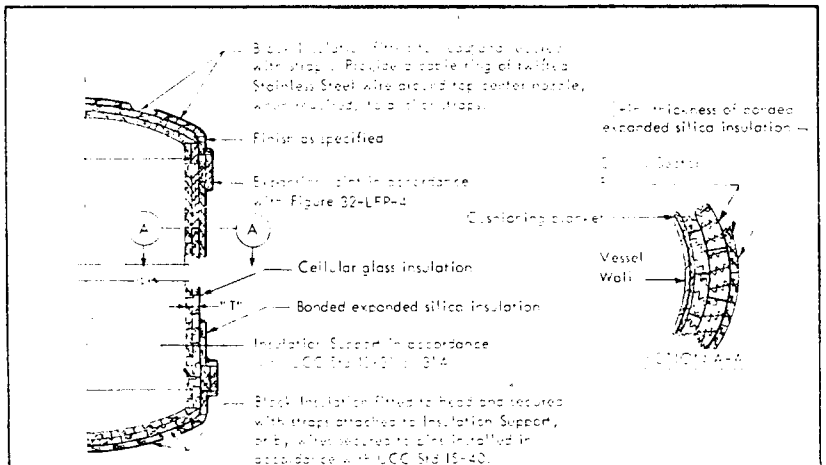
e. Securement

1) All layers of cellular glass and banded expanded silica insulation shall be secured in place with stainless steel insulation straps where continuous support is provided for firm and effective attachment. Insulation shall be secured to irregular surfaces with stainless steel wire.

2) Inner layer or layers of cellular glass insulation on bottom heads of vertical equipment, or heads of horizontal equipment, shall be held in place with specified stainless steel insulation straps secured to insulation supports as shown in Carbide Std. Dwgs. 13-31, 13-36, and 13-42. Outer layer of cellular glass insulation on bottom heads of vertical equipment, or heads of horizontal equipment, shall be secured with insulation straps as shown in Figure 32-LFP-2.

f. Expansion Joints

1) Expansion-contraction joints, constructed as shown in Figure 32-LFP-3, shall be provided at [illegible] flanges. Where movement [illegible] the sealer shall be applied to surfaces of insulation, as shown, to provide proper slip joint.

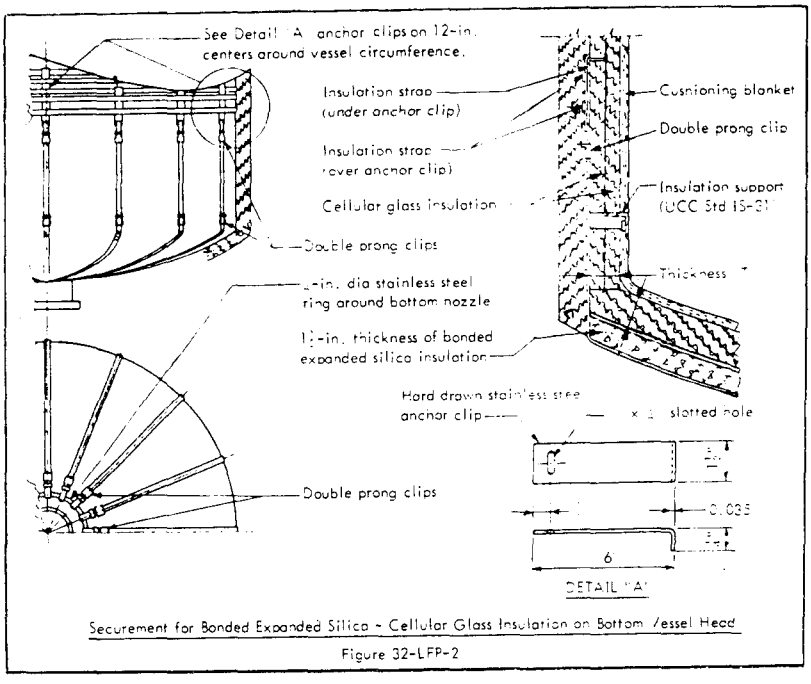


Application of Banded Expanded Silica - Cellular Glass Insulation to Vessel Shell and Heads

Figure 32-LFP-1

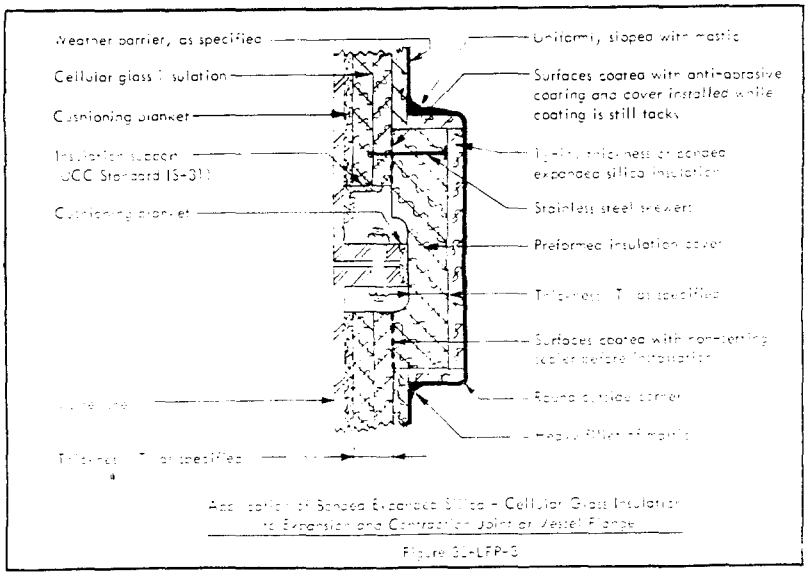
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1. EQUIPMENT - contd



Securement for Bonded Expanded Silica - Cellular Glass Insulation on Bottom Vessel Head

Figure 32-LFP-2



Application of Bonded Expanded Silica - Cellular Glass Insulation to Expansion and Contraction Joint at Vessel Flange

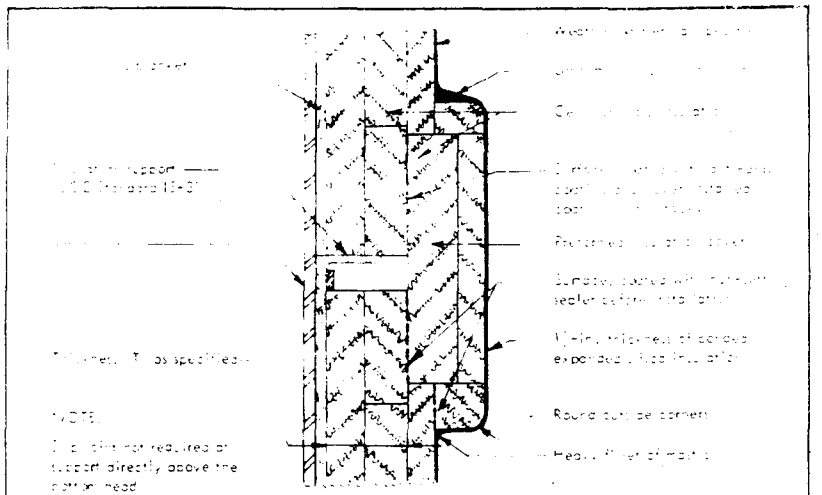
Figure 32-LFP-3

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SECTION 32 - APPLICATION

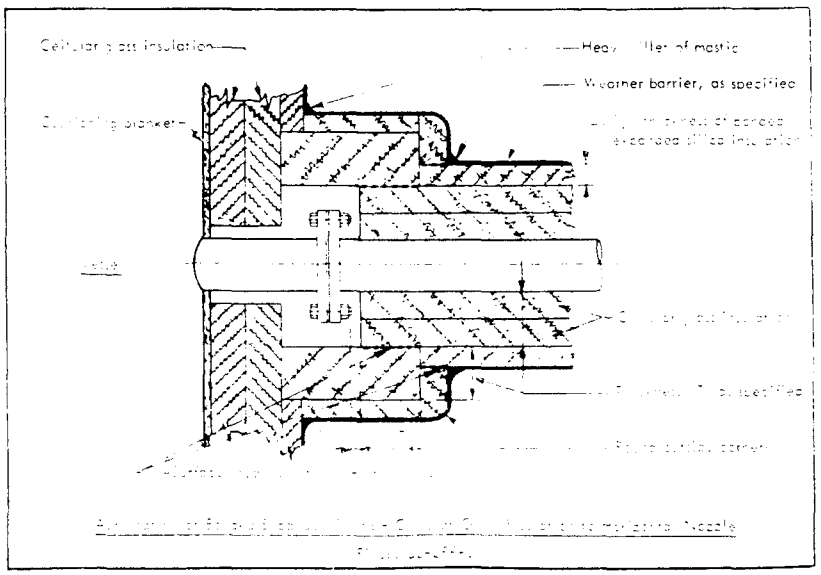
[illegible] at the insulation supports [illegible] provided at the junction of two different [illegible] total thickness is specified for the [illegible] an insulation support [illegible] in a manner similar to that shown in Figure 32-LFP-4. Where movement [illegible] to occur, lap sealer and [illegible] to provide proper slip joint.

[illegible] pipe [illegible] wall [illegible] around nozzles or [illegible] through the [illegible], as shown in Figure 32-LFP-5. [illegible] sealer shall [illegible] to provide proper [illegible].



Application of Bonded Expanded Silica - Cellular Glass Insulation to Expansion and Contraction Joint at Insulation Supports

Figure 32-LFP-4



Application of Expanded Silica - Cellular Glass Insulation to Nozzle

Figure 32-LFP-5

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SECTION B - APPLICATION - cont'd

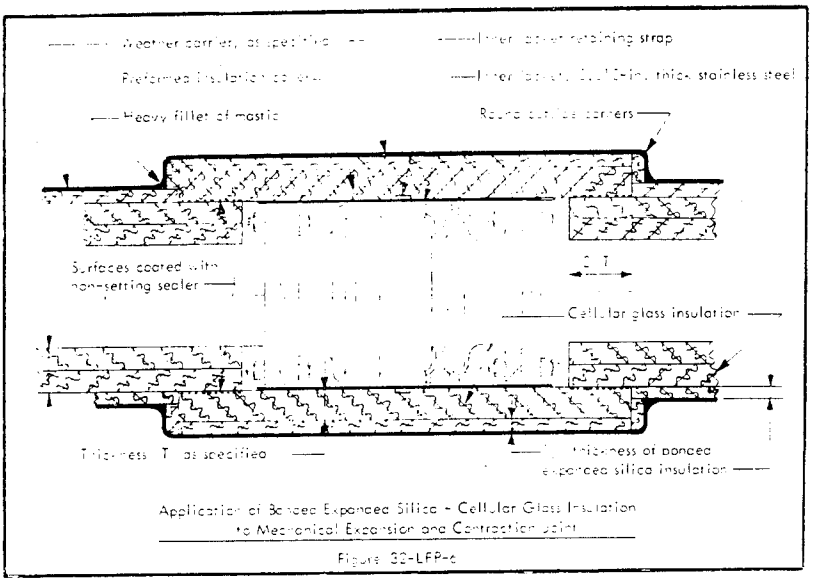
1. EQUIPMENT - cont'd

c. Mechanical Expansion Joints. Corrugated mechanical expansion joints in piping (usually classed as equipment items) shall be insulated as shown in Figure [illegible]. Where movement is likely to occur, [illegible] sealer shall be applied to surfaces of insulation to provide proper slip joint.

d. Flat Heads

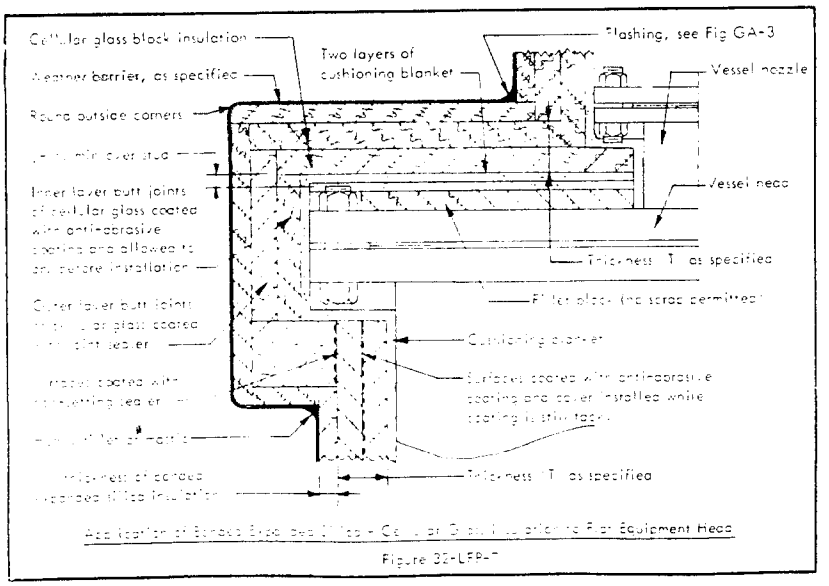
1) Insulation on top of flat heads of vertical equipment shall be applied in the same manner as previously described in this specification. Water pockets shall be eliminated and proper drainage provided as shown in Figure 32-LFP-7.

