UNION CARBIDE **STANDARD**
CHEMICALS AND PLASTICS OPERATIONS DIVISION
AND UNION CARBIDE CANADA LIMITED

PLAINTIFF'S EXHIBIT
UC-4915

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

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:	
Equipment Operating Above 400 F	VII.A. 1
Equipment Operating at 400 F and Below	VII.A. 2
Piping Operating Above 400 F	VII.A. 1
Piping Operating at 400 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.88
Weather-Barrier Mastic (color as specified)	VII.B.1.a
Reinforcing Cloth	VII.B.1.b
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 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 1-inch thick cushioning blanket shall be applied over the top head, and one layer to the sides and bottom head, 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 insulation thickness for thermal design. Insulation Scheaule shall state total thickness of cushion blanket and insulation.

(2) On horizontal equipment, except stainless steel, one layer of cushioning blanket shall be applied over the entire surface and secured in the sc manner as that specified in Paragraph (1) above. 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 specifie in Paragraph (1) or (2) above.

VI. SPECIFICATIONS FOR INDIVIDUAL INSULATION MATERIALS - contd

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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VI. 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, hr, 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/inch, hr, sq ft, ° F
0	0.16
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 375,000 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, above 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 700 lb/linear ft.

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, with all 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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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 c

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 0.60 mm.

Hygroscopicity . . . . . When oven-dried to constant weight, then exposed to air at 70 F and 90% relative humidit 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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VI. 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.

Forms: 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	0.015 (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 a 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 bid 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 - 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-B-19564A, 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 68 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 180 F without mechanical, thermal, or chemical failure.
Resistance to Chemicals	See Tables I and II.
Shore Hardness (Burm 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.

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VI. SPECIFICATIONS FOR INDIVIDUAL INSULATION MATERIALS - contd

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 5 lb per sq in. 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	0.71

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.

Adhesion . . . . . 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, 60% 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, 60% relative humidity.

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Up-date all materials - Eliminate "or equal" - List three acceptable Vendors

VII. SPECIFICATIONS FOR INDIVIDUAL ACCESSORY MATERIALS

A. Fabrication and Application Accessories

1. Cushioning Blanket – High Temperature (for temperature above 400 F on stainless steel) and for oxygen service heat treated "Temp-Mat" 2 lb glass wool blanket insulation, as manufactured by Pittsburgh Corning, or approved equal.

2. Cushioning Blanket – Low and Moderate Temperature (for temperature up to 400 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, Spin-Glas as manufactured by Johns-Manville, or approved equal.

4. Cushioning Glass Fiber Molded Pipe Insulation – Low and Moderate Temperature (for temperature up to 400 F): Phenolic resin bonded molded pipe insulation, Micro-Loc, as manufactured by Johns-Manville, one-piece as manufactured by Owens-Corning Fiberglas, or approved equal.

5. Mineral Wool Blankets: 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, 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 302, Detrick T-60, or approved equal.

9. Former Steel Strapping: For insulation supports on 3-inch NPS and larger vertical pipe and vertical vessels up to 1 ft 5 in. OD – Acroflex 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.

} eliminate Use wooden skewers ditto

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. – Not req'd when supports are specified

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.

So many of these are out of date. Keep up together

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VII. SPECIFICATIONS FOR INDIVIDUAL ACCESSORY MATERIALS - contd

A. Fabrication and Application Accessories - contd

27. "S" 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 metal jacket as shown in Figure GA-7 in GENERAL SPECIFICATIONS.

28. 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 Hypolon washer, as manufactured by KSM, Nelson Stud, or approved equal.

31. Aluminum Flashing: 3003 aluminum, 0.016 inch thick, embossed aluminum sheet, fabricated and formed as shown in Figure 19-H-1.

32. Sheet Metal Screws: Stainless steel, Type A, pan head, gimlet point, self-tapping, No. 7 by 3/8 inch, furnished with Neoprene washers attached.

33. Strapping Tape: 1 inch wide glass filament, vinyl backed, No. 400 Dutch Brand; 3/4 inch wide glass filament, vinyl backed, No. 6497 Mystic 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, Block Stic as manufactured by Forty-Eight Insulation, Inc., High Temperature Adhesive, Brush Grade 78 as manufactured by Michael Walter Industries, 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): Thur-Ma-Lox Silicon No. 70 Black, as manufactured by The Dampney Company.

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

42. Heat-Resistant Sealer: Silastic 732 RTV Adhesive/Sealant as manufactured by Dow Corning Corporation, or approved equal.

43. Vinyl Asphalt Joint Sealer: Vicarlon 49 as manufactured by Vimasco or approved equal.

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

45. Mastic: Mastic 703 C as manufactured by Vimasco, Code 400 B Type K as manufactured by Pamrod, 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 Lax-Seal F No. 731 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. Roofing Cement: Pittsburgh Corning Pittcote 300 Trowel Grade, or approved equal.

51. Roofing Vapor Barrier: Philip Carey Fire-Chex Vapor Barrier Sheet, or approved equal.

52. Roofing Fire-Resistant Adhesive: Philip Carey Fire-Chex No. 400, or approved equal.

53. Roofing Asphalt: Philip Carey Steep Manco Asphalt, or approved equal.

54. Roofing Felt: 15-lb Asphalt Saturated - Philip Carey Feltex, or approved equal.

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

56. Flashing Cement: Philip Carey C-5 Flashing Cement, or approved equal.

57. Rosin-Sized Paper: Philip Carey Red Rosin Dry Sheet, or approved equal.

58. Bead Mastic: Pittsburgh-Corning P. C. Mastic 100, or approved equal.

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

65. Contact Adhesive (Standard): No. 520 Adhesive as manufactured by Armstrong, O. C.-500 as manufactured by Owens-Corning, No. 372 as manufactured by Rubatex Co., 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 510 a 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 Stic-Klip, or approved equal.

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

77. Nylon Clip Pin Adhesive: Clipfas 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 KSM, 1/8 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 TW-L Style L, or approved equal.

87. Curved Wood Block Isolation Supports: Yellow pine "Penta" treated cradle blocks, as manufactured by Pamrod, or approved equal.

88. Non-Setting Sealer for Cellular Glass: Pittseal 111 as manufactured by Pittsburgh-Corning, or approved equal.

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VII. SPECIFICATIONS FOR INDIVIDUAL ACCESSORY MATERIALS - contd

A. Fabrication and Application Accessories - contd

89. Tape for Preformed Flexible Plastic Foam Insulation: Dutch Brand Trantex V-10, Scotch Brand No. 472, or approved equal.

90. Glass Cloth Jacket for Preformed Fibrous Glass Insulation: White, pre-sized, 6-oz glass cloth.

91. High Temperature Fabricating Cement for Preformed Fibrous Glass Insulation: Fibrous Adhesive No. 81-27 as manufactured by Benjamin Foster, or approved equal.

92. Bonding Adhesive for Preformed Fibrous Glass Insulation: No. 34, as manufactured by the 3M Company, 81-20 as manufactured by Benjamin Foster, or approved equal.

93. Glass Wool Metal Mesh Blanket for Preformed Fibrous Glass Insulation: White glass wool, expanded metal lath on one side, 1-inch hexagonal wire netting on the other side, Fiberglas Metal Mesh Blanket TW-L Style O, or approved equal.

94. Low Temperature Fabricating Cement for Preformed Fibrous Glass Insulation: Benjamin Foster Fire Resistive Adhesive No. 81-33, or approved equal.

95. Vapor Seal Mastic: FR-100 as manufactured by Flintkote, Monolar 60 x 36 as manufactured by Benjamin Foster, or approved equal.

96. Vapor Seal for High-Density Preformed Fibrous Glass Insulation: No. 77 as manufactured by the 3M Company, IC-225 as manufactured by Insul-Coustic, No. 81-20 as manufactured by Benjamin Foster, or approved equal.

97. Jacket Bonding Cement: R-418 as manufactured by Sinclair, No. 33 as manufactured by the 3M Company, or approved equal.

98. Vapor Seal Lap Cement for Low-Density Preformed Fibrous Glass Insulation: No. 82-07 as manufactured by Benjamin Foster, No. 77 Spray Adhesive as manufactured by the 3M Company, or approved equal.

99. PVA Finish Coating and Lagging Adhesive (color as specified) for Low-Density Preformed Fibrous Glass Insulation: No. 708 as manufactured by Vimasco, Inc., No. IC-110 as manufactured by Insul-Coustic Corporation, or approved equal.

100. Fire-Resistant Adhesive: No. 81-99 as manufactured by Benjamin Foster, IC-233 as manufactured by Insul-Coustic Corporation, or approved equal.

101. Fire-Resistant Caulking Mastic: No. 60-30N as manufactured by Benjamin Foster, or approved equal.

102. Outer Covering for Preformed Fibrous Glass Vapor Seal Rigid Faced Insulation: 8-oz canvas.

103. Joint Sealing Tape for Preformed Fibrous Glass Vapor Seal Rigid Faced Insulation: 0.0025-inch aluminum foil, 4 inches wide.

104. Joint Tape for Fibrous Glass Flexible Duct Insulation: Fire-resistant foil-reinforced kraft paper 4 inches wide, No. 610 as manufactured by Sisalkraft, or approved equal.

105. Insulation Adhesive for bonding Cellular Glass Insulation to metal Spheres: Two-part adhesive, 100% solids, suitable for bonding cellular glass to metal; Code 550 as manufactured by Pamrod, or approved equal.

106. Mineral Wool Blanket: Spun rock wool with stainless steel or Monel hexagonal wire netting on one side and galvanized expanded metal lath on the other side.

107. "S" Clips for Sprayable Asbestos: 1 inch wide by 2 inches deep, made of 0.032-inch stainless steel. Also used on vertical storage tanks.

108. Battens for Vertical Storage Tanks: 4 inches wide by 48 inches long by 0.08 inch thick, as manufactured by Owens-Corning, or approved equal.

109. Studs: Multiple grooved pins 5/16 inch in diameter by thickness of insulation plus 1/8 inch, with 3/16-inch diameter by 0.437-inch grooved ends, cadmium-plated; Koer pins as manufactured by KSM, Setlock as manufactured by Nelson Stud, or approved equal. Alternate: Threaded studs 5/16 inch in diameter by insulation thickness plus 1/8 inch, with 1/8 inch diameter by 10-24 by 0.468-inch threaded ends, cadmium-plated; shoulder studs as manufactured by KSM, Type SBF as manufactured by Nelson Stud, or approved equal.

110. Caps for Grooved Studs: Multiple-grooved Koer pin retainers as manufactured by KSM, or Type NXX-0022 as manufactured by Nelson Stud, or approved equal. Alternate for threaded studs: Cadmium-plated nuts 10-24 by 0.468-inch with neoprene washers, as manufactured by KSM, Nelson Stud, or approved equal.

111. Roof Tape: 6-inch-wide glass-reinforced roof tape as manufactured by Owens-Corning, or approved equal.

112. Incombustible Adhesive: Factory Mutual approved Class I adhesive as manufactured by Lexsuco, Philip Carey, or approved equal.

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VII. 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 by 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.

(a) Solids Content

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

(b) 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 5/8-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.

(c) 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 specimens shall be 1/8-inch wide and 1-1/2-inches long in the narrow portion and have an overall length of four 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 1-1/2 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.

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II. SPECIFICATIONS FOR INDIVIDUAL ACCESSORY MATERIALS - contd

B. Weather Barriers

2. Stainless Steel Metal Weather-Barrier - Specification Designation M

a. Scope

These specifications cover the material specifications for stainless 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 stainless steel jackets and closure bands are:

(1) Jackets for cylindrical section of vertical equipment over 2 ft 0 in. OD shall be stainless steel, 3/16-inch corrugations, not less than 0.007-inch thick, 36 inches wide, as manufactured by Childers Prod, or approved equal.

(2) Jackets for equipment 2 ft 0 in. OD and under and field formed jackets over heads, fittings, and pipe covering shall be austenitic stainless steel, smooth, dead soft annealed, not less than 0.007-inch thick, in coil form, 36 inches wide, or prerolled, preformed, with "Z" joint.

(3) Preformed jacket for pipe shall be stainless steel, one quarter hard, not less than 0.007-inch thick, preformed to fit designated insulation outside diameter, with preformed interlocking "Z" joint, as manufactured by Childers Prod. or approved equal. Where desired, this jacket may be factory attached to the pipe insulation.

(4) Smooth jacket for pipe shall be stainless steel, one quarter hard, not less than 0.007-inch thick.

(5) Closure bands for both ends of pipe jackets shall be stainless steel, not less than 0.007-inch thick, 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 bands shall be Sealer-Band as manufactured by Insul-Coustic Corporation, Childers, Johns-Manville, or approved equal.

(6) 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 0.007-inch thick as manufactured by Mirror Insulation Company, Metals Unlimited, or approved equal.

c. Accessories for Stainless 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 Clip - 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.46. of this Article.

(11) Heat Resistant Sealer - Section A.42. of this Article.

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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, Travis Mills, 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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VII. SPECIFICATIONS FOR INDIVIDUAL ACCESSORY MATERIALS - contd

B. Weather Barriers - contd

3. 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 3/16-inch corrugations, in coil form, 36 inches wide, color as specified; Tuf-Jac as manufactured by Insul-Coustic, 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-Coustic, 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-Coustic 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 0.008-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.46. of this Article.

(11) Heat Resistant Sealer - Section A.42. of this Article.

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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 weatherable 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 dead soft annealed Type 304 or 430 stainless steel.

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VII. SPECIFICATIONS FOR INDIVIDUAL ACCESSORY MATERIALS - contd

B. Weather Barriers - contd

4. Weather-Vapor Barriers

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VII. SPECIFICATIONS FOR INDIVIDUAL ACCESSORY MATERIALS - contd

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-85 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-85 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.

(7) E-1

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 18-inch size.

b. Cellular glass board 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. 58
Roofing Vapor Barrier	VII. A. 51	Asphalt Emulsion	VII. A. 59
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 laid 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

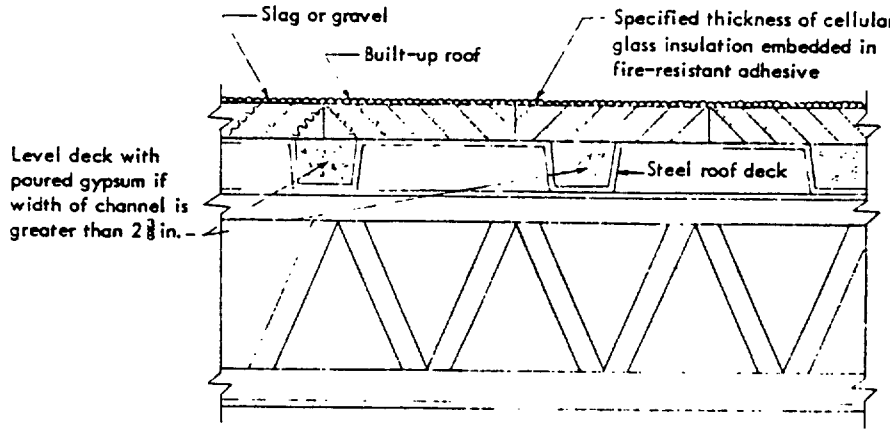
a. Deck shall be plane, dry, and free from holes.

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.c., d., e., and f. of this section, and as shown in Figure 10-B-2

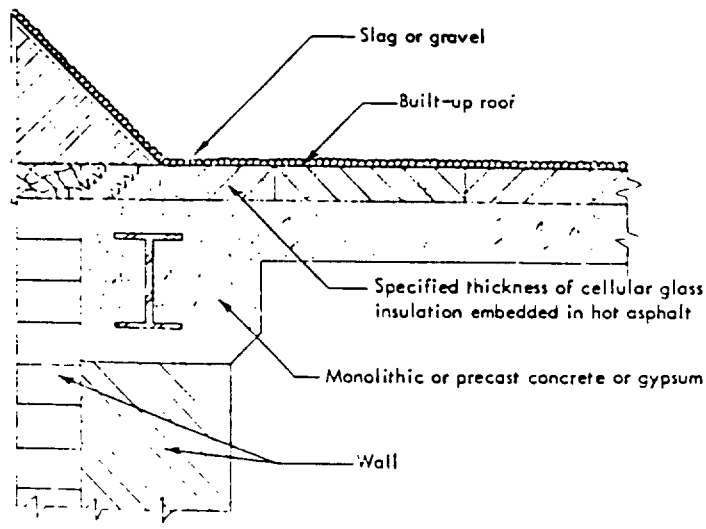
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SECTION B - APPLICATION - contd



Metal Roof Deck

Figure 10-B-1



Monolithic or Precast Roof Deck

Figure 10-B-2

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SECTION B - APPLICATION - contd

3. 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.

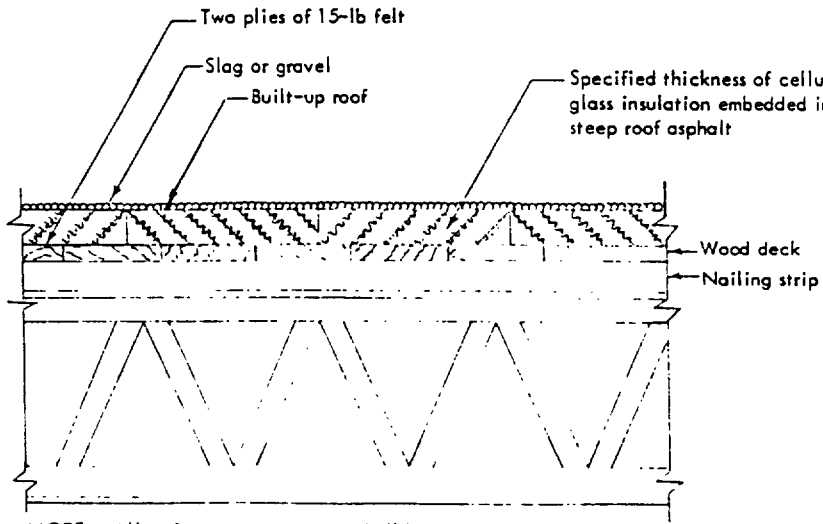
d. If the humidity of the interior is excessive, two plies of 15-lb felt shall be applied with mopping of hot steep roof asphalt. Felt shall be applied by lapping each sheet 19 inches, leaving 17 inches exposed, and mopping hot steep roof asphalt between felts so that at no place shall felt touch felt.

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 molten 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. Installation shall be as shown in Figure 10-B-3.



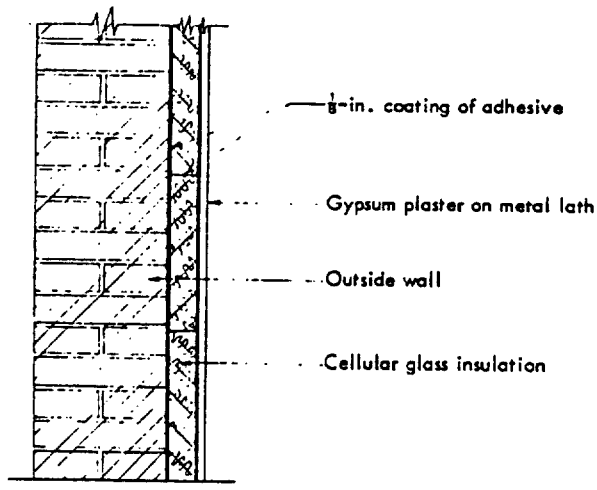
NOTE: All resinous spots or areas shall be covered with one ply of rosin sized paper before applying vapor barrier.

Wood Roof Deck

Figure 10-B-3

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SECTION 8 - APPLICATION - contd



Application of Cellular Glass Insulation for Wall Lining

Figure 10-8-5

6. 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 in 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.

7. 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.

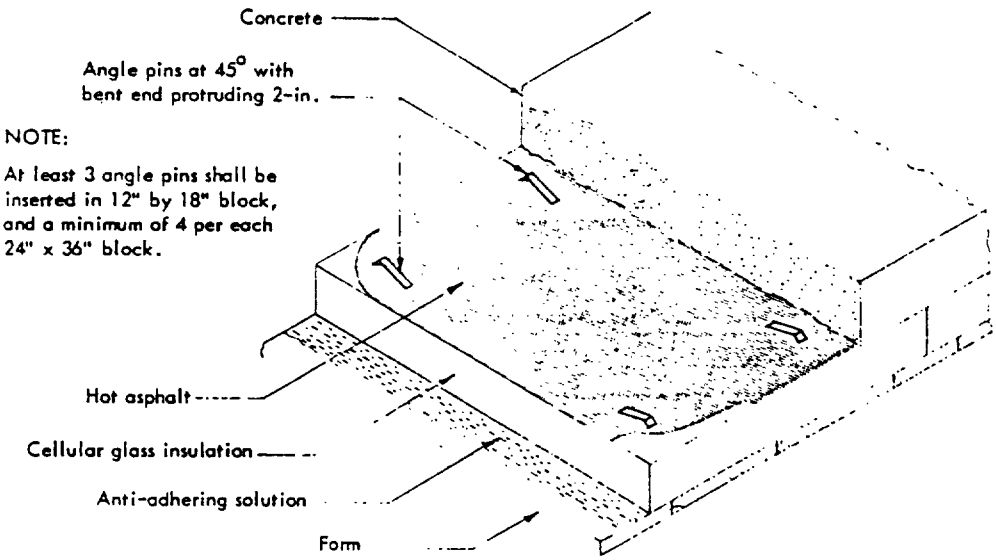
d. After concrete reinforcement is placed, angle pins shall be inserted in the insulation at a 45-degree angle. At least three pins shall be used on each 12-inch by 18-inch block, and at least four pins on each 24-inch by 18-inch block. Bent end of pin shall protrude at least 2 inches. Installation shall be as shown in Figure 10-8-6.

e. Concrete shall then be placed over the insulation.

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SECTION 8 - APPLICATION - contd



Application of Cellular Glass Insulation for Concrete Placed on the Insulation

Figure 10-8-6

8. WALL FINISH

a. Exposed surface of cellular glass insulation shall be given a brush coat of asphalt emulsion.

b. Wire mesh shall be fastened to insulation with lath clips on 18-inch staggered centers on the walls. Inside corners shall be reinforced with strip lath, and outside corners with corner bead.

c. 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.

d. Coating shall be vinyl emulsion as specified in Union Carbide Corporation Design and Construction Coating Specifications.

9. CONCRETE FLOOR SLABS

a. Foundation Wall Method

(1) Where specified, insulation shall be applied to foundation walls, as shown in Figure 10-8-7.

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

(3) A layer of roofing felt, cut to the thickness of the floor slab, shall be applied to the insulation to prevent concrete from bonding to the insulation.

b. Slab-Border Method

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

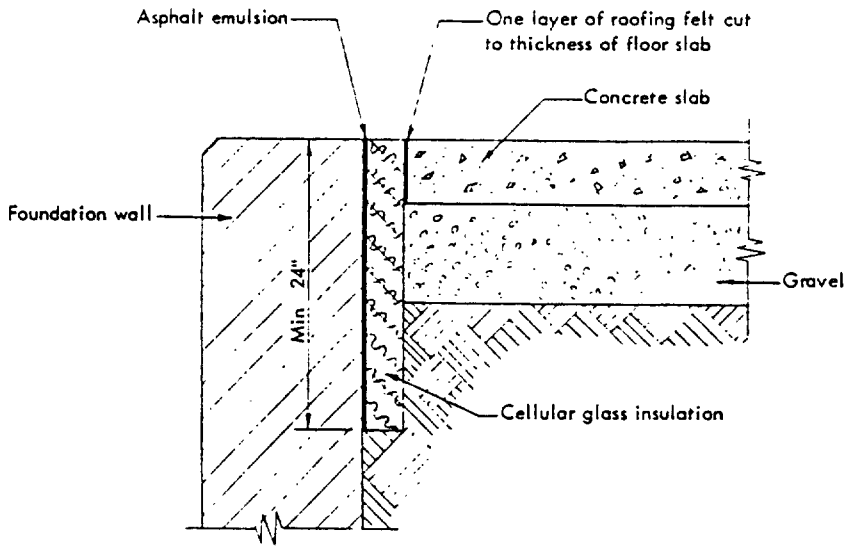
(2) A layer of sand approximately 1 inch thick shall be applied over gravel before applying insulation. Insulation shall extend inward from foundation wall a minimum of 24 inches, or under complete slab, as specified.

(3) Blocks shall be installed with all joints tightly butted.

(4) After insulation is installed as specified, the entire surface shall be flood-mopped with a 1/16-inch-thick (minimum) coat of hot asphalt before placing floor slab. Asphalt shall be heated to a temperature not exceeding 360 F.

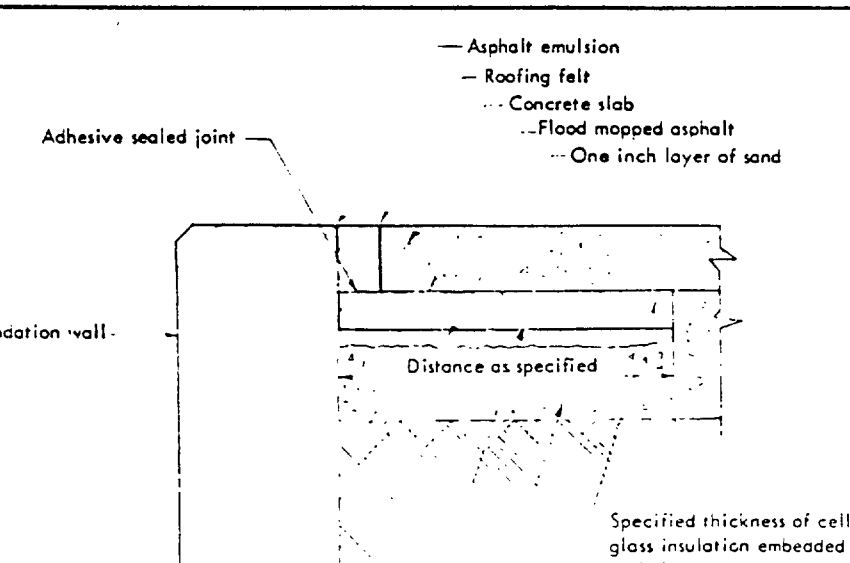
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SECTION B - APPLICATION - contd



Insulated Foundation Wall

Figure 10-8-7



Insulated Floor Slab

Figure 10-8-8

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SECTION B - APPLICATION - contd

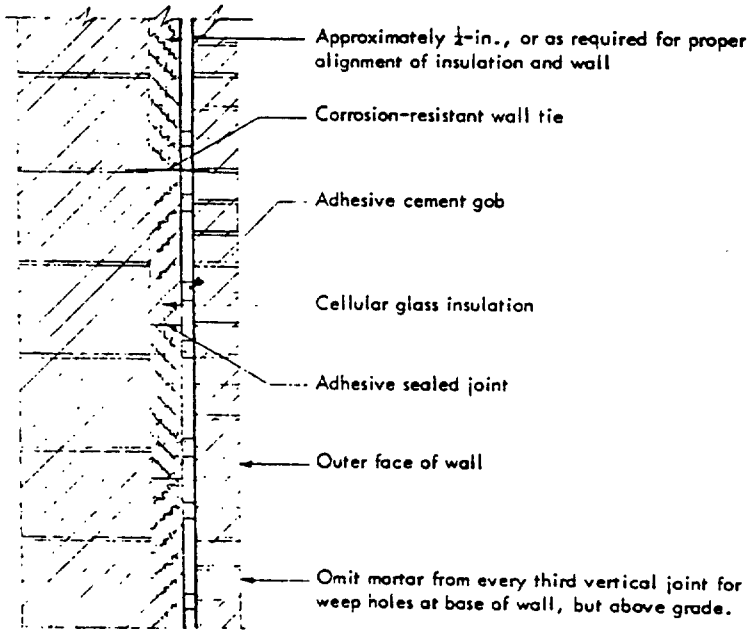
4. INSULATION FOR CORE WALLS

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 1/4-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 uniform 1/8-inch-thick coat of adhesive shall be applied to the back face of each block of cellular insulation, and to edges of blocks in contact.

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

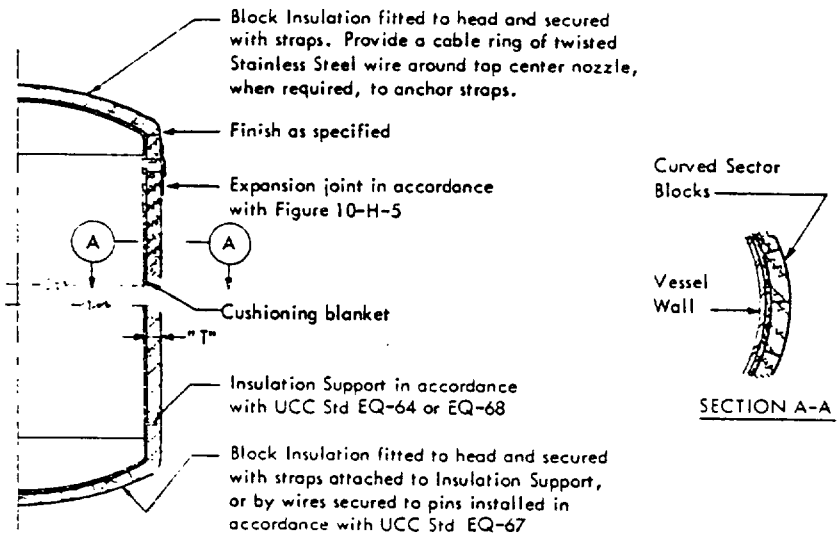
1. EQUIPMENT - contd

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 to Vessel Shell and Heads

Figure 10-H-1

e. 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 strap. Where required, insulation strap shall be attached to strap anchor angles in accordance with Owner's Standards EQ-64, EQ-65. Insulation applied to irregular surfaces, where use of strap is impracticable, shall be secured with stainless steel wire attached to EQ-67 or EQ-69 welding pins in accordance with EQ-67, drawn taut, and ends twisted together and pressed into insulation.

(2) 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 EQ-64 or EQ-70. On large diameter vessels (over 16 ft OD), where use of strap is impracticable, insulation shall be secured by wire attached to welding pins in accordance with Owner's Standard EQ-67 and as shown in Figure 10-H-2.

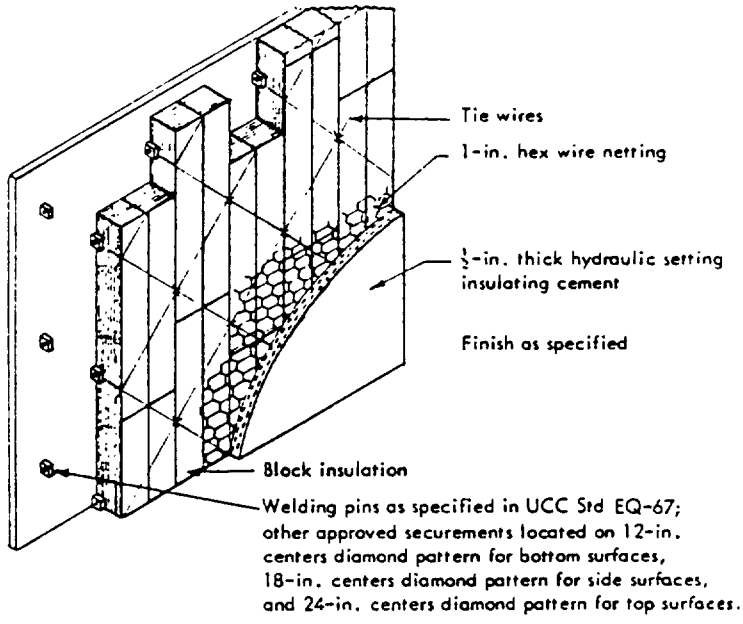
f. Flanges. Manhole flanges, blind flanges, and vessel flanges shall be insulated unless otherwise specified.

g. 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 150F. When operating temperature of equipment is 150 F or below, cushioning material shall 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 - contd

1. EQUIPMENT - contd

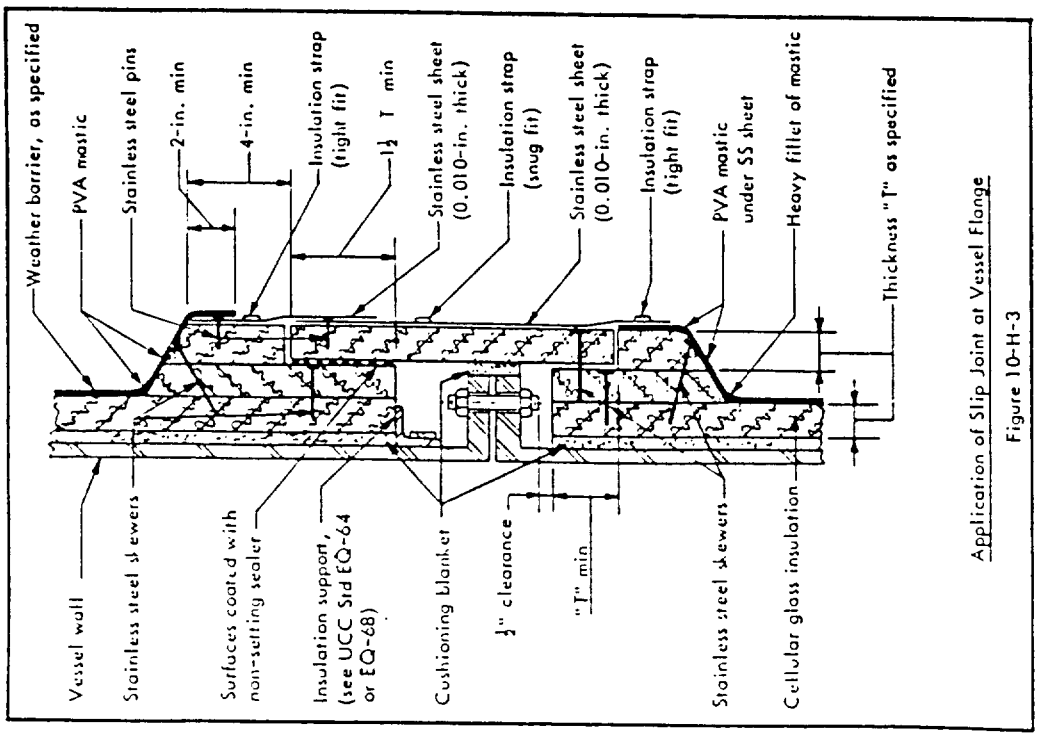


Application of Cellular Glass Insulation to Flat Surface

Figure 10-H-2

h. Expansion Joints

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



Application of Slip Joint at Vessel Flange

Figure 10-H-3

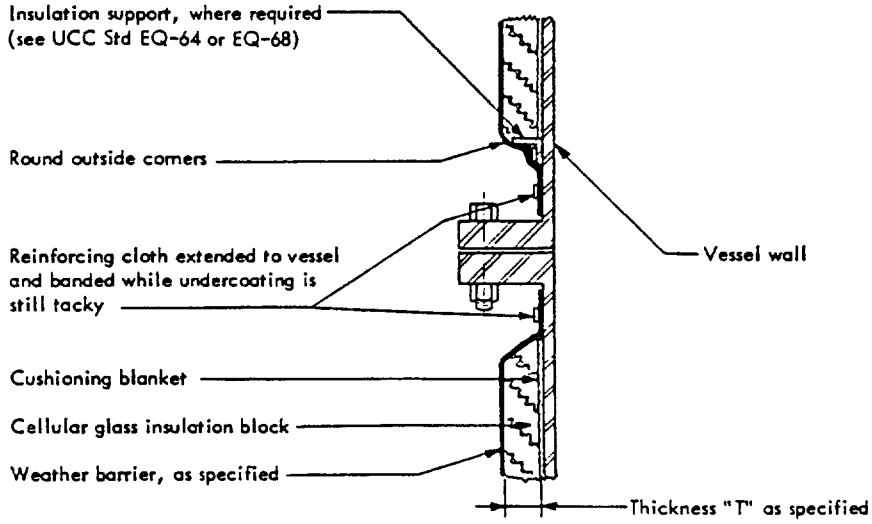
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SECTION B - APPLICATION - contd

1. EQUIPMENT - contd

h. Expansion Joints - contd

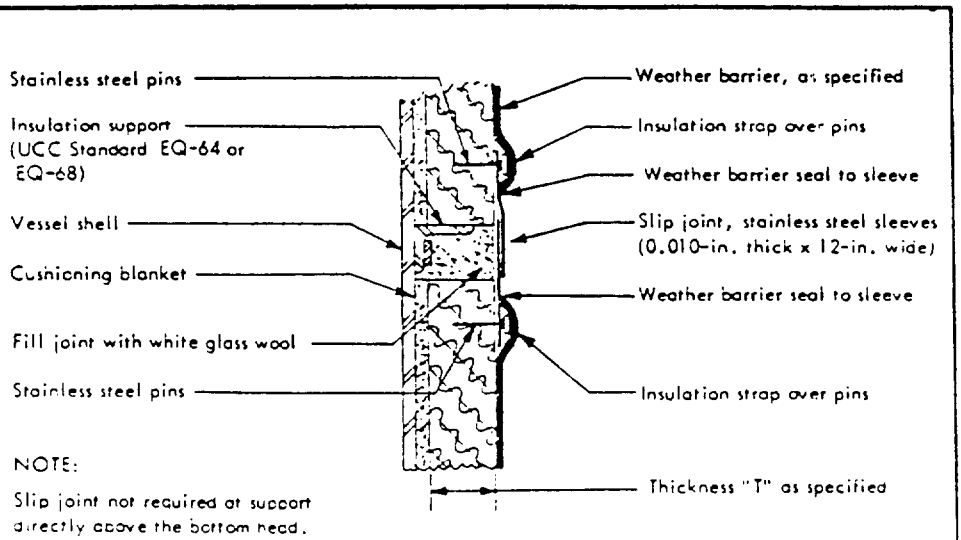
(2) Where vessel flanges are uninsulated, the reinforcing cloth of the weather barrier on the adjacent vessel insulation shall be extended to metal of vessel body, coated with heat resistant sealer, and banded while sealer is still tacky. A second application of sealer shall then be applied over the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



Application of Cellular Glass Insulation Adjacent to Uninsulated Flanges

Figure 10-H-4

(3) Longitudinal expansion of vessels shall be provided for by installing expansion joints at the insulation supports, as shown in Figure 10-H-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-H-5.