2) All [illegible] nozzles on insulated equipment shall be provided with flashing as shown in Figure GA-3 of the GENERAL SPECIFICATIONS.



Application of Packed Expanded Silica - Cellular Glass Insulation to Mechanical Expansion and Contraction Joint

Figure 32-LFP-6



Application of Packed Expanded Silica - Cellular Glass Insulation to Flat Equipment Head

Figure 32-LFP-7

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SECTION B - APPLICATION - cont'd

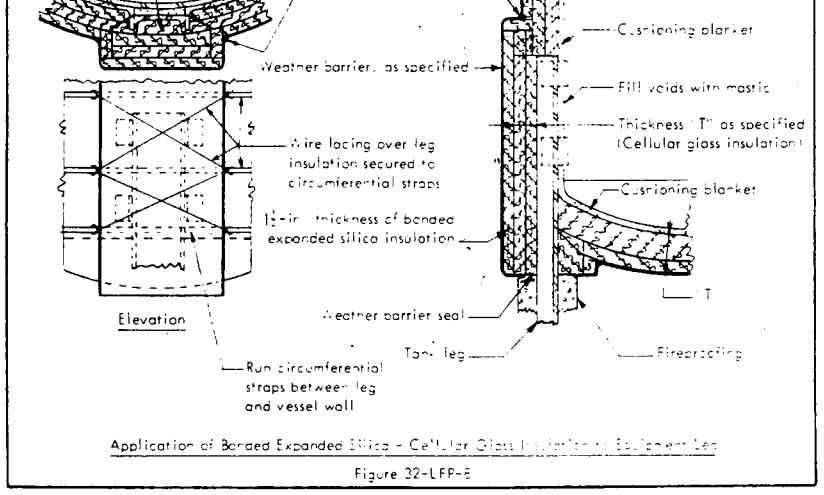
1. EQUIPMENT - cont'd

i. Vessel Legs

(1) Concrete-filled structural tubing legs shall be insulated for a distance not less than four times the specified insulation thickness, measured from the junction of the vessel with the leg. Thickness over the leg shall be not less than one-half that specified for body of vessel.

(2) Channel legs shall be insulated with block which shall extend over channel flanges and down channel legs to junction with fire-resistant material. Thickness shall be as specified for body of vessel. Body insulation shall be brought up to and butted firmly against tank leg flange.

(3) Reentrant space between channel flanges shall be filled with block cemented in place with the specified adhesive cement. Surface of fire-resistant material abutting tank leg insulation shall be coated with weather-barrier coating. Installation shall be as shown in Figure 32-LFP-8.



Application of Banded Expanded Silica - Cellular Glass Insulation, Equipment Leg

Figure 32-LFP-8

j. Vessel Skirts

(1) Both interior and exterior surfaces of skirts supporting vertical equipment shall be insulated. Insulation shall extend downward from junction of skirt with bottom head, to junction with fire-resistant material or to concrete base. Thickness of insulation over skirt shall be as specified for body of vessel. Insulating material shall be secured to inside of skirt with adhesive cement.

(2) Support for insulation inside skirts and support for securement of bottom head insulation shall be in accordance with Owner's Standards (Sect. Installation shall be as shown in Figure 32-LFP-9.

k. Equipment Supports

(1) Where equipment is supported on cradles, vessel insulation shall extend over cradles as shown in Figure 32-LFP-10.

(2) Where equipment is supported by structural steel members, insulation shall be extended not less than four times the specified insulation thickness in each direction, measured from junction of vessel with insulated support lugs. Thickness of insulation over steel supports shall be not less than one-half that specified for body of vessel. Thickness of insulation over support lugs shall be the same as body insulation. Installation shall be as shown in Figure 32-LFP-11.

l. Weather Barrier. Weather-barrier coating or jacket, whichever is called for, shall be applied as specified in Articles XII.B and XIII.B, respectively, of the GENERAL SPECIFICATIONS. Mastic weather barrier shall be used unless metal jacket is called for as follows:

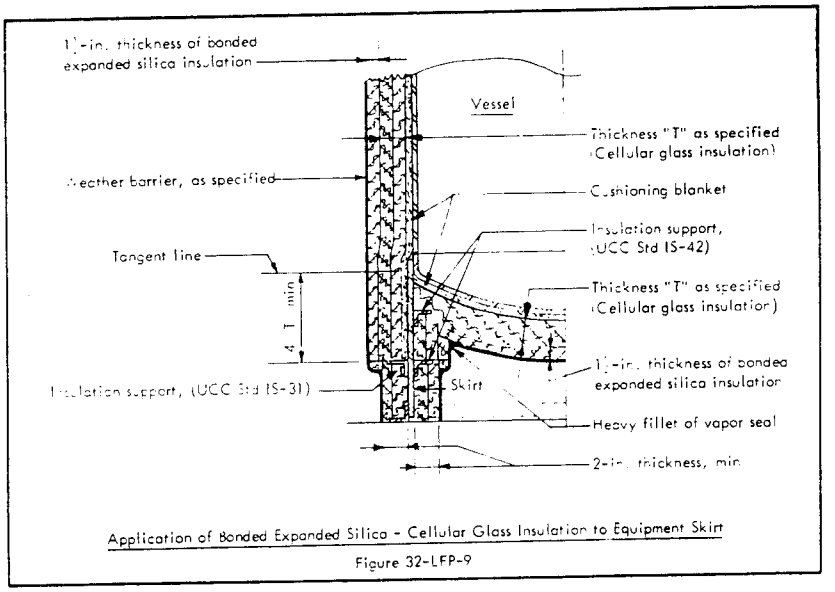
(1) Weather barrier consisting of stainless steel jacketing, where required, shall be called for by the addition of the letter M to the specification designation, thus 32-LFPM or 32-LFPSSM.

(2) Weather barrier consisting of treated steel jacketing, where required, shall be called for by the addition of the letters MT to the specification designation, thus 32-LFPMT or 32-LFPSSMT.

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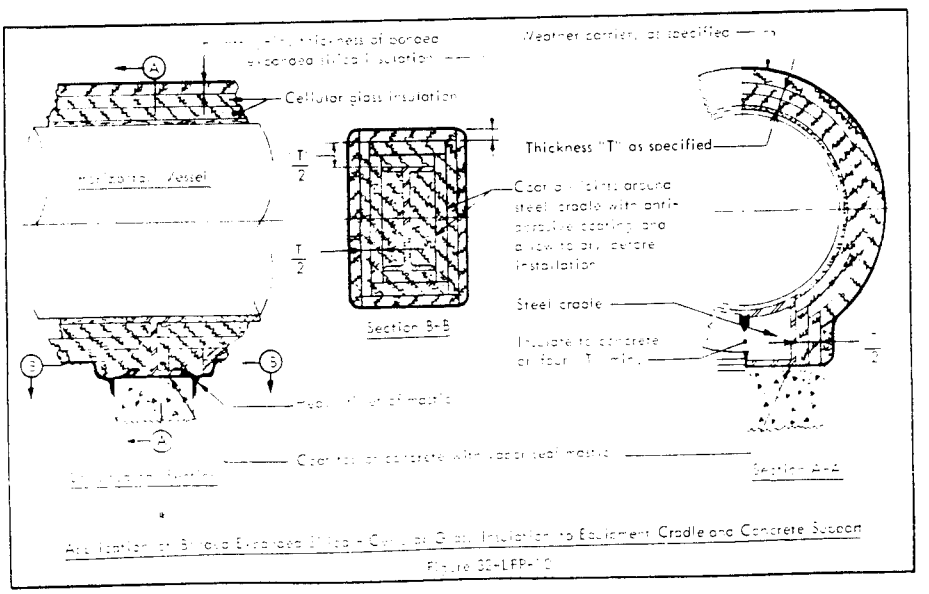
SECTION B - APPLICATION - cont'd

1. EQUIPMENT - cont'd



Application of Bonded Expanded Silica - Cellular Glass Insulation to Equipment Skirt

Figure 32-LFP-9

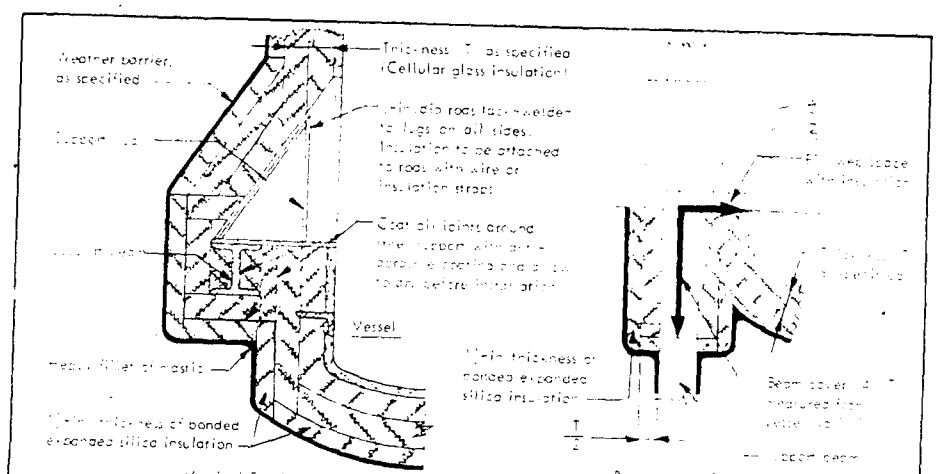


Application of Bonded Expanded Silica - Cellular Glass Insulation to Equipment Cradle and Concrete Support

Figure 32-LFP-10

SECTION B - APPLICATION - cont'd

C. EQUIPMENT - cont'd



Application of Bonded Expanded Silica - Cellular Glass Insulation to Equipment Legs and Support Lugs

Figure 32-LFP-11

D. PIPING

a. Pipe Insulation

1) Unless otherwise specified, insulation shall be applied in multiple layers. Inner layer, or layers, shall be the required thickness of cellular glass insulation. The outer layer shall be bonded expanded silica insulation a minimum of [illegible]

2) Cellular glass insulation thicknesses in excess of 2½ inches shall be applied in multiple layers as specified in Article [illegible] of these SPECIFICATIONS.

3) Pipe insulation shall be applied in staggered position in accordance with Figures GA-1 and GA-2 of the GENERAL SPECIFICATIONS.