Application of Slip Joint to Vessel Wall at Insulation Supports

Figure 10-H-5

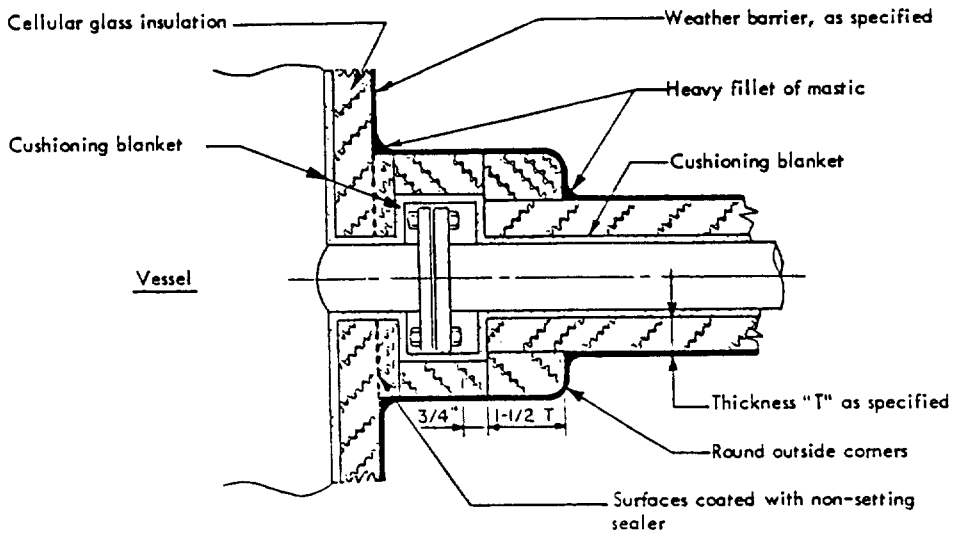
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SECTION B - APPLICATION - contd

1. EQUIPMENT - contd

h. Expansion Joints - contd

(4) One inch of cushioning material shall be packed around nozzles and projections where they extend through the insulation, to prevent crus ing 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

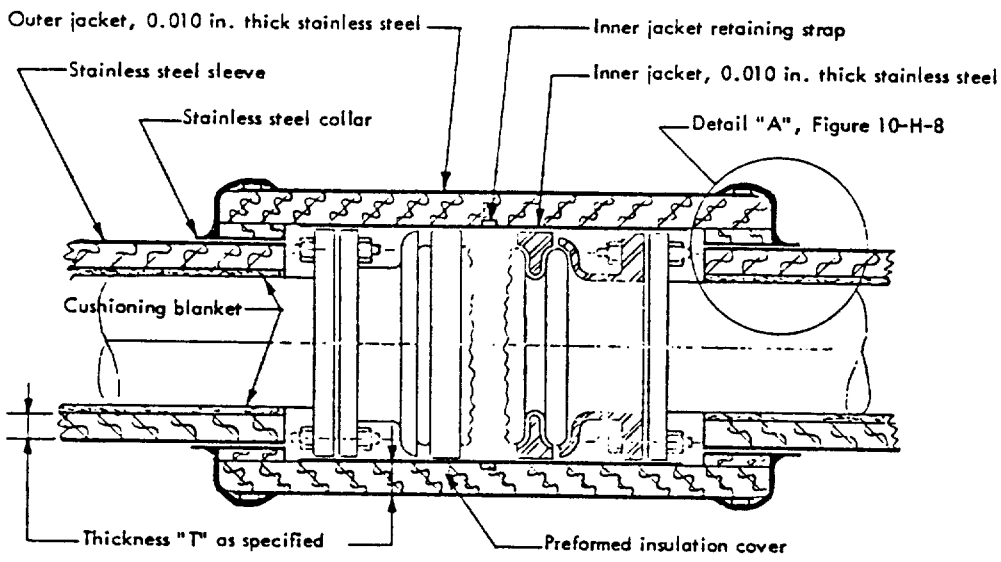
(5) Mechanical Expansion Joints - Corrugated mechanical expansion joints in piping (usually listed as equipment items) shall be insulated as shown in Figures 10-H-7 and 10-H-8. A slip joint shall be provided by applying an 18-inch-long sleeve of 0.010-inch-thick stainless steel over the pipe insulation at each end of the expansion joint, placed flush with the butt end of the pipe covering. The sleeve shall be secured with strap at one end only, that farthest from the expansion joint cover. A collar band of 0.010-inch-thick stainless steel of sufficient lengt to project one inch beyond the expansion joint insulation cover shall be applied over the sleeve and held in place by the expansion joint cov 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.

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

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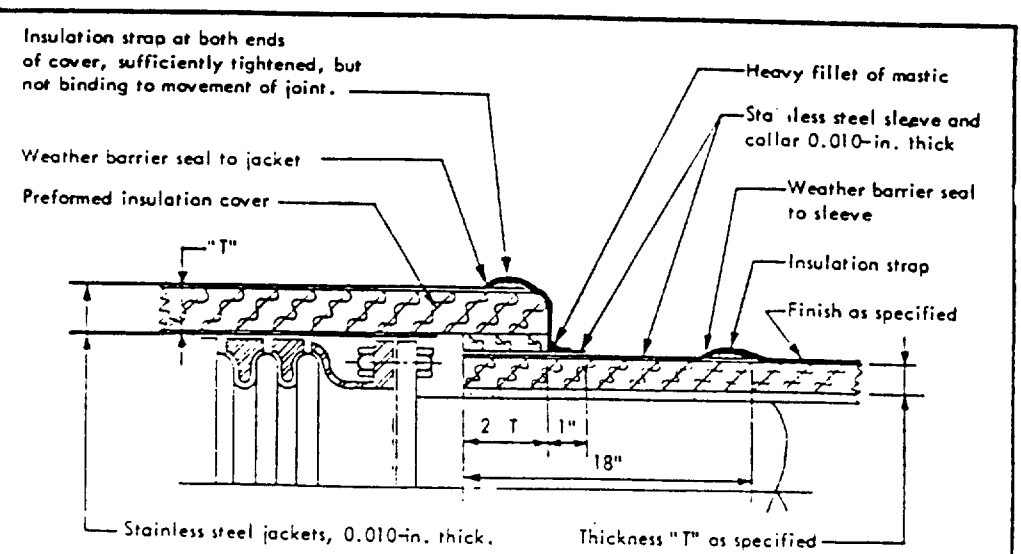
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Cellular Glass Insulation to Mechanical Expansion and Contraction Joint

Figure 10-H-7



Detail "A"

(Slip Joint Detail for Figure 10-H-7)

Figure 10-H-8

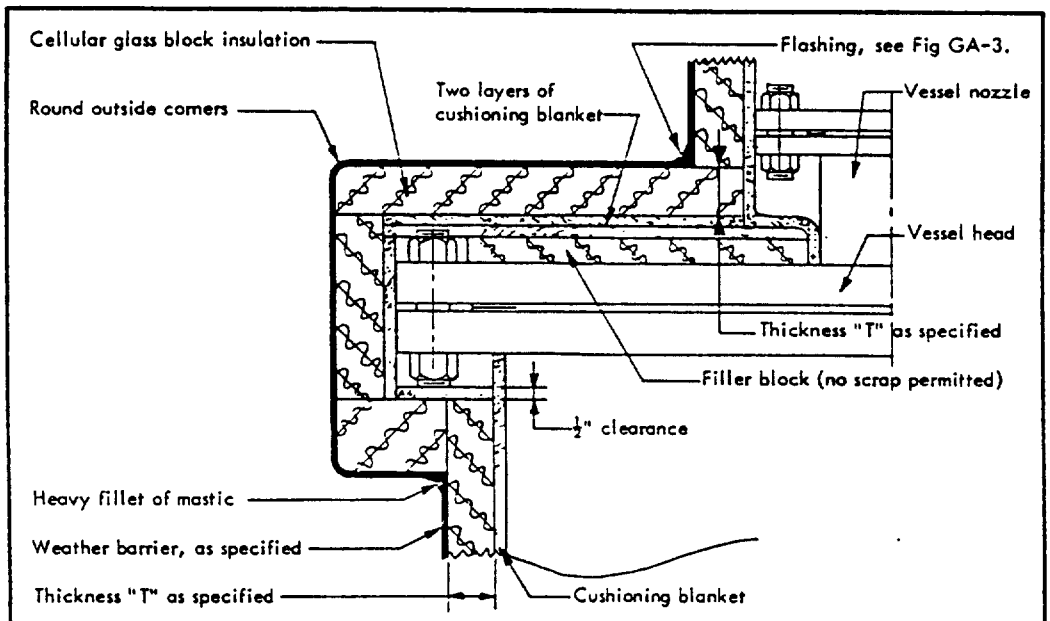
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SECTION B - APPLICATION - contd

1. EQUIPMENT - contd

i. 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-9

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

j. Vessel Legs

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

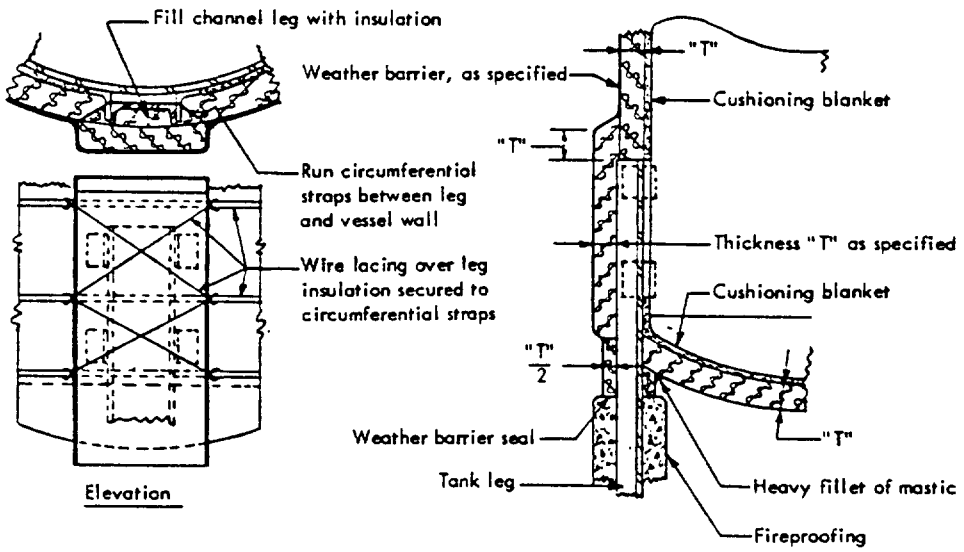
(2) Channel legs shall be insulated with block which shall extend over channel flanges and down channel legs to junction with any fire-resistant material. Thickness shall be 1/2 that specified for body of vessel. Body insulation shall be brought up to and butted firmly against tank leg flange.

(3) Re-entrant space between channel flanges and over channel flanges between body insulation shall be filled with block cemented in place with adhesive cement. Surface of fireproofing material abutting tank leg insulation shall be coated with weather barrier coating. Installation shall be as shown in Figure 10-H-10.

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SECTION 8 - APPLICATION - contd

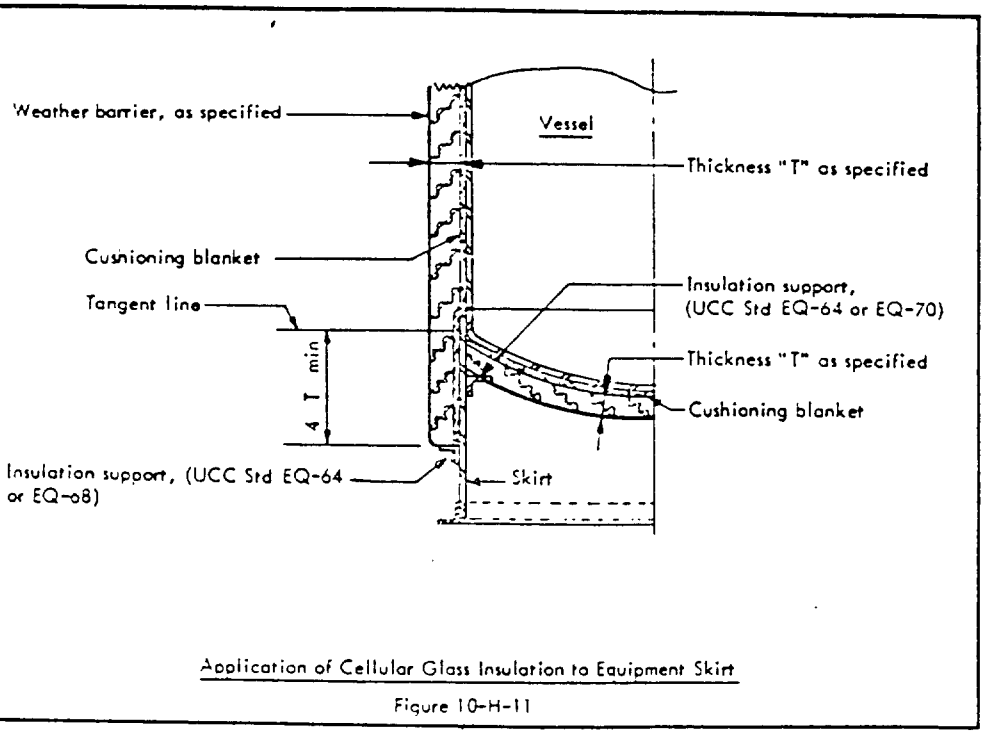
EQUIPMENT - contd



Application of Cellular Glass Insulation to Equipment Leg

Figure 10-H-10

k. 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 EQ-64, EQ-68 and EQ-67. Installation shall be as shown in Figure 10-H-11.



Application of Cellular Glass Insulation to Equipment Skirt

Figure 10-H-11

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SECTION B - APPLICATION - contd

1. EQUIPMENT - contd

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

m. Weather Barrier. Weather-barrier coating or jacket, whichever is called for, shall be applied as specified in Articles XIV.B and XV.B, respecti 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 specificatior designation, thus 10-HMT or 10-HSSMT.

2. 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 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 SPECIFICATI

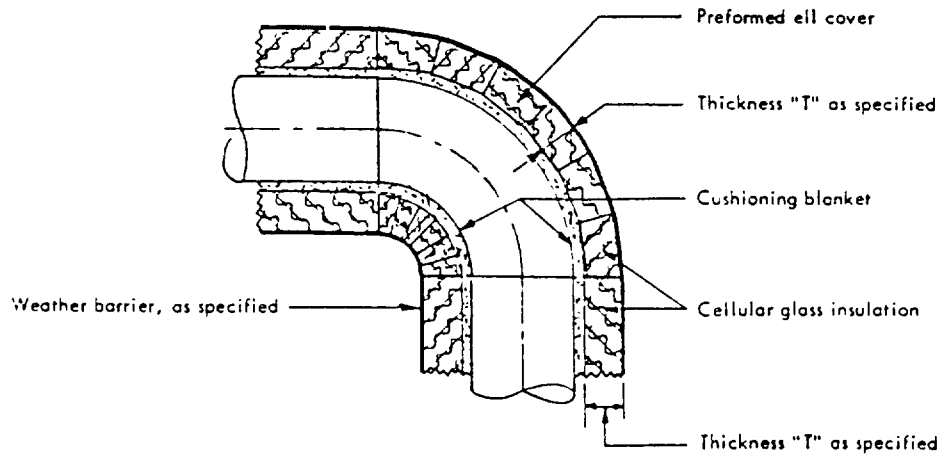
(4) Piping operating at temperatures of 350 F and below, except stainless steel, shall have one-half-inch-thick preformed cushioning material apc before application of cellular glass insulation and secured with a minimum of four staples per three-foot section. Piping, operating at temperature above 350 F (except stainless steel), or where preformed cushioning material is not available, shall have one-inch-thick cushioning blanket secure with stainless steel wire and compressed to approximately one-half-inch thickness, applied before application of cellular glass insulation. Cushio ing 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 stainles 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 befor application.

b. 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 for cushioning material.



Application of Cellular Glass Insulation to Welded Ell

Figure 10-H-12

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SECTION B - APPLICATION - contd

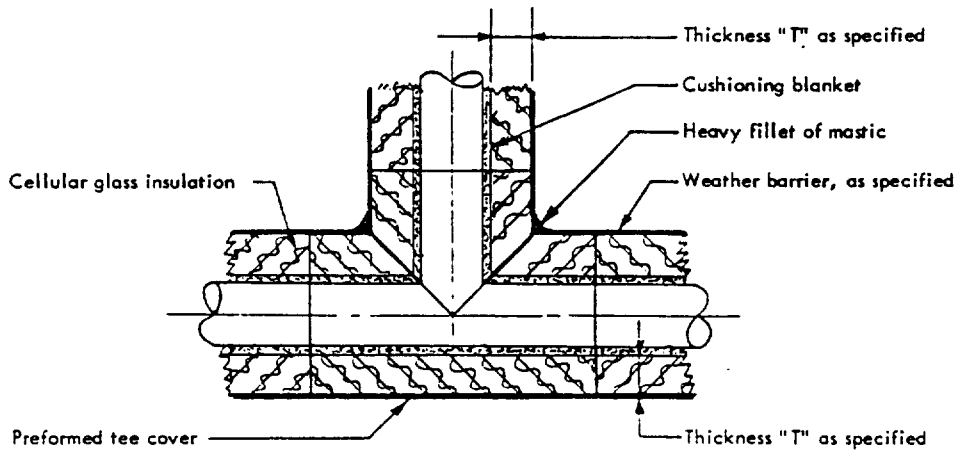
2. PIPING - contd

b. Fitting, Flange, and Valve Covers - contd

(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.

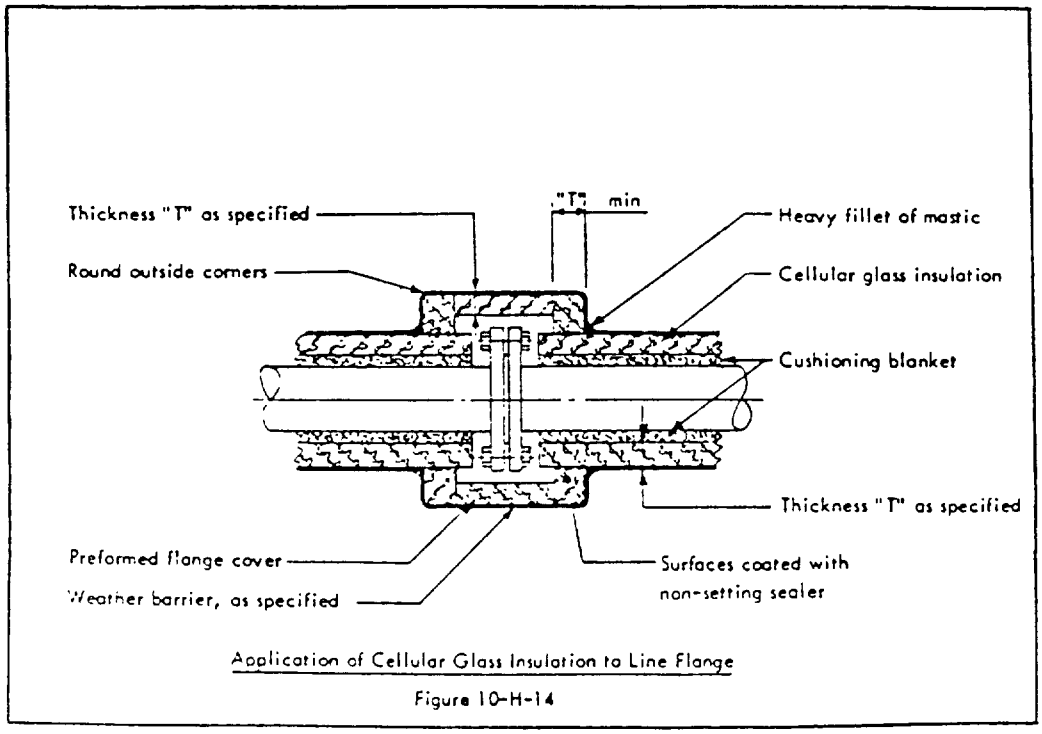
(3) Ball and plug valve covers shall be field fabricated of proper sized pipe covering.

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



Application of Cellular Glass Insulation to Welded Tee

Figure 10-H-13



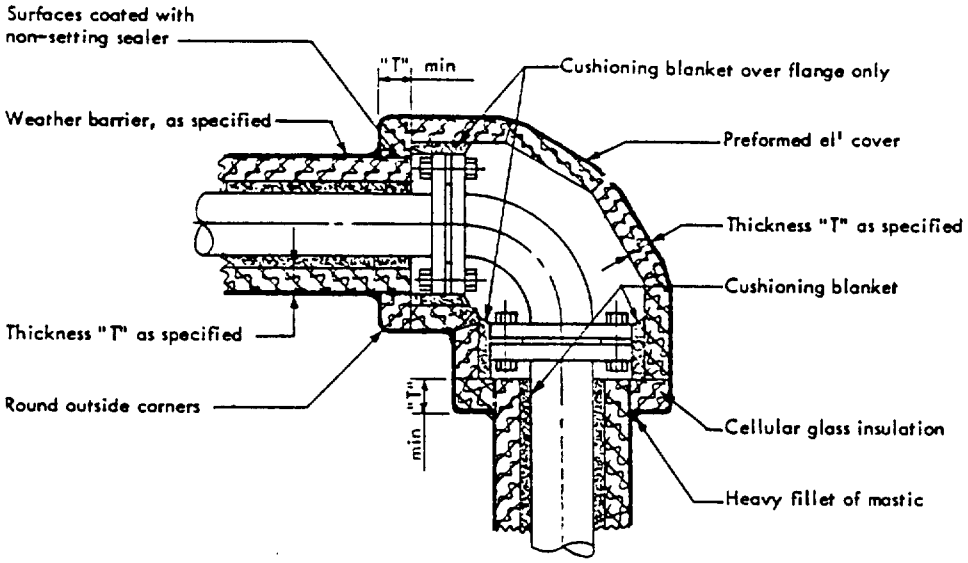
Application of Cellular Glass Insulation to Line Flange

Figure 10-H-14

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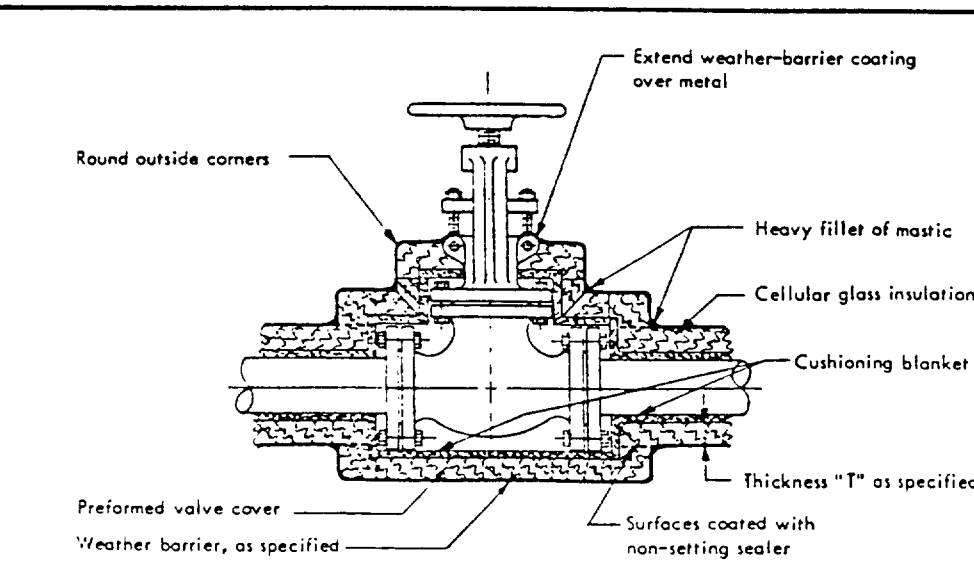
SECTION B - APPLICATION - contd

2. PIPING - contd



Application of Cellular Glass Insulation to Flanged Ell

Figure 10-H-15



Application of Cellular Glass Insulation to Flanged Valve

Figure 10-H-16

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SECTION B - APPLICATION - contd

2. PIPING - contd

b. Fittings, Flange, and Valve Covers - contd

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

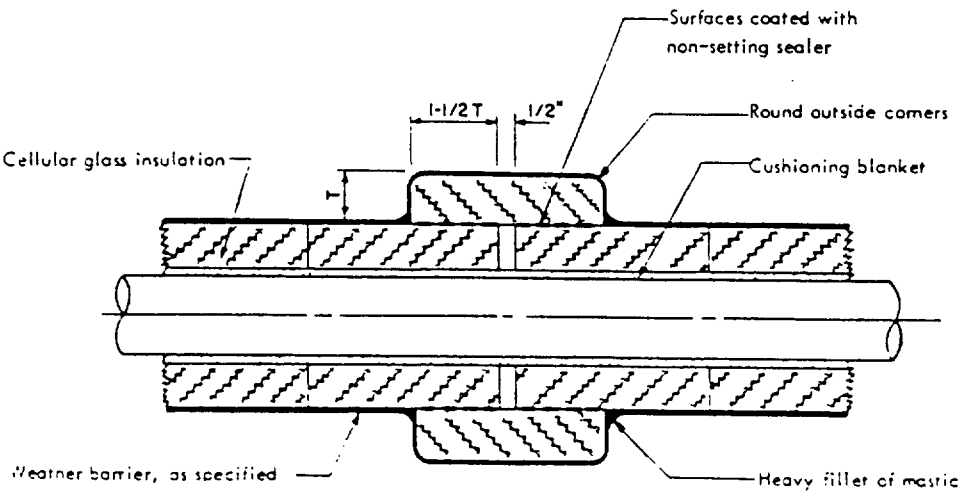
(6) Cementing of shop assemblies shall be done with fabricating cement. In all cases the joints shall be as thin as possible with just sufficient cement to obtain good adhesion and complete closure. In no case will wide cement joints, or voids and holes plugged with cement, be permitted.

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 expansion-contraction joints in the insulation will not be required.



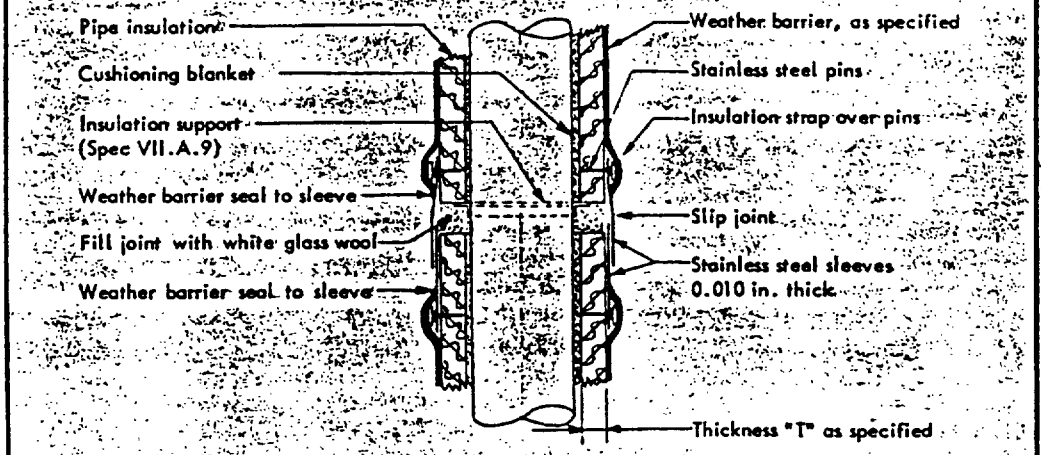
Application of Cellular Glass Insulation to Expansion and Contraction Joint in Horizontal Piping

Figure 10-H-17

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SECTION B – APPLICATION – contd.

2. PIPING – contd.



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

Figure 10-H-18

Stopping Top up to 9 5/8" O.D.

d. Securement: Cellular glass pipe insulation shall be secured with pipe insulation strap.

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

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.

Insulating Cement	VII. A. 6	Strap Anchor Clip	VII. A. 24
Pipe Insulation Support	VII. A. 9	Strapping Tape	VII. A. 33
Equipment Insulation Strap	VII. A. 11	Moderate Temperature Fabricating Cement	VII. A. 35
Clips for Insulation Strap	VII. A. 12	Heat-Resistant Sealer	VII. A. 42
Pipe Insulation Strap	VII. A. 13	Glass Wool Metal Mesh Blanket	VII. A. 86
Clips for Pipe Strap	VII. A. 14	Non-Setting Sealer	VII. A. 88
Stainless Steel Wire	VII. A. 17	Weather-Barrier Mastic (color as specified)	VII. B. 1. a
Welding Pins	VII. A. 19	Reinforcing Cloth	VII. B. 1. b
Stainless Steel Pins	VII. A. 20	Stainless Steel Weather Barrier (Designation M)	VII. B. 2
Stainless Steel Skewers	VII. A. 21	Treated Steel Weather Barrier (Designation MT)	VII. B. 3
		High and Low Temperature Anti-Abrasive Coating	VII. A. 40

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 EQ-64, EQ-65, EQ-68 or EQ-69. 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.

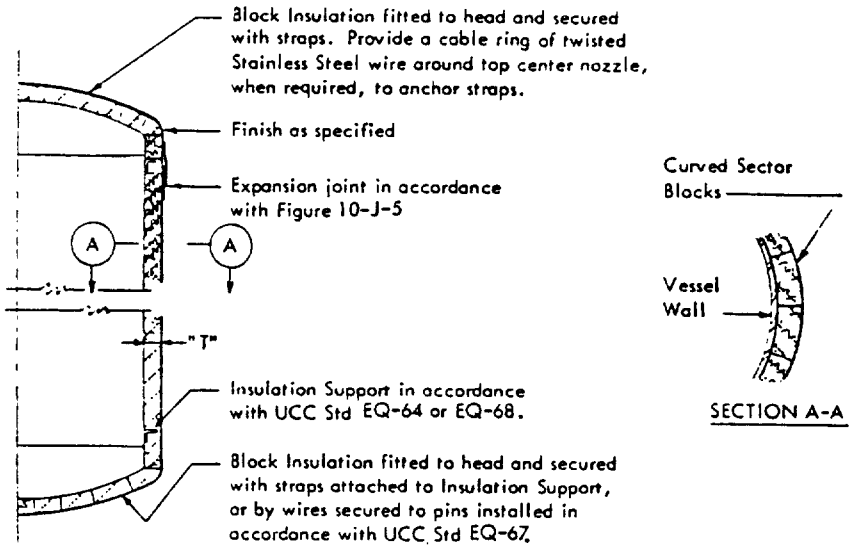
(b) Cellular glass insulation on bottom heads of vertical equipment, or heads of horizontal equipment, shall be held in place with stainless steel insulation strap secured to insulation supports as shown in Owner's Standards EQ-64, EQ-65, EQ-68 or EQ-70. Insulation on heads of large diameter vessels (over 16 ft OD), where use of strap is impracticable, shall be secured by wire attached to welding pins in accordance with Owner's Standard EQ-67 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.

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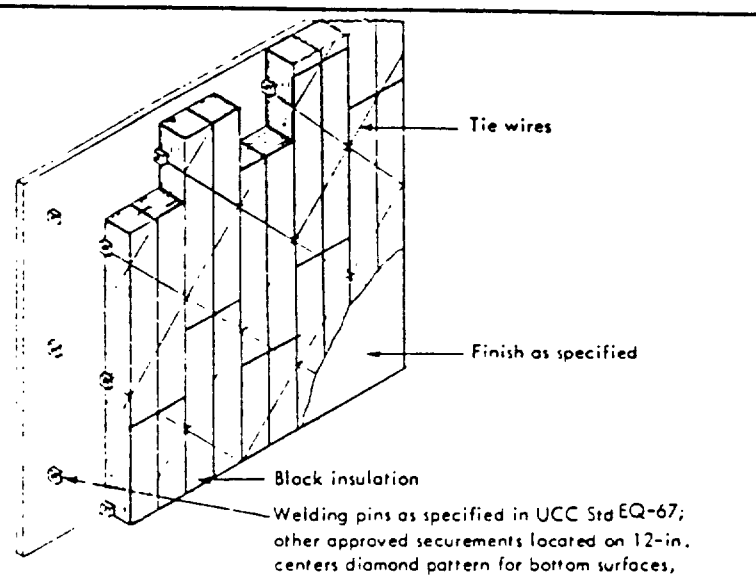
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Cellular Glass Insulation to Vessel Shell and Heads

Figure 10-J-1



Application of Cellular Glass Insulation to Flat Surface

Figure 10-J-2

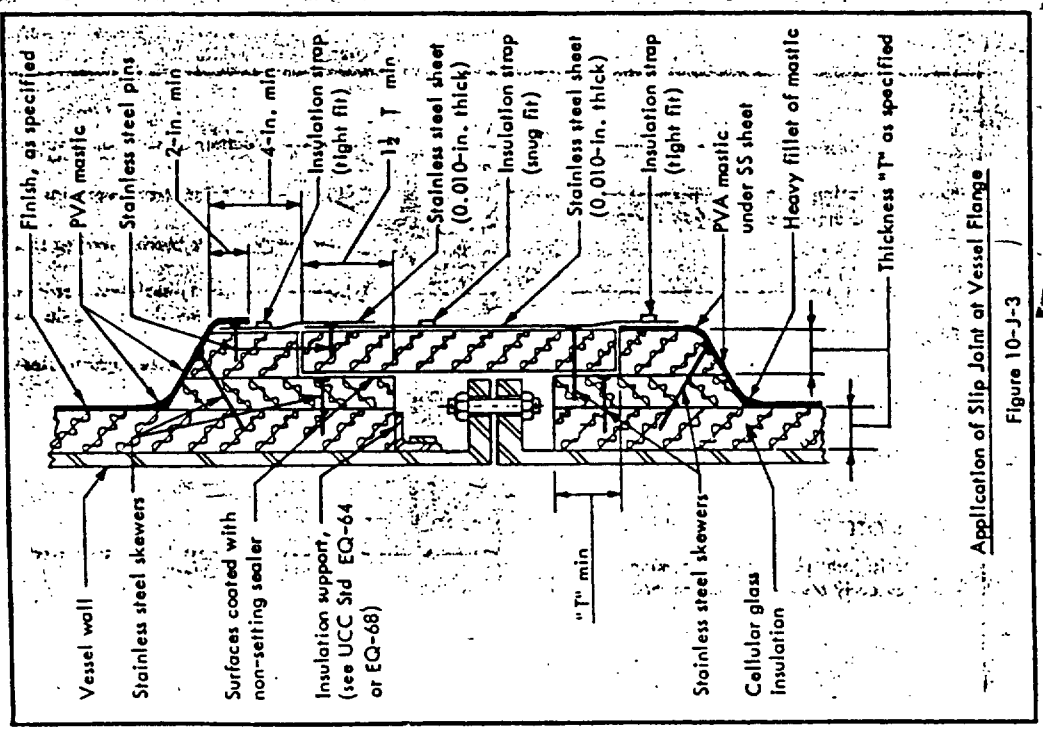
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SECTION B – APPLICATION – contd

I. EQUIPMENT – contd

g. Expansion Joints

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

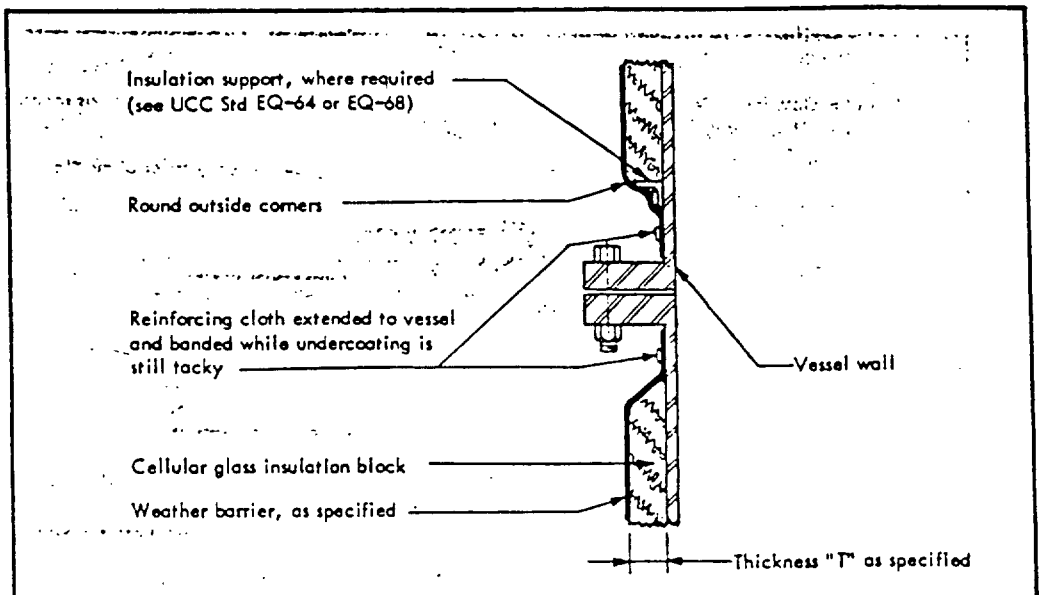


Application of Slip Joint at Vessel Flange

Figure 10-J-3

Eliminate ?

(2) Where vessel flanges are uninsulated, the reinforcing cloth of the weather barrier on the adjacent vessel insulation shall be extended metal of vessel body, coated with heat-resistant sealer, and banded while sealer is still tacky. A second application of sealer shall then b 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

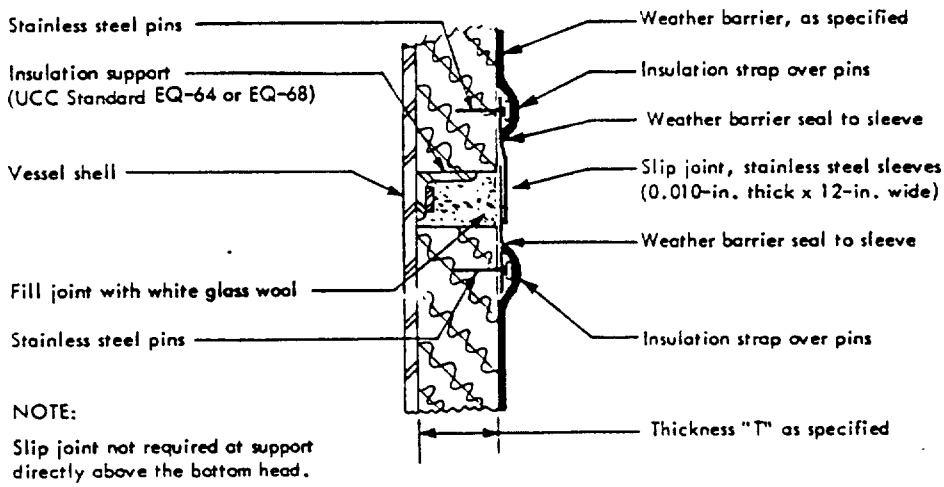
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SECTION B - APPLICATION - contd

1. EQUIPMENT - contd

g. Expansion Joints - contd

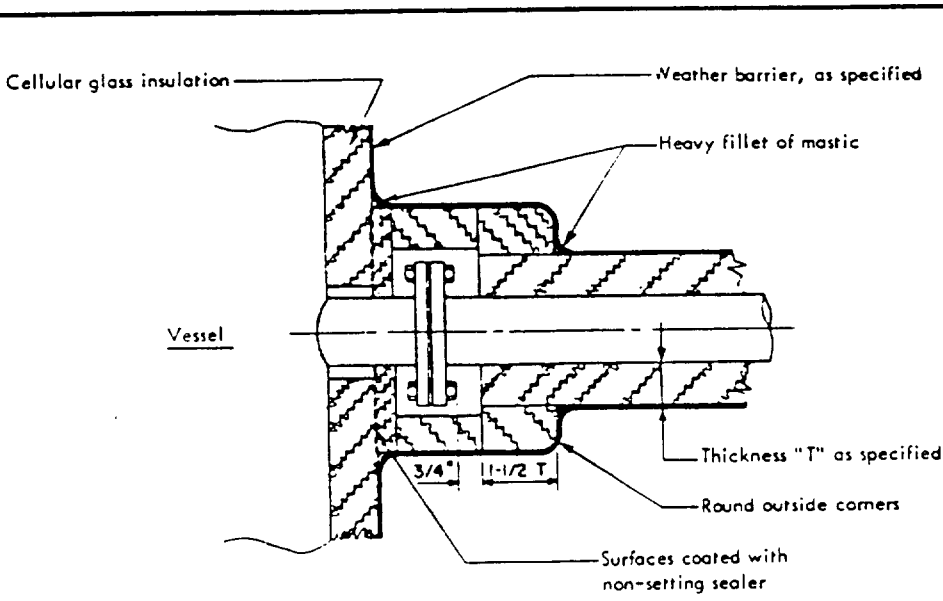
(3) Longitudinal expansion of vessels shall be provided for by installing expansion joints at the insulation supports as shown in Figure 10-J-5. When more than one thickness is specified for a vessel, an insulation support shall be provided at the junction of two different thicknesses and insulated in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

Figure 10-J-6

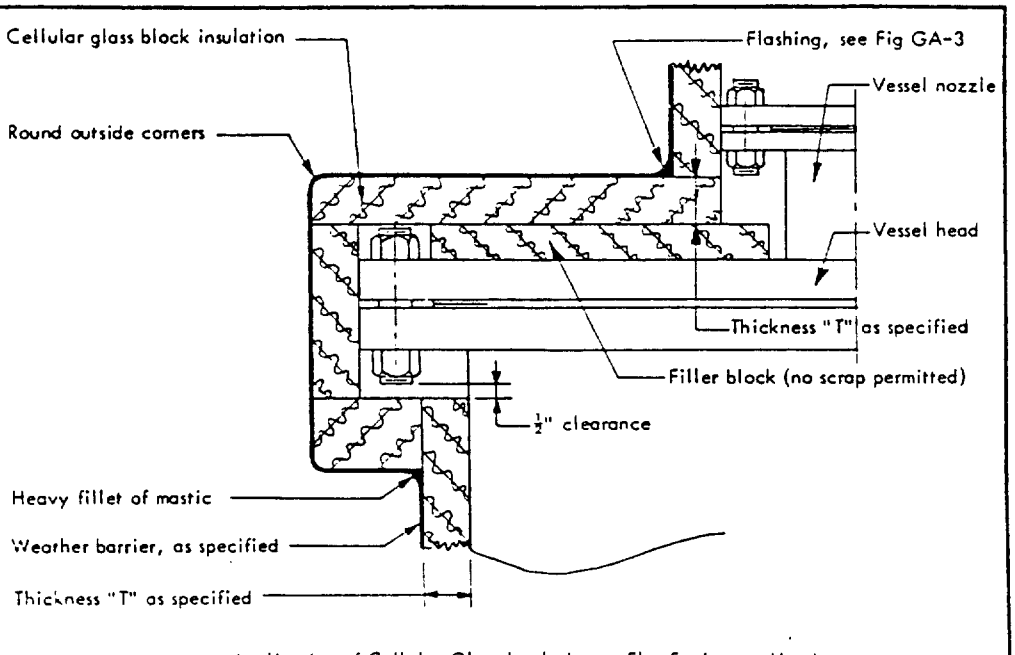
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SECTION 8 - APPLICATION - contd

1. EQUIPMENT - contd

h. 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 V pockets shall be eliminated and proper drainage provided as shown in Figure 10-J-7.



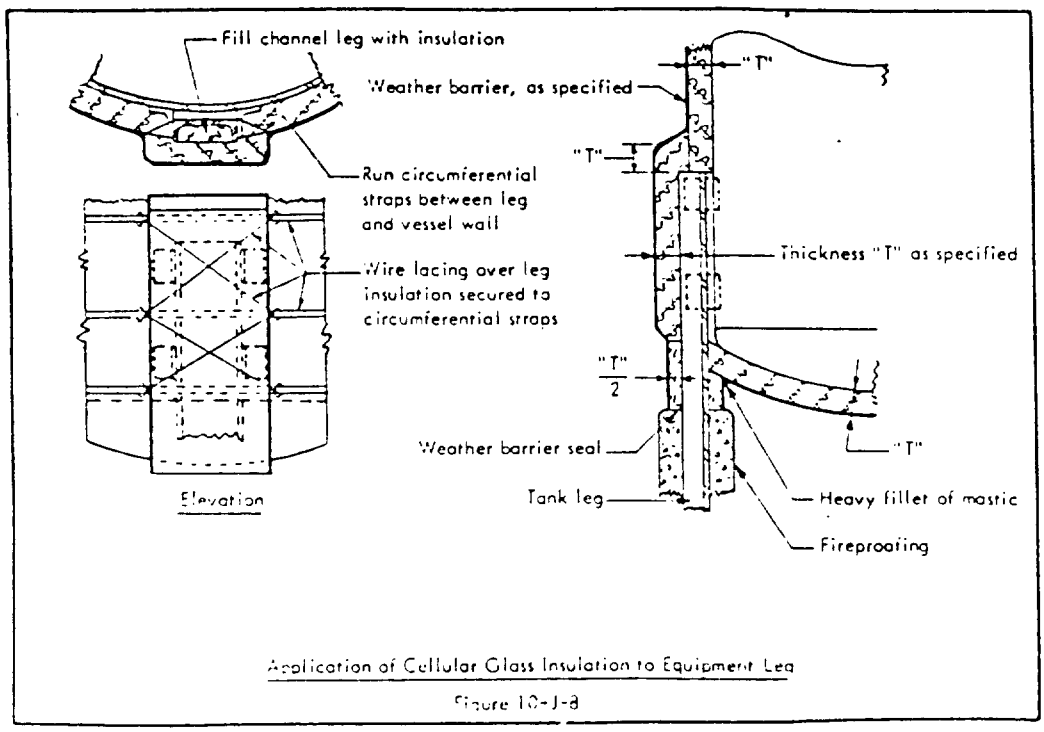
Application of Cellular Glass Insulation to Flat Equipment Head

Figure 10-J-7

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

i. Vessel Legs

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



Application of Cellular Glass Insulation to Equipment Leg

Figure 10-J-8

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SECTION B - APPLICATION - contd

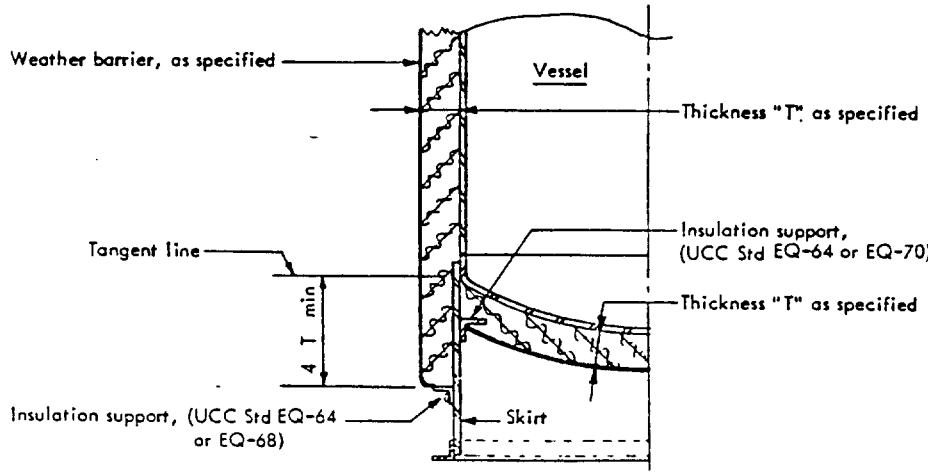
1. EQUIPMENT - contd

i. Vessel Legs - contd

(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 adhesive 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.

j. 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 EQ-64 or 70 and EQ-67, respectively. Installation shall be as shown in Figure 10-J-9.



Application of Cellular Glass Insulation to Equipment Skirt

Figure 10-J-9

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

l. 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-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.

2. PIPING

a. Pipe Insulation

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

(2) Insulation thicknesses 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 to piping in a staggered position in accordance with Figures 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 either be retitting or replacing insulation. Any rounded corners on the insulation surfaces to be butted shall be trued before application.

(5) Butt edges, ends, and bore of all inner layers shall be given a smooth brush or spray coat of heat-resistant sealer and allowed to dry for a minimum of four 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.

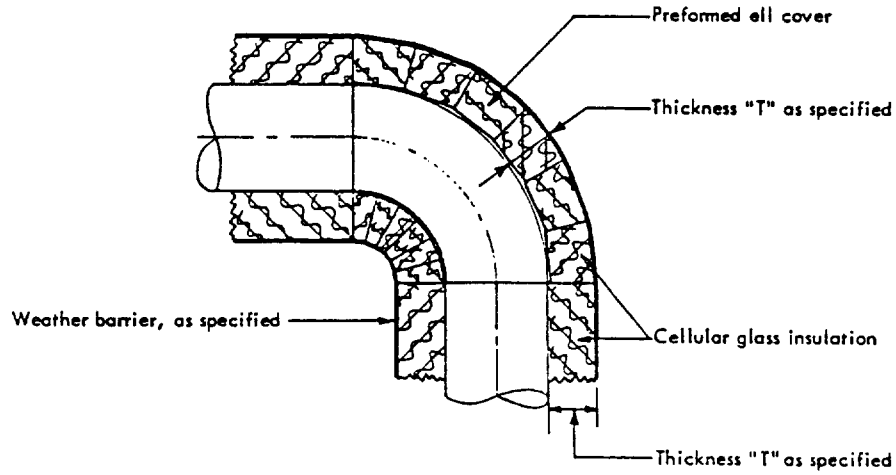
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SECTION B - APPLICATION - contd

2. PIPING - contd

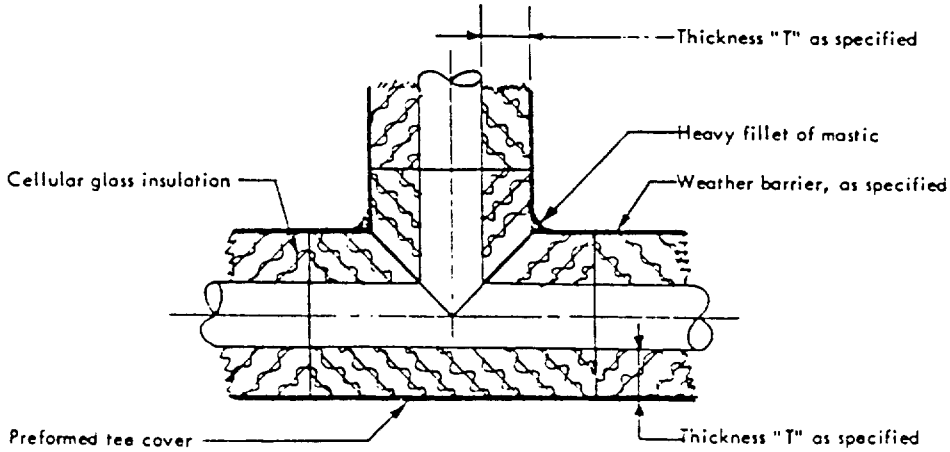
b. Fitting, Flange, and Valve Covers

(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 Ell

Figure 10-J-10



Application of Cellular Glass Insulation to Welded Tee

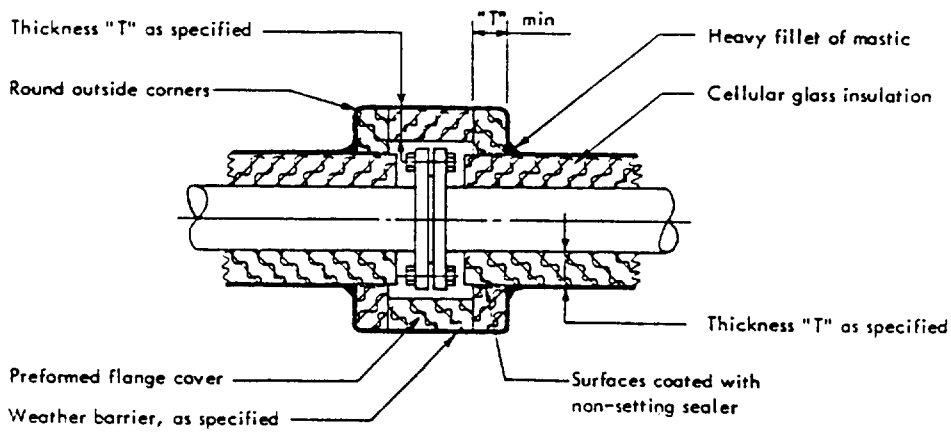
Figure 10-J-11

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SECTION 8 - APPLICATION - contd

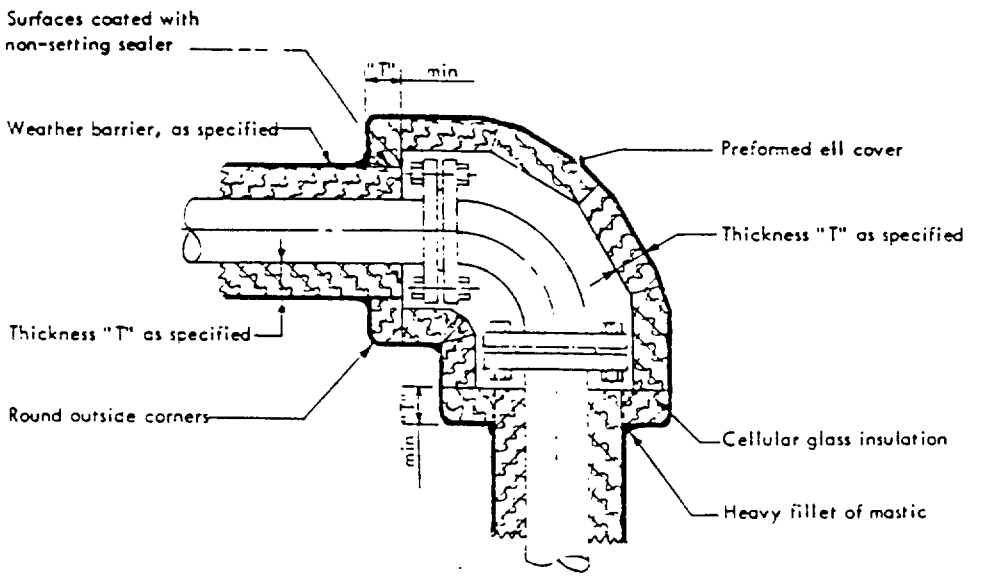
2. PIPING - contd

b. Fitting, Flange, and Valve Covers - contd



Application of Cellular Glass Insulation to Line Flange

Figure 10-J-12



Application of Cellular Glass Insulation to Flanged Ell

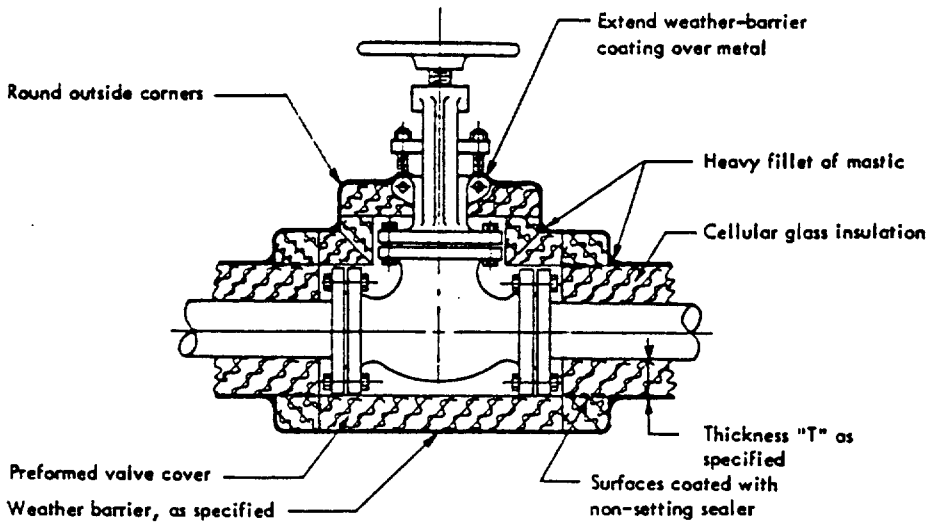
Figure 10-J-13

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SECTION B - APPLICATION - contd

2. PIPING - contd

b. Fitting, Flange, and Valve Covers - contd

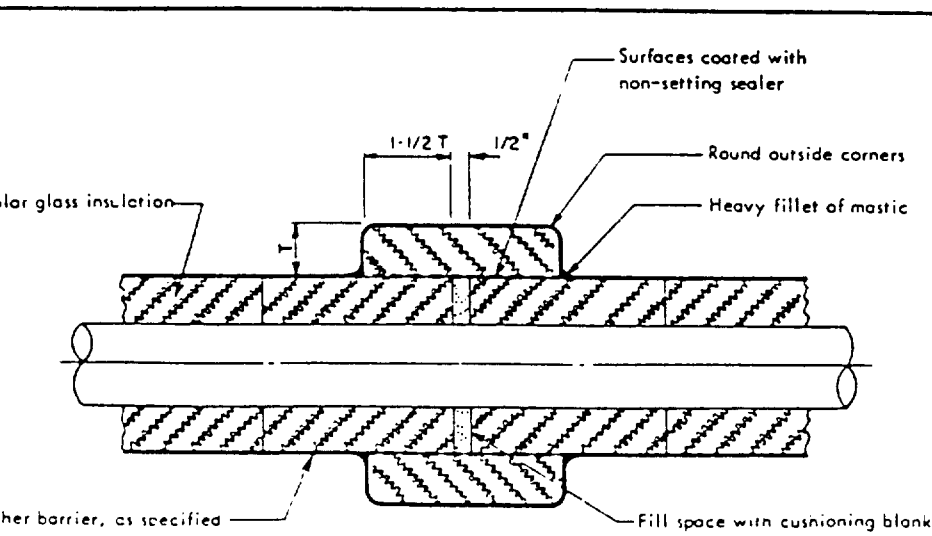


Application of Cellular Glass Insulation to Flanged Valve

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.



Application of Cellular Glass Insulation to Expansion and Contraction Joint in Horizontal Piping

Figure 10-J-15

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SECTION II - APPLICATION - contd.

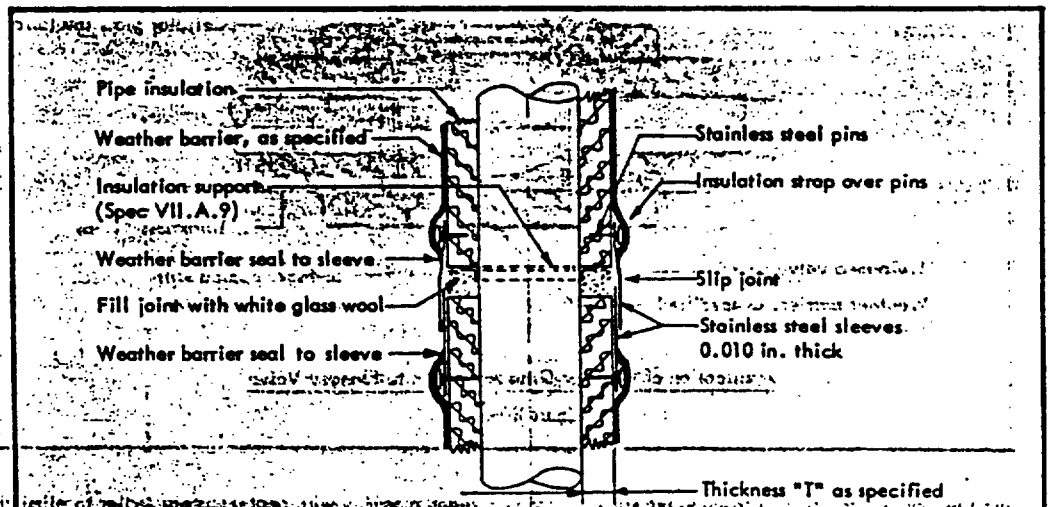
2. PIPING - contd.

c. 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 Joint to Cellular Glass Insulation on Vertical Piping

Figure 10-J-16

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

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:

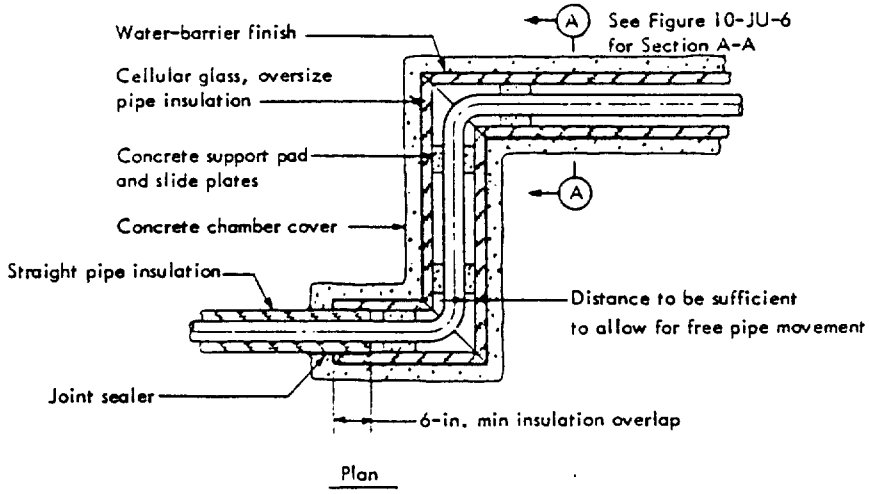
(1) Weather barrier consisting of stainless steel jacketing, where required, shall be called for by the addition of the letter M to the specification designation, thus 10-JM or 10-JSSM.

(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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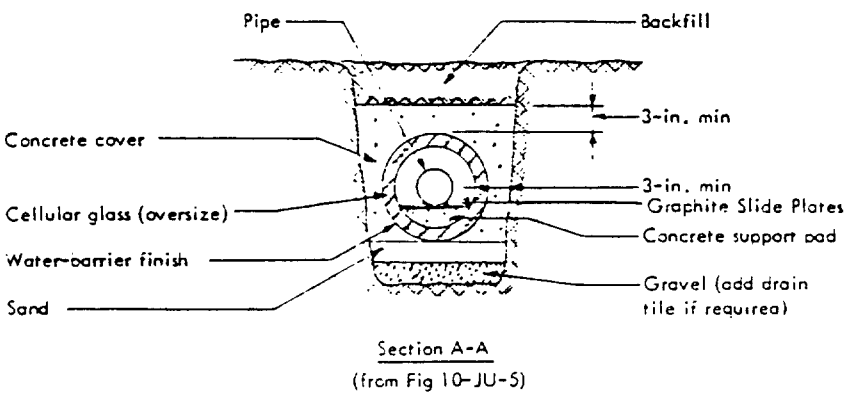
SECTION 8 - APPLICATION - contd

3. EXPANSION CHAMBERS - contd



Expansion Chamber for Elbows and Expansion Loops

Figure 10-JU-5



Expansion Loop Cross Section with Installation Completed

Figure 10-JU-6

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SECTION B - APPLICATION - contd

3. EXPANSION CHAMBERS - contd

b. Finish Application. The expansion chamber shall be given the same water-barrier finish as specified for straight piping.

c. 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 trench must be deeper where expansion chambers are to be installed so as to compensate for increased diameter of oversize pipe insulation of which the chamber is constructed.

(2) Expansion chamber shall then be encased in concrete which shall be not less than 3 inches thick on top and sides, as shown in Figure 10-JU-6

d. Backfill. Backfill over expansion chamber concrete cover may be of any available fill material.

4. TRACED INSTALLATIONS

Tracing and insulation on traced lines shall be installed as specified in Part XIII of the GENERAL SPECIFICATIONS.

5. SPECIAL NOTE

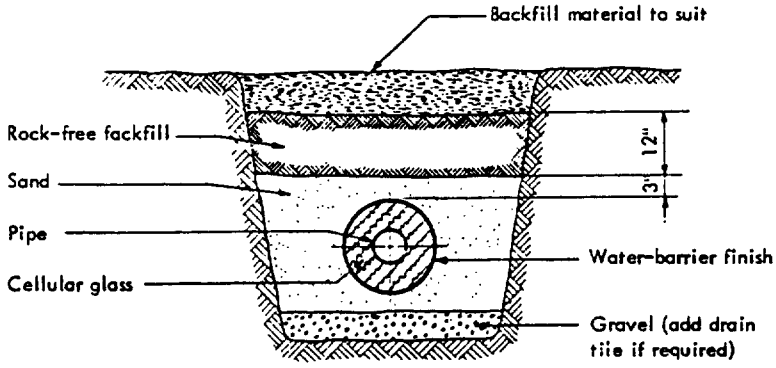
a. Underground piping design shall be such that pipe movement does not exceed the free space allowed by expansion chambers.

b. The pipe shall be anchored as near as possible to the elbow where it rises above ground so that standard elbow insulation can be provided at this location.

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SECTION B - APPLICATION - contd

2. PIPING - contd



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 directic at elbows.

(2) Expansion chambers shall be prefabricated of cellular glass pipe insulation of specified thickness for straight pipe, but not less than 2 inc 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 inside diameter shall be increased to allow for free movement wi in the chamber.

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

(5) Concrete pad supports molded to fit inside the bottom of the expansion chamber insulation shall support the bare pipe and permit free mov ment of the pipe inside the expansion chamber. A table for determining length and spacing of these concrete support pads is given in Figure 10-JU-3.

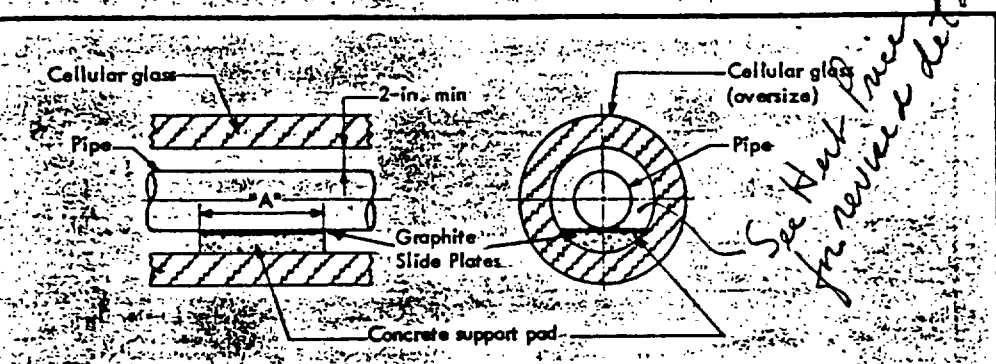
(6) Details of expansion chamber at lead-off lines are shown in Figure 10-JU-4.

(7) Details of expansion chamber for elbows or expansion loops are shown in Figures 10-JU-5 and 10-JU-6.

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SECTION B - APPLICATION - contd

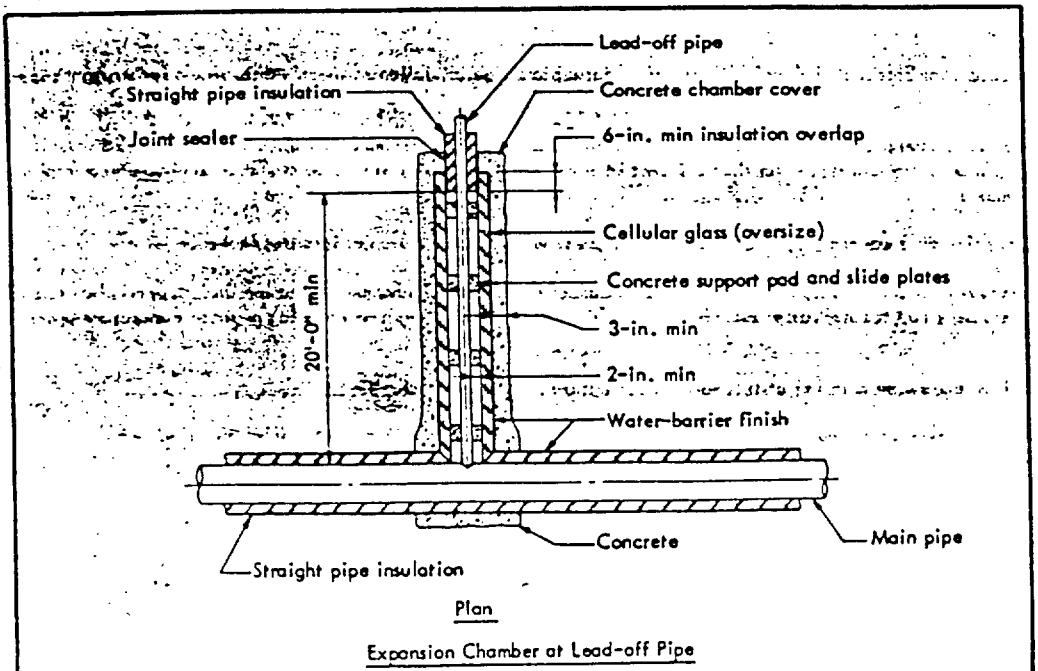
3. EXPANSION CHAMBERS - contd



Nominal Pipe Size (Inches)	Length of Concrete Pad Dim "A" (Inches)	Max C-to-C Spacing (feet)
3 and smaller	6	8
4	6	5
5	12	8
6	12	6
8	12	4
10	12	3
12	Continuous	—

Size and Spacing of Concrete Support Pads

Figure 10-JU-3



Plan

Expansion Chamber at Lead-off Pipe

Figure 10-JU-4

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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 a 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.
Pipe Insulation Strap	VII. A. 13	Joint Sealer	VII. A.
Clips for Pipe Strap	VII. A. 14	Reinforcing Cloth	VII. A.
Anti-Abrasive Coating (for stainless steel)	VII. A. 40	Water-Barrier Coating	VII. A.
Anti-Abrasive Coating	VII. A. 39	Graphite Pipe Slides For Support Pads	STD. P-
Concrete Support Pad (Field Poured)			

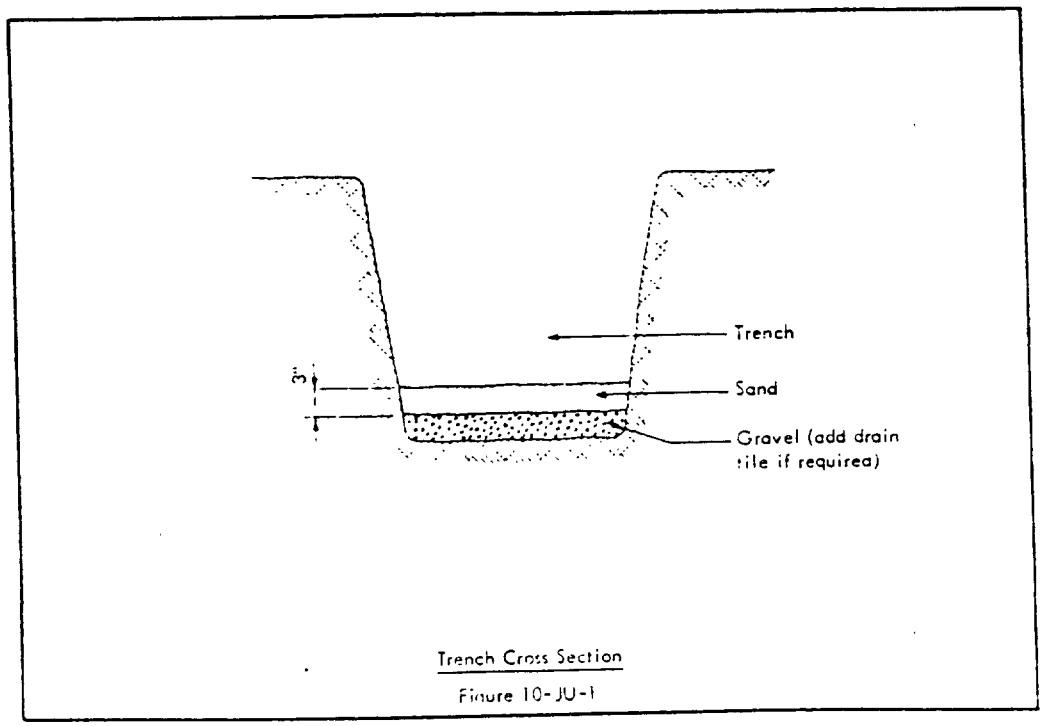
SECTION B - APPLICATION

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 Fi 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

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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.

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THERMAL INSULATION APPLICATION SPECIFICATIONS

CELLULAR GLASS

Never use aluminum jacketing

SCOPE

This specification describes the essential requirements for application of shaped cellular glass insulation for use on equipment and piping normally operatin 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 ser

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

Cushioning Material:		Strap Anchor Clip	VII.A.24
Equipment Operating Above 400 F	VII.A. 1	Strapping Tape	VII.A.33
Equipment Operating at 400 F and Below	VII.A. 2	Fabricating Cement	VII.A.36
Pipe Insulation Support	VII.A. 9	Vinyl Asphalt Joint Sealer	VII.A.43
Equipment Insulation Strap	VII.A.11	Mastic	VII.A.45
Clips for Equipment Strap	VII.A.12	Lap Sealer	VII.A.46
Pipe Insulation Strap	VII.A.13	Curved Wood Block Isolation Supports	VII.A.87
Clips for Pipe Strap	VII.A.14	Non-Setting Sealer	VII.A.88
Stainless Steel Wire	VII.A.17	Weather-Barrier Mastic (Color as Specified)	VII.B.1.a
Welding Pins	VII.A.19	Reinforcing Cloth	VII.B.1.b
Stainless Steel Skewers	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 in 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.43

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

c. Cushioning Blanket

(1) On all equipment operating below 400 F, except stainless steel, a 1-inch thick cushioning blanket shall be applied over the entire surface, and compressed to 1/2-inch 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 insulation thickness for thermal design. Insulation Schedule shall state total thickness of cushioning blanket and insulation.

(2) On all equipment operating above 400 F, except stainless steel, a 1/2-inch thick white glass wool cushioning blanket shall be applied over entire surface, and secured in the same manner as that specified in Paragraph (1) above.

(3) On all stainless steel equipment, a 1/2-inch thick white glass wool cushioning blanket, as specified for stainless steel, shall be applied over entire surface, and secured in the same manner as that specified in Paragraph (1) above.

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SECTION B – APPLICATION – contd

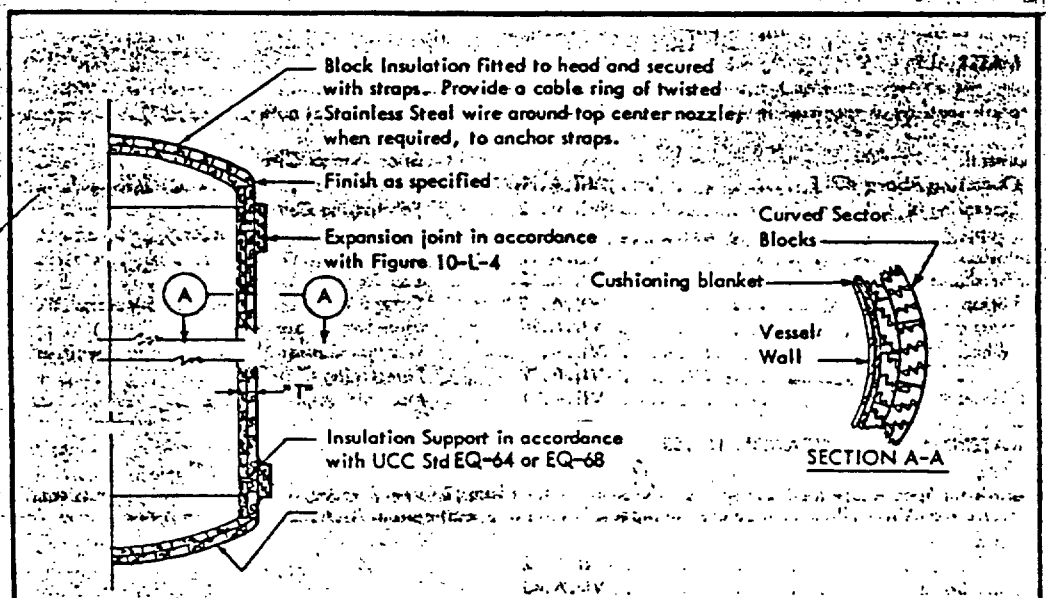
1. EQUIPMENT – contd

d. Curved Surfaces

(1) Cellular glass block insulation shall be shop fabricated and fitted to allow a ½-inch space for cushioning blanket between block and vessel. Block insulation shall be applied over cushioning material on all equipment, with all joints tightly butted. Multiple layers of insulation shall be applied so that the butt joints of one layer do not coincide with those of any other layers.

(2) All butt edges and ends of both layers (or single layer) of formed insulation shall be sealed with a buttered coat of the specified joint sealer. This coating shall be of sufficient thickness to provide proper adhesion, seal, and cushion between the individual pieces of insulation. Typical installation is shown in Figure 10-L-1.

Do not butter joint on inner layer



Application of Cellular Glass Insulation to Vessel Shell and Heads

Figure ~~10-L-1~~ AP3-1

e. 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 strap. Where required, insulation strap shall be attached to strap anchor angles in accordance with Owner's Standard EQ-64. Insulation applied to irregular surfaces, where use of insulation strap is impracticable, shall be secured with stainless steel wire attached to welding pins, drawn taut, and ends twisted together and pressed into insulation.

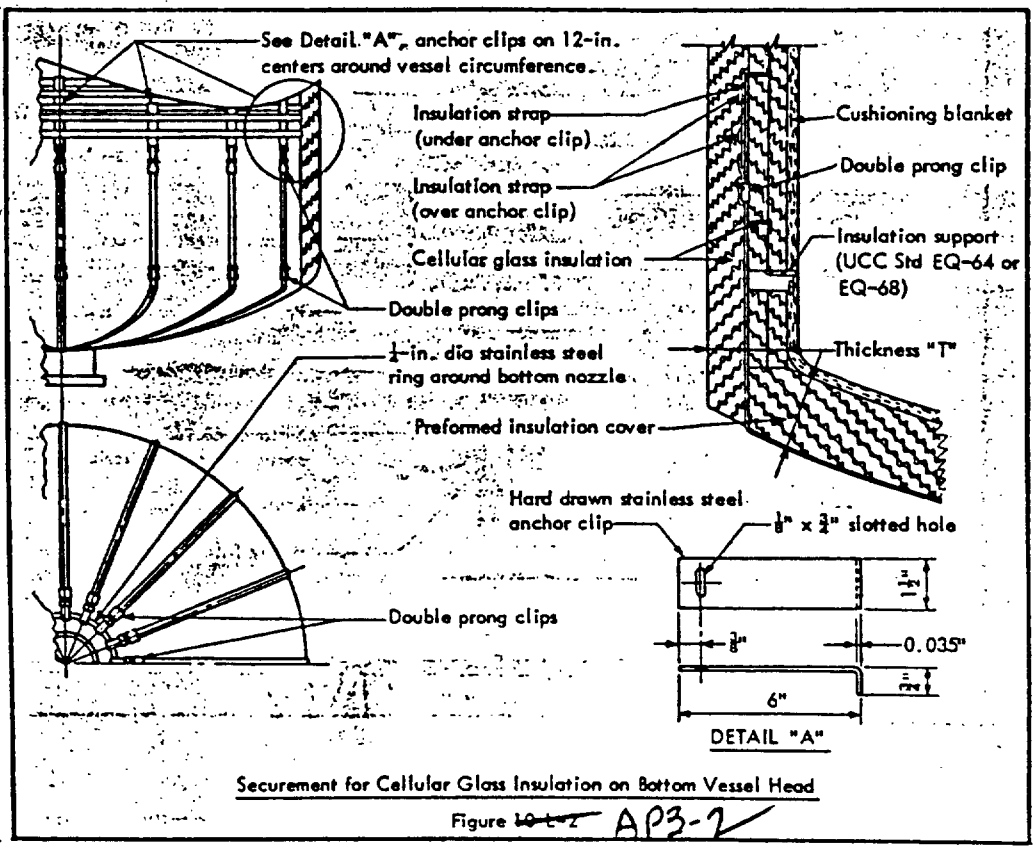
(2) Inner layer or layers of cellular glass insulation of bottom heads of vertical equipment, or heads of horizontal equipment, shall be held in place with stainless steel insulation strap secured to insulation supports, as shown in Owner's Standards EQ-64, EQ-65, EQ-68 and EQ-69. Outer layer of cellular glass insulation on bottom heads of vertical equipment, or heads of horizontal equipment, shall be secured with insulation strap, as shown in Figure 10-L-2.

(3) Where specified, block shall be applied directly to metal surfaces, such as ductwork, with adhesive or other approved securement. Where block is specified to be secured with adhesive, it shall be embedded firmly in a surface coat.

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SECTION B – APPLICATION – contd

1. EQUIPMENT – contd



Securement for Cellular Glass Insulation on Bottom Vessel Head

Figure ~~10-L-2~~ AP3-2

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.