4) All butt edges and ends of single layer cellular glass insulation and outer layer of multiple layer [illegible] shall be given a coat of joint sealer before application. Joints shall be drawn together when insulation is applied. Hot asphalt, pitch, or other [illegible] coat separates the sections of insulation.

5) Insulation shall be applied with all joints tightly butted and firmly to eliminate voids. [illegible] eliminated either by refitting or replacing insulation. Any recessed corners or [illegible] shall be filled [illegible]

6) Butt edges and ends of all inner layers of cellular glass shall be given a smooth brush or spray coat of anti-abrasive coating [illegible] for a minimum of four hours before application. Care shall be exercised to obtain a tight, even coat on butt edges of the insulation.

7) When scheduled for installations where thermal shock is expected, furnishing glass fiber mineral wool insulation [illegible] before application of the cellular glass insulation. Pipe [illegible] or any heating system [illegible]

b. Flanges, Flanged Valves and Valve Covers

1) Flanges, flanged valves [illegible]

2) Flanges, flanged valves and valve covers shall be prefabricated in accordance with [illegible] Recommended Practice [illegible]

3) Flanges, flanged valves and valve covers shall be insulated in two layers. Inner layer shall be [illegible] of the cellular glass insulation. Outer layer shall be [illegible] bonded expanded silica insulation.

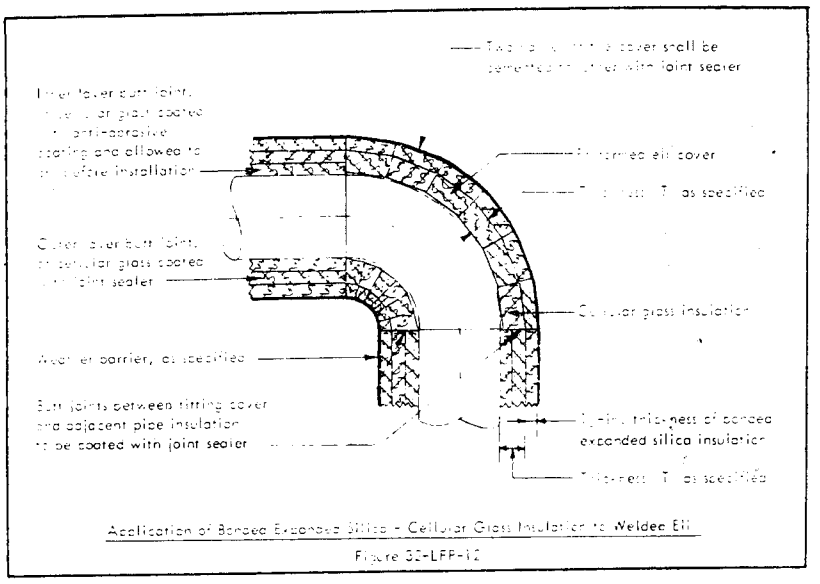
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SECTION B - APPLICATION - cont'd

2. PIPING - cont'd

a. Fitting, Flange, and Valve Covers - cont'd

4. Welded fitting covers shall be fabricated to fit snugly on the pipe. The two halves of the cover shall be cemented together with joint sealer. The adjacent pipe insulation shall be fitted tightly to the butt ends of the fitting cover and sealed as specified for piping. Typical welded fitting covers are shown in Figures 32-LFP-12 and 32-LFP-13.



Application of Bonded Expanded Silica - Cellular Glass Insulation to Welded Ell

Figure 32-LFP-12

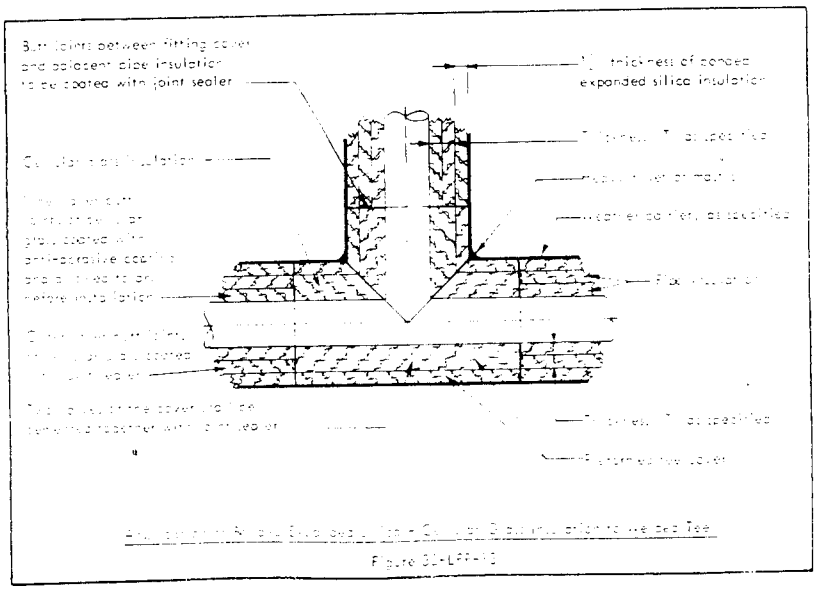


Figure 32-LFP-13

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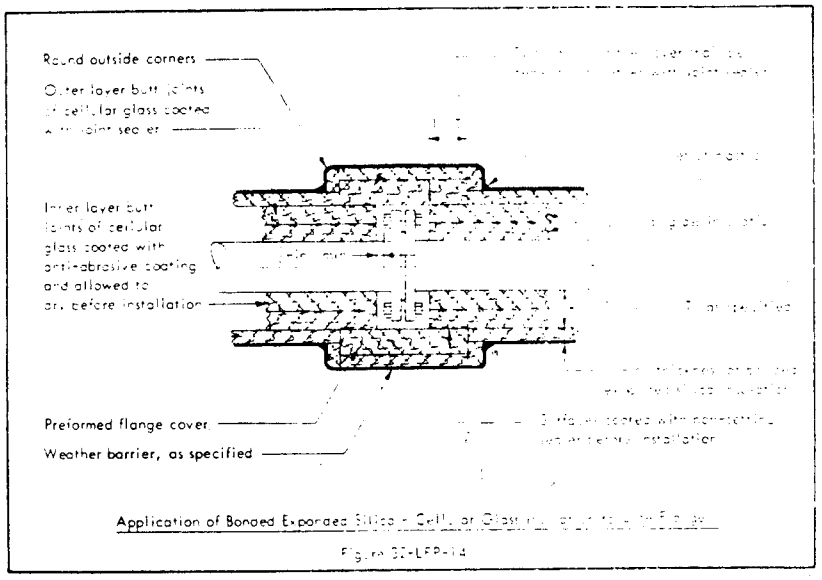
SECTION 8 - APPLICATION

2. PIPING

a. Fittings, Flanges, and Valve Covers - cont'd

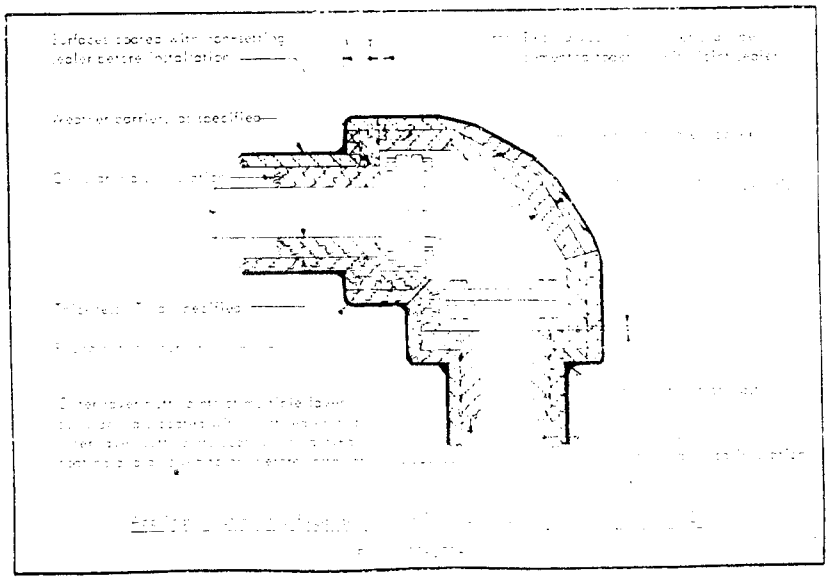
2) A [illegible] cast and fitted around valve stem [illegible]

3) Installations of preformed covers for flanged fittings and valves are [illegible] 32-LFP-15, and 32-LFP-16.



Application of Bonded Expanded Silica or Cellular Glass [illegible]

Figure 32-LFP-14

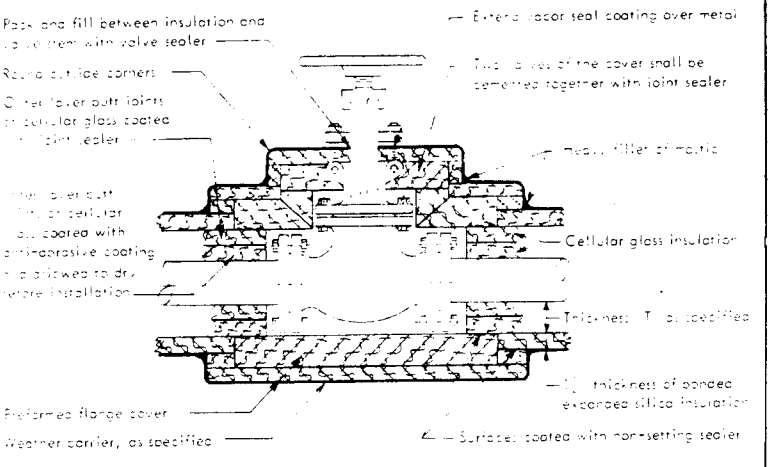


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SECTION 3 - APPLICATION - cont'd

C. PIPING - cont'd

4. Fittings, Flanges, and Valve Covers - cont'd



Application of Bonded Expanded Silica - Cellular Glass Insulation to Flanged Valve

Figure 32-LFP-16

a. All fittings shall be fitted and assembled with very thin, tight joints. Cementing of shop assemblies shall be done with fabricating cement. In all cases the joints shall be as thin as possible with just sufficient cement to obtain good adhesion and complete closure. Cement shall not be applied to mating surfaces of insulation. Fittings or notes chipped with fabricating cement will not be permitted.

b. Insulation. All covers of cellular glass and bonded expanded silica pipe insulation shall be secured in place with [illegible] as specified in Article II of the GENERAL SPECIFICATIONS.

5. Supports and Hangers

a. [illegible] are horizontal low-temperature piping is supported on the outside of insulation surfaces, in accordance with Owner's Standard P-80, [illegible] cellular glass insulation shall be completed with weather barrier applied before piping is placed in cradles. Standard P-80 is a guide for the [illegible] of pipe that may be supported on the outside of insulation.

b. Hangers which are directly to piping shall be insulated as shown in Figure 32-LFP-17.

6. Expansion and Contraction Joints

a. Expansion and contraction joints shall be installed as shown in Figure 32-LFP-18 in both horizontal and vertical straight runs of piping at intervals as follows:

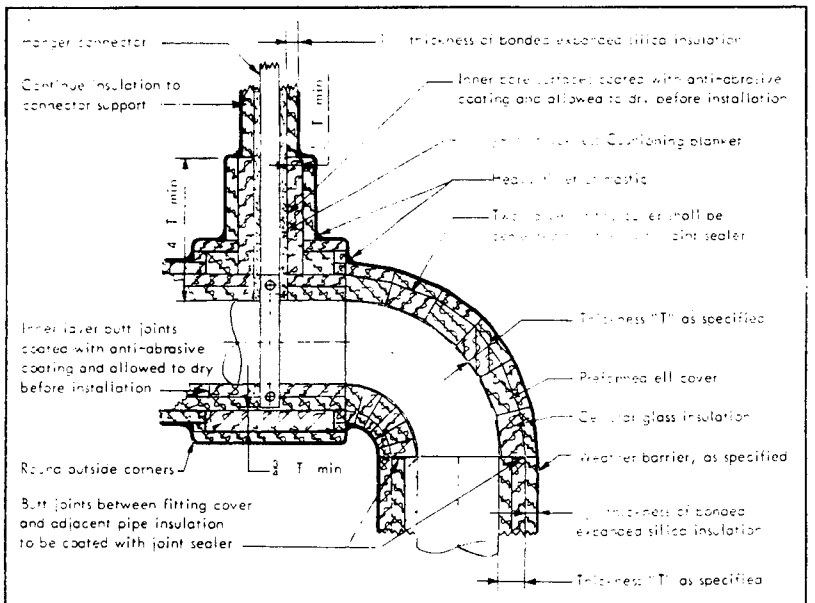
[illegible] insulation - one for each 45 feet
[illegible] to five inches thick insulation - one for each 33 feet
[illegible] to seven and one-half inches thick insulation - one for each 27 feet

b. Where flanged joints occur within these limits, expansion and contraction shall be provided for in the flange cover, and expansion-contraction joints [illegible] will not be required.

c. Where it is impossible to install expansion-contraction joints in insulation on vertical piping, an insulation support shall be provided [illegible] as shown in Figure 32-LFP-19.

SECTION B - APPLICATION - cont'd

I. PIPING - cont'd



Application of Bonded Expanded Silica - Cellular Glass Insulation to Welded Ell with Hanger Connected Directly to Pipe

Figure 32-LFP-17

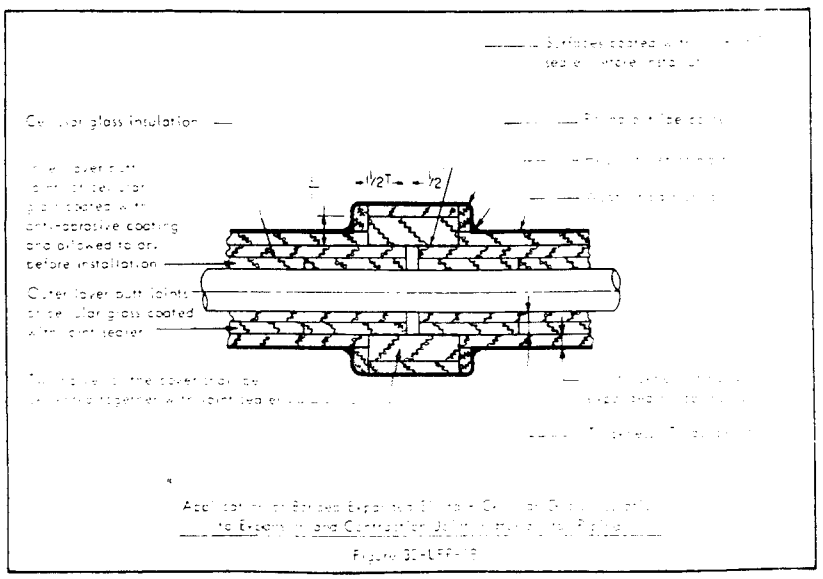
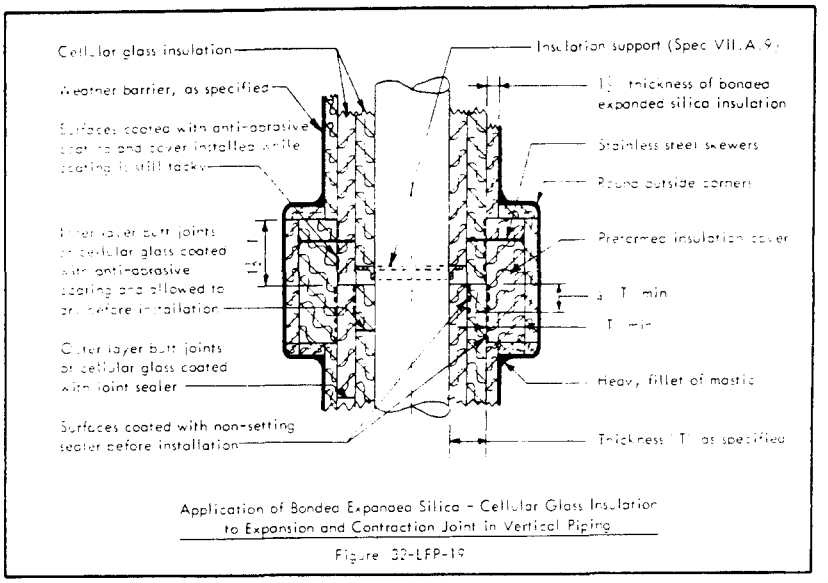


Figure 32-LFP-18

Union Carbide trial exhibit UC-4586: W. G. Hammar Transmittal Memoranda and Union Carbide Thermal Insulati…
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SECTION B - APPLICATION - contd

D. PIPING - contd



Application of Bonded Expanded Silica - Cellular Glass Insulation to Expansion and Contraction Joint in Vertical Piping

Figure 32-LFP-19

1. Traced Installations. Tracing and insulation on traced lines shall be installed as specified in Article XIII of the GENERAL SPECIFICATIONS.

2. Weather Barrier. Weather-barrier coating or jacket, whichever is called for, shall be applied as specified in Articles XI.A.3 and XI.B, respectively, of the GENERAL SPECIFICATIONS. Mastic weather barrier shall be used unless metal jacket is called for as follows:

(1) Weather barrier consisting of stainless steel jacketing, where required, shall be called for by the addition of the letter M to the specification designation, thus 32-LFPM or 32-LFPSSM.

(2) Weather barrier consisting of treated steel jacketing, where required, shall be called for by the addition of the letters MT to the specification designation, thus 32-LFPMT or 32-LFPSSMT.

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THERMAL INSULATION APPLICATION SPECIFICATIONS

INSULATED METAL CONDUIT

SCOPE

This specification describes the essential requirements for the installation of insulated conduit for use on underground systems normally operating at temperatures up to and including 750 F.

SECTION A - MATERIALS

1. INSULATED CONDUIT

Insulated conduit shall be as specified in MATERIAL SPECIFICATION 37.

2. ACCESSORY MATERIALS

Accessory materials shall be as specified in MATERIAL SPECIFICATION 37.

SECTION B - APPLICATION

1. TRENCH PREPARATION

a. Lines shall be installed in accordance with piping drawings.

b. The bottom of the trench shall be made smooth and uniform before the installation of conduit.

2. PROCESS PIPE

a. After process line has been welded and tested, insulation shall be applied to uninsulated joints.

b. All loose paint, dirt, grease, rust, scale, wax, and other extraneous materials shall be removed from the exposed ends of the pipe before the conduit connections are made.

c. Insulation of the type specified for conduit shall be applied to the area of the pipe left bare for field welding, and joints and cracks filled with insulating cement.

3. FIELD CONNECTIONS

a. Field Welded Conduit Connections

(1) An asbestos felt jacket shall be applied over the insulation and secured with wire.

(2) The cylindrical conduit closure supplied by the manufacturer shall be installed at the joint, and the circumferential and longitudinal joints welded.

(3) The system shall be required to withstand air test at 15 psig without leaks.

(4) The welds shall be smoothed and cleaned, and an industrial tape applied around each circumferential weld. The entire connection shall then be wrapped continuously with tape.

(5) Typical installation shall be as shown in Figure 37-H-1.

b. Mechanical Conduit Connections

(1) The entire area of exposed insulation shall be thoroughly covered with PVA mastic and reinforcing cloth, MATERIAL SPECIFICATION 37-B.

(2) The outer metal jacket, furnished by manufacturer, shall be installed overlapping the conduit jacket at both ends, and tack welded in place to prevent before securing with stainless steel insulation straps.

(3) A [illegible] pour hole shall be cut in the top center of the connection jacket if the pipe is level. The pour hole shall be located at the highest point.

(4) The asphalt shall be poured into the joint at a temperature between 400 F and 450 F in the following stages:

(a) Fill to top of insulation and let cool for one hour.

(b) Fill to within 1 inch of the top and let cool for one hour.

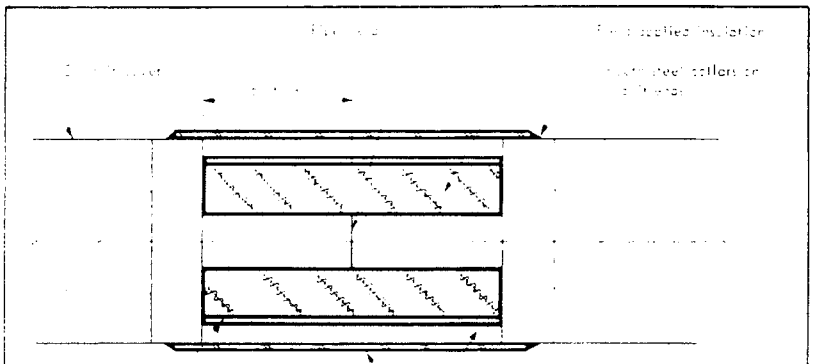
(c) Fill until asphalt is level with top of metal jacket.

(5) Typical installation is shown in Figure 37-H-2.

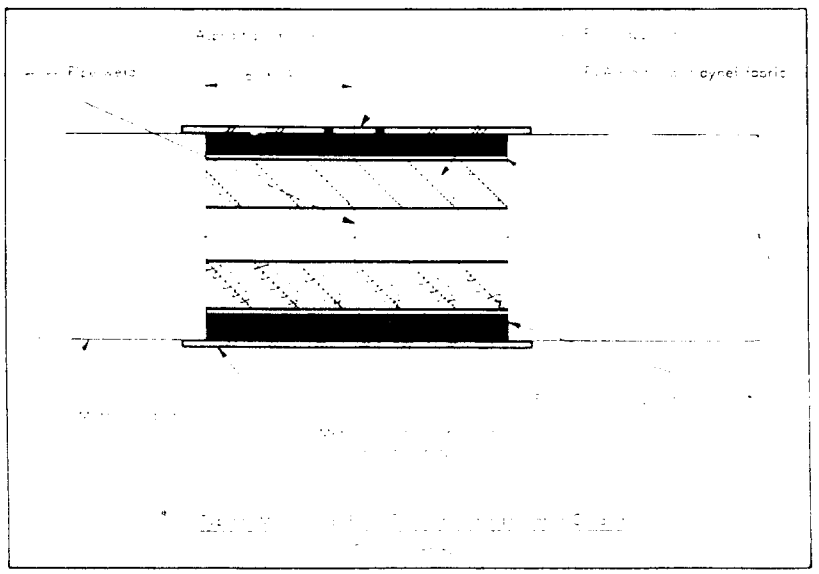
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SECTION B - APPLICATION - cont'd

D. FIELD CONNECTIONS - cont'd



Typical Welded Field Connection for Insulated Conduit



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SECTION B - APPLICATION - cont'd

4. CONDUIT TERMINALS

a. Where the conduit terminates at a building, manhole, or pit, it shall extend through the concrete to the inner face. A weather seal shall be applied between the conduit and the concrete.

b. A water seal shall be applied to the conduit end, and the remainder of the line insulated as specified in the Insulation Schedule.

5. BACKFILL

a. Boulders and concrete debris shall not be used as a portion of the backfilling materials.

b. The soil shall be carefully deposited in uniform layers not over 6 inches thick and carefully and solidly tamped so as not to injure or disturb the conduit.

Backfilling shall be done on both sides of the conduit simultaneously.

6. CATHODIC PROTECTION.

a. Where required and specified, cathodic protection will be provided by the Owner.

b. Cathodic protection will be as specified in Owner's Standard Specifications B 260, and as shown in Owner's Standards EL-[illegible]5, EL-[illegible]6, EL[illegible]
and EL-[illegible]8.