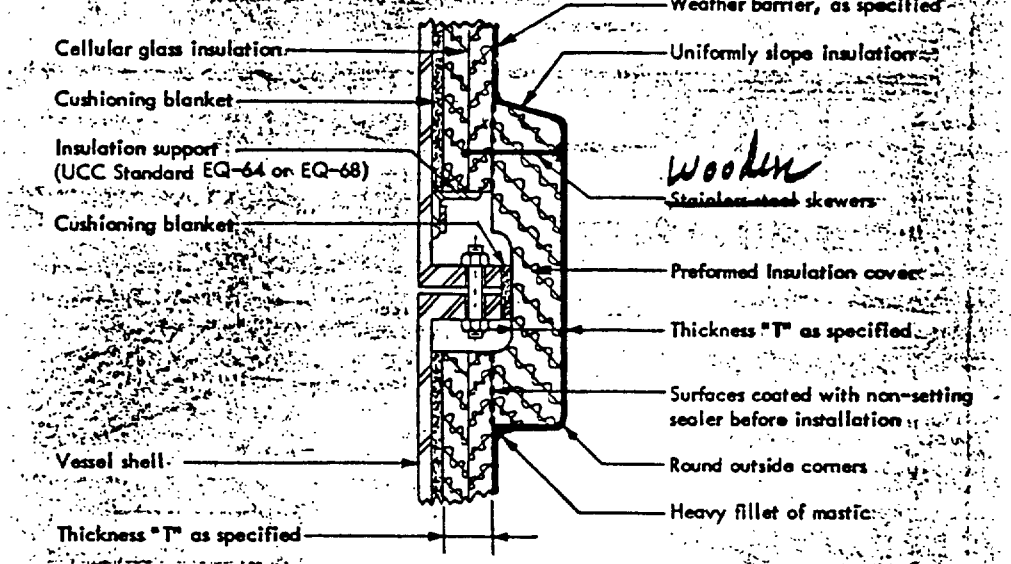
(2) Longitudinal expansion and contraction of vessels shall be provided for by installing expansion-contraction joints at the insulation suppor as shown in Figure 10-L-4. Where more than one thickness of insulation is specified for a vessel, an insulation support shall be provided at th junction of two different thicknesses, and insulated in a manner similar to that shown in Figure 10-L-4. Lap sealer shall be applied to surface 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-5. Where movement is likely to occur, non-setting sealer shall be applied to surfaces of insulation to provide proper slip joint.

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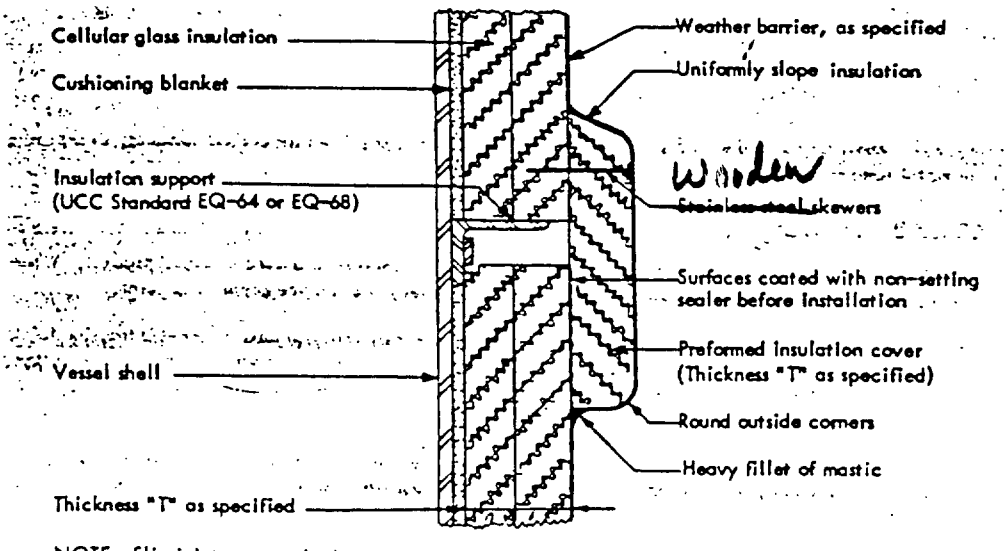
SECTION B – APPLICATION – contd

1. EQUIPMENT – contd



Application of Cellular Glass Insulation to Expansion and Contraction Joint at Vessel Flange

Figure ~~10-L-3~~ AP3-3



NOTE: Slip joint not required at support directly above the bottom head.

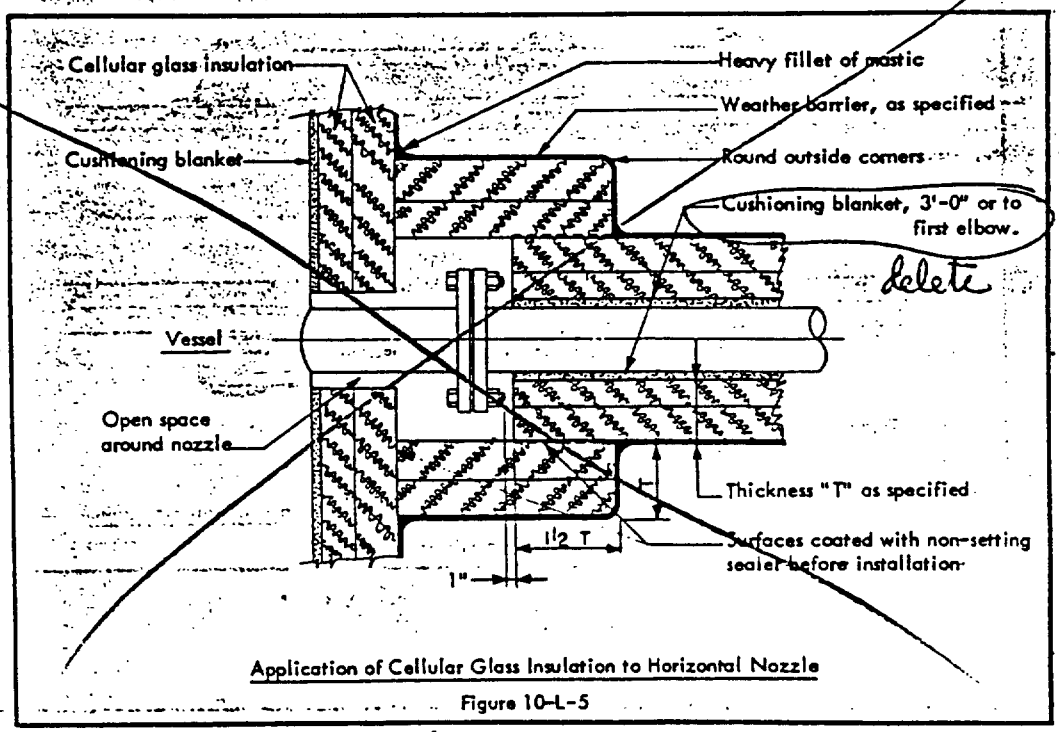
Application of Cellular Glass Insulation to Expansion and Contraction Joint at Insulation Supports

Figure ~~10-L-4~~ AP3-4

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SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Cellular Glass Insulation to Horizontal Nozzle

Figure 10-L-5

Eliminate this figure

Put under pipe

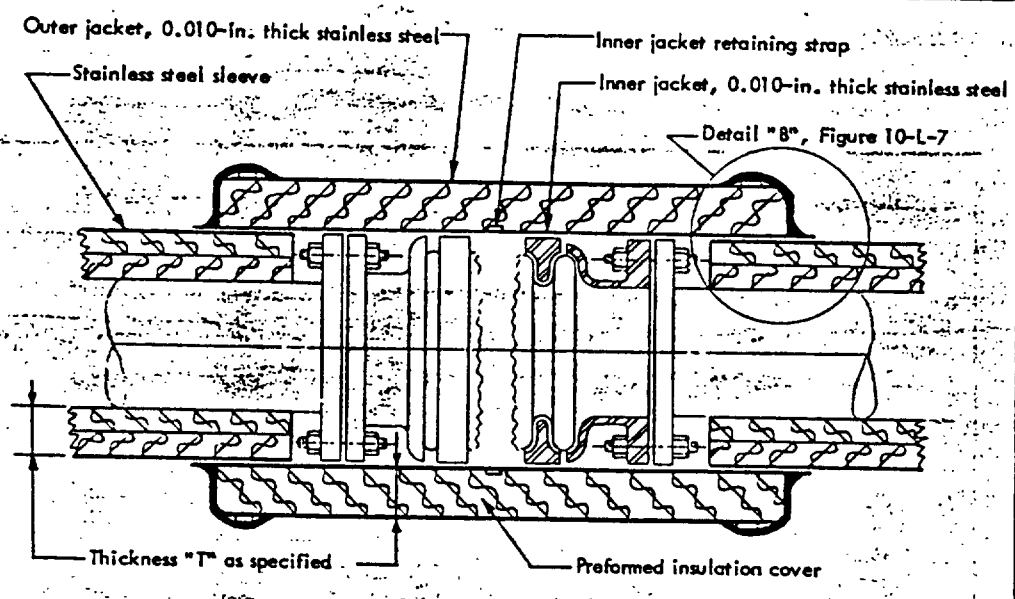
h. Mechanical Expansion Joints. Corrugated mechanical expansion joints in piping (usually listed as equipment items) shall be insulated as shown in Figures 10-L-6 and 10-L-7. A slip joint shall be provided at both ends of the corrugated item when horizontally installed in piping. Apply a stainless steel 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 × "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 × "T" 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 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 securely fastened to the pipe covering.

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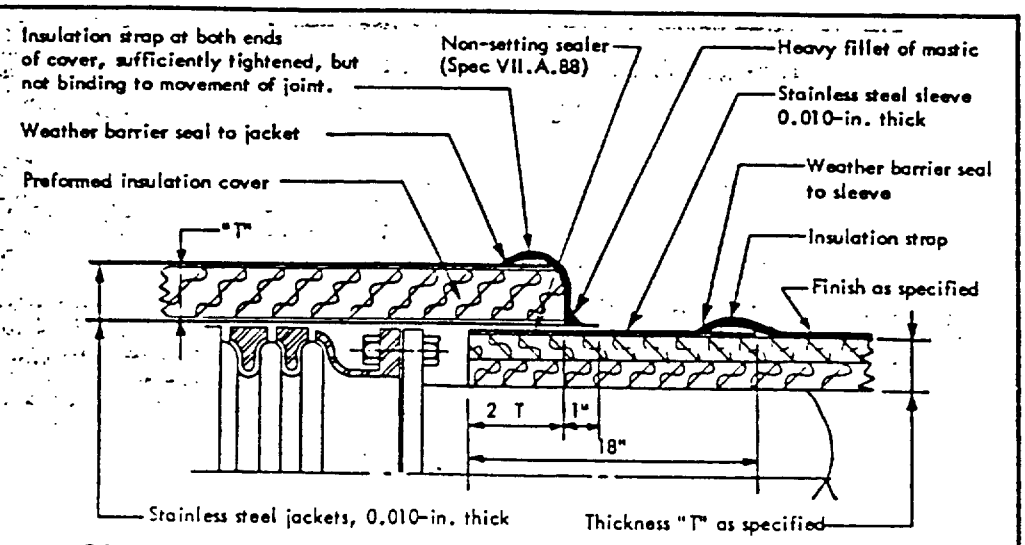
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Cellular Glass Insulation to Mechanical Expansion and Contraction Joint

Figure 10-L-6



Detail "B"

(Slip Joint Detail for Figure 10-L-6)

Figure ~~10-L-7~~ ABM/11

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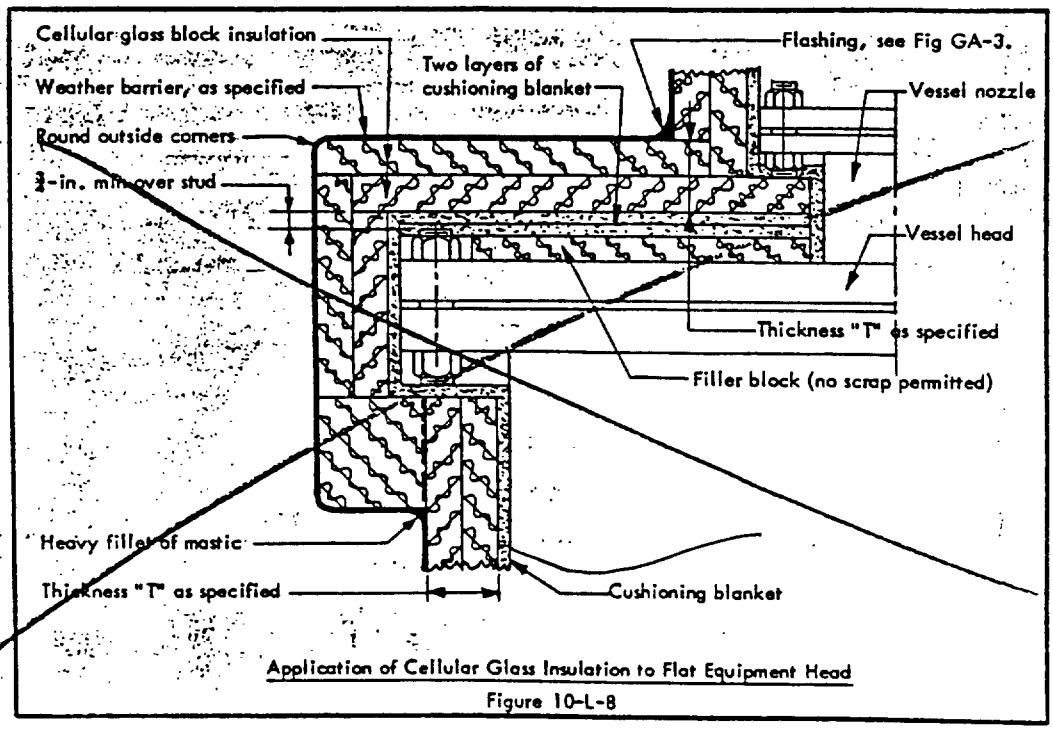
SECTION B – APPLICATION – contd

1. EQUIPMENT – contd

f. 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. Wate pockets shall be eliminated and proper drainage provided as shown in Figure 10-L-8.

(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

(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 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.

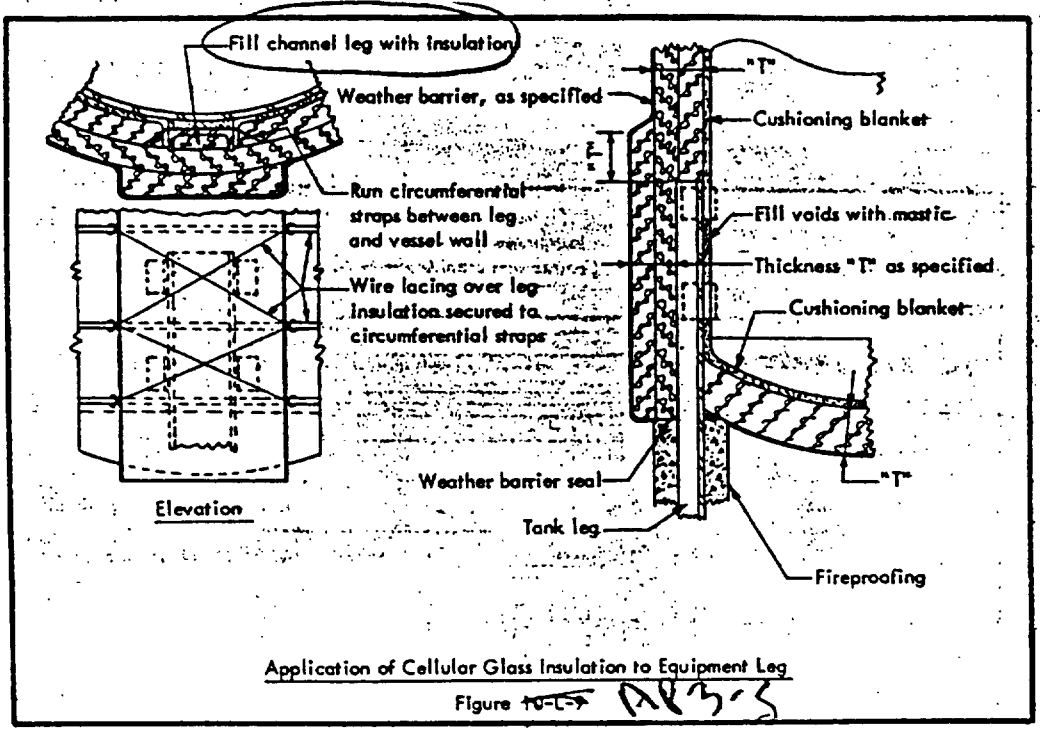
(3) Reentrant space between channel flanges shall be filled with block cemented in place with the specified adhesive cement. Surface of fire-resistant material abutting tank leg insulation shall be coated with weather-barrier coating. Insulation shall be as shown in Figure 10-L-9.

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SECTION B – APPLICATION – contd

1. EQUIPMENT – contd

Do not fill leg



Application of Cellular Glass Insulation to Equipment Leg

Figure ~~10-L-9~~ AP3-5

k. Vessel Skirts. Skirts supporting vertical equipment shall be insulated inside and outside. Insulation shall extend downward, from junction of inside of skirt 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 skirts shall be as specified for body of vessel, but not less than 2 inches. Insulation material shall be secured to inside of skirt with with adhesive cement. Support for inside skirt insulation and bottom head insulation shall be in accordance with Owner's Standard EQ-64 or EQ-70. Installation shall be as shown in Figure 10-L-10.

l. Equipment Supports

(1) Where equipment is supported on cradles, vessel insulation shall extend over cradles as shown in Figure 10-L-11.

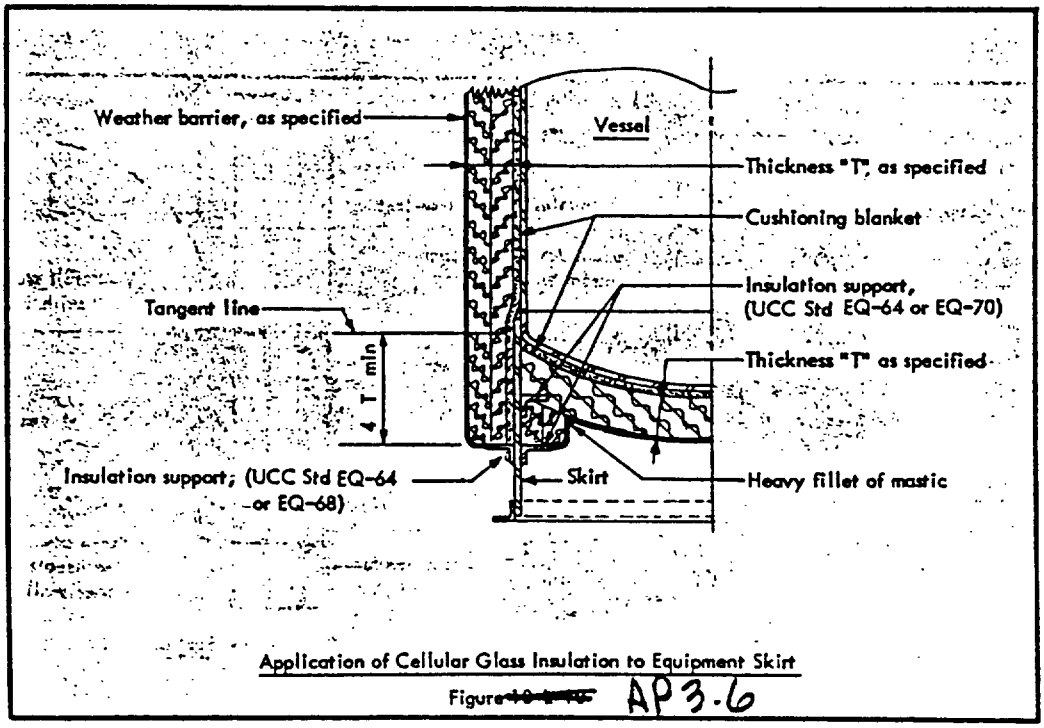
(2) Where equipment is supported by structural steel members, insulation shall extend not less than four times the specified insulation thickness in each direction, measured from junction of vessel with insulated support lug. Thickness of insulation over steel supports shall be not less than 1/2 that 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-L-12.

m. Weather-Barrier Coating. Weather-barrier coating shall be applied as specified in Article XIV.8 of the GENERAL SPECIFICATIONS.

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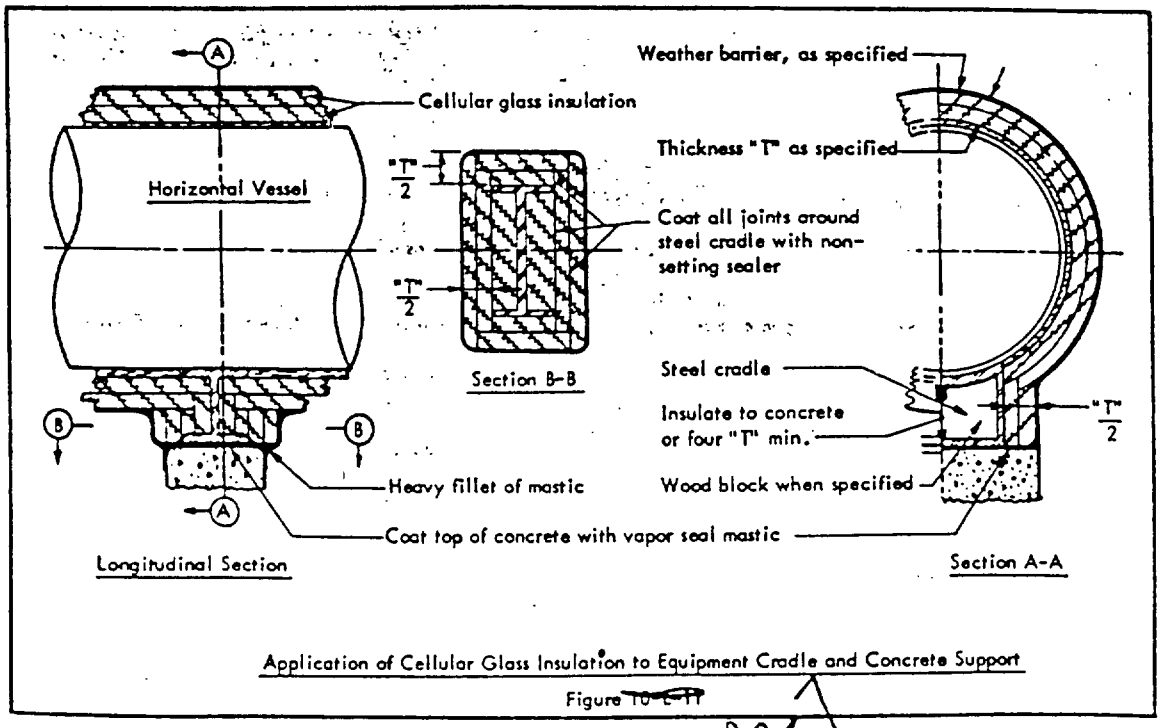
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Cellular Glass Insulation to Equipment Skirt

Figure ~~10-L-10~~ AP3.6



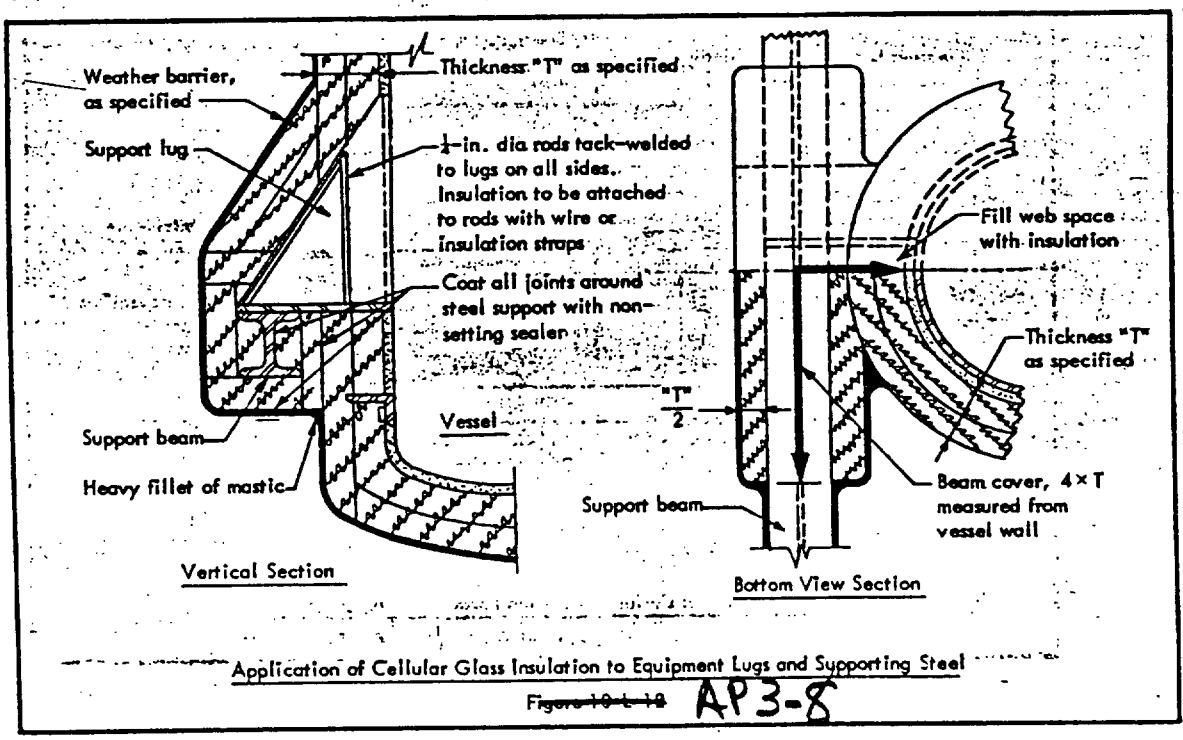
Application of Cellular Glass Insulation to Equipment Cradle and Concrete Support

Figure ~~10-L-11~~

AP3.7

SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Cellular Glass Insulation to Equipment Lugs and Supporting Steel

~~Figure 10-L-18~~ AP3-8

2. 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 tightly butted and fitted, 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.

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SECTION B - APPLICATION - contd.

2. PIPING - contd

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, using hot (180 F) asphalt as a fabricating cement.

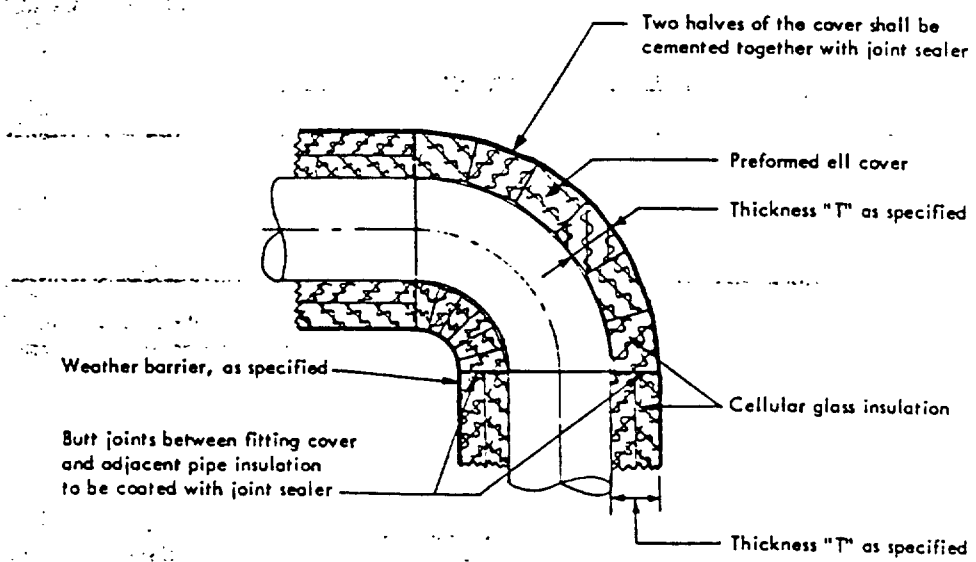
(2) Welded fitting covers shall be fabricated to fit snugly on the pipe. The two halves of the cover shall be cemented together with joint sealer. The adjacent pipe insulation shall be fitted tightly to the butt ends of the fitting cover and sealed as specified for piping. Typical fitting covers are 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 assembly 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 shop assemblies shall be done with hot (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 voids, or holes plugged with asphalt, be permitted.



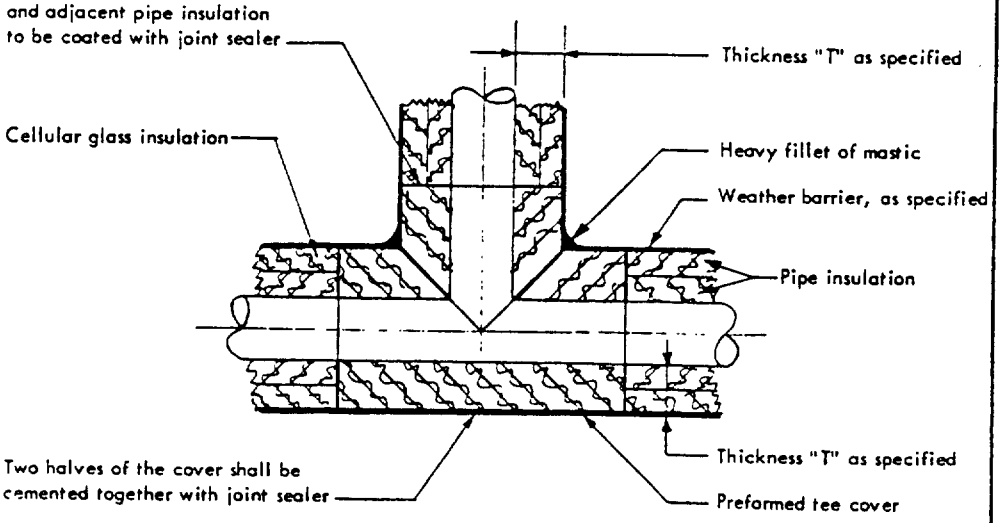
Application of Cellular Glass Insulation to Welded Ell

Figure ~~10-L-13~~ AP3.10

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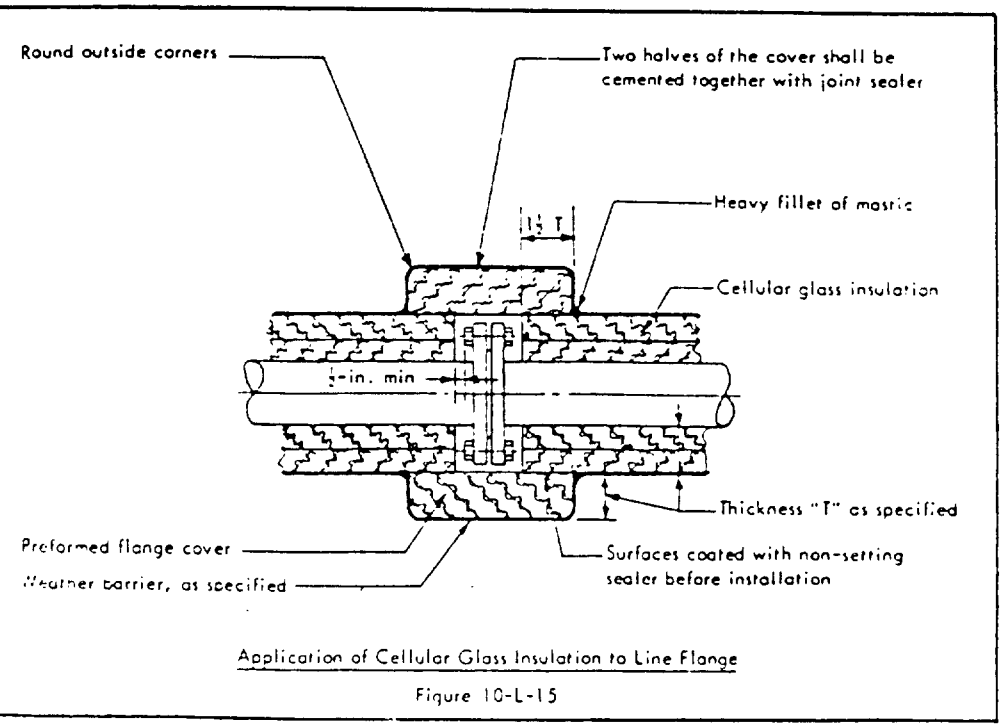
SECTION B – APPLICATION – contd

2. PIPING – contd



Application of Cellular Glass Insulation to Welded Tee

Figure 10-L-14



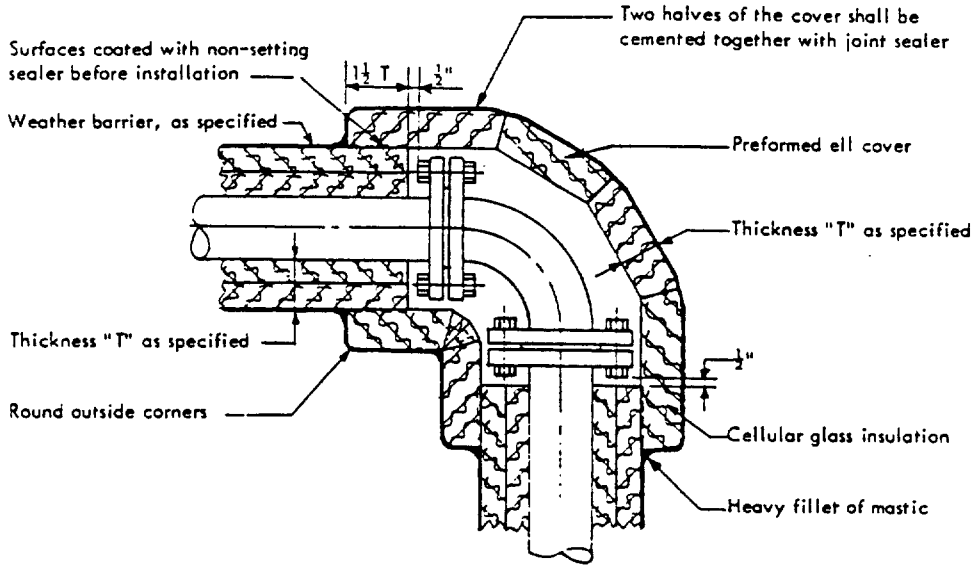
Application of Cellular Glass Insulation to Line Flange

Figure 10-L-15

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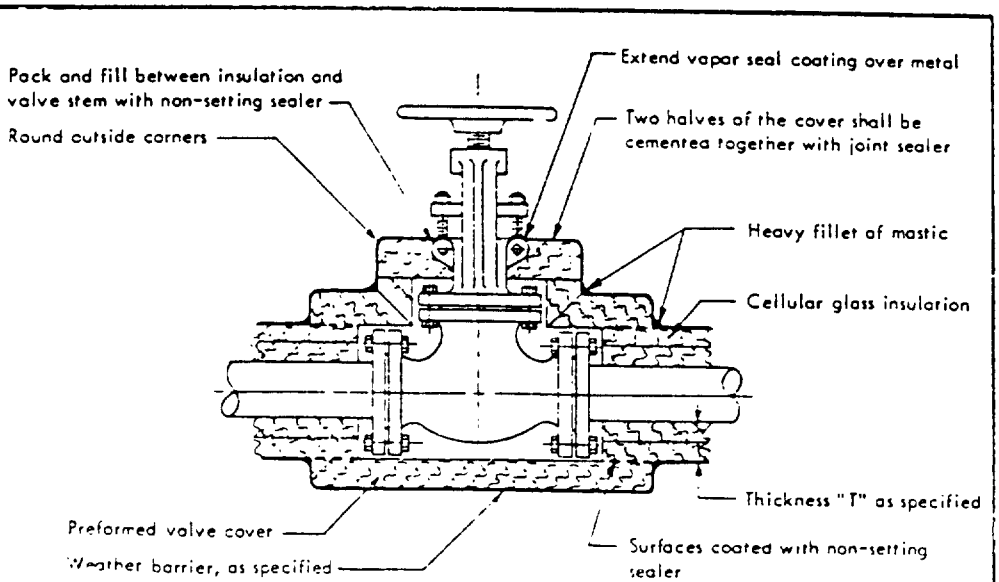
SECTION B - APPLICATION - contd

2. PIPING - contd



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 – contd

2. PIPING – contd

c. Securement

(1) All outer layers of cellular glass pipe insulation larger than 4-1/2 inches in outside diameter shall be secured with insulation strap.

(2) All inner layers, and outer layers 4-1/2 inches and less in outside diameter, shall be secured with strapping tape. Use tape up to 9 5/8"

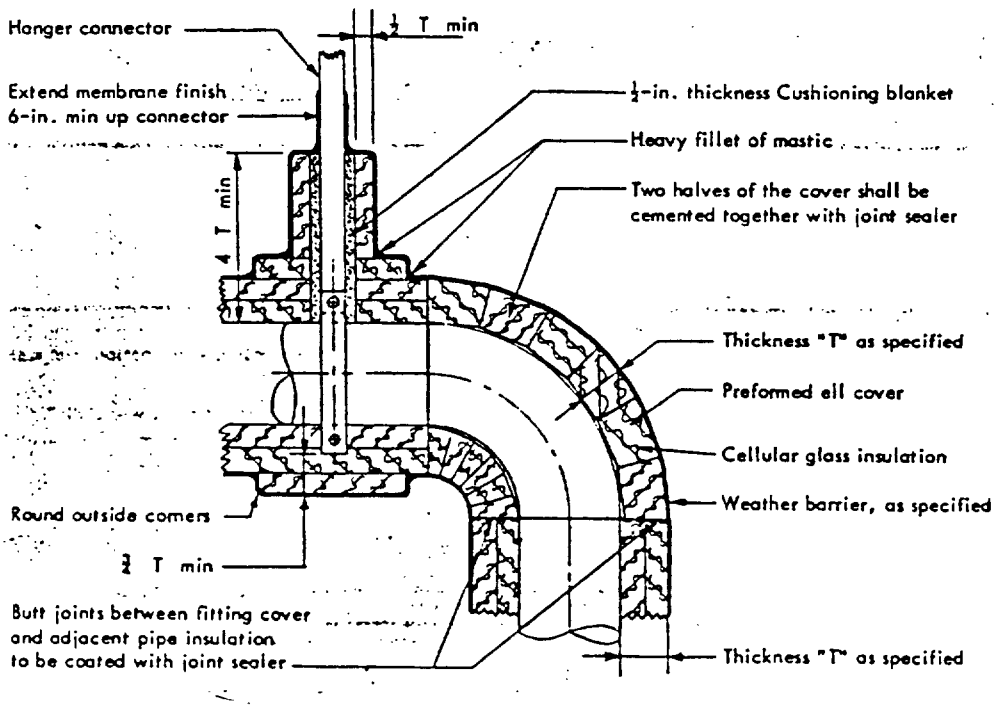
(3) Use and location of strap and tape shall be as specified in Articles III.C and III.D of the GENERAL SPECIFICATIONS.

d. Supports and Hangers

(1) Where horizontal low temperature piping is supported on the outside of insulation surfaces, in accordance with Owner's Standard P-82, insulation shall be complete with weather-barrier applied before piping is placed in cradles. Standard P-82 is a guide to the maximum horizontal span of pipe which may be supported on the outside of insulation.

(2) On horizontal tangents at the bottom of all vertical piping where the operating temperature does not exceed 250 F, and where the tangents are supported on the outside of insulated surfaces in accordance with Standard P-82, the insulation between cradle and pipe shall be the specified treated wood cradles.