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THERMAL INSULATION APPLICATION SPECIFICATIONS

URETHANE FOAM INSULATION-PVC JACKET CONDUIT

PREINSULATED PIPE SYSTEM

SCOPE

This specification describes the essential requirements for installation of pipe insulated with rigid urethane, protected with PVC jacket conduit for use on underground systems normally operating at temperatures between 50 F and 250 F.

SECTION A - MATERIALS

1. INSULATED PIPE OR TUBING CONDUIT

   a. Insulated pipe conduit shall be as specified in MATERIAL SPECIFICATION NO. 38.

   b. Insulated pipe fittings shall be as specified in MATERIAL SPECIFICATION NO. 38.

2. ACCESSORY MATERIALS

   Accessories, such as compression coupling and coupling stock insulation, shall be furnished by the same manufacturer as the insulated pipe or tubing conduit, and as specified in MATERIAL SPECIFICATION NO. 38.

SECTION B - APPLICATION

1. TRENCH PREPARATION

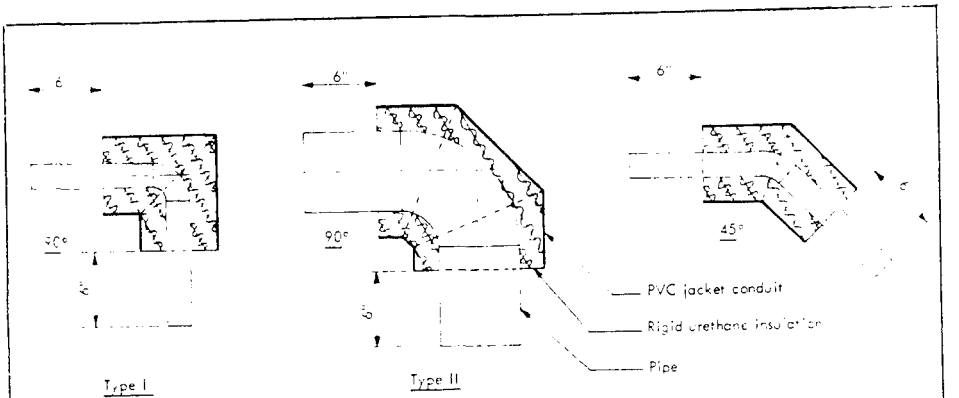
   a. Lines shall be installed in accordance with piping drawings.

   b. The bottom of the trench shall be made smooth and uniform before installation of conduit.

2. PROCESS PIPING

   a. Typical preinsulated fittings are shown in Figures 38-H-1 and 38-H-2.

   b. Compression coupling and its components must be placed on the conduit adjacent to points where sections of pipe, or pipe and fittings are to be jointed, prior to welding of the joint.



Typical Preinsulated Pipe and Tubing Elbow Fittings

Figure 38-H-1

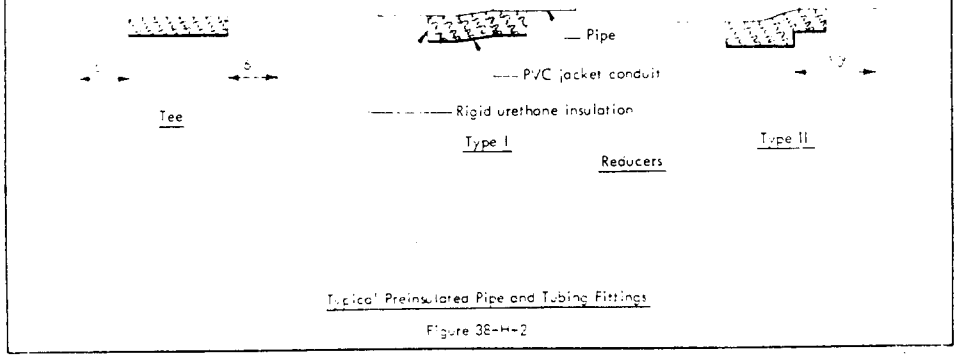
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SECTION B - APPLICATION - cont'd

A. PROCEDURE FOR FIELD INSTALLATION - cont'd

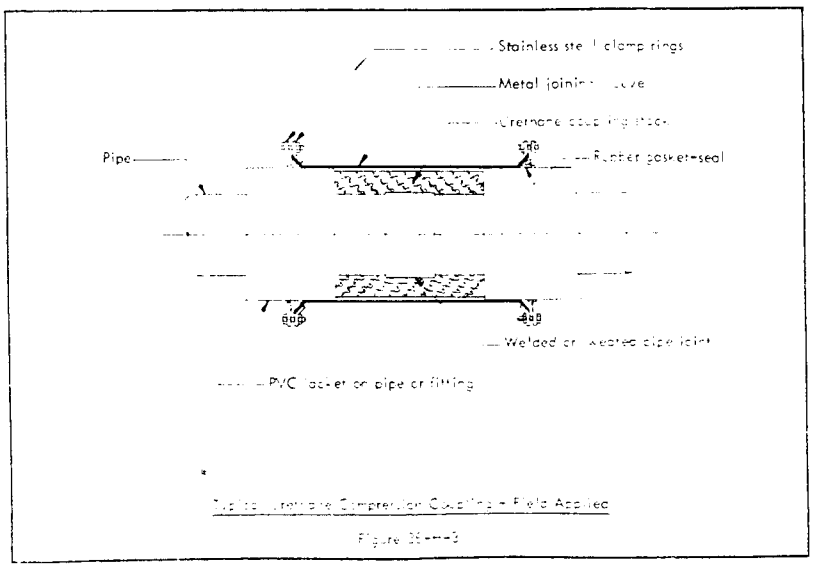
[illegible] dirt, grease, scale and other extraneous materials from the exposed ends of the pipe, finish the welding and testing, [illegible] the same as applying plastic insulation to the uninsulated joints.

[illegible] shall then be slid into position over the insulated joints and the rubber gaskets centered [illegible] seal around the conduit by tightening the stainless steel clamp rings. Typical installation is shown in Figure 38-H-3.



Typical Preinsulated Pipe and Tubing Fittings

Figure 38-H-2



Typical Insulation Compression Coupling - Field Applied

Figure 38-H-3

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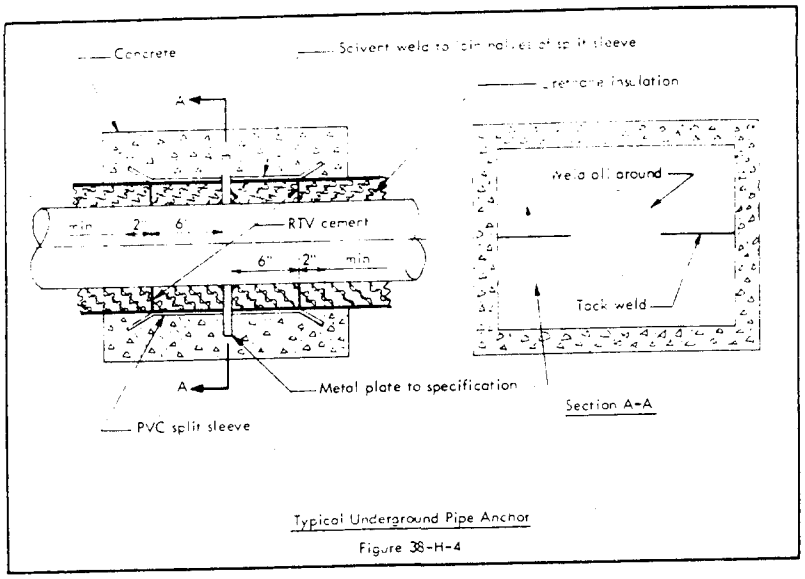
SECTION 3 - APPLICATION - cont'd

3. PIPE ANCHOR

Underground pipe anchors are constructed in the preinsulated pipe as shown in Figure 38-H-4

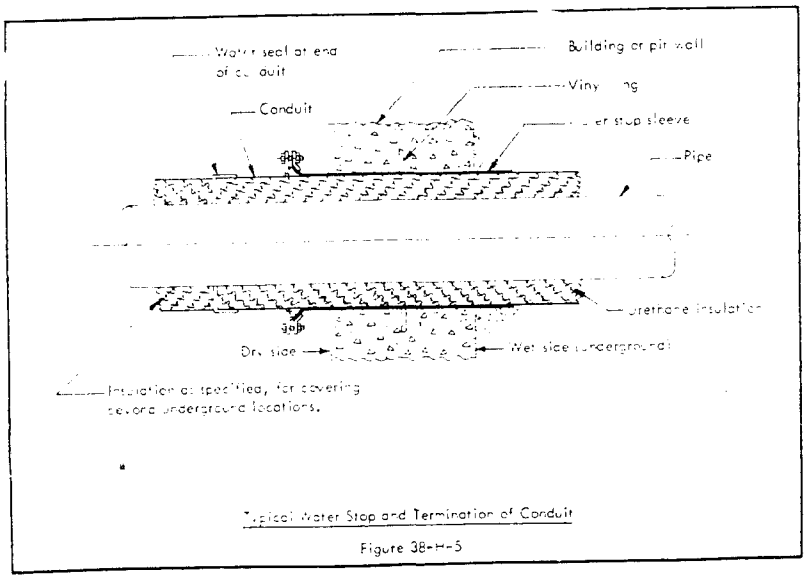
4. CONDUIT TERMINAL

a. Where the conduit terminates at a building, manhole, or pit, it shall extend through the concrete to the inner face. A seal shall be constructed at a water stop sleeve as shown in Figure 38-H-5.



Typical Underground Pipe Anchor

Figure 38-H-4



Typical Water Stop and Termination of Conduit

Figure 38-H-5

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SECTION B - APPLICATION - cont'd

4. CONDUIT TERMINALS - cont'd

b. A water-resistant mastic shall be applied to the butt end of the exposed conduit insulation, and the remainder of the line insulated as specified in [illegible].

5. BACKFILL

a. Brush, debris and concrete debris shall not be used as a portion of the backfill materials.

b. Backfilling shall be done on both sides of the conduit simultaneously.

c. Backfill materials shall be deposited in uniform layers, not over 6 inches thick, tamped solidly and cautiously so as not to injure or disturb [illegible].

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THERMAL INSULATION APPLICATION SPECIFICATIONS

UNDERGROUND BITUMINOUS FILL

SCOPE

This specification describes the essential requirements for application of bituminous insulation for use on underground piping normally operating at temperatures from 220 F up to and including 320 F.

SECTION A - MATERIALS

1. INSULATION

Insulation shall be as specified in MATERIAL SPECIFICATION 39.

2. ACCESSORY MATERIALS

Accessory materials shall be as specified in the MATERIAL SPECIFICATIONS, article numbers as noted.