(3) 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

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SECTION B – APPLICATION – contd

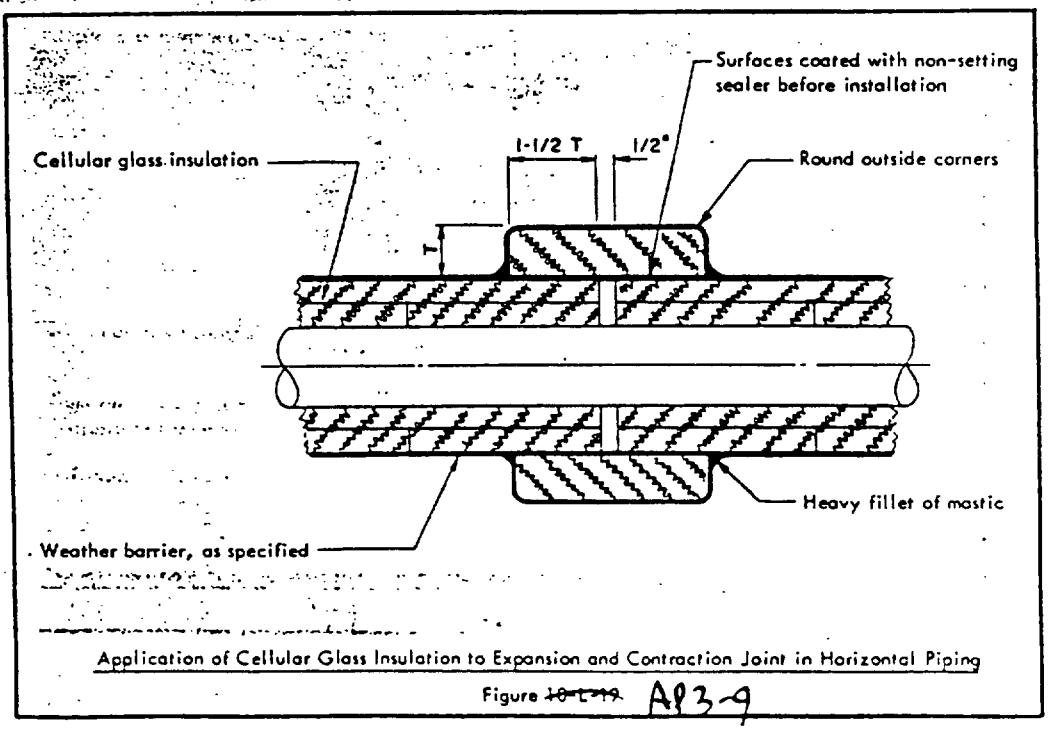
2. PIPING – contd

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 Piping

Figure ~~10-L-19~~ A13-9

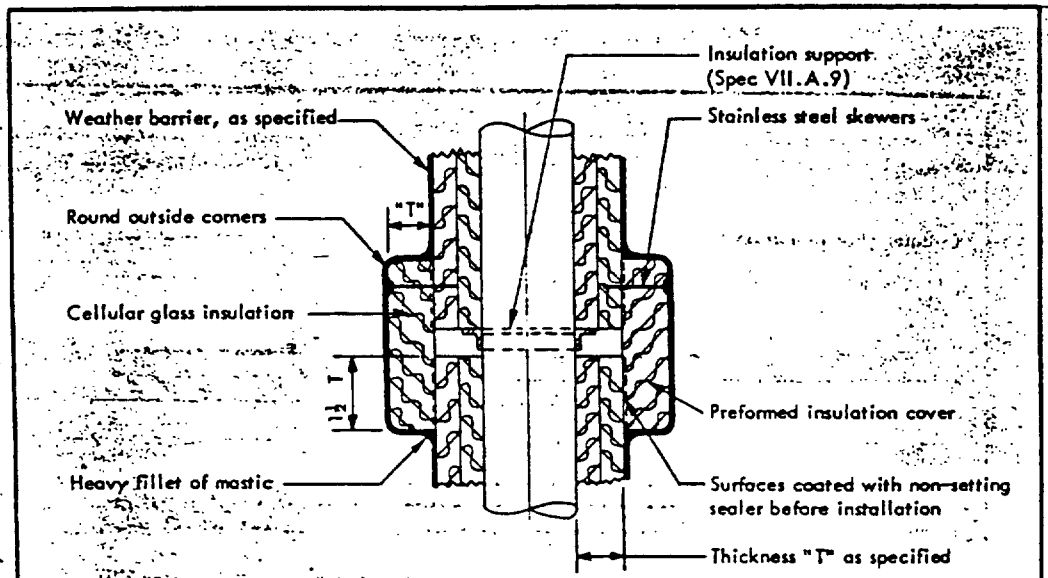
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SECTION B - APPLICATION - contd

2. PIPING - contd

f. Traced Installations. Traced lines, where specified, shall be installed and insulated as specified in Article XIII of the GENERAL SPECIFICATIONS.

g. Weather-Barrier Coating. Weather-barrier coating shall be applied as specified in Article XIV.B of the GENERAL SPECIFICATIONS.



Application of Cellular Glass Insulation to Expansion and Contraction Joint in Vertical Piping

Figure 10-L-20

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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

1. INSULATION MATERIALS

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

2. ACCESSORY MATERIALS

Accessory materials shall be as specified in MATERIALS SPECIFICATIONS article numbers as noted.

Equipment Insulation	VII.A.11	Fireproofing Insulation	Spec. No. 22
Clips For Equipment Strap	VII.A.12	Mastic (caulking)	VII.A.45
Pipe Insulation Strap	VII.A.13	Non Setting Sealer	VII.A.88
Clips for Pipe 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
Vinyl Asphalt Joint Sealer	VII.A.43	Stainless Steel Wire	VII.A.117
Water Sealer	VII.A.116	Expansion Springs	VII.A.15

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 two support rings, one to be added at 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, and Owner's Standard EQ-66. 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 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.

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, stainless straps shall be installed between support rings. These straps shall be installed on 12 inch centers on uppermost support ring. An expansion spring shall be installed in each band. Bands shall be drawn taut but with sufficient expansion still left in the spring that band can be pulled away from vessel for insertion of block.

(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.

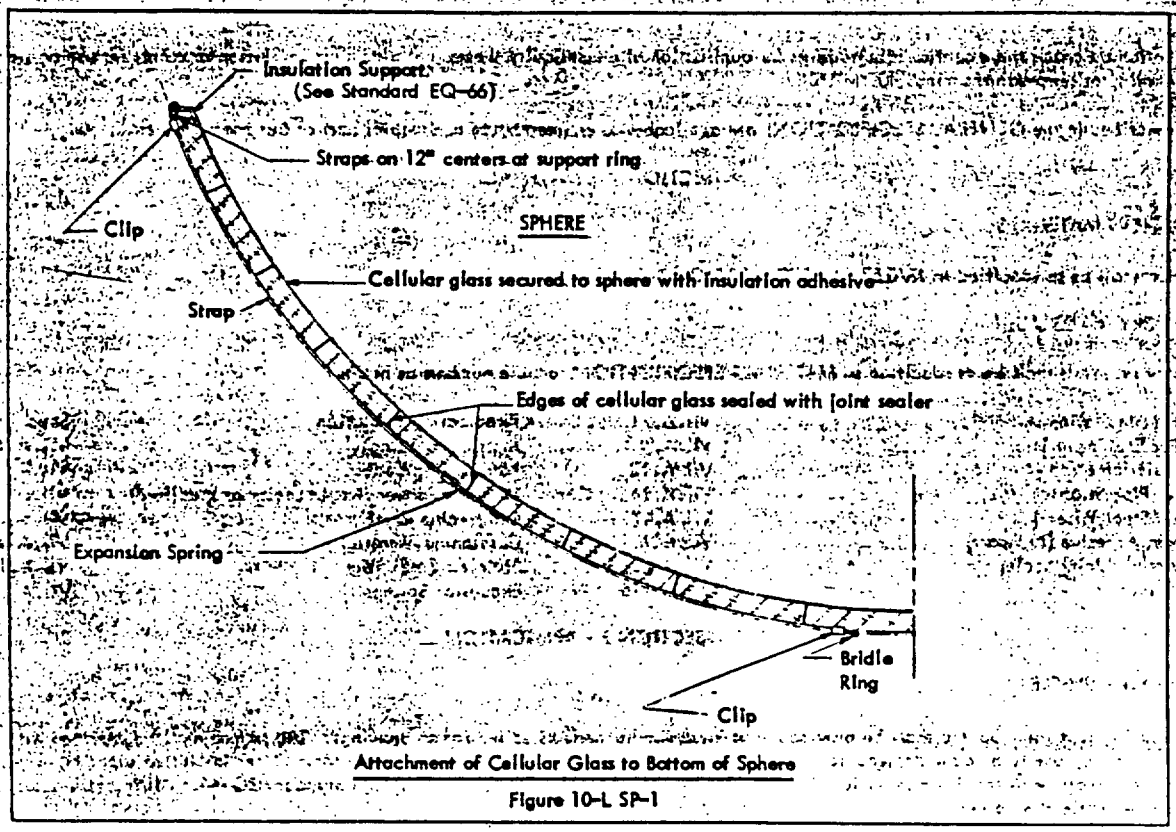
(7) If a second layer of cellular glass is required, a second set of bands shall be installed on bottom of vessel and insulation applied in same manner as specified in (2), (3), (4), (5), and (6) above.

(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 - Contd

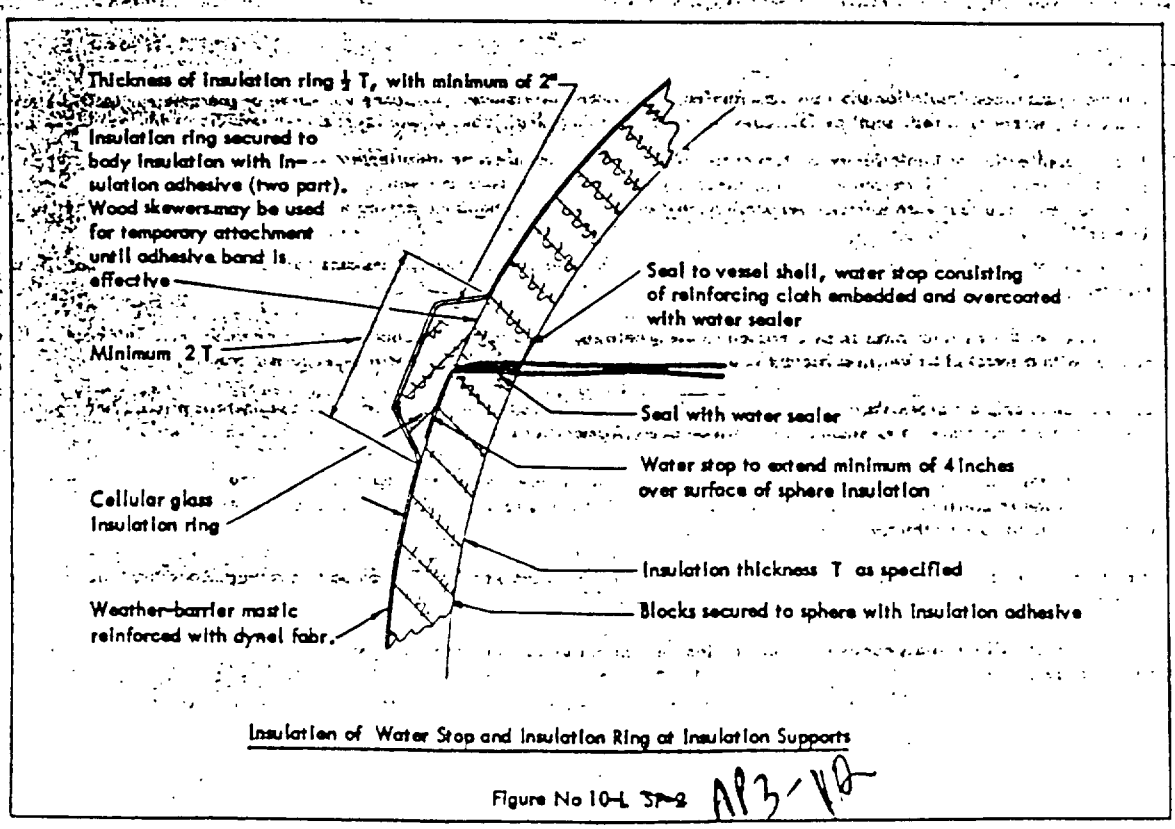
1. EQUIPMENT SPHERE - Contd



Attachment of Cellular Glass to Bottom of Sphere

Figure 10-L SP-1

(9) 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

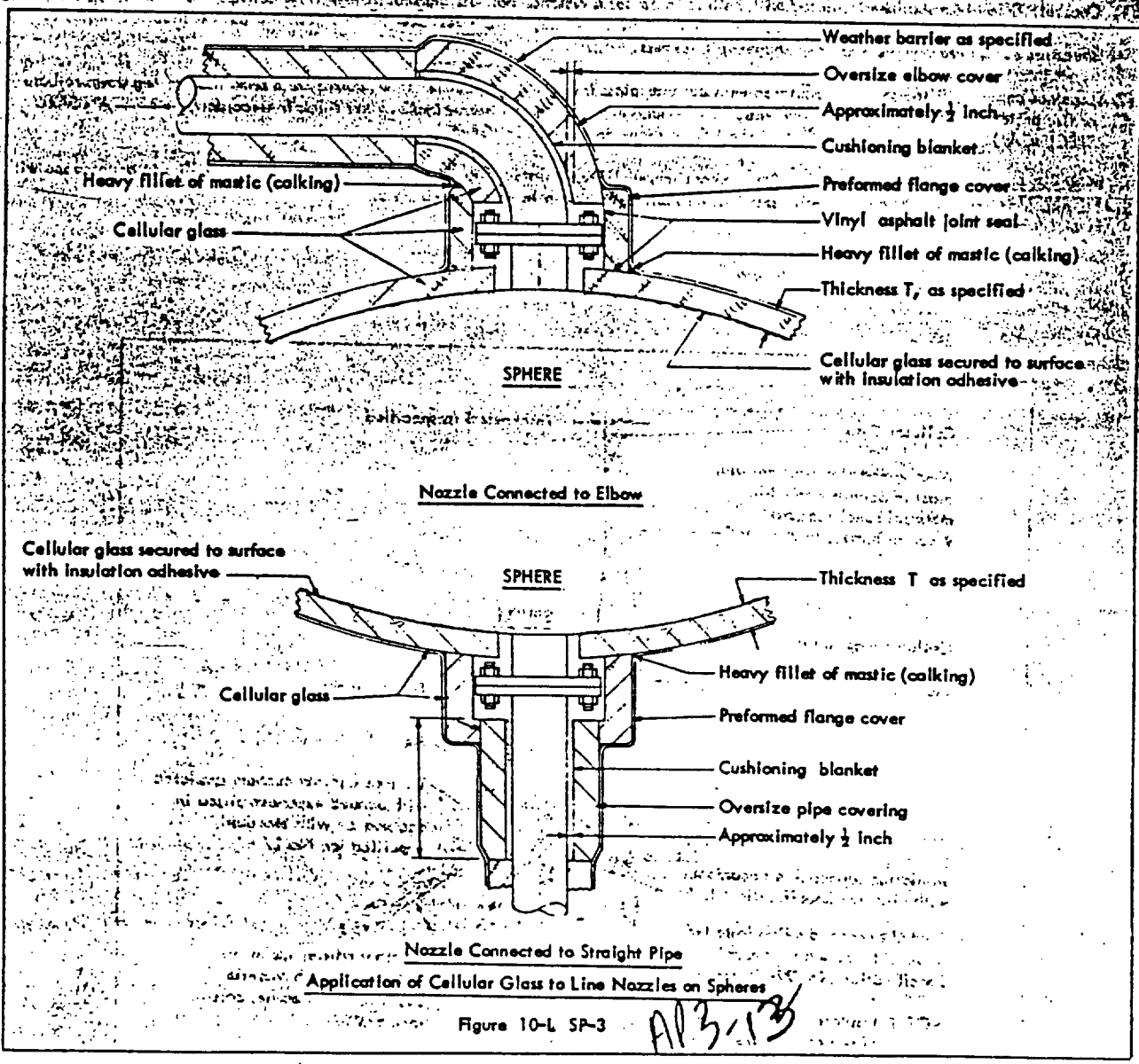
Figure No 10-L SP-2 AP3-16

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SECTION B – APPLICATION – Contd

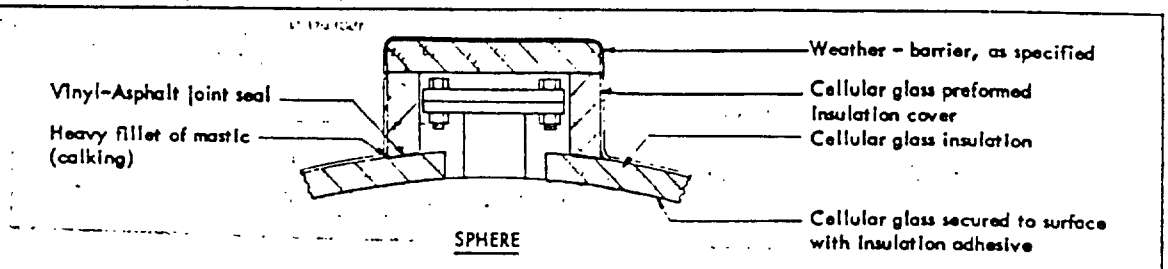
1. EQUIPMENT SPHERE – Contd

e. Vessel Manholes and Line Nozzles. Vessel manhole and nozzles shall be insulated as shown in Figures 10-L SP-3, and 10-L SP-4.



Application of Cellular Glass to Line Nozzles on Spheres

Figure 10-L SP-3 AP3-13



Application of Celular Glass to Manholes and Blind Nozzles

Figure 10-L SP-4 AP3-13

SECTION B – APPLICATION – Contd

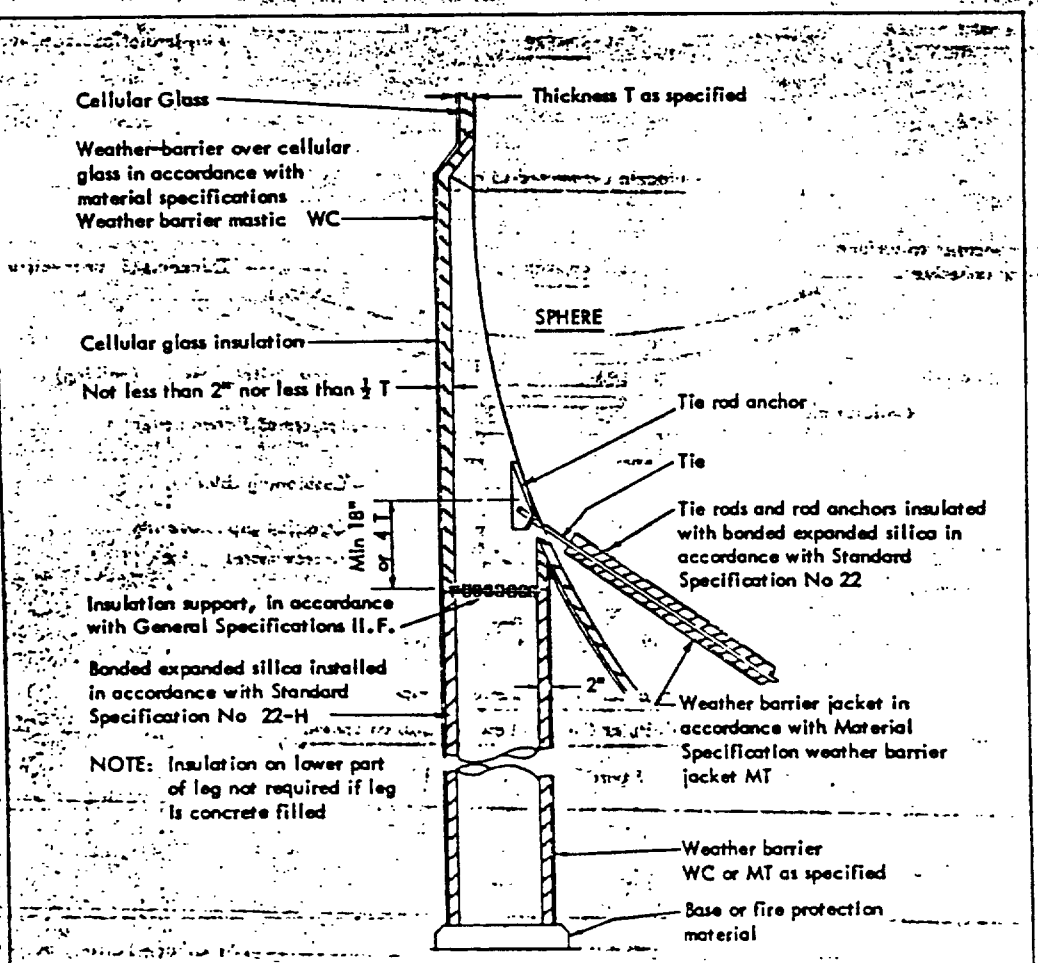
EQUIPMENT SPHERE – Contd

f. 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.

g. 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 Rods

Figure No 10-L SP-5 AP3-18

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SECTION B - APPLICATION - Contd

1. EQUIPMENT SPHERE - Contd

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 serv 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. 1.
Stainless Steel Wire	VII. A. 17	Reinforcing Cloth	VII. B. 1.
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-6 Hercules No. 765-N, or approved equal
Strap Anchor Clip	VII. A. 24	Stainless Steel Skewers	VII. A. 21
Pipe Insulation Support	As shown in Figure 10-OX-18	Welding Pins	VII. A. 19
Anti-Abrasive Coating	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. 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 1-inch thick cushioning blanket shall be applied over the top head and compressed to 1-inch thickn and one 1-inch thick layer to the sides and bottom head and compressed to 1/2-inch thickness, before application of the cellular glass insulat Blanket shall be secured in place with a minimum amount of stainless steel wire. Cellular glass insulation shall then be applied over the blank in the manner described in this specification. Cushioning blanket shall not be considered as part of the insulation thickness for thermal design Insulation Schedule shall state total thickness of cushion blanket and insulation.

(2) On horizontal equipment, one layer of 1-inch thick cushioning blanket shall be applied over the entire surface and compressed to 1/2-inc thickness, and secured in the same manner as that called for in Paragraph (1) above.

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 fabricated and fitted to allow a 1-inch space for cushioning blank 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 applie so that the butt joints of one layer do not coincide with those of any other layer.

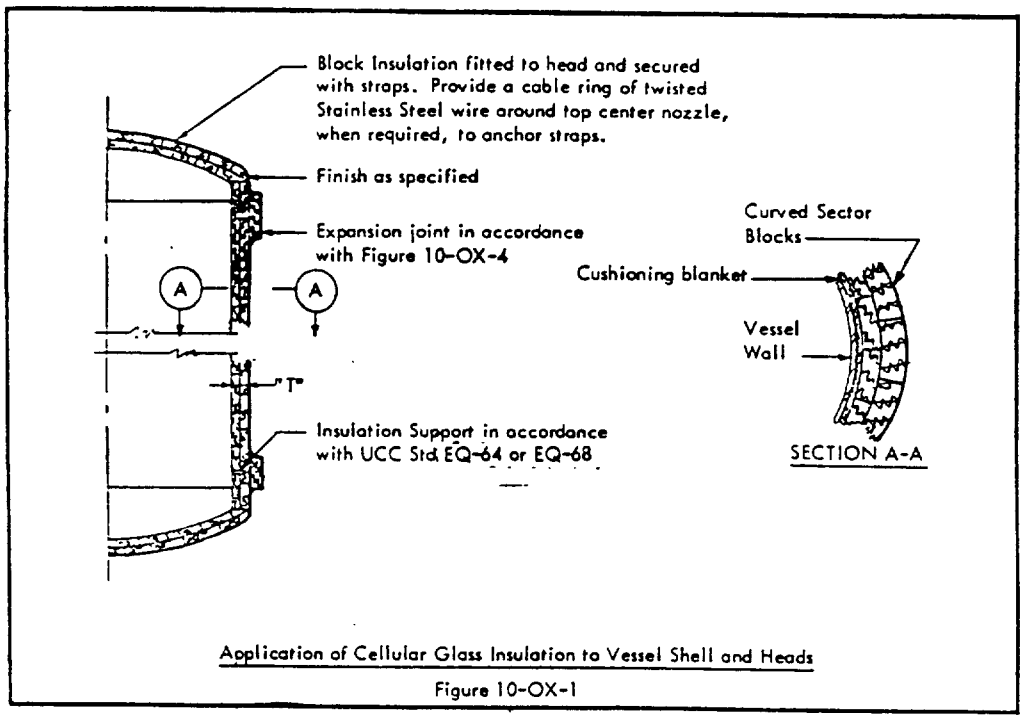
(4) All butt edges and ends of insulation fabricated for inner layer or layers shall be given a smooth brush or spray coat of anti-abrasive coat and allowed to dry for a minimum of 1/2 hour, but preferably 2 hours, before application of insulation to equipment.

(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. This coating shall be of sufficient thickness to provide proper adhesion, seal, and cushion between the individual pieces of insulation Typical installation is shown in Figure 10-OX-1.

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SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Cellular Glass Insulation to Vessel Shell and Heads

Figure 10-OX-1

e. Securement

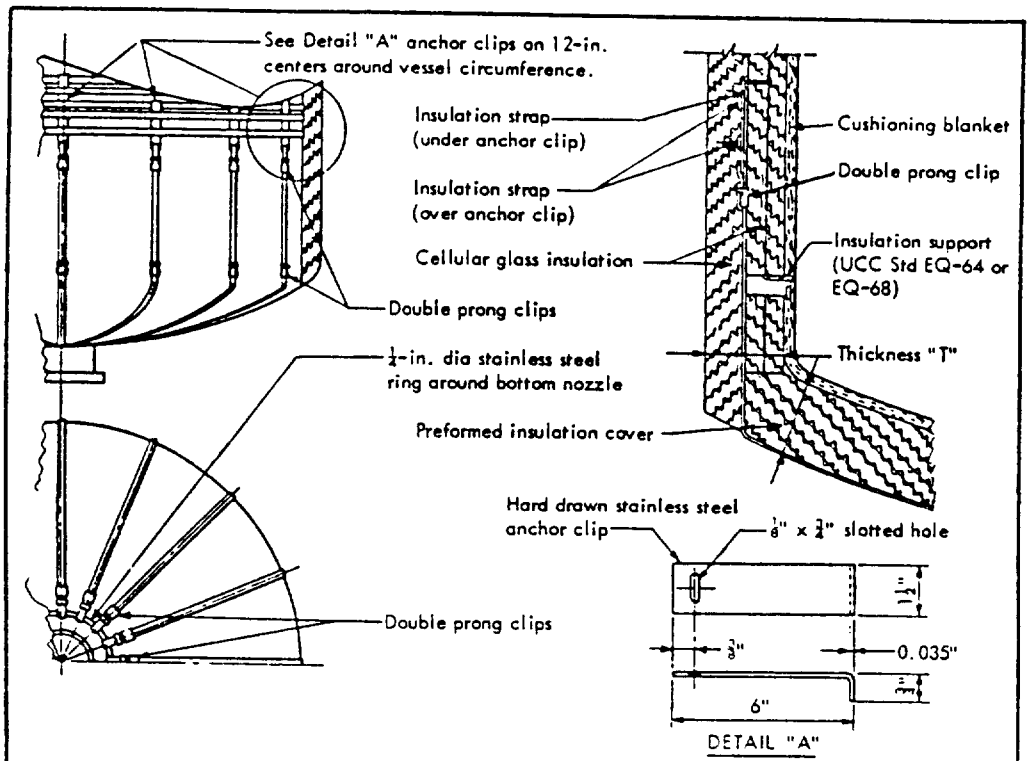
(1) Where contour of vessel permits firm and effective attachment, all layers of cellular glass insulation shall be secured in place with stainless steel insulation strap. Where required, insulation strap shall be attached to strap anchor angles in accordance with Owner's Standard EQ-64, EQ-65, EQ-68 and EQ-69. Insulation applied to irregular surfaces.

(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 stainless steel insulation strap secured to insulation supports, as shown in Owner's Standards EQ-64, EQ-65, EQ-68, EQ-69 or EQ-70. Outer layer of cellular glass insulation on bottom heads of vertical equipment or heads of horizontal equipment shall be secured with insulation strap, as shown in Figure 10-OX-2.

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SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Securement for Cellular Glass Insulation on Bottom Vessel Head

Figure 10-OX-2

f. Flat Surfaces. Block shall be applied to flat surfaces in the same manner as previously specified for curved surfaces.

g. 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.

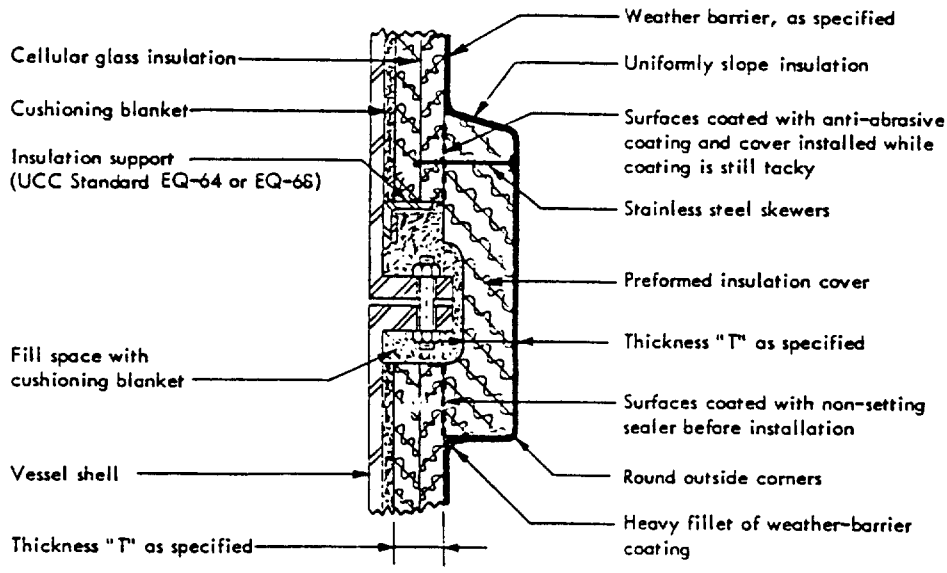
(2) Longitudinal expansion and contraction of vessels shall be provided for by installing expansion-contraction joints at the insulation supports, as shown in Figure 10-OX-4. Where more than one thickness of insulation is specified for a vessel, an insulation support shall be provided at the junction of two different thicknesses, and insulated in a manner similar to that shown in Figure 10-OX-4.

(3) One-inch of 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.

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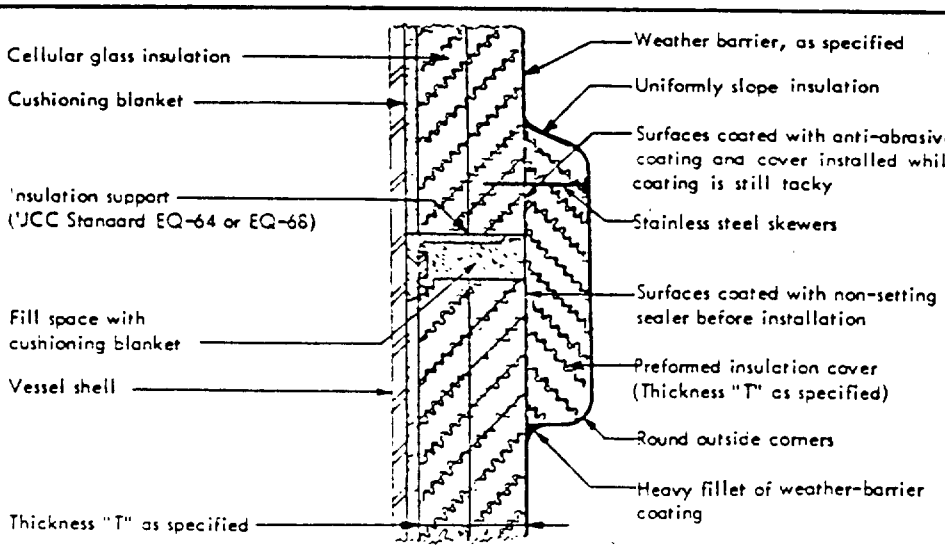
SECTION 8 - APPLICATION - contd

1. EQUIPMENT - contd



Application of Cellular Glass Insulation to Expansion and Contraction Joint at Vessel Flange

Figure 10-OX-3



NOTE: Slip joint not required at support directly above the bottom head.

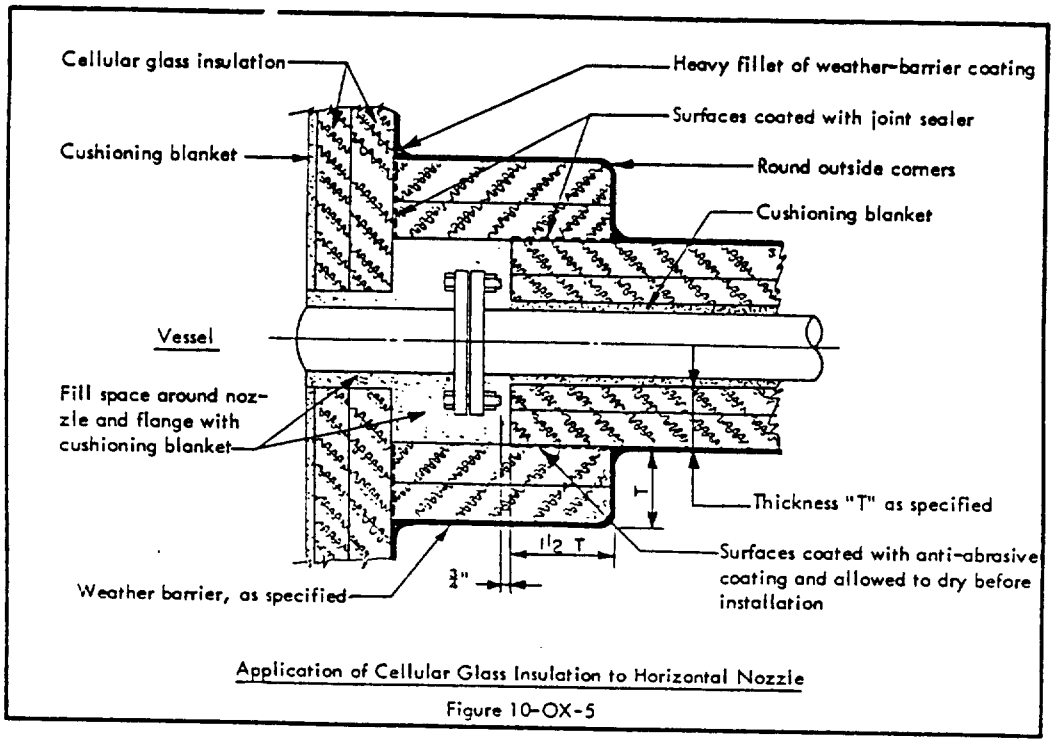
Application of Cellular Glass Insulation to Expansion and Contraction Joint at Insulation Supports

Figure 10-OX-4

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SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Cellular Glass Insulation to Horizontal Nozzle

Figure 10-OX-5

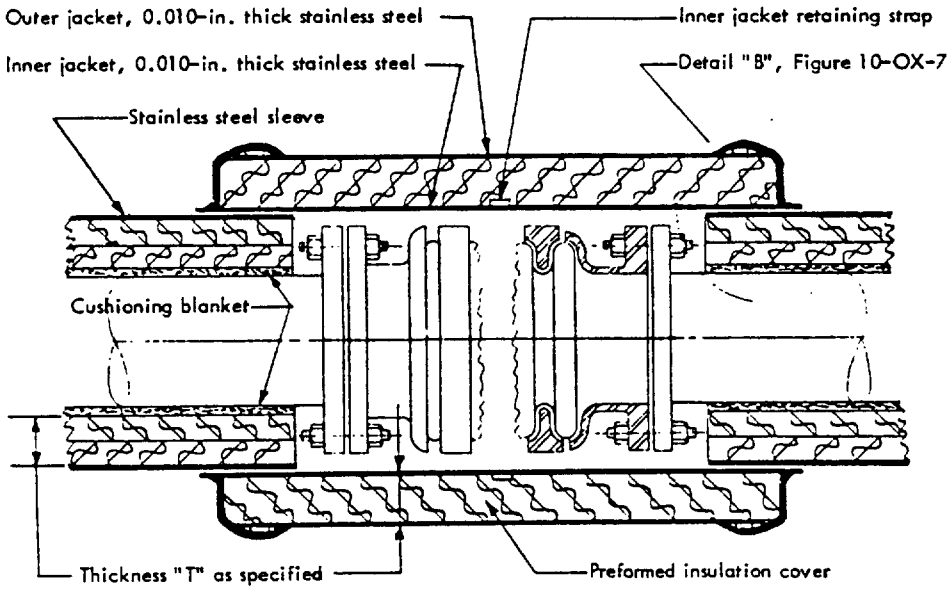
h. Mechanical Expansion Joints. Corrugated mechanical expansion joints in piping (usually listed as equipment items) shall be insulated as shown in Figures 10-OX-5 and 10-OX-7. A slip joint shall be provided at both ends of the corrugated item when horizontally installed in piping. Apply a stainless 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 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 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 securely fastened to the pipe covering.

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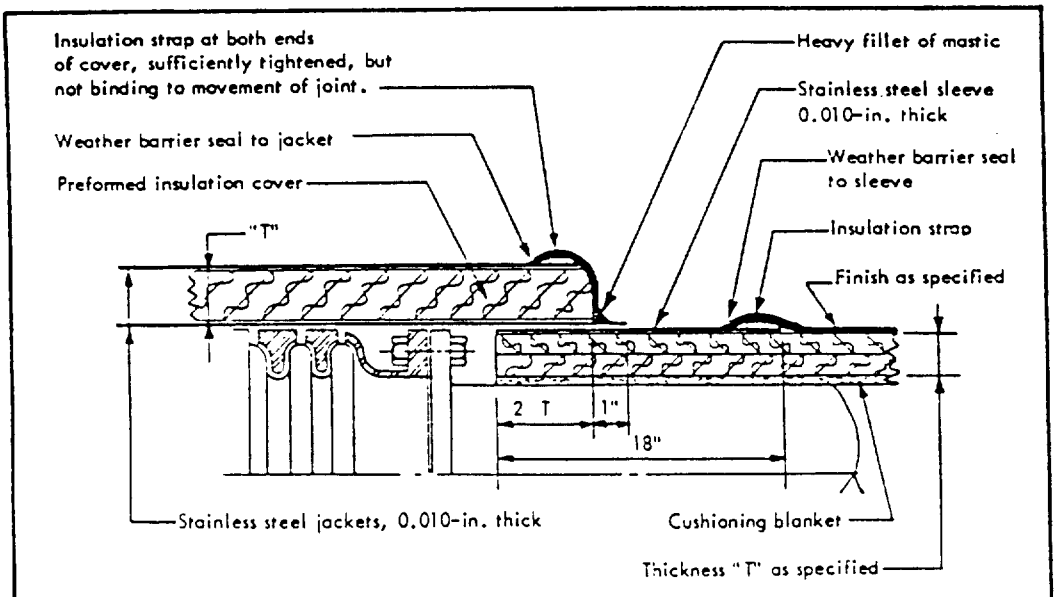
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Cellular Glass Insulation to Mechanical Expansion and Contraction Joint

Figure 10-OX-6



Detail "B"

(Slip Joint Detail for Figure 10-OX-6)

Figure 10-OX-7

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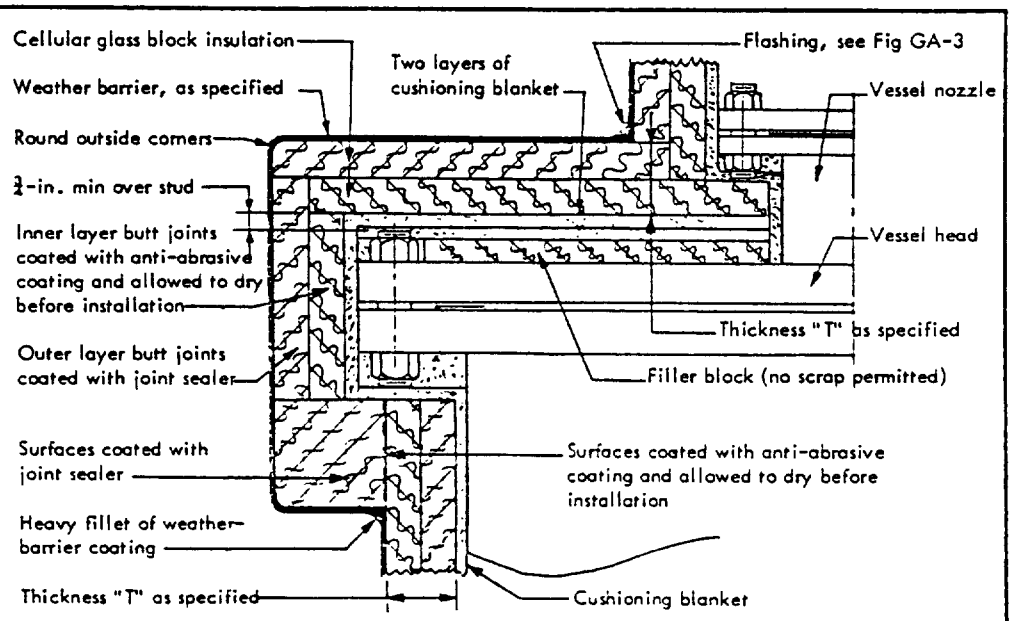
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd

i. 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-OX-8.

(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-OX-8

j. Vessel Legs

(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 body of vessel.

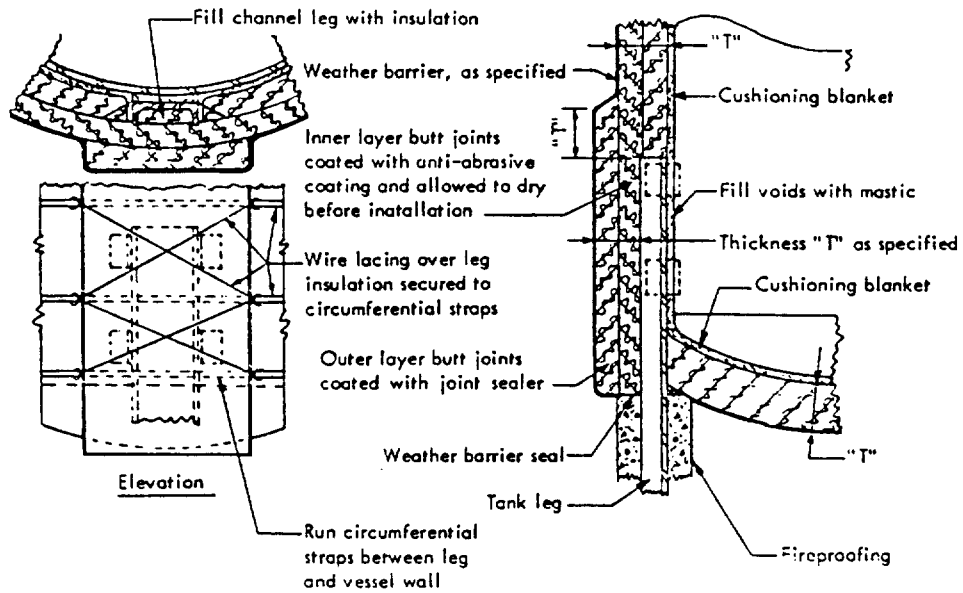
(2) Channel legs shall be insulated with block which shall extend over channel flanges and down channel legs to the junction with any fire-resistant material, or a distance of four times the insulation thickness, but not less than 24 inches. Thickness shall be as specified for body of vessel but never less than 2 inches. Body insulation shall be butted firmly against tank leg flange.

(3) Re-entrant space between channel flanges shall be filled with block, cemented in place with 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 10-OX-9.

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SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Cellular Glass Insulation to Equipment Leg

Figure 10-OX-9

k. Vessel Skirts. Skirts supporting vertical equipment shall be insulated inside and outside. Insulation shall extend downward, from junction of inside of skirt 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 skirts shall be as specified for body of vessel, but never less than 2 inches. Insulating material shall be secured to inside of skirt with joint sealer. Support for inside skirt insulation, and bottom head insulation, shall be in accordance with Owner's Standard EQ-64 or EQ-70. Installation shall be shown in Figure 10-OX-10.

l. Equipment Supports

(1) Where equipment is supported on cradles, vessel insulation shall extend over cradles 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 1/2 that 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.

m. Weather Barrier

(1) Weather-barrier coating shall be as specified in Article XIV.B of the GENERAL SPECIFICATIONS.

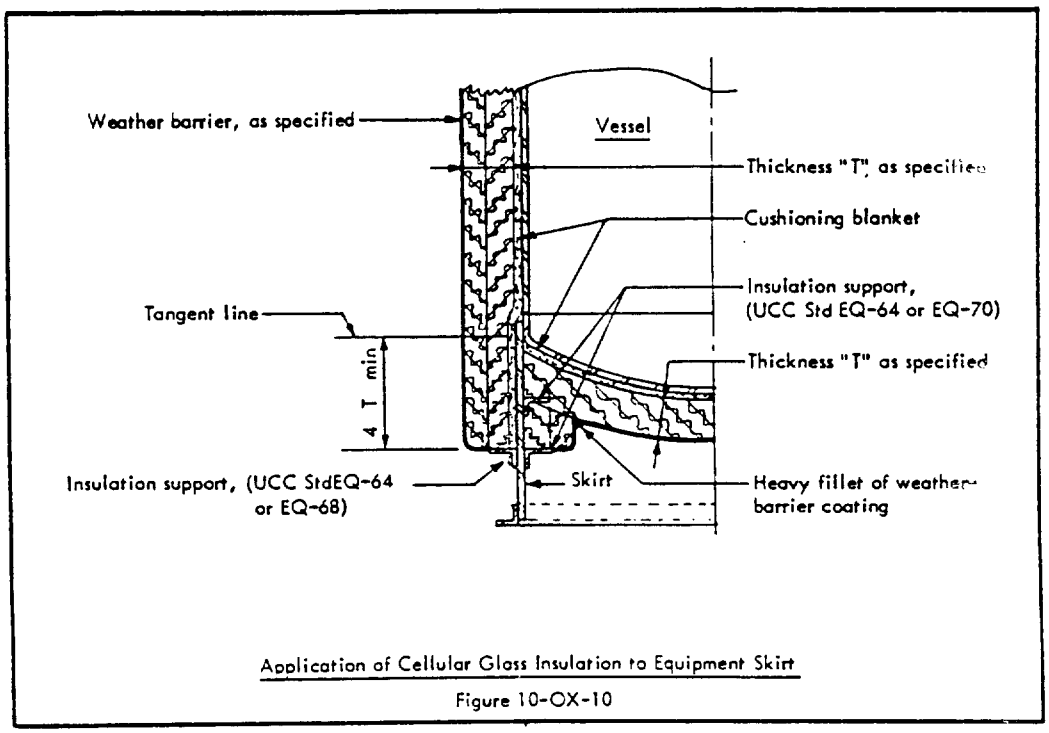
(2) Weather barrier consisting of stainless steel jacketing, if required, shall be applied as specified in Article XV.B of the GENERAL SPECIFICATIONS. This requirement is indicated by the addition of the letter M to the specification designation, thus: 10-OXM.

(3) Weather-barrier membrane shall be carried out 3 inches onto any metal, beyond termination of insulation.

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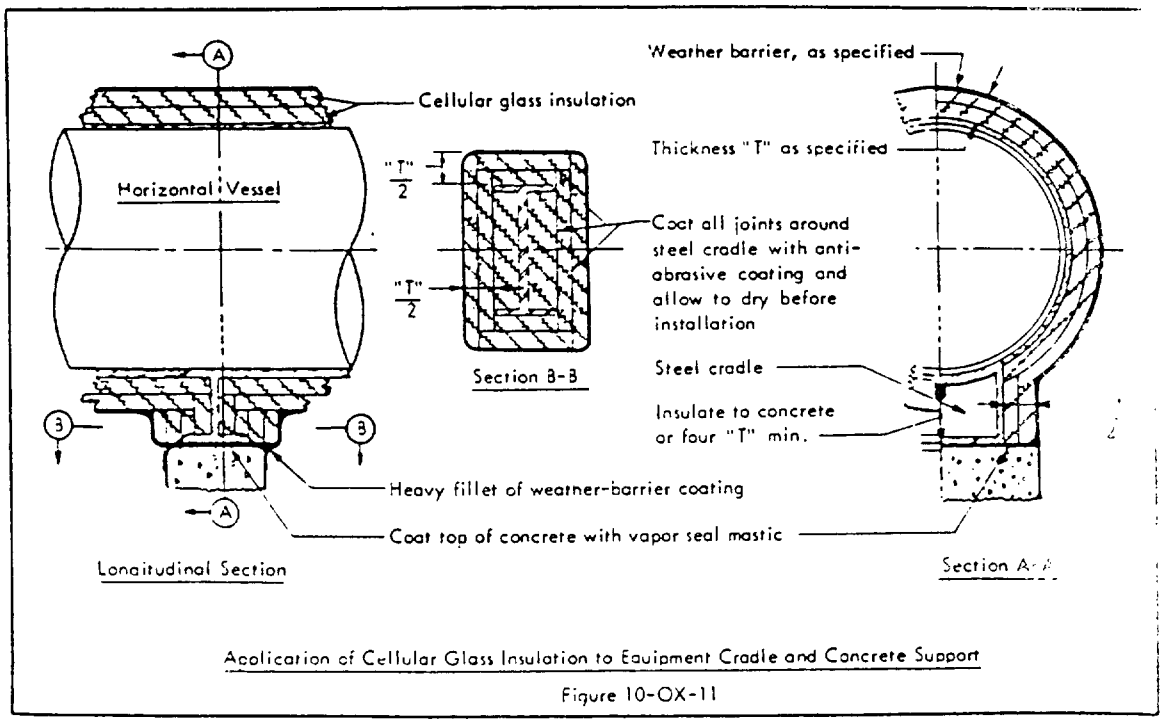
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Cellular Glass Insulation to Equipment Skirt

Figure 10-OX-10



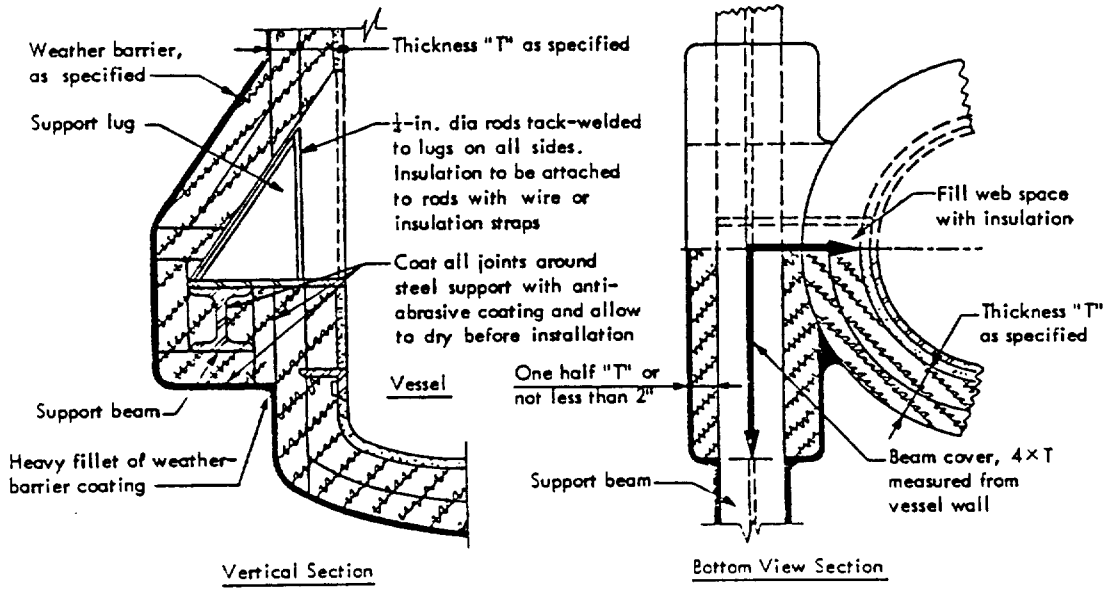
Application of Cellular Glass Insulation to Equipment Cradle and Concrete Support

Figure 10-OX-11

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SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Cellular Glass Insulation to Equipment Lugs and Supporting Steel

Figure 10-OX-12

2. 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 2-1/2 inch total thickness shall be applied in multiple layers as specified in Article III. E. of the MATERIAL SPECIFICATIONS.

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

(4) Piping shall have 1-inch-thick cushioning blanket secured with stainless steel wire and compressed to approximately 1/2 inch, applied before the application of cellular glass insulation. Cushioning material shall not be considered as part of insulation thickness.

(5) All butt edges and ends of single layer insulation, and outer layer of multiple layer applications, 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.

(6) Insulation shall be applied with all joints tightly butted and fitted, 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.

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SECTION B - APPLICATION - contd

2. PIPING - contd

a. Pipe Insulation - contd

(7) 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 d 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 thick ness only to cover and fill the cut cells of the insulation.

(8) 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.(7) of this section.

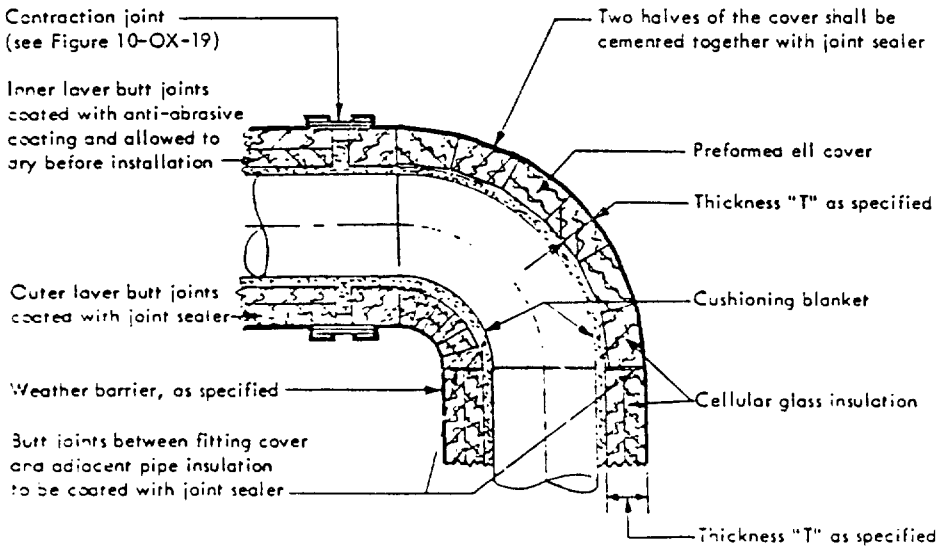
b. Fitting, Flange, and Valve Covers

(1) Welded fitting covers shall be fabricated to an inside diameter 1 inch greater than the outside diameter of the welded fitting to allow for cushioning material.

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

(3) All valves shall be packed and filled around valve stem and packing gland assembly with joint sealer, to eliminate water pockets.

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



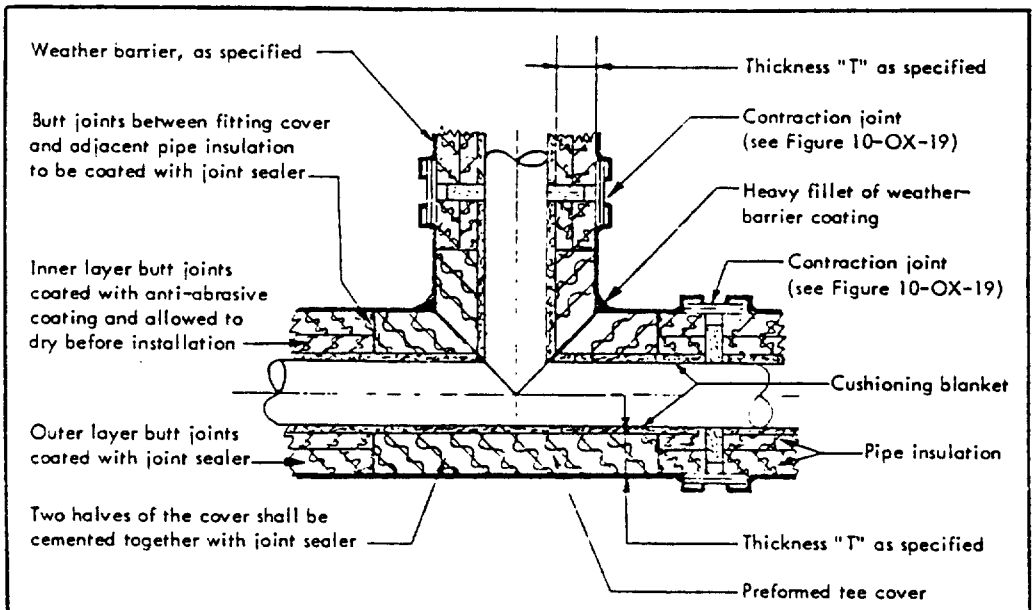
Application of Cellular Glass Insulation to Welded Ell

Figure 10-OX-13

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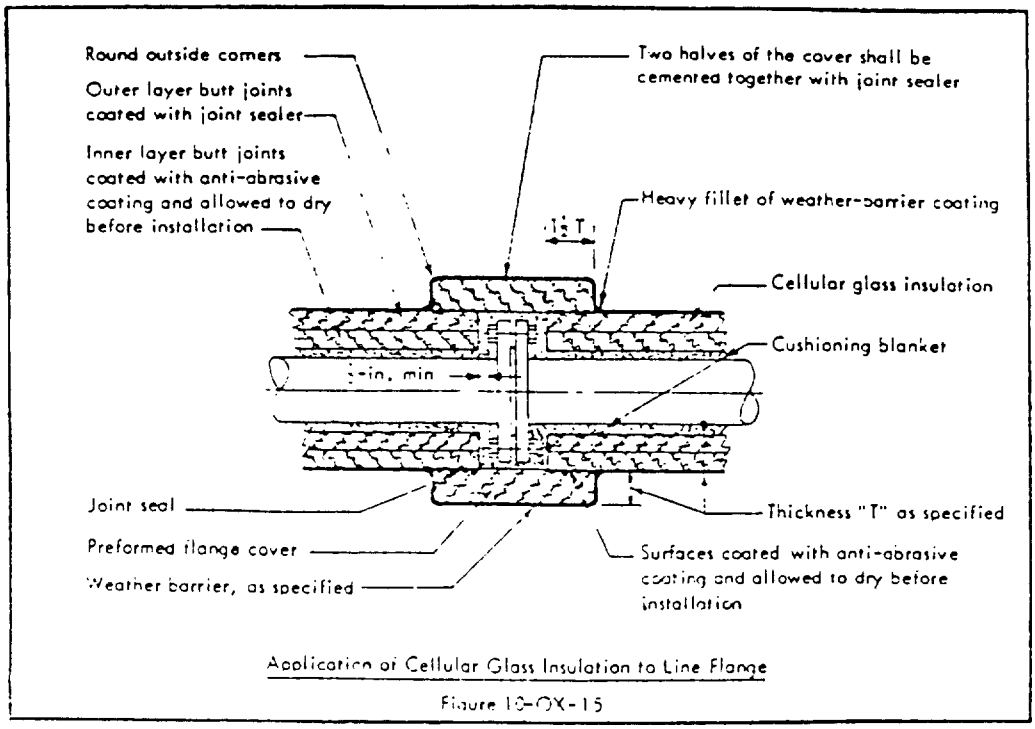
SECTION B – APPLICATION – contd

2. PIPING – contd



Application of Cellular Glass Insulation to Welded Tee

Figure 10-OX-14



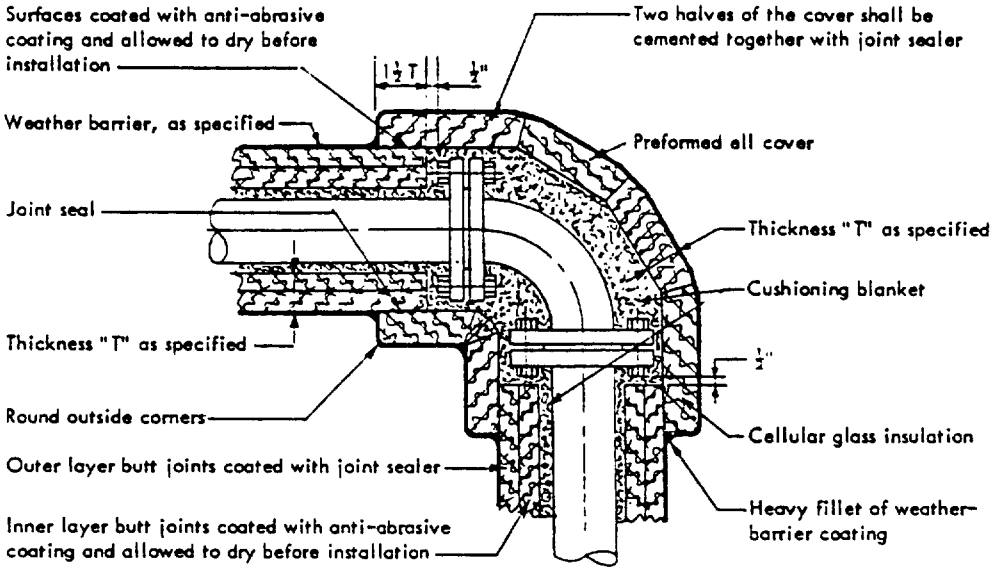
Application of Cellular Glass Insulation to Line Flange

Figure 10-OX-15

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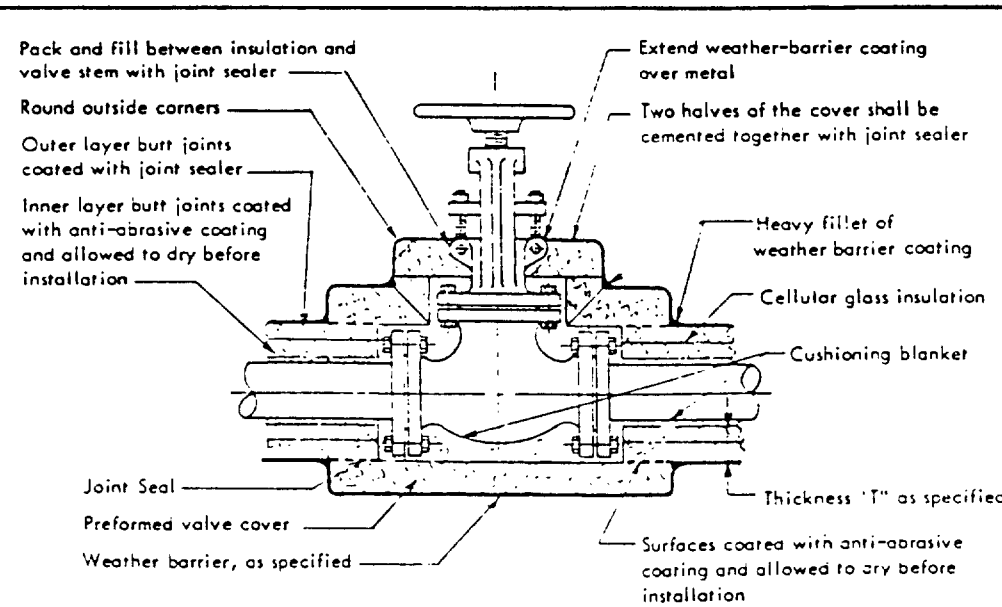
SECTION B - APPLICATION - contd

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

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SECTION B - APPLICATION - contd

2. PIPING - contd

c. Sealing Plate

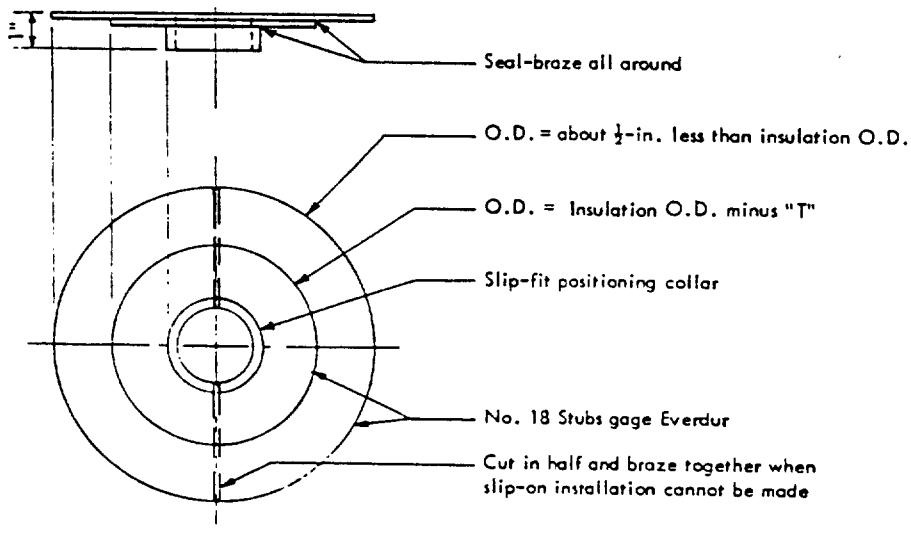
(1) This plate, shown in Figure 10-OX-18, shall be used wherever insulation is terminated. A typical installation is shown in Figure 10-OX-2

(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.

d. 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 run piping, at 10-foot intervals.

(2) At the various fittings, 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.



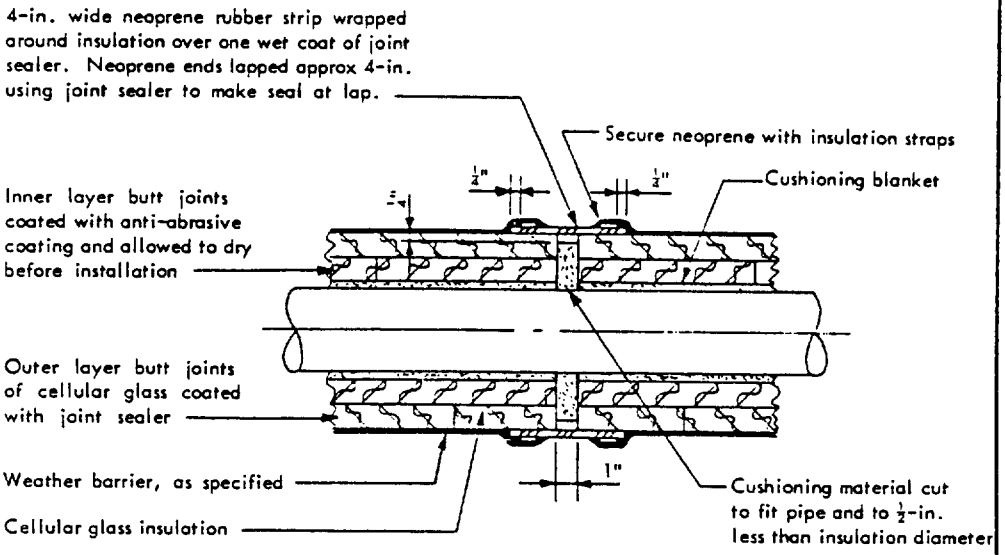
Sealing Plate and Insulation Support for Vertical Piping

Figure 10-OX-18

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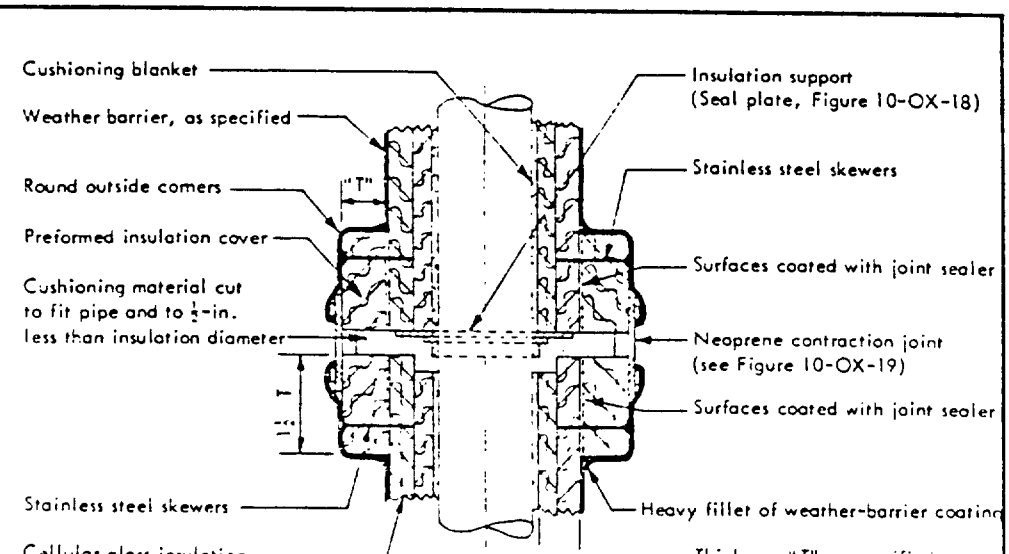
SECTION B - APPLICATION - contd

2. PIPING - contd



Application of Cellular Glass Insulation to Expansion and Contraction Joint in Horizontal Piping

Figure 10-OX-19



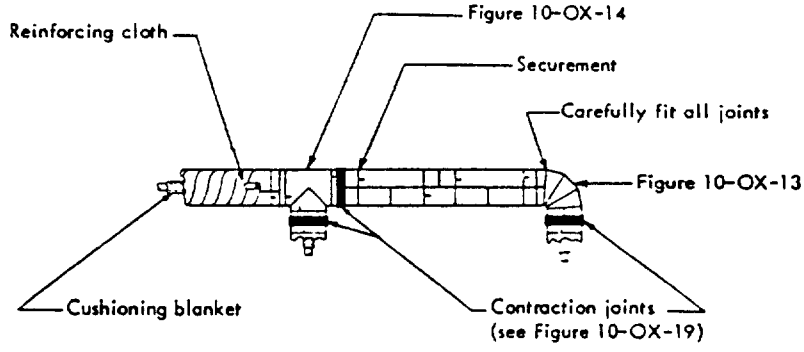
Application of Cellular Glass Insulation to Expansion and Contraction Joint in Vertical Piping

Figure 10-OX-20

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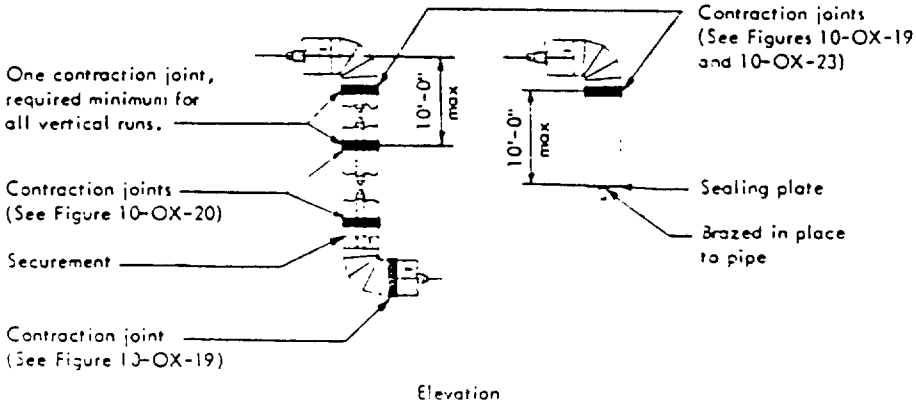
SECTION B - APPLICATION - contd

2. PIPING - contd



Application of Cellular Glass Insulation to Horizontal Piping

Figure 10-OX-21



Application of Cellular Glass Insulation to Vertical Piping

Figure 10-OX-22

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SECTION B - APPLICATION - contd

2. PIPING - contd

e. 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.

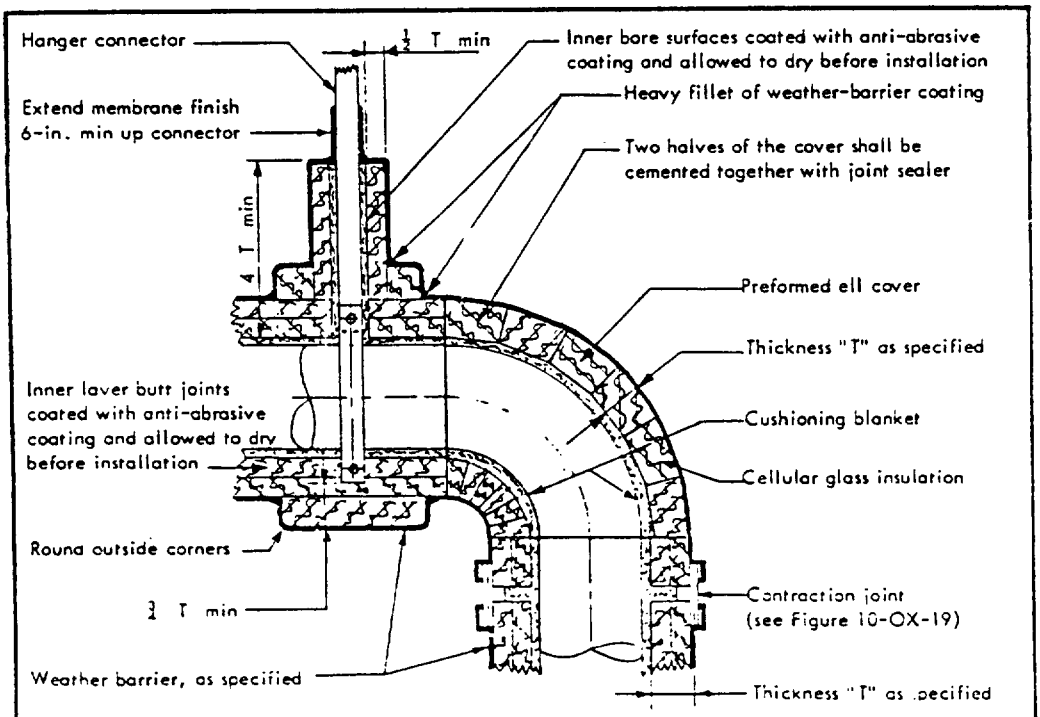
(2) All inner layers and outer layers less than 4-1/2 inches in outside diameter shall be secured with stainless steel wire.

(3) Use and location of strap and wire shall be as specified in Articles III.C and III.D of the GENERAL SPECIFICATIONS.

f. Supports and Hangers

(1) Where horizontal, low temperature piping is supported on the outside of insulation surfaces, in accordance with Owner's Standard P-82, insulation shall be complete with weather-barrier applied before piping is placed in cradles. Standard P-82 is a guide to the maximum horizontc span or pipe which may be supported on the outside of insulation.

(2) Hangers attached direction to piping shall be insulated as shown in Figure 10-OX-23.



Application of Cellular Glass Insulation to Welded Ell with Hanger Connected Directly to Pipe

Figure 10-OX-23

g. Traced Installations. Traced lines, where specified, shall be installed and insulated as specified in Article XIII of the GENERAL SPECIFICATIC

h. Weather Barrier

(1) Weather-barrier coating shall be applied as specified in Article XIV.B of the GENERAL SPECIFICATIONS.

(2) Weather barrier of stainless steel jacketing, if required, shall be as specified in Article XV.B of the GENERAL SPECIFICATIONS. This requirement is indicated by the addition of the letter M to the specification designation, thus: 10-OXM.

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THERMAL INSULATION APPLICATION SPECIFICATIONS

RIGID URETHANE FOAM

SCOPE

This specification describes the essential requirements for application of shaped rigid urethane foam insulation for use on equipment, piping and ductwork normally operating at temperatures above 50 F up to and including 250 F. It is applicable to both indoor and outdoor service.

The second designation, 12-HSS, 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

Insulation shall be as specified in MATERIAL SPECIFICATION NO. 12.

2. ACCESSORY MATERIALS

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

Insulating Cement	VII.A. 6	Strapping Tape	VII.A. 33
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. 99
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 it is 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, blind flanges and vessel flanges shall be insulated with preformed covers unless otherwise specified.

e. Securement.

(1) Curved Surfaces.

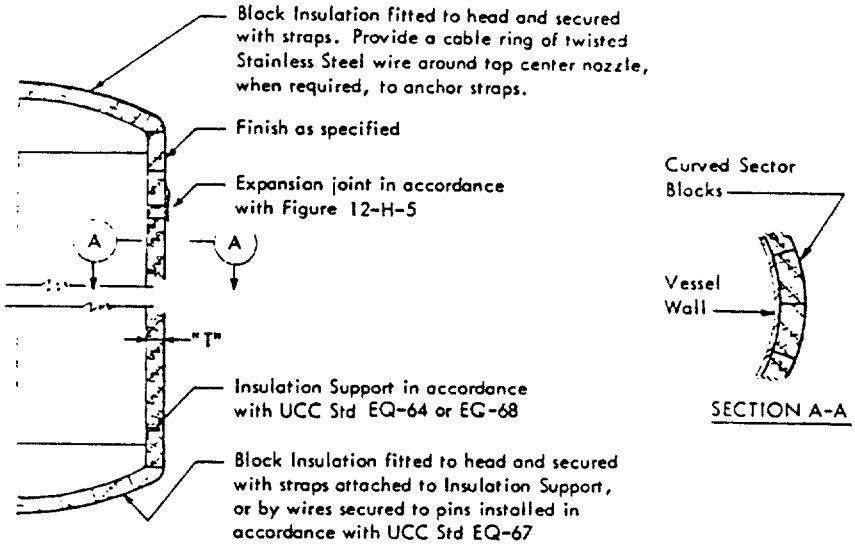
(a) Where contour of vessel permits, insulation shall be secured with stainless steel insulation strap. Where required, insulation strap shall be attached to strap anchor angles in accordance with Owner's Standard EQ-64 or EQ-68. Insulation applied to irregular surfaces, where the use of strap is impracticable, shall be secured with stainless steel wire attached to welding pins, (as shown in Owner's Standard EQ-67) 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 strap secured to insulation supports as shown in Owner's Standards EQ-64, EQ-65, EQ-68 or EQ-69. Insulation on heads of large diameter vessels (over 16 ft OD), where use of strap is impracticable, shall be secured by wire attached to welding pins in accordance with Owner's Standard EQ-67.