Corrosion-Resistant Coating (for ambient temperatures from 40 F to 120 F) VII.A.70
Corrosion-Resistant Coating (for ambient temperatures below 40 F) VII.A.71
Weather-Barrier Mastic (color as specified) VII.B.1.a

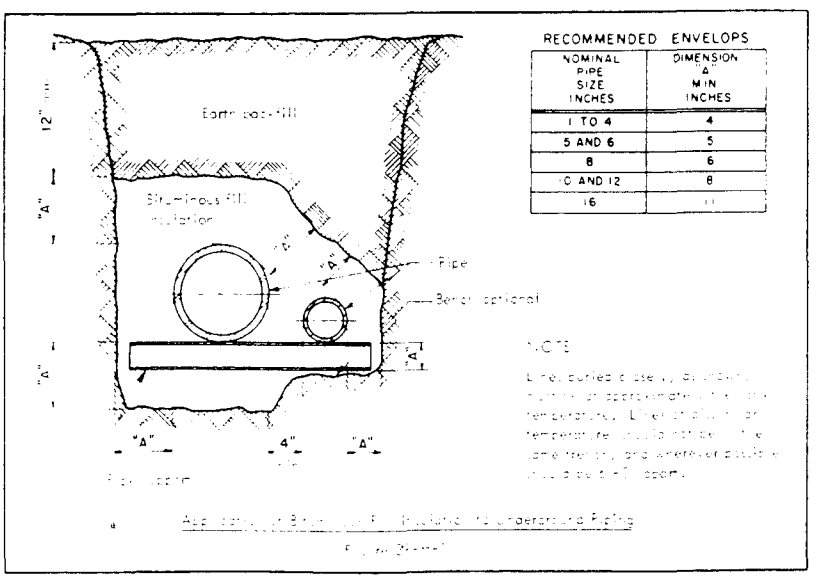
SECTION B - APPLICATION

1. PIPING

a. Unless otherwise specified, insulation thickness shall be not less than that shown in Figure 39-H-1. Where the piping passes under areas subject to heavy loads, thickness of insulation on top side of pipe shall be increased 3 inches.

b. The trench shall be dewatered, and shall be kept free from water until the installation is completed and the insulating material has cured.

c. Process lines shall be supported, welded and tested, and loose paint, dirt, rust, scale, wax, and other extraneous materials removed before the insulating material is applied.



Application of Bituminous Fill Insulation to Underground Piping

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SECTION B - APPLICATION - cont'd

PARAGRAPH cont'd

a. The bituminous insulation shall be poured into the trench and then tamped around the pipe using a 12-inch strip of asphalt saturated felt or similar material. The first application shall be covered with the bag in which the insulation was shipped.

b. The packing material shall be kept free of soil or other foreign matter before and during the pouring procedure.

c. Where the width of the trench is greater than required, a wooden form shall be used for the insulation. The insulation material shall be applied and carefully tamped before forms are moved to the next position.

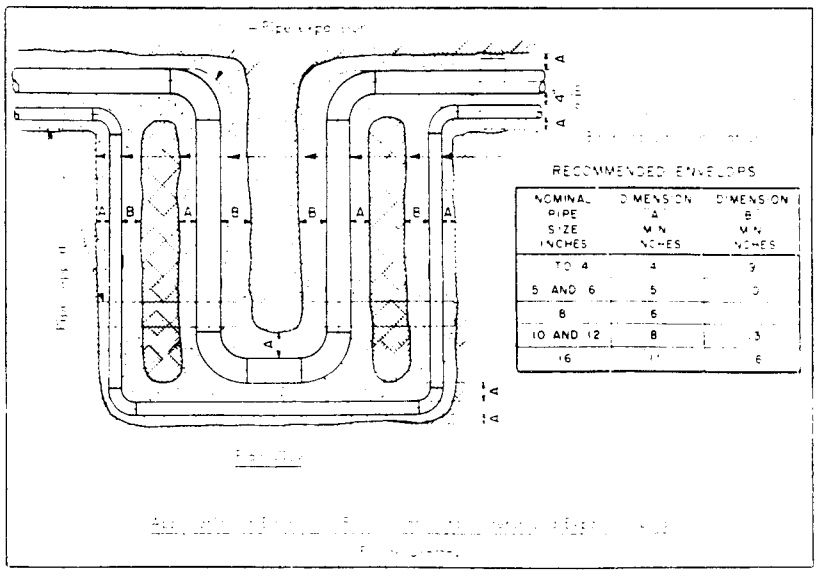
d. The curing of the bituminous insulation shall be not less than the time and temperature specified by the manufacturer for the material used.

e. The trench shall be backfilled only after curing is completed, unless the installation is being made in dry soil.

f. A [illegible] shall be placed over the bituminous insulation [illegible] Figure 39-H-1.

EXPANSION LOOPS

The [illegible] shall be provided with expansion loops as shown in Figure 39-H-2.



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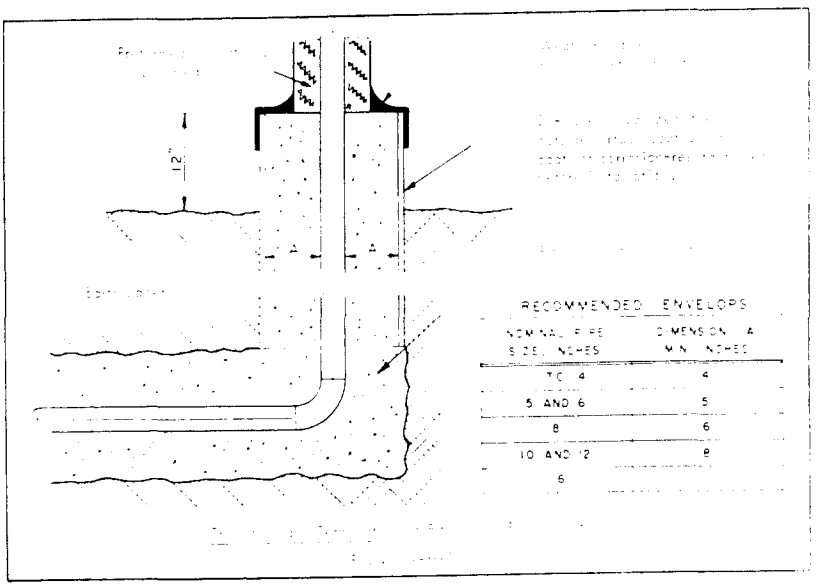
SECTION 5 - APPLICATION - cont'd

TRANSITION AND TERMINATION

At the point where the insulation system emerges above the surface, a transition consisting of a 24 gauge galvanized steel jacket shall be applied for the portion above the surface. The junction of the jacket and the insulation and the adjacent buried portion of the jacket shall be sealed with vapor barrier coating. Installation shall be as shown in Figure 39-H-3.

At the point where the bituminous fill enter a manhole or building wall, an asbestos rope or wad packing shall be applied between the pipe and the wall.

The exposed surface of the galvanized steel jacket shall be cleaned of all dirt, mud, oil, grease, and other foreign matter and painted with two coats of specified corrosion-resistant coating, applied by brush or spray. Coating shall be allowed to dry thoroughly before backfilling is started.



RECOMMENDED ENVELOPS

NOMINAL PIPE SIZE, INCHES	DIMENSION A MIN. INCHES
TO 4	4
5 AND 6	5
8	6
10 AND 12	8
6	

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THERMAL INSULATION APPLICATION SPECIFICATIONS

CORK-FILLED POLYVINYL ACETATE MASTIC

SCOPE

This specification describes the essential requirements for application of cork-filled polyvinyl acetate insulating mastic for use on equipment and piping normally operating at temperatures from 34 F up to and including 180 F.

SECTION A - MATERIALS

1. INSULATION

Insulation shall be as specified in MATERIAL SPECIFICATION 40-J.

2. ACCESSORY MATERIALS

None

SECTION B - APPLICATION

1. PREPARATION OF SURFACE

The surface to be insulated shall be dry, and cleaned by thorough wire brushing to remove all rust, grease paint, loose mill scale, or other foreign matter. Surface shall then be wiped down with a volatile solvent, such as coal tar naphtha, to remove any oil or grease remaining.

2. PRIMING

a. Primer shall be Amercoat 86, Porter Paint Company No. 3078B Heavy Duty Cromate Primer, or approved equal.

b. All steel surfaces to be insulated shall be coated with the specified corrosion-inhibitive, moisture-resistant primer before insulation is applied.

3. METHODS OF APPLICATION

Insulation may be applied in one coat by palming, troweling, or spraying. The following apparatus is required for application by spraying:

a. Gravco Mogul Type Pump, 8 to 1 ratio, equipped with follow-plate and Evenflo regulators, or approved equal.

b. One-inch material hose; ½-inch air hose.

c. Gravco or approved equal mastic gun equipped with ½-inch minimum tip.

Spraying is recommended only for equipment or pipe not less than 24 inches in diameter. Required thickness of insulation shall be obtained in multiple passes.

4. SURFACE TEMPERATURE

The temperature of the surface to be insulated shall not exceed 180 F. If insulation is to be applied to operating equipment or piping, application should be made, when possible, while equipment or piping, or both, is shut down, or during the high-temperature portion of a cycle period. It may be applied but never be applied to a surface at a temperature below the dew point, or when the surface temperature is expected to be below the dew point before the insulation has dried and cured.

5. DRYING

A minimum drying period of 24 hours shall be allowed for each 1-inch thickness of insulation, plus an additional 24-hour drying period before equipment, or piping, or both, is put in operation.

6. THICKNESS AND COVERAGE

a. The thickness of insulation shall be as specified in the Insulation Schedule.

b. Coverage shall be as follows:

Single thickness: 8 to 10 Gal per 100 sq ft.

Double thickness: 15 to 20 Gal per 100 sq ft.

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THERMAL INSULATION APPLICATION SPECIFICATIONS
SPRAYABLE AMOSITE ASBESTOS FIBERS AND INORGANIC BINDERS
SPRAYABLE CROCIDOLITE ASBESTOS FIBERS AND INORGANIC BINDERS

SCOPE

This specification describes the essential requirements for application of asbestos fibers, blended with inorganic binders, to equipment, ducts, or steel structures by spray process. The Amosite Asbestos Fiber and Binders Grade (41H) is suitable for use on surfaces operating at temperatures from atmospheric to 700 F. The Crocidolite Asbestos and Binders Grade (42H) is suitable for use on surfaces operating at temperatures from atmospheric to 1350 F.

Procedures in the GENERAL SPECIFICATIONS are applicable to and constitute an integral part of this specification.

SECTION A - MATERIALS

1. INSULATION MATERIAL

Spray-on Amosite and Crocidolite asbestos fiber insulations shall be as specified in MATERIAL SPECIFICATIONS 41-H and 42-H, respectively.

2. ACCESSORY MATERIAL

Accessory materials shall be as specified in the MATERIAL SPECIFICATIONS, article numbers as noted.

Equipment Insulation Studs	VII.A.11	Finishing Cement	VII.A.15
Duct and Equipment Studs	VII.A.12	Split Welding Pins	VII.A.16
Expansion Shields	VII.A.13	Asbestos Paper	VII.A.17
Self-locking Steel Cups	VII.A.17	Asbestos Paper Adhesive	VII.A.17
Wire Netting	VII.A.18	Tie Wires	VII.A.19
Weather Pan Insulation Fasteners	VII.A.22	Weather-Barrier Mastic (color as specified)	VII.B.1
Pin Caps	VII.A.23	Reinforcing Cloth	VII.B.1
Lead Wool	VII.A.32	Stainless Steel Weather Barrier (Designation MT	VII.B.2
Lead Sealer	VII.A.46	Treated Steel Weather Barrier (Designation MT	VII.B.2
		Cellular Glass Insulation	Material Specification

SECTION B - PREPARATION AND APPLICATION

1. PREPARATION.

a. Supports and Securements

1) Cylindrical vessels and ducts 24 inches in diameter and less with insulation thickness not over one inch require no securements or supports for the insulation.

2) Cylindrical vessels and ducts over 24 inches in diameter, square ducts, and equipment to be insulated up to two inches in thickness shall have 12 base pins welded to surfaces to be insulated. Pins shall be spaced 18 inches on centers on side surfaces and 12 inches on centers on bottom faces and edges.

3) If insulation on side wall of vessel does not extend to base of vessel, an angle with an outstanding leg equal to that of the insulation shall be welded around vessel at level where insulation is to terminate.

4) Tops, bottoms of vessels and equipment such as turbine casings to be insulated 2 inches thick and over shall have pins welded to surfaces 12 inches on centers on side, 12 inches on centers on bottom, and with additional split pins around edges on 12-inch centers for attachment of wire for retaining hexagonal wire netting.

b. Surface Preparation. To ensure that surface will be suitable to provide base for good adhesion of the cement care shall be taken that the surface is clean and, if coated, that the finish is completely dry and cured. Coating shall be as specified in the Coating Schedule.