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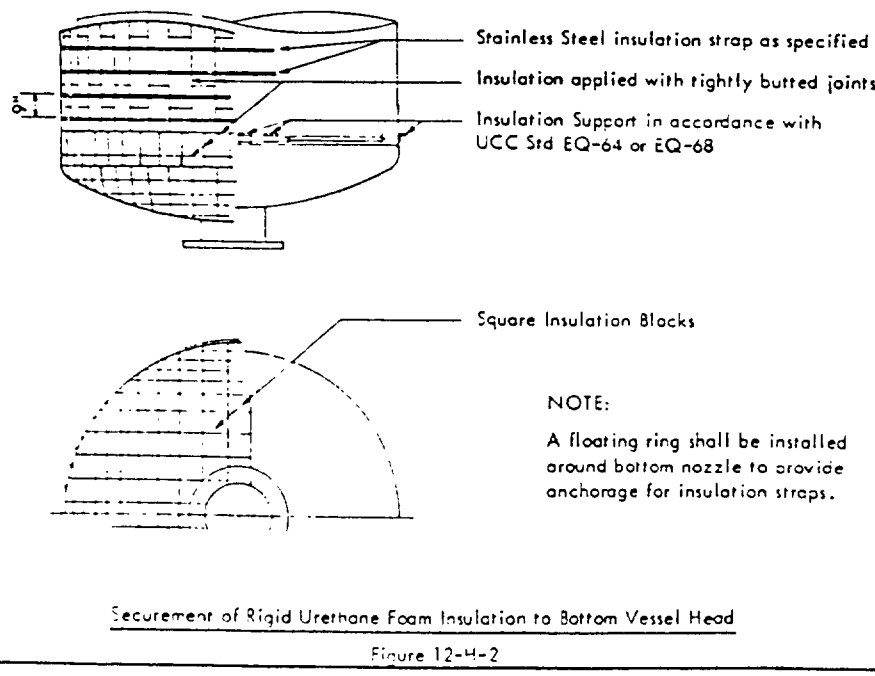
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Rigid Urethane Foam Insulation to Vessel Shell and Heads

Figure 12-H-1



Securement of Rigid Urethane Foam Insulation to Bottom Vessel Head

Figure 12-H-2

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SECTION 8 - APPLICATION - contd

1. EQUIPMENT - contd

e. Securement - contd

(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 160 F, whereas high temperature contact adhesive shall be used if operating temperature is above 160 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 installation of block to allow the adhesive to dry to a non-tacky state. At temperatures from 32 F to 40 F, the drying time is much longer than at temperatures above 40 F. Boards shall be pressed into place with care not to trap air between the insulation and surface.

(c) Where operating temperatures exceed 180 F, rigid urethane insulation shall be secured with welding pin fasteners and pin clips, spaced so as to provide a minimum of five attachments per block, as shown in Figure 12-H-3.

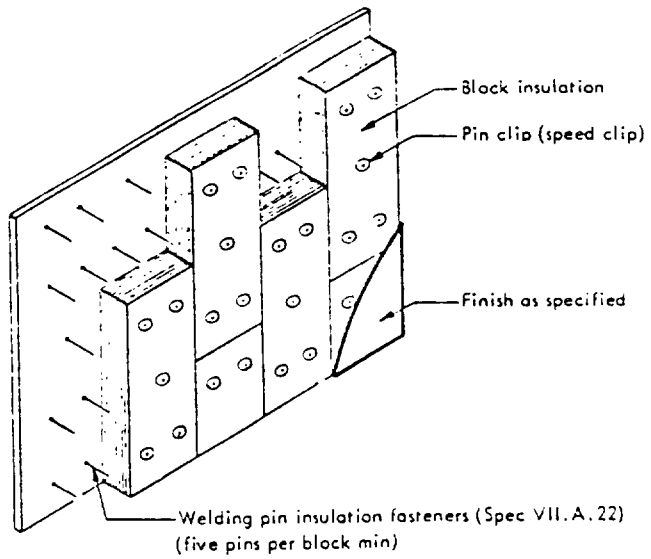
(d) Pin clips shall be pressed tight to the insulation and pins to be cut off flush with insulation face. Any sharp projection shall be covered with cork-filled polyvinyl acetate mastic as called for in MATERIAL SPECIFICATION NO. 40-J.

f. 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-5.

(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 ten-pound density. Typical installation is shown in Figure 12-H-6.



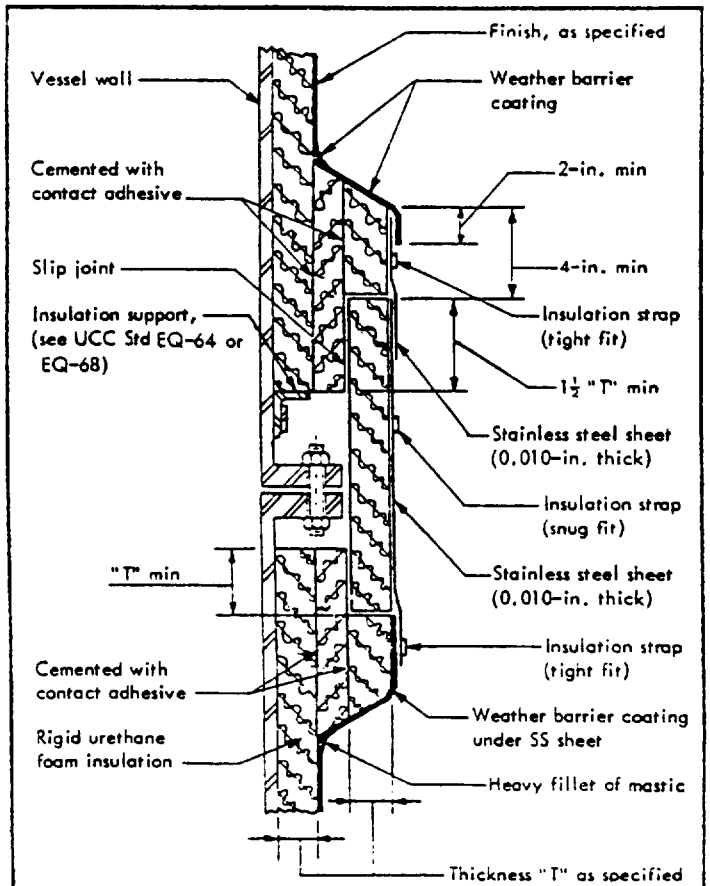
Application of Rigid Urethane Foam Insulation to Flat Surface

Figure 12-H-3

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SECTION 8 - APPLICATION - contd

1. EQUIPMENT - contd



Application of Slip Joint at Vessel Flange

Figure 12-H-4

g. Uninsulated Vessel Flanges. Where vessel flanges are uninsulated, the reinforcing cloth of the weather barrier on the adjacent vessel insulation shall be extended to the metal of the vessel body, coated with heat resistant sealer and banded while the 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 12-H-7.

h. Vessel Nozzles. Unless otherwise specified, all vessel nozzles shall be insulated as shown in Figure 12-H-8.

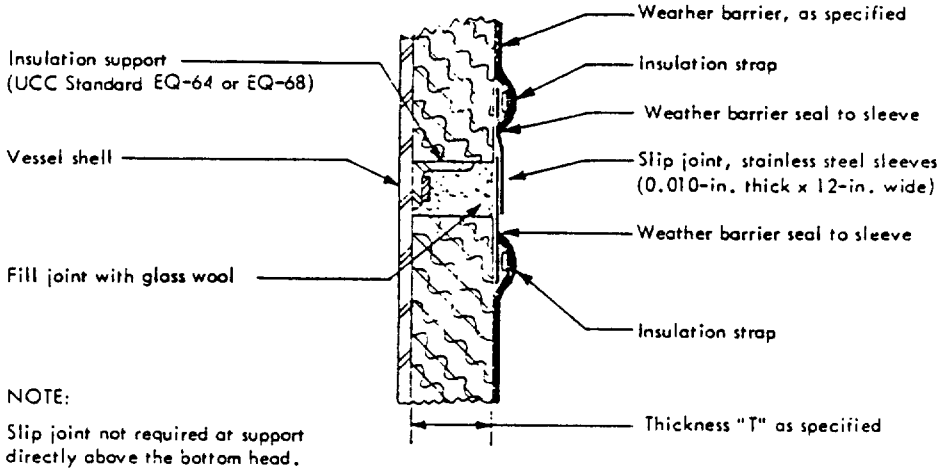
i. Vessel Legs. Insulation shall not be extended over vessel legs or equipment supports. Junction of insulation with legs and supporting steel shall be sealed with weather barrier coating.

j. 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 the concrete pad whichever is nearer. Thickness shall be as specified for body of vessel. An insulation support, or welded pin securement shall be provided for bottom head insulation in accordance with Owner's Standards EQ-64, EQ-65, EQ-67, EQ-68 or EQ-69, or EQ-70 . Installation shall be as shown in Figure 12-H-9.

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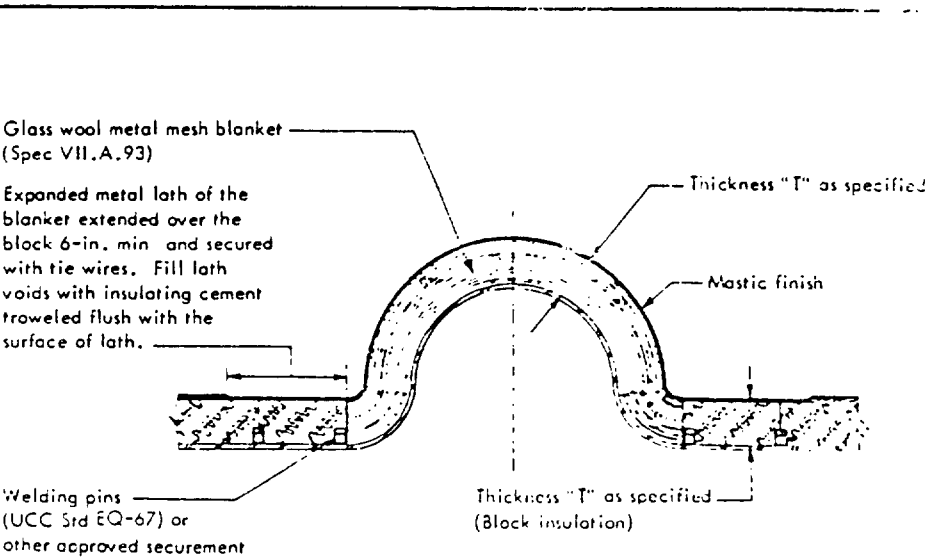
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



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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the Defendant in the above entitled cause, wherein JACK L. FREY is the Plaintiff and FIBREBOARD CORPORATION, ET AL are the Defendants, pending in the United States District Court, for the Western District of Texas, Austin Division, before KATHY SCHAEFER, a Notary Public in and for the State of Texas, on the 27th day of September, A.D. 1983, in the OFFICES OF BROCK & KELFER, 1700 One Riverwalk Place, San Antonio, Bexar County, Texas, between the hours of 9:40, o'clock a.m. and 1:20 o'clock p.m., pursuant to due notice and the following agreement of counsel:

It is stipulated and agreed by and between counsel and the respective parties hereto, that the deposition of the witness named in the caption hereto, may be taken at this time and place, pursuant to due notice, and that the said deposition, or any part thereof, when so taken may be used on the trial of this case the same as if the witness were present in Court and testifying in person.

It is further stipulated and agreed by and between counsel and the respective parties hereto that the necessity for preserving objections to the questions propounded or to the answers given, whether said objections go to the substance or the form of the questions or the answers, at the time of the taking of

the deposition or any time thereafter, whether orally or in writing, is waived and that any and all objections to this deposition, or any part thereof, may be made and urged for the first time at the time same is sought to be offered in evidence on the trial of this cause.

It is further stipulated and agreed by and between counsel and the respective parties hereto, that the witness may sign said deposition before any duly authorized and acting Notary Public in the State of Texas.

ROBERT L. BOCKSTAHLER, a witness of lawful age, being first duly sworn on the above cause, testified on his oath as follows:

DIRECT EXAMINATION

Questions by Mr. Rosenthal:

Q. Would you state your full name for the record, please?

A. Robert L. Bockstahler.

B-O-C-K-S-T-A-H-L-E-R.

Q. What is your current employment, sir?

A. I am employed by Eagle-Picher Industries, Incorporated.

Q. In what capacity?

A. As a litigation assistant.

Q. How long have you been employed in that capacity by Eagle-Picher Industries?

A. Since November of 1981.

Q. Prior to that, what was your position?

A. Immediately prior to that, for the period of 1971 to 1981, I was president and general manager of the chemicals and fibers division of Eagle-Picher headquartering in Joplin, J-O-P-L-I-N, Missouri.

Q. Okay. When did you start your employment with Eagle-Picher?

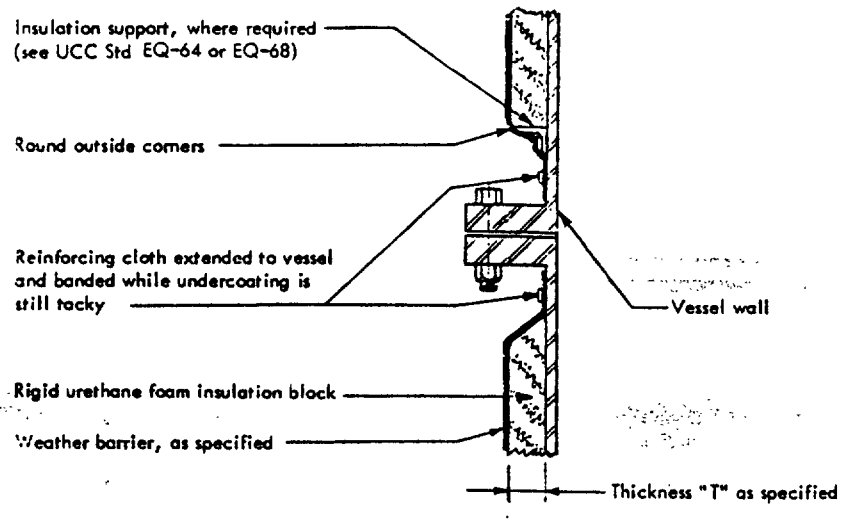
A. October first, 1955.

Q. And would you to save time run down the various positions and offices that you have held with Eagle-Picher Industries since you joined the company in 1955?

A. For the period of 1955 to 1961, I served as an administrative assistant to the sales manager of the Celatom, that's C-E-L-A-T-O-M, department of the company. That department dealt with mining and marketing of diatomaceous earth products. For the period 1961 to 1966, I was general sales manager for export of the diatomaceous earth products. And from 1966 to 1971, I was general sales manager and later vice-president sales for the fibers department of the company, ~~which produced industrial insulation~~

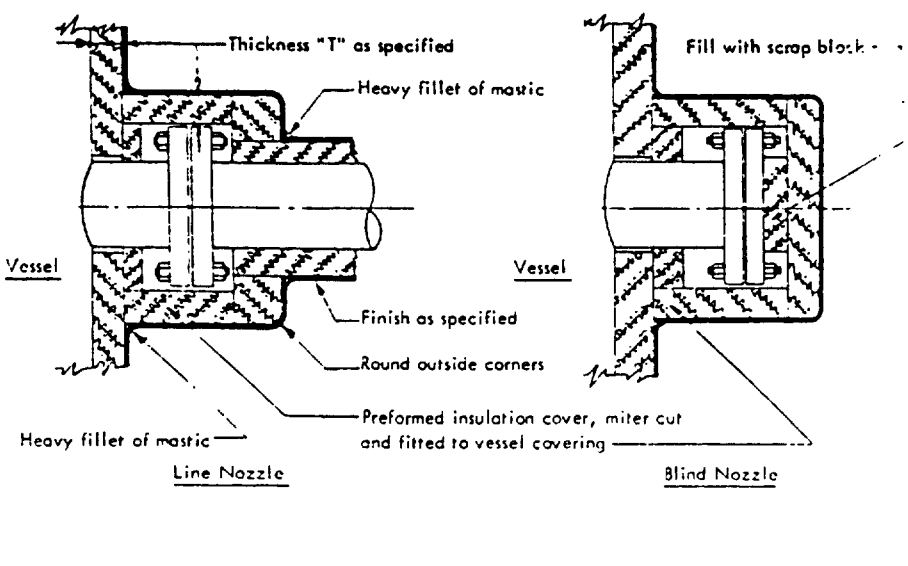
SECTION B – APPLICATION – contd

1. EQUIPMENT – contd



Application of Rigid Urethane Foam Insulation Adjacent to Uninsulated Flanges

Figure 12-H-7



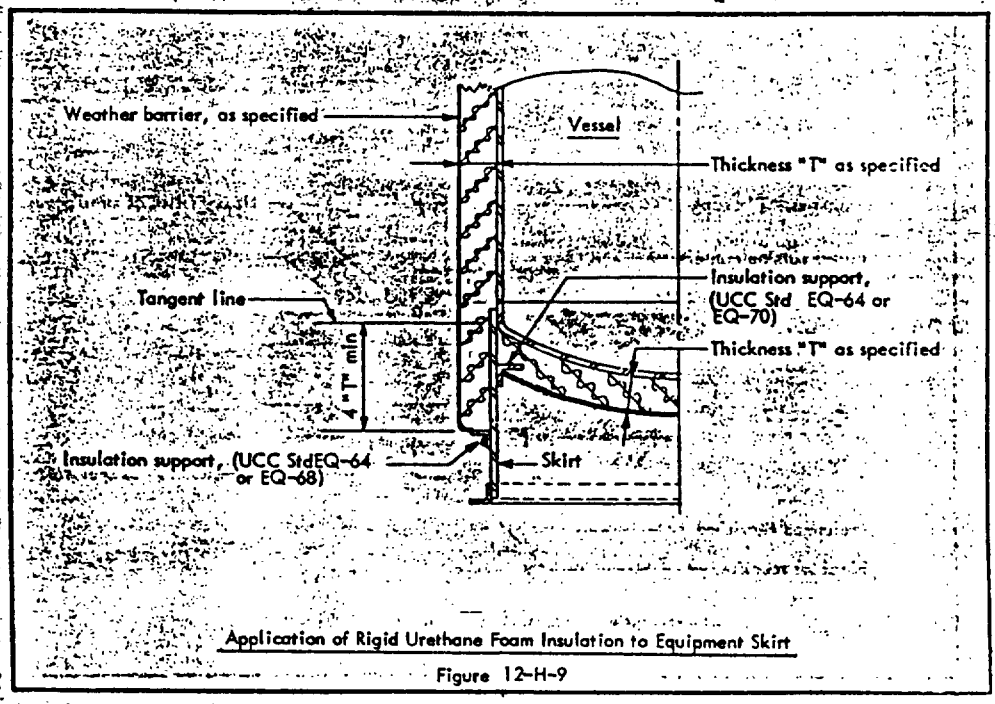
Application of Rigid Urethane Foam Insulation to Horizontal Vessel Nozzles

Figure 12-H-8

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SECTION B – APPLICATION – contd

1. EQUIPMENT – contd



Application of Rigid Urethane Foam Insulation to Equipment Skirt

Figure 12-H-9

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

l. Surface Finish. When insulation of the specified thickness has been applied, all small cracks and depressions shall be filled with cork-filled polyvinyl acetate mastic flush with the surface.

m. 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.

not possible since pre-molded in 3' sections

(2) Insulation shall be applied with all joints tightly butted to eliminate voids. Large voids shall not be filled with mastic, but eliminated by recutting 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.

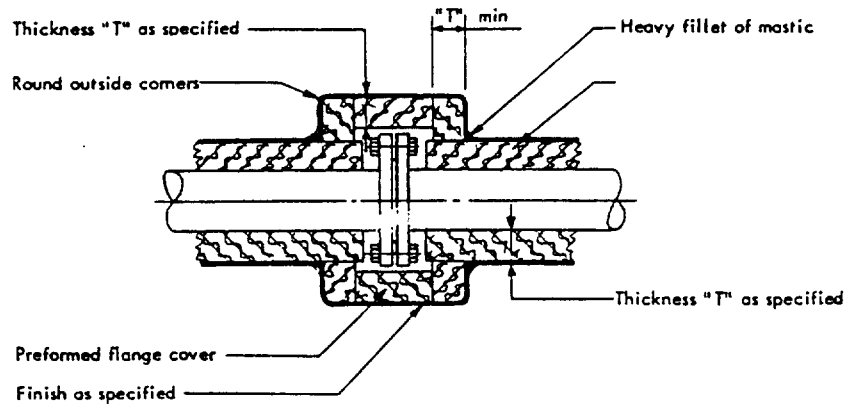
show Pipe support requirement

Wire is best method

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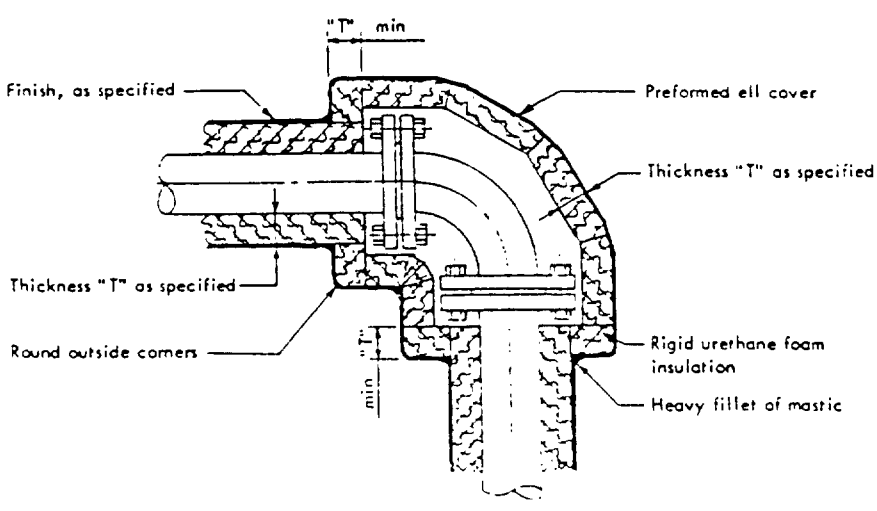
SECTION 8 - APPLICATION - contd

2. PIPING - contd



Application of Rigid Urethane Foam Insulation to Line Flange

Figure 12-H-10



Application of Rigid Urethane Foam insulation to Flanged Ell

Figure 12-H-11

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SECTION 8 – APPLICATION – contd

2. PIPING – contd

b. Fitting, Flange and Valve Covers.

Molded up to 4" in shop

(1) All fittings, valves in one inch NPS and smaller piping shall be insulated with insulating cement. Fittings above one inch up to three inch NPS may be insulated with field fabricated or shop preformed covers.

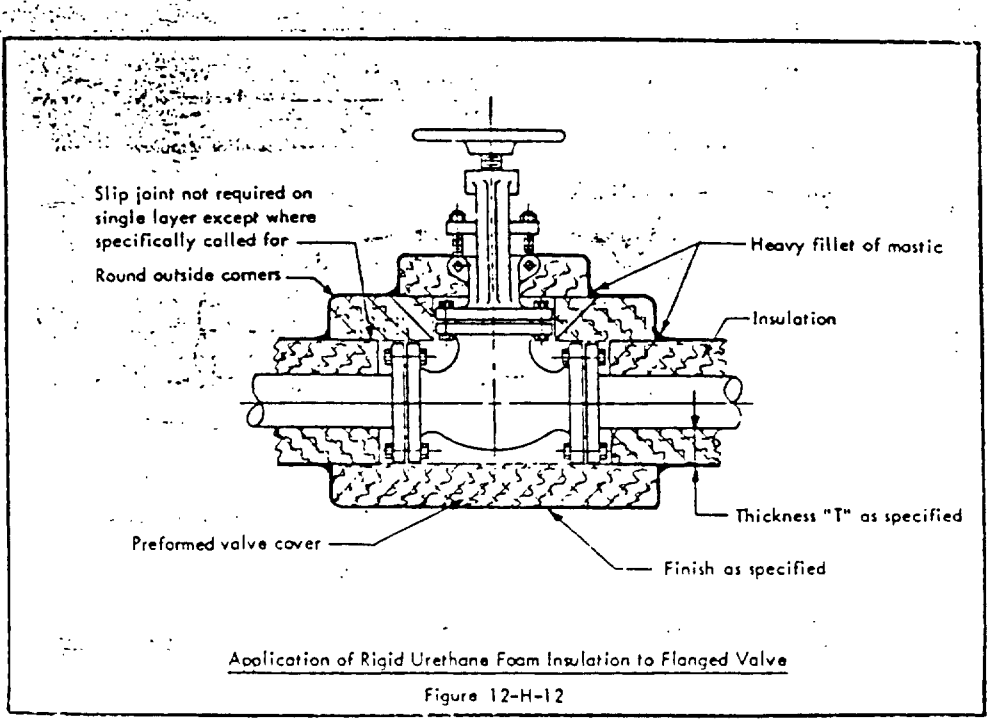
(2) With exception of ball and plug valves, all fittings over three inch NPS shall be insulated with covers prefabricated in accordance with ASTM Recommended Practice C-450, latest revision. Installation of typical covers are shown in Figures 12-H-10, 12-H-11, and 12-H-12.

(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 exception for use on stainless steel – small fittings shall not be insulated with insulating cement. These shall be insulated with rigid urethane. No insulation cement shall be used with insulation covering stainless steel pipe or equipment.

(6) Cementing of shop 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 - contd

2. PIPING - contd.

c. Expansion and Contraction Joints.

(1) Expansion and contraction joints shall be provided on three inch NPS and larger piping. An expansion joint shall be installed in each 48 feet of straight pipe not interrupted by flanges or flanged fitting. Typical installation is shown in Figure 12-H-13.

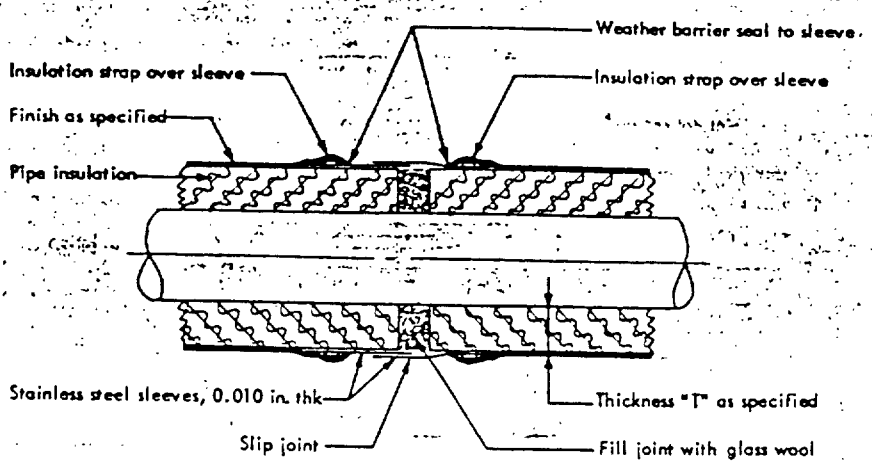
(2) If an expansion or contraction crack occurs after line has been put in service, the crack shall be filled with glass wool, and an expansion and contraction joint shall be installed at that location.

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

e. Surface Finish. When insulation of the specified thickness has been applied, all small cracks and depressions shall be filled with cork-filled polyvinyl acetate mastic flush with the surface.

f. Weather-Barrier or Exterior Finish. Piping-Weather Barriers. Weather-barrier coating materials and application shall be as specified in Articles XIV.A and XIV.B of the GENERAL SPECIFICATIONS.

Sealing cuts of PVC vent done w/ Vimasco 703C Liquid Vinyl -



Application of Expansion and Contraction Joint to Rigid Urethane Foam Insulation on Horizontal Piping

Figure 12-H-13

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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 ope 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 shall be as specified in MATERIAL SPECIFICATION 15.

2. ACCESSORY MATERIALS

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

Glass Wool Blanket	VII.A. 1	Pin Clips	VII.A
Insulating Cement	VII.A. 6	Heat-Resistant Sealer	VII.A
Pipe Insulation Support	VII.A. 9	Mastic	VII.A
Expansion Sleeve	VII.A.10	Glass Cloth Jacket	VII.A
Equipment Insulation Strap	VII.A.11	High Temperature Fabricating Cement	VII.A
Clips for Equipment Strap	VII.A.12	Bonding Adhesive	VII.A
Pipe Insulation Strap	VII.A.13	Glass Wool Metal Mesh Blanket	VII.A
Clips for Pipe Strap	VII.A.14	PVA Finish Coating and Lagging Adhesive	VII.A
Stainless Steel Wire	VII.A.17	Weather-Barrier Mastic (color as specified)	VII.B
Welding Pins	VII.A.19	Reinforcing Cloth	VII.B
Stainless Steel Pins	VII.A.20	Stainless Steel Weather Barrier (Designation M)	VII.B
Stainless Steel Skewers	VII.A.21	Treated Steel Weather Barrier (Designation MT)	VII.B
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 Schedule. Unless otherwise specified, insulation in excess of three inches total thickness shall be applied in multiple layers as sp 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 in curved ments 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 vesse face, shall be used. 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 tightly butted. Multiple layers shall be applied so that the butt joints of one layer do 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 tightly butted. Multiple layers shall be applied so the butt joints of one layer do not coincide with those of any other layer.

(2) Voids and fastener depressions in insulation shall be pointed up with insulation cement troweled flush with the surface.

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 preformed fibrous glass insulation shall be secured in p with stainless steel insulation strap. Where required, insulation strap shall be attached to strap anchor angles in accordance with Sec

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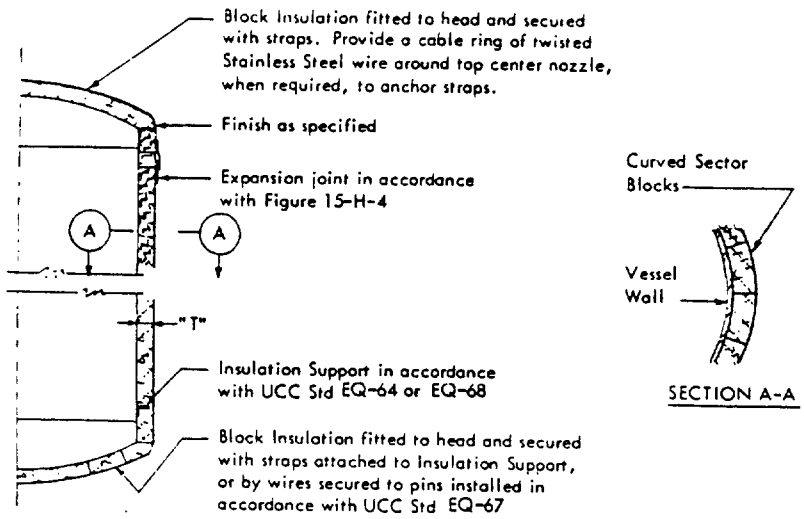
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd

f. Securement - contd

(1) Curved Surfaces - contd

Standard EQ-64 or EQ-68. 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. Typical installation is shown in Figure 15-H-1.



Application of Fibrous Glass Insulation to Vessel Shell and Heads

Figure 15-H-1

(b) Preformed fibrous 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 EQ-64, EQ-65, EQ-68, EQ-69 or EQ-70. Insulation on heads of large diameter vessels (over 16 ft OD), where use of strap is impracticable, shall be secured by wire attached to welding pins in accordance with Owner's Standards EQ-67 as shown in Figure 15-H-2.

(2) Flat Surfaces

(a) All layers of preformed fibrous glass insulation shall be secured with welding pin insulation fasteners and pin clips, spaced so as to provide a minimum of five attachments per block, as shown in Figure 15-H-3.

(b) Pin clips shall be pressed into insulation sufficiently to allow pins to be cut off below insulation surface.

g. Insulation Supports. 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 15-H-4.

h. Expansion Joints. Expansion joints in flat surfaces or cylindrical vessels 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 ten-pound density. Typical installation is shown in Figure 15-H-5.

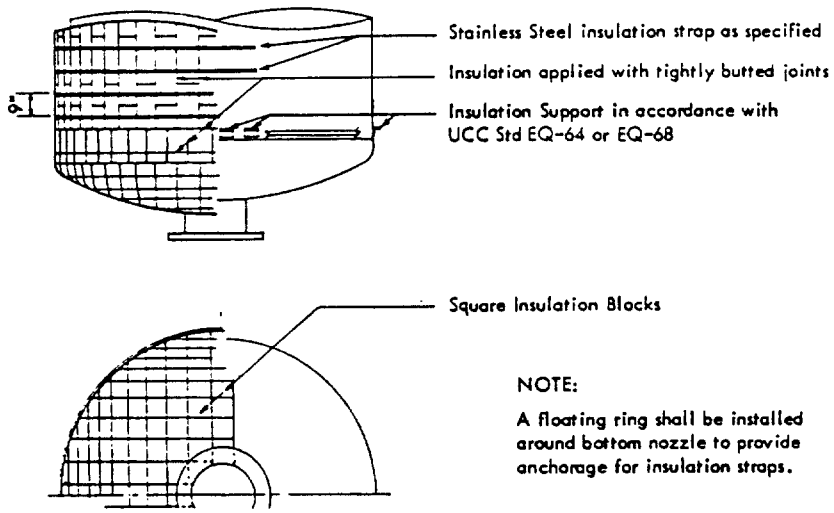
i. Mechanical Expansion Joints. Corrugated mechanical expansion joints in piping (usually listed as equipment items) shall be insulated as shown in Figures 15-H-6 and 15-H-7. A slip joint shall be provided by applying an 18-inch long sleeve of 0.010-inch thick stainless steel over the pipe insulation at each end of the expansion joint, placed flush with the butt end of the pipe covering. The sleeve shall be secured with strap 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 which is then secured with insulation strap. The longitudinal laps of the stainless steel bands shall be a minimum of two 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.

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.

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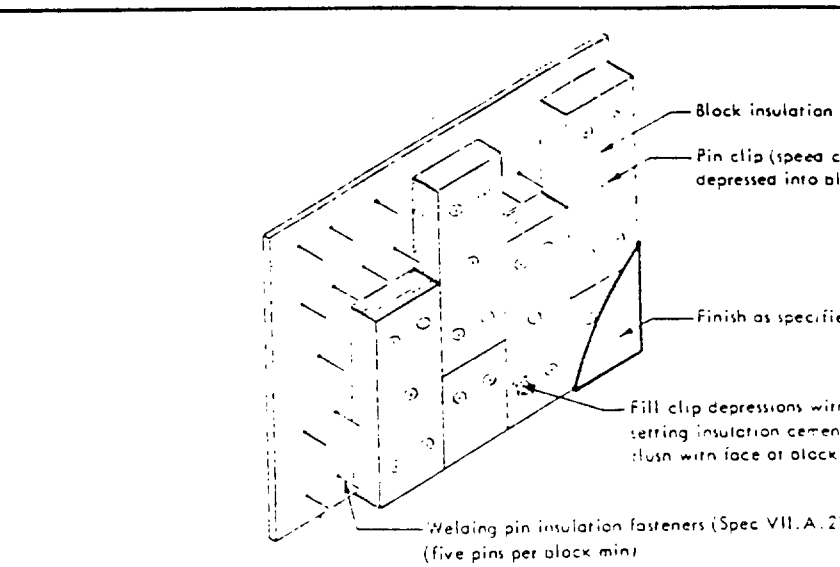
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Securement of Fibrous Glass Insulation to Bottom Vessel Head

Figure 15-H-2



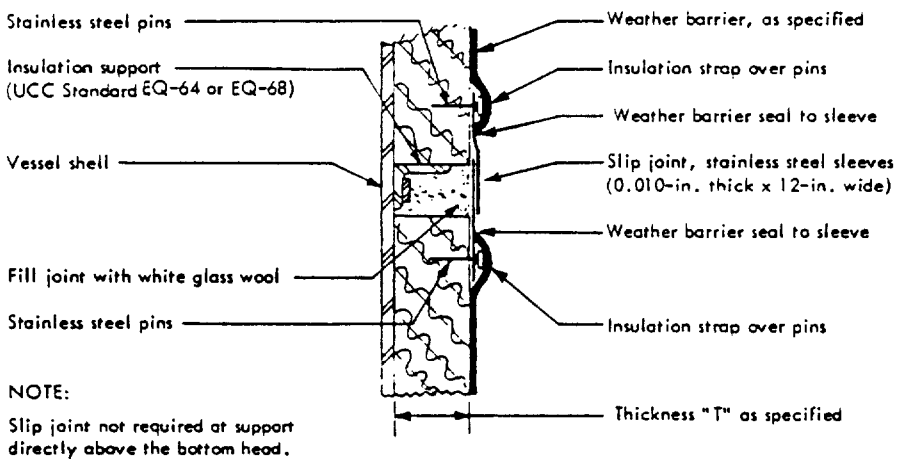
Application of Preformed Fibrous Glass Insulation to Flat Surface

Figure 15-H-3

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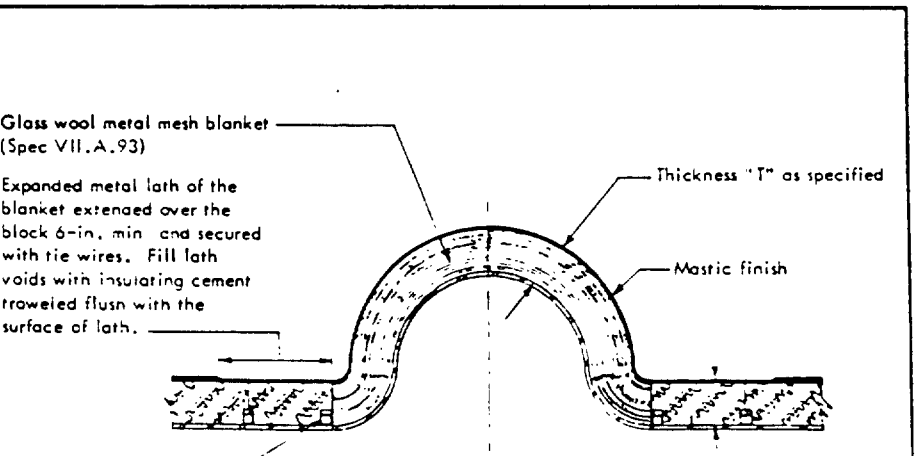
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Slip Joint to Vessel Wall at Insulation Supports

Figure 15-H-4



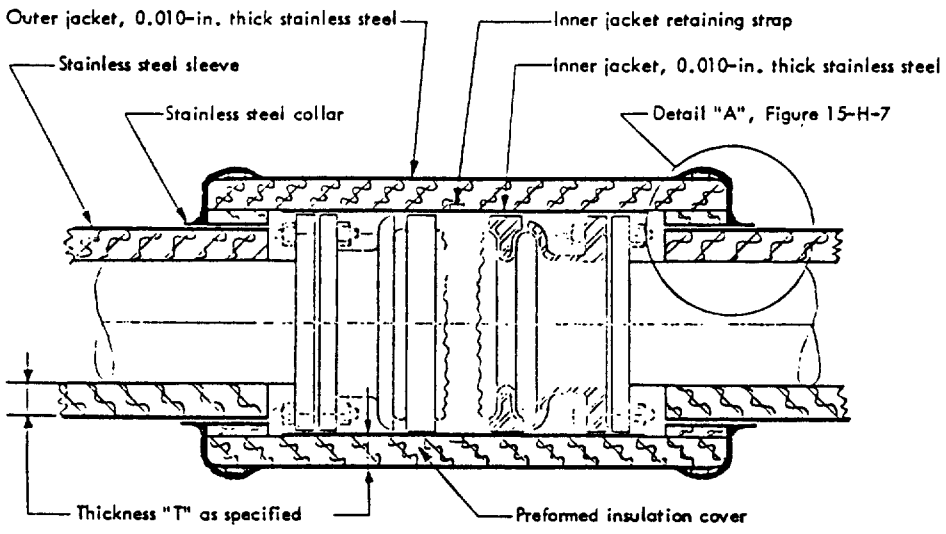
Application of Blanket Insulation to Expansion Joints on Flat Surface

Figure 15-H-5

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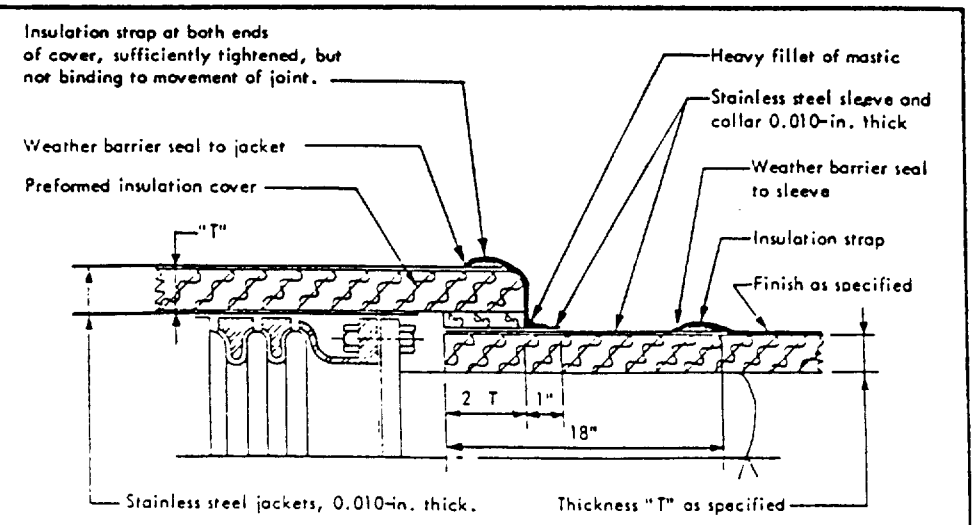
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Fibrous Glass Insulation to Mechanical Expansion and Contraction Joint

Figure 15-H-6



Detail "A"

(Slip Joint Detail for Figure 15-H-6)

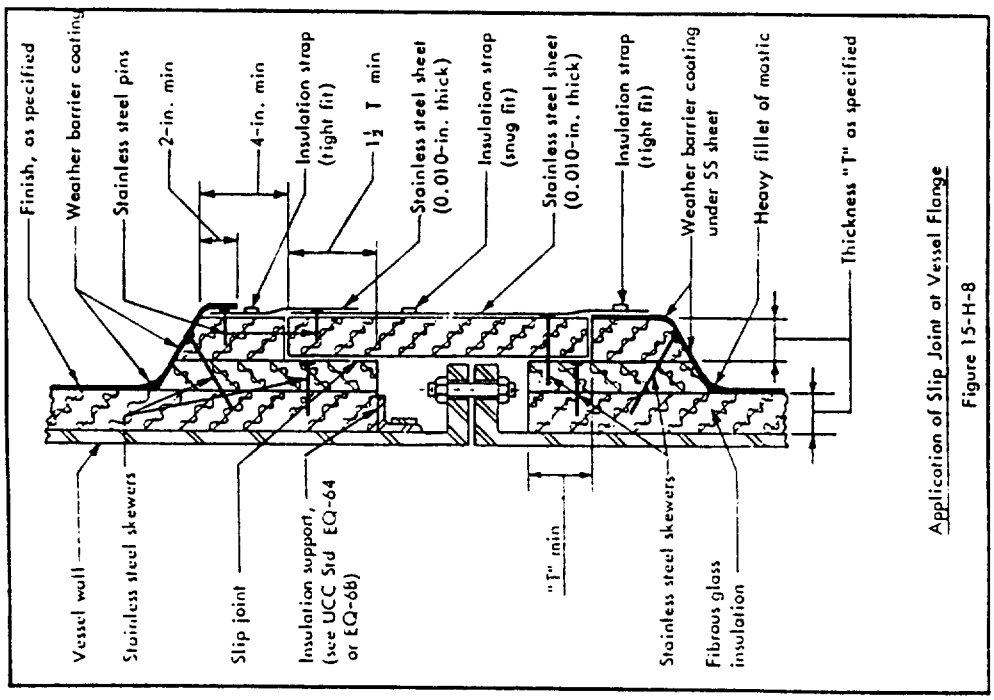
Figure 15-H-7

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SECTION 8 - APPLICATION - contd

1. EQUIPMENT - contd

j. Insulated Vessel Flanges. Unless otherwise specified, all vessel flanges shall be insulated with preformed fibrous glass block insulation and the assembly shall be weather protected by stainless steel jacket. An insulation support shall be provided immediately above vessel flange. Assembly shall be installed so as to provide a slip joint allowing movement between insulation and weather-barrier jacket. Typical installation is shown in Figure 15-H-8.