2. APPLICATION.

a. Thickness of Sprayed Insulation

The thickness of installed insulation, semi-dried and compressed, shall be as called for on the Insulation Schedule.

b. Where insulation is applied where level of rain or drainage water can reach bottom edge of insulation, a course of cellular glass [illegible] shall be installed at the bottom of the vessel, and of specified thickness, shall be installed to a level not greater than highest expected water [illegible]

SECTION B - PREPARATION AND APPLICATION - cont'd

D. APPLICATION - cont'd

1. Insulating or Sprayable Insulation - cont'd

3) Layers of the sprayable insulation shall be applied to the surface by suitable spray machines adjusted for correct material and water mixtures.

a) Thicknesses up to one and one-half inches shall be applied in sufficient quantity so that when consolidated to specified thickness density of all after drying will be between eight and fifteen pounds per cubic foot.

b) On certain temperature items such as steam turbines, which require thicknesses over 3 inches, the insulation shall be applied in two layers. First layer shall be applied and consolidated with edge of flat trowel forming a scrub pattern to 50 percent of its applied thickness. Surface shall be sprayed apart before application of last sprayed layer which is consolidated to the final thickness. Each layer shall be allowed 30 minutes after application of preceding layer.

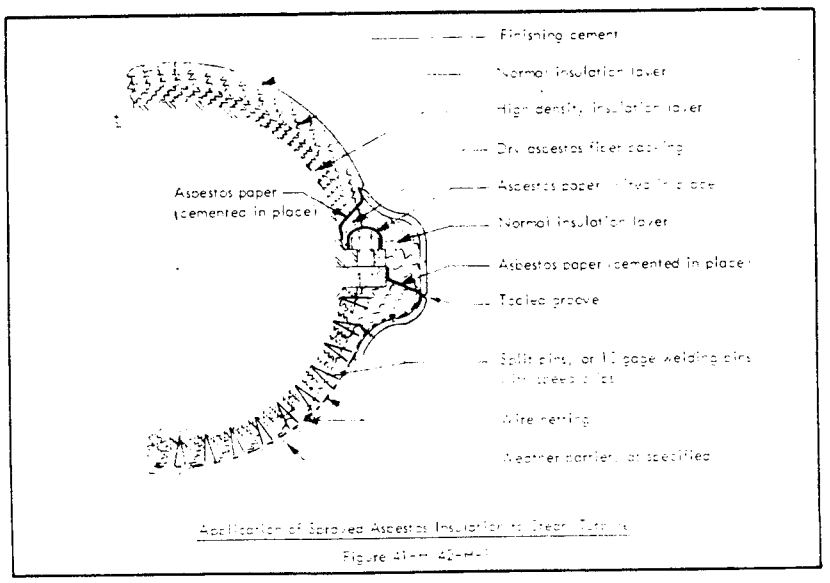
4) On vessels, nozzles, manholes and the top quadrant of horizontal surfaces receiving insulation shall be applied in two layers. Each layer shall be sufficient so its compressive strength is sufficient to permit it to be walked on without mechanical damage.

e. Insulating Around Flange Bolts

1) Bolts, studs, or flanges shall be wrapped with asbestos paper and secured with wire. Loose bolts or studs shall be painted with graphite grease.

2) Sprayed insulation shall be tapered inward to vessel surface or flange. Asbestos paper shall be applied to the tapered edge of insulation and cover as follows. The cover shall be extended over the entire bolt area and flange.

3) A gasket insulation shall be sprayed onto paper in layer or layers as specified in subparagraphs 3, a, and b, above. The gasket shall be shown in Figure 41-H - 42-H-1.



Application of Sprayed Asbestos Insulation to Steam Turbines

Figure 41-H - 42-H-1

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SECTION B - PREPARATION AND APPLICATION - cont'd

B. APPLICATION - cont'd

3. Finish

(1) Where asbestos insulation is to be covered with metal jacket it requires no finish cement. The consolidated asbestos insulation shall be allowed to air until moisture has evaporated before metal jacket is installed.

(2) Where asbestos insulation is to be covered with fabric reinforced mastic it shall be provided with a finish cement coating of finish cement installed in the following manner, and as shown in Figure 41-H - 42-H - 2.

a. Wire netting shall be applied over the insulation. Netting shall be secured to the welding pins or split pins with stainless steel wire. It shall be stretched and laced in place.

b. Over the hexagonal wire netting a 3/8-inch coat of finishing cement shall be troweled to a smooth even finish. Areas longer than 5 feet in either direction shall be scored with a cement finisher's tool to form a panel approximately four feet by four feet prior to drying to control cracking.

4. Weather Barrier

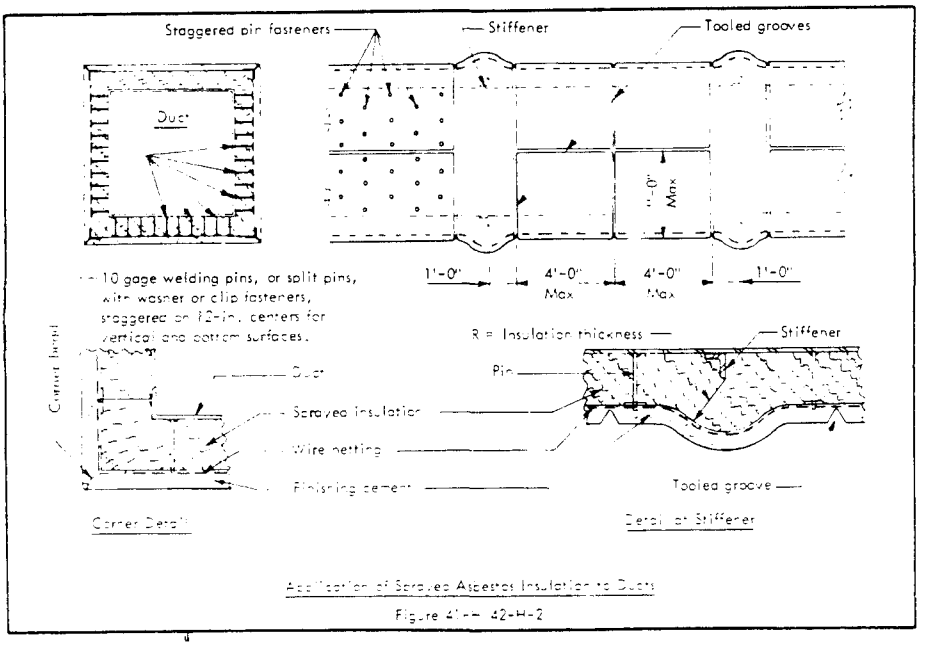
a. Vessels over [illegible] feet in diameter, insulated for conservation of heat, and where fire protection of the vessel is not a major factor, shall have [illegible] portion of the vessel jacketed with treated steel as specified in Article XIV.B of the GENERAL SPECIFICATIONS.

b. Vessels over two feet in diameter, insulated for fire protection, shall have the cylindrical section of the vessel jacketed with stainless steel as specified in Article XIV.B of the GENERAL SPECIFICATIONS.

c. Equipment, vessels smaller than those mentioned above, vessel heads, ducts, and irregular surfaces shall have weather-barrier coating applied as specified in Article XIV.B of the GENERAL SPECIFICATIONS.

(4) Weather barrier consisting of stainless steel jacketing, where required, shall be called for by the addition of the letter M to the specification designation, thus 41-HM or 42-HM.

(5) Weather barrier consisting of treated steel jacketing, where required, shall be called for by the addition of the letters MT to the specification designation, thus 41-HMT or 42-HMT.



Application of Sprayed Asbestos Insulation to Ducts

Figure 41-H - 42-H-2

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UNION CARBIDE **STANDARD**
CHEMICALS AND PLASTICS OPERATIONS DIVISION
AND UNION CARBIDE CANADA LIMITED

THERMAL INSULATION APPLICATION SPECIFICATIONS
SPRAYED RIGID URETHANE FOAM

SCOPE

This specification describes the essential requirements for application of sprayed rigid urethane foam insulation to equipment, vessels and ducts normally operating at temperatures from 50F up to 250F.

SECTION A - MATERIALS

1. INSULATION MATERIAL

Insulation material after being sprayed and cured for not less than three days shall be as specified in MATERIAL SPECIFICATION NO. 1.

2. ACCESSORY MATERIALS

Accessory materials shall be as specified in the MATERIAL SPECIFICATIONS, article numbers as noted.

Asbestos Paper	VII.A.80	Treated Steel Jacket	VII.B.
Stainless Steel Wire	VII.A.17	Weather Barrier Mastic (color as specified)	VII.B.1.c.
Equipment Insulation Strap	VII.A.11	Designation WB	
Clips for Equipment Strap	VII.A.12	Bonded Expanded Silica Insulation	Spec. No. 22
Contact Adhesive	VII.A. 65 or 66		

SECTION B - APPLICATION

1. EQUIPMENT

a. Surface Preparation. To ensure that surface will be suitable for good adhesion of sprayed insulation, surfaces shall be treated prior to installation as follows:

(1) Carbon Steel Surfaces

(a) Unpainted carbon steel shall be cleaned of rust, mill scale, dirt, grease, or other contamination.

(b) Painted carbon steel, with the exception of long oil red lead primers and long oil oleoresinous finish paints, old or newly painted surfaces are suitable, providing the new paint is fully dry and old painted surfaces are clean, free of dirt, grease, oil or other contaminations.

(c) Zinc-coated carbon steel shall not be insulated with spray urethane insulation.

(2) Stainless steel surfaces shall be coated with Thermatox No. 70 in accordance with UCC Coating Manual. Coating shall be completely dry prior to application of spray urethane insulation.

(3) Aluminum surfaces shall be cleaned of dirt, grease, oil or other contamination. Note: Thin gage aluminum will require special treatment. Consult with Engineering Department or Materials of Construction Group for specific instructions.

b. Protection of Surfaces Not to be Insulated

(1) Prior to spray application, flanges, manholes and all other surfaces not to be insulated shall be wrapped with suitable coverings and secured with wire or tape. This covering shall be removed after application.

(2) Instruments and all other areas which are to be kept free of insulation or overspray shall be protected with suitable covering.

(3) All equipment and piping within 25 feet of spray application shall be covered or screened for protection against overspray and drift.

c. Urethane Foam System

The urethane foam system shall consist of a two package system, suitable for spray application. The system shall be UCC NIAX Foam System T-352 T-624, or approved equal. Note: The NIAX Resin T-352 should be stored below 90° F to prevent build up of excessive pressure. Both T-352 and T-624 should be protected from air and moisture during storage.

d. Application of Foam

(1) The foam system shall be applied to areas to be insulated by chamber-mix or internal-mix spray gun at one to one mix ratio. Pressure settings of spray equipment shall be adjusted to obtain proper mixing depending upon the type of gun and atmospheric temperature.

(2) It is recommended that application be done above 50F, in dry weather, and at relatively moderate humidity conditions and when wind velocity is less than 5 mph. For best results substrate temperature should be between 70F and 120F.

SECTION B - APPLICATION - Contd

1. EQUIPMENT - Contd

a. Application of Foam - Contd

(3) When weather temperature is lower than 50F, feed tanks and hose to spray gun should be heated.

(4) When substrate temperature is less than 35F, a thin layer of froth shall be applied to surface prior to installation of the principal insulation layer. This frothing shall be obtained by adding UCON Propellant 12 to the T-624 stream just before entry into the spray gun mixing chamber or heating section, depending upon type of equipment.

(5) Final insulation thickness shall be as scheduled on the insulation schedule.

b. Insulation thickness shall not be less than specified on any area. Nonuniformity shall not exceed 50% of applied thickness. Installation shall be generally smooth with depressions or cavities not exceeding 1/4 inch.

c. Cured insulation shall have properties as specified in MATERIAL SPECIFICATION NO. 43.

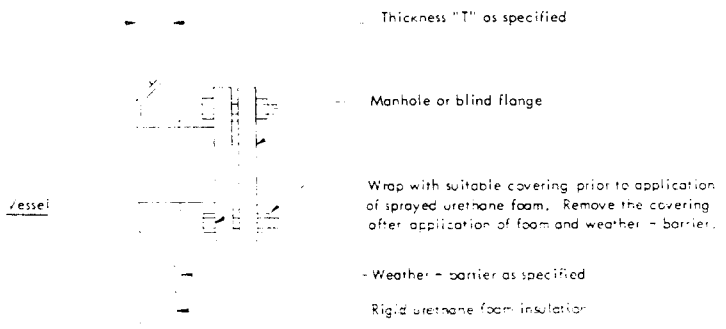
e. Surfaces to be Insulated

(1) Curved, flat, heads, and irregular equipment surfaces shall be insulated to specified thickness in accordance with Subsection a.

f. Flanges

(1) Manhole flanges, blind flanges and vessel flanges shall not be insulated unless specifically specified.

(2) Manhole flanges, and blind flanges not insulated shall have insulation tapered inward as shown in Figure 43-H-1.



Application of Sprayed Urethane Foam Adjacent to Uninsulated Nozzle
Figure 43-H-1

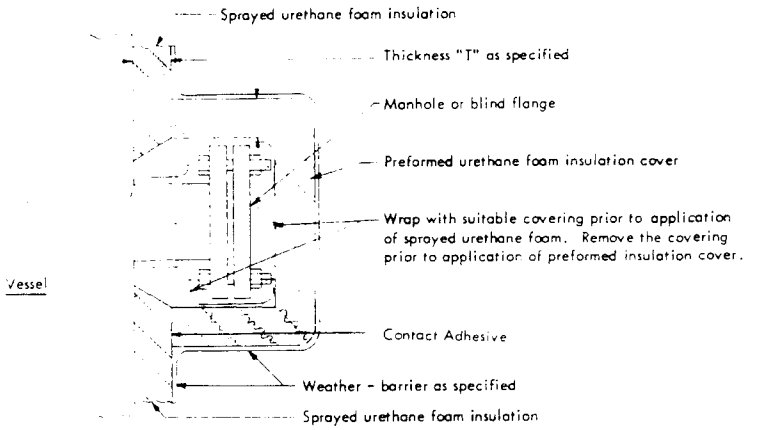
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SECTION B - APPLICATION - Contd

1. EQUIPMENT - Contd

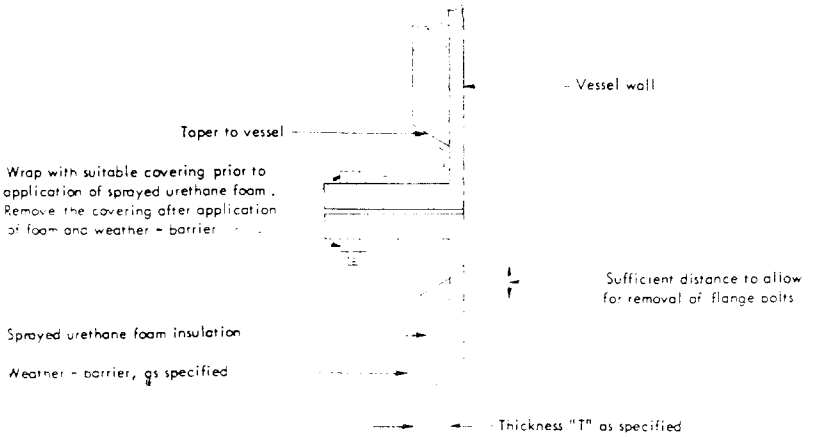
f. Flanges

(3) Insulated manhole and blind flanges shall be insulated as shown in Figure 43-H-2



Application of Sprayed Urethane Foam to Insulated Nozzle
Figure 43-H-2

(4) Vessel flanges not insulated shall have insulation tapered inward as shown in Figure 43-H-3.



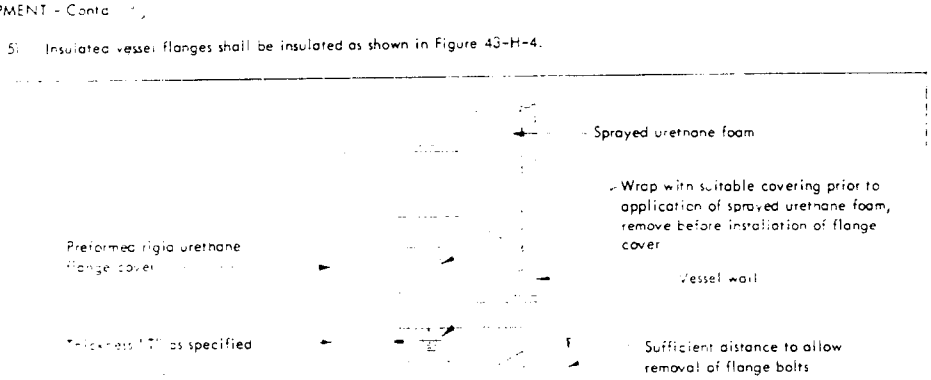
Application of Sprayed Urethane Foam Insulation Adjacent to Uninsulated Flange
Figure 43-H-3

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SECTION B - APPLICATION - Contd

EQUIPMENT - Contd

5. Insulated vessel flanges shall be insulated as shown in Figure 43-H-4.



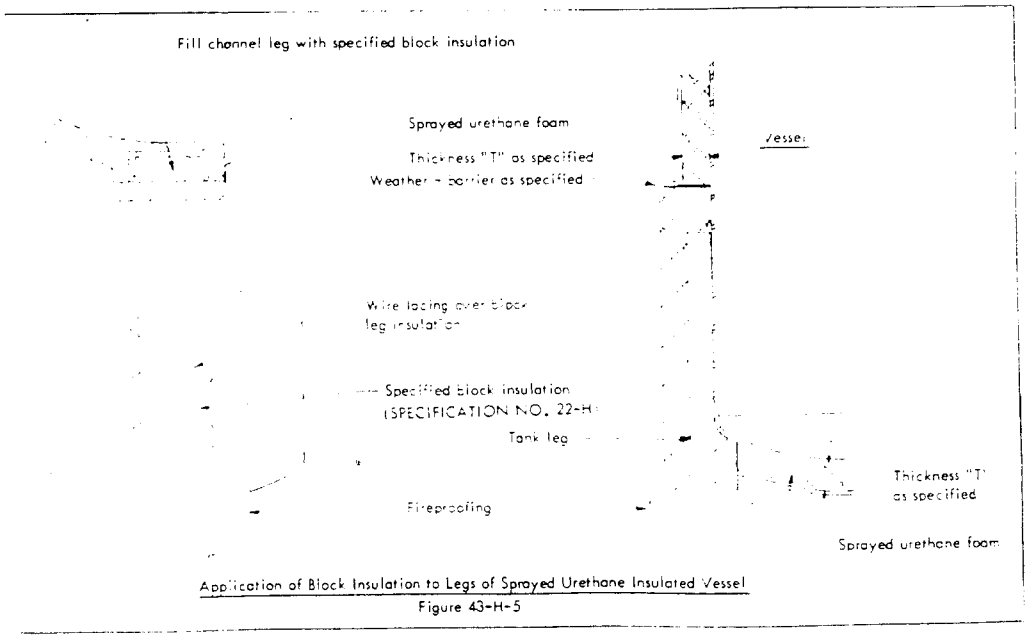
Application of Sprayed Urethane Foam Insulation to Insulated Flanges
Figure 43-H-4

9. Vessel Legs

(1) Concrete-filled structural tubing legs shall be insulated as specified in Article V-C of the GENERAL SPECIFICATIONS.

(2) Channel legs shall be insulated with 1-1 2 inch thick bonded expanded silica insulation, SPECIFICATION NO. 22-H, which shall extend over channel flanges to fireproofing. Reentrant space between channel flanges and over channel flanges shall be insulated with this block insulation. Legs shall be insulated prior to application of sprayed foam insulation.

(3) The sprayed urethane foam insulation shall be butted firmly to the vessel leg insulation. Installation shall be as shown in Figure 43-H-5.



Application of Block Insulation to Legs of Sprayed Urethane Insulated Vessel
Figure 43-H-5

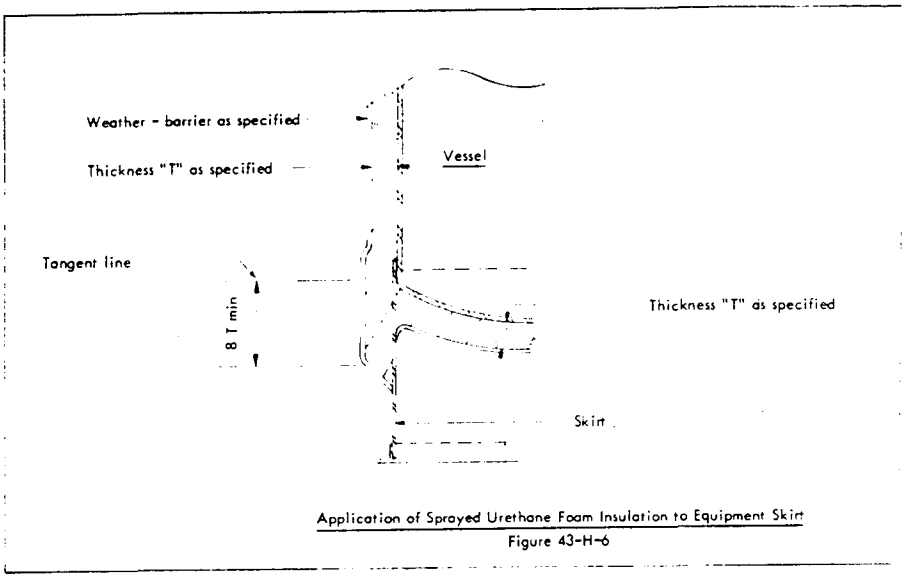
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SECTION B - APPLICATION - Contd

1. EQUIPMENT - Contd

h. Vessel Skirts.

Skirts supporting vertical equipment shall be insulated outside. Insulation shall extend downward from junction of skirt with bottom head a distance of not less than eight times the specified thickness or to concrete pad, whichever is nearer. Where specified, entire surface of skirt shall be insulated. Thickness shall be as specified for body of vessel. Installation shall be as shown in Figure 43-H-6.



Application of Sprayed Urethane Foam Insulation to Equipment Skirt
Figure 43-H-6

i. Surface Finishing

Where smoothness is beyond tolerances given, or where specified for extreme neatness of appearance, high projects of the rigid urethane foam shall be grounded or cut off to provide an even surface.

j. Weather-Barrier

(1) Weather-barrier material shall be weather-barrier mastic (color as specified) spray grade, Designation WB as specified in the MATERIAL SPECIFICATIONS VII.B.1.a.

(2) Insulation shall be protected from weather as soon as possible after curing. However, weather-barrier mastic shall not be applied at atmospheric temperature lower than that recommended in GENERAL SPECIFICATION XIV.B.7.

(3) Prior to application, adjacent areas not to be coated, such as valve stems, handles, gauge glasses, instruments, equipment, structural steel, floors or walls, shall be masked or otherwise protected from rebound or overspray.

(4) Spray application of mastic on the rigid urethane foam insulation shall be done in two coats. After first coat has taken its set, a second coat of mastic shall be applied. The combined thickness of two coats shall not be less than 50 mils when dry.

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