Application of Slip Joint at Vessel Flange
Figure 15-H-8

k. Uninsulated Vessel Flanges. Where vessel flanges are located outdoors and 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 banded 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 15-H-9.

l. Vessel Nozzles. Unless otherwise specified, all vessel nozzles shall be insulated as shown in Figure 15-H-10.

m. 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 block which shall extend over channel flanges 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 flanges. Reentrant space between channel flanges and over channel flanges between body insulation shall be filled with block. Installation shall be as shown in Figure 15-H-11.

n. 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 EQ-64, EQ-70 and EQ-67, respectively. Installation shall be as shown in Figure 15-H-12.

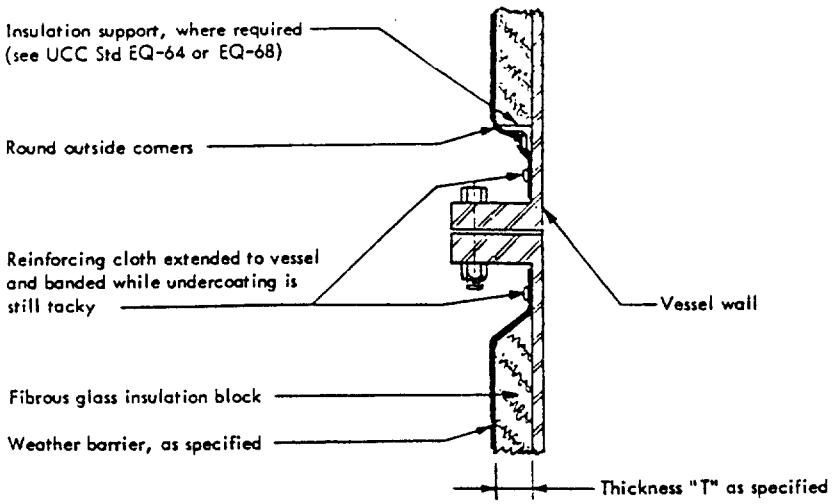
o. Traced Installations. Tracing and insulation on traced equipment shall be installed as specified in Article XIII of the GENERAL SPECIFICATIONS.

p. Surface Finish. When insulation of the specified thickness has been applied, all small cracks and depressions shall be filled with insulating cement and troweled flush with the surface.

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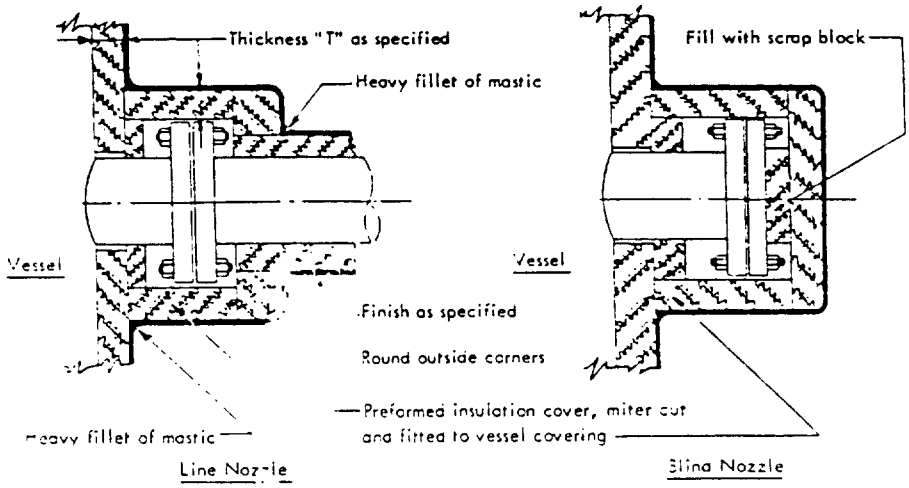
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Fibrous Glass Insulation Adjacent to Uninsulated Flanges

Figure 15-H-9



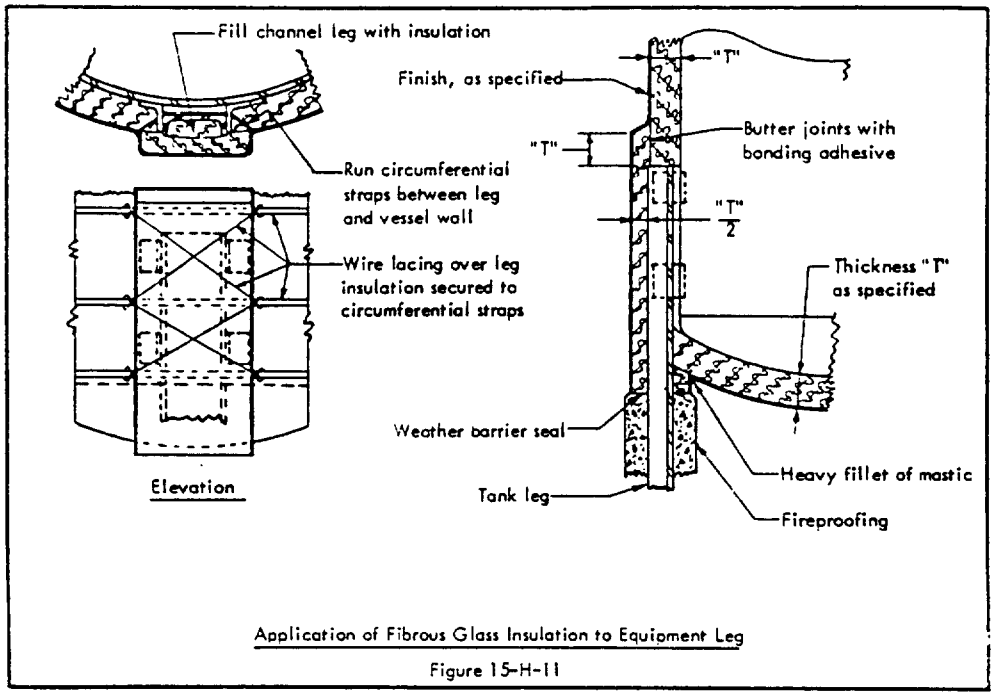
...lication of Fibrous Glass Insulation to Horizontal Vessel Nozzles

Figure 15-H-10

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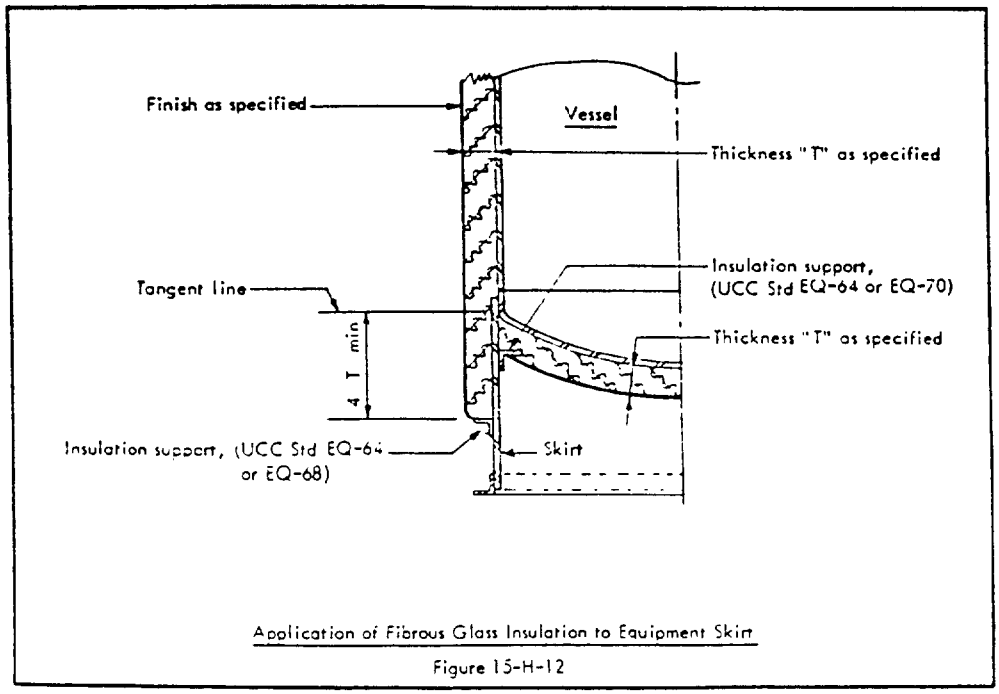
SECTION 8 - APPLICATION - contd

1. 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

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SECTION B - APPLICATION - contd

1. EQUIPMENT - contd

q. 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, o GENERAL SPECIFICATIONS.

(b) Flat Surfaces and Heads of Equipment. Weather-barrier coating shall be applied as specified in Article XIV.B of the GENERAL SPE FICATIONS.

(2) Indoor Equipment. The specified glass cloth jacket shall be adhered with uniform tautness to the surface of the insulation with bonding adhesive. All joints shall be overlapped a minimum of two inches. After adhesive has dried, the entire surface shall be coated with mastic fin coating (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 SPECIFI CATIONS.

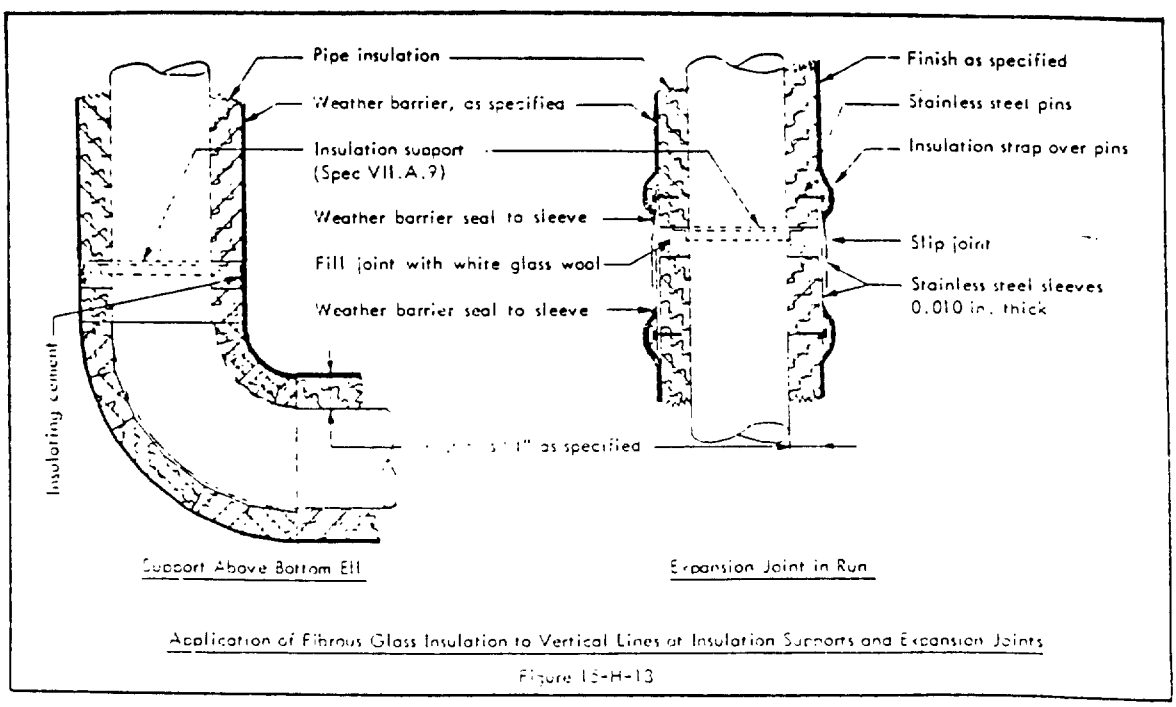
(3) Pipe insulation shall be applied to piping in staggered position in accordance with Figures GA-1 and GA-2 of the GENERAL SPECIFICAT

(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 be 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 eac 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 s ports 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 Fibrous Glass Insulation to Vertical Lines at Insulation Supports and Expansion Joints

Figure 15-H-13

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SECTION B - APPLICATION - contd

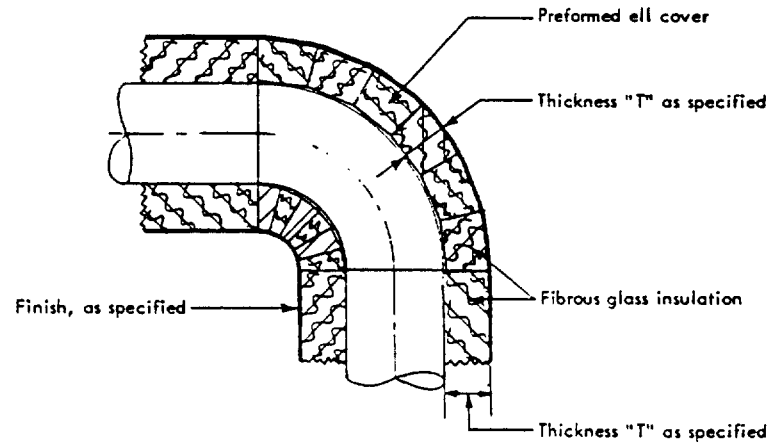
2. PIPING - contd

c. Fitting, Flange, and Valve Covers

(1) All fittings, flanges, and valves in one-inch NPS and smaller piping shall be insulated with insulating cement.

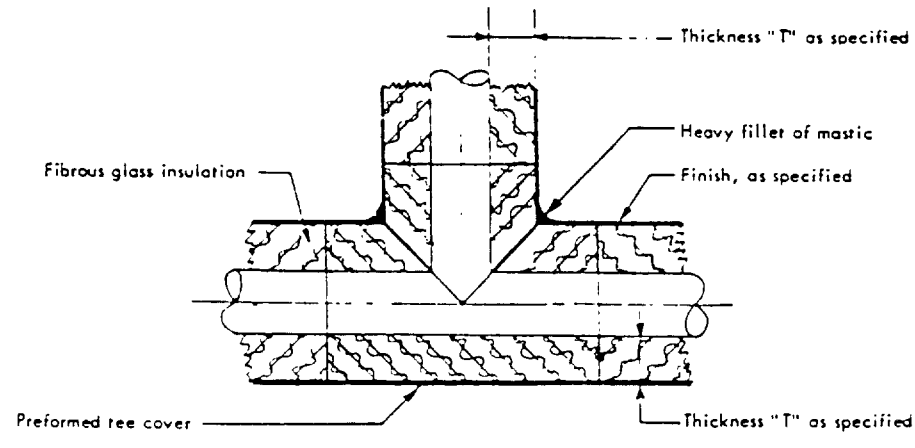
(2) With exception of ball and plug valves, all fittings, flanges, and valves over three-inch NPS shall be insulated with covers prefabricated in accordance with ASTM Recommended Practice C 450, latest revision.

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



Application of Fibrous Glass Insulation to Welded Ell

Figure 15-H-14



Application of Fibrous Glass Insulation to Welded Tee

Figure 15-H-15

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SECTION B - APPLICATION - contd

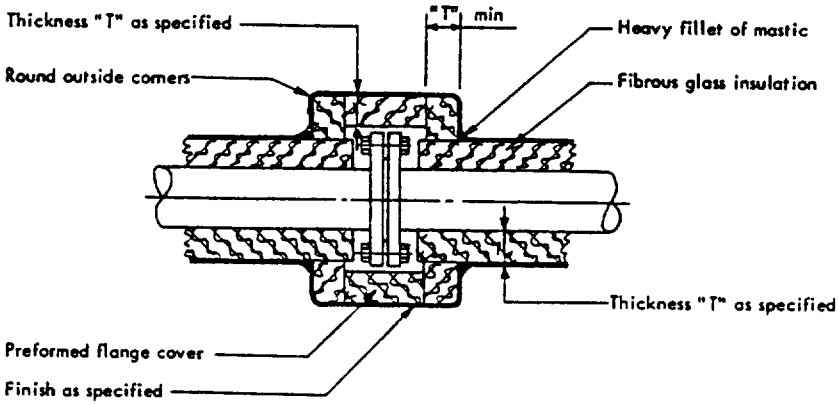
2. PIPING - contd

c. Fitting, Flange, and Valve Covers - contd

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

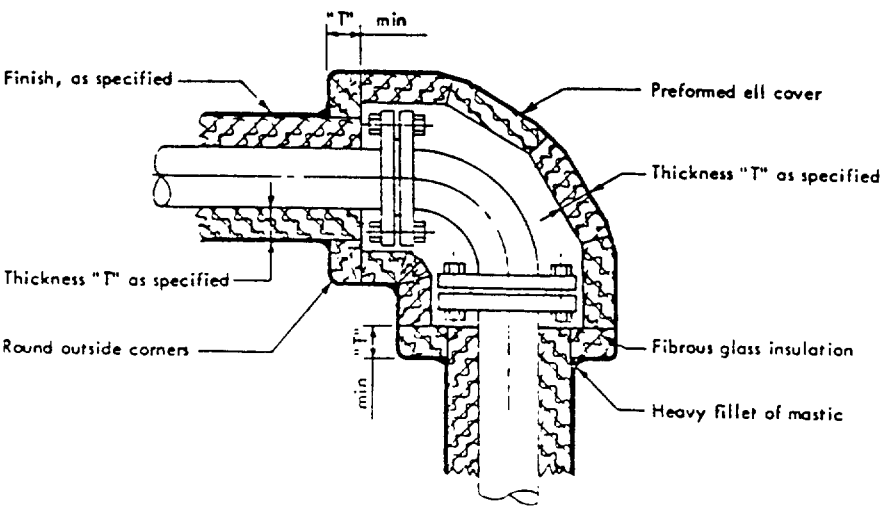
(5) All valves shall be packed and filled around valve stem and packing gland assembly with heat-resistant sealer to eliminate water pockets.

(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 Fibrous Glass Insulation to Line Flange

Figure 15-H-16



Application of Fibrous Glass Insulation to Flanged Ell

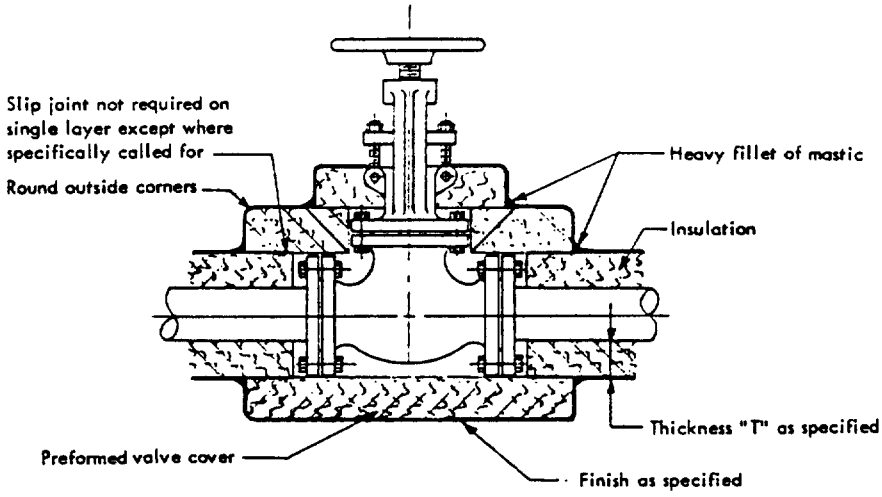
Figure 15-H-17

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SECTION B - APPLICATION - contd

2. PIPING - contd

c. Fitting, Flange, and Valve Covers - contd

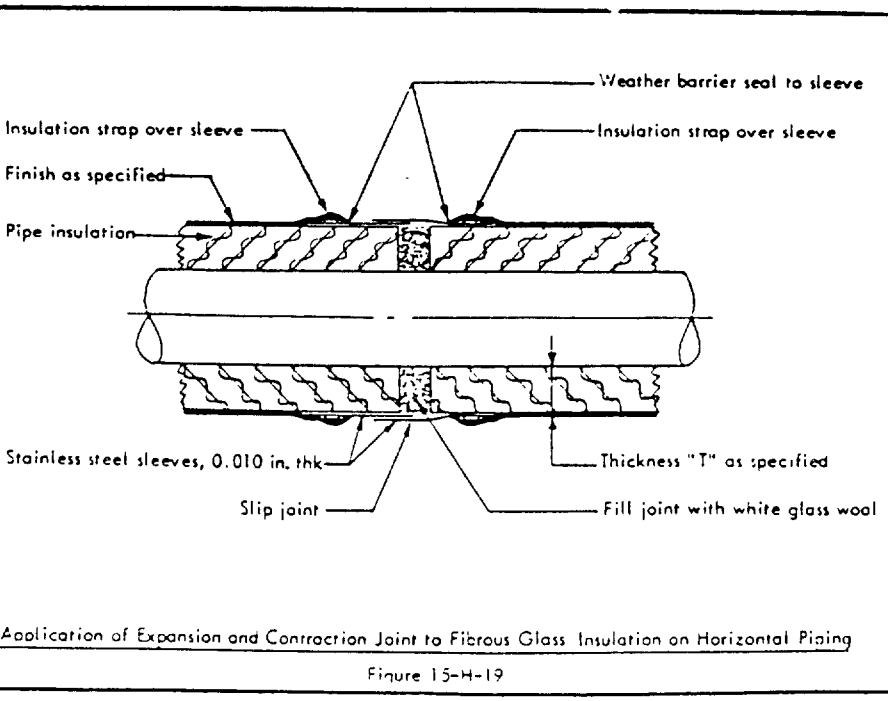


Application of Fibrous Glass Insulation to Flanged Valve

Figure 15-H-18

d. Expansion and Contraction Joints

(1) 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 15-H-19. 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.



Application of Expansion and Contraction Joint to Fibrous Glass Insulation on Horizontal Piping

Figure 15-H-19

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SECTION B - APPLICATION - contd

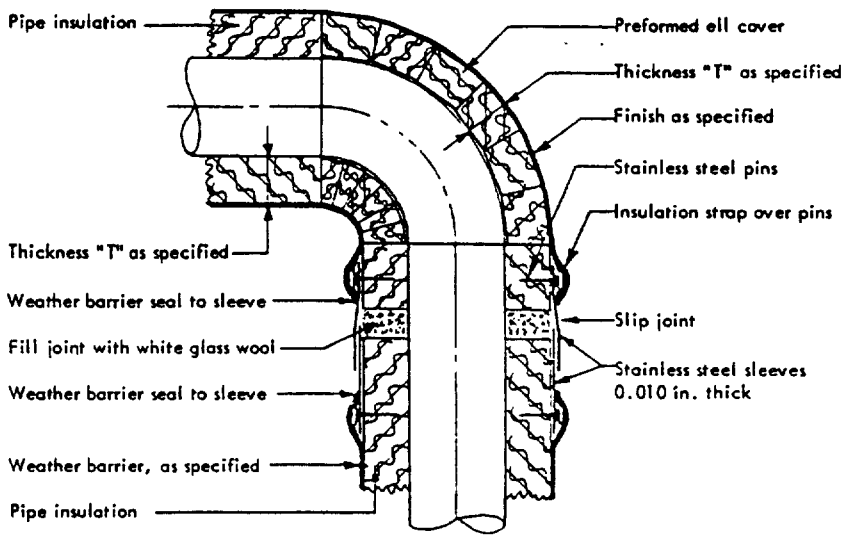
2. PIPING - contd

d. Expansion and Contraction Joints - contd

(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 a 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 slip joints shall also be provided at the junction of fitting covers and pipe insulation located at the tops of risers where riser 15 feet in height and pipe is 4-inch NPS and larger. Typical installation is shown in Figure 15-H-20.



Application of Fibrous Glass Insulation to Welded Ell 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 SPECIFICATIC

f. Surface Finish. When insulation of the specified thickness has been applied, all small cracks and depressions shall be filled with insulatin 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 XIV.B and XV. 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 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) The specified glass cloth jacket shall be adhered with uniform tautness to the surface of the insulation with bonding adhesive. Aft adhesive has dried, the entire surface shall be coated with PVA finish coating (color as specified) to present a uniform color and surfc texture.

(b) Fitting, flange, and valve covers shall be coated with weather-barrier coating as specified in Article XIV.B of the GENERAL SP FICATIONS.

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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 ope 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

1. INSULATION MATERIAL

Insulation shall be as specified in MATERIAL SPECIFICATION 15.

2. ACCESSORY MATERIALS

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

Glass Wool Blanket	VII.A. 1	White Vapor-Barrier Adhesive	VII.A
Insulating Cement	VII.A. 6	Laminated Vapor-Barrier Jacket	VII.A
Pipe Insulation Support	VII.A. 9	Curved Wood Block Isolation Supports	VII.A
Expansion Sleeve	VII.A.10	Non-Setting Sealer	VII.A
Equipment Insulation Strap	VII.A.11	Bonding Adhesive	VII.A
Clips for Equipment Strap	VII.A.12	Low Temperature Fabricating Cement	VII.A
Pipe Insulation Strap	VII.A.13	Vapor Seal Mastic	VII.A
Clips for Pipe Strap	VII.A.14	Jacket Bonding Cement	VII.A
Stainless Steel Wire	VII.A.17	Vapor Seal Lap Cement	VII.A
Welding Pins	VII.A.19	PVA Finish Coating and Lagging Adhesive	VII.A
Welding Pin Insulation Fasteners	VII.A.22	Reinforcing Cloth	VII.A
Pin Clips	VII.A.23	Weather-Barrier Mastic (color as specified)	VII.A
Fire-Retardant Vapor-Barrier Jacket and Butt Joint Strips	VII.A.72		

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 2½ inches total thickness shall be applied in multiple layers as specif Article III.E 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 in curved seg 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 su shall be used. See Item 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 tightly butted. Multiple layers shall be applied so that the butt joints of one layer do not cide with those of any other layer.

d. Flat Surfaces

(1) Block insulation shall be applied to flat surfaces in staggered position with all joints tightly butted. Multiple layers shall be applied so t butt joints of one layer do not coincide with those of any other layer.

(2) Voids and fastener depressions in insulation shall be pointed up with insulation cement and troweled flush with the surface.

e. Securement

(1) Curved Surfaces

(a) Where contour of vessel permits firm and effective attachment, all layers of preformed fibrous glass insulation shall be secured in plac stainless steel insulation strap. Where required, insulation strap shall be attached to strap anchor angles in accordance with Owner's Stan EQ-64, EQ-65, EQ-68, EQ-69 or EQ-70. Insulation applied to irregular surfaces, where use of strap is impracticable, shall be secured stainless steel wire attached to welding pins, in accordance with Owner's Standard EQ-67, drawn taut, and ends twisted together and pr into insulation. Typical installation is shown in Figure 15-L-1.

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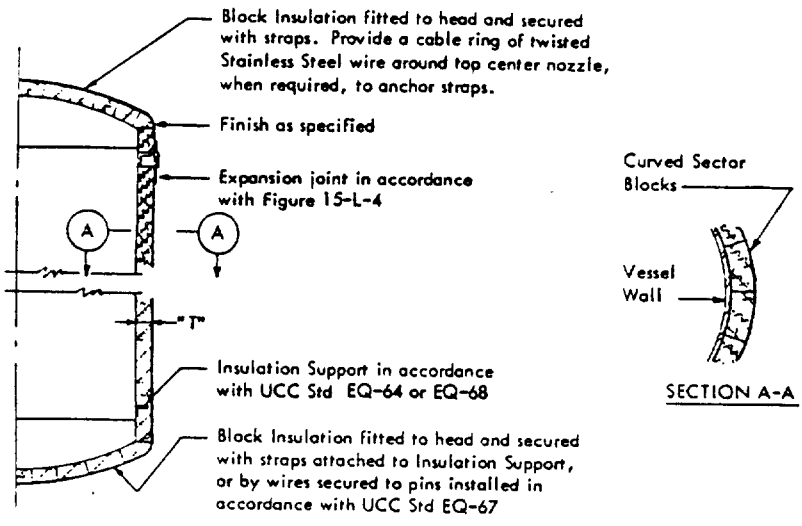
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd

e. Securement - contd

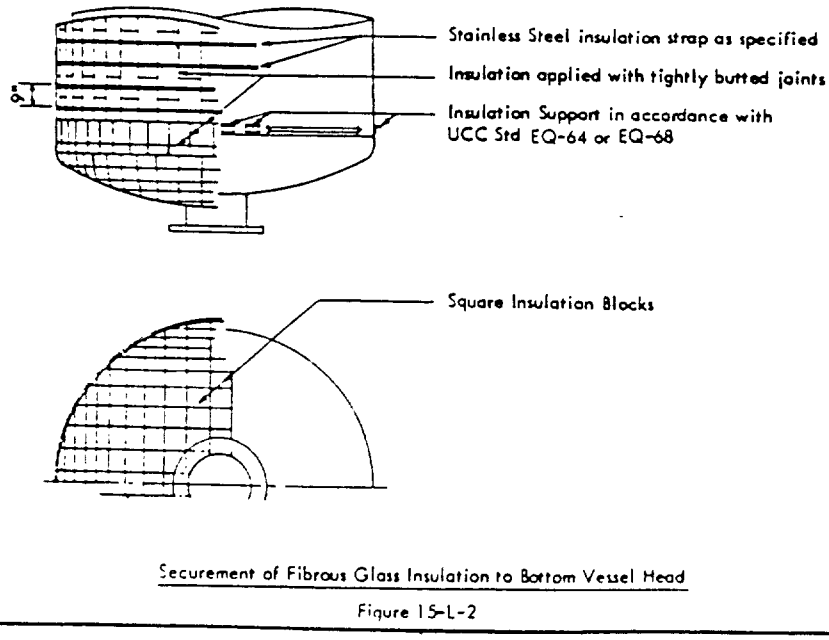
(1) Curved Surfaces - contd

(b) Preformed fibrous 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 EQ-64, EQ-65, EQ-68, EQ-69 or EQ-70. Insulation in heads of large diameter vessels (over 16 ft OD) where use of strap is impracticable shall be secured by wire attached to welding pins in accordance with Owner's Standard EQ-67 and as shown in Figure 15-L-2.



Application of Fibrous Glass Insulation to Vessel Shell and Heads

Figure 15-L-1



Securement of Fibrous Glass Insulation to Bottom Vessel Head

Figure 15-L-2

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SECTION B - APPLICATION - contd

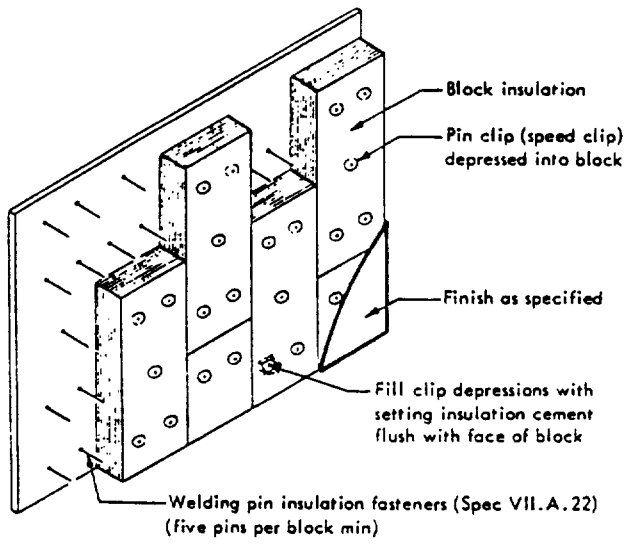
1. EQUIPMENT - contd

e. Securement - contd

(2) Flat Surfaces

(a) All layers of preformed fibrous glass insulation shall be secured with welding pin insulation fasteners and pin clips, spaced so as to prov a minimum of five attachments per block, as shown in Figure 15-L-3.

(b) Pin clips shall be pressed into insulation sufficiently to allow pins to be cut off below insulation surface.



Application of Preformed Fibrous Glass Insulation to Flat Surface

Figure 15-L-3

f. Insulation Supports. 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 15-L-4.

g. Expansion Joints. Expansion joints in flat surfaces or cylindrical vessels 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 ten pound density. Typical installation as shown in Figure 15-L-5.

h. Mechanical Expansion Joints. Corrugated mechanical expansion joints in piping (usually listed as equipment items) shall be insulated as shown i Figures 15-L-6 and 15-L-7. A slip joint shall be provided by applying an 18-inch long sleeve of 0.010 inch thick stainless steel over the pipe insulat at each end of the expansion joint, placed 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 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 which is then secured with insulation strap. The longitudinal laps of the stainless steel sleeves shall be a minimum of two inches and placed so as to shed water. Weather-barrier mastic shall be appli as specified to the ends of the expansion joint cover and carried down and sealed to the collar band. Weather-barrier mastic shall overlap the stainles steel weather jacket on the expansion joint cover.

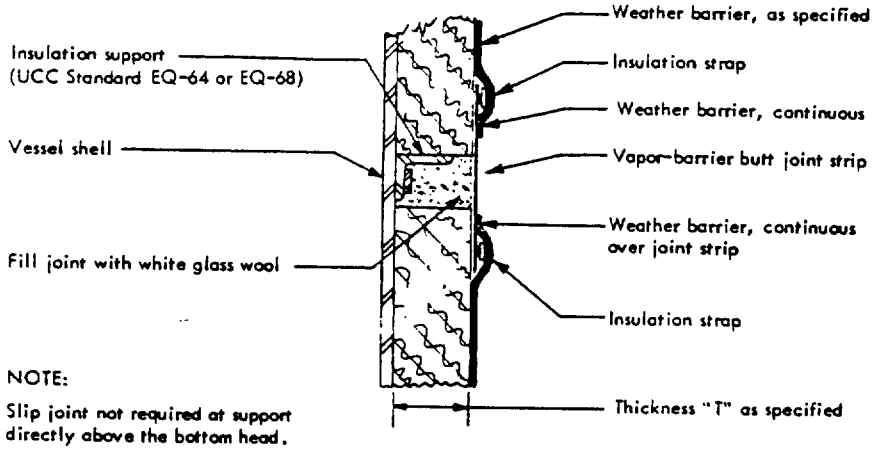
Where expansion joints are installed vertically in piping, the slip joint at the top shall be omitted and the expansion joint cover shall be securely fast to the pipe covering.

i. Insulated Vessel Flanges. Unless otherwise specified, all vessel flanges shall be insulated with preformed fibrous glass block insulation and the assembly shall be weather protected by stainless steel jacket. An insulation support shall be provided immediately above vessel flange. Assembly sha be installed so as to provide a slip joint allowing movement between insulation and weather-barrier jacket. Typical installation is shown in Figure 15-

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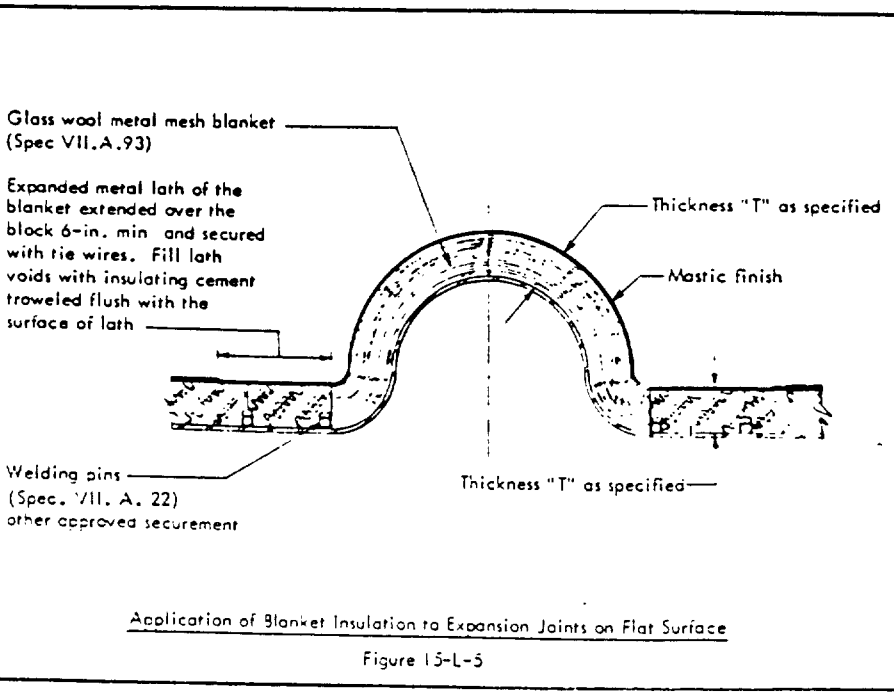
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Slip Joint to Vessel Wall at Insulation Supports

Figure 15-L-4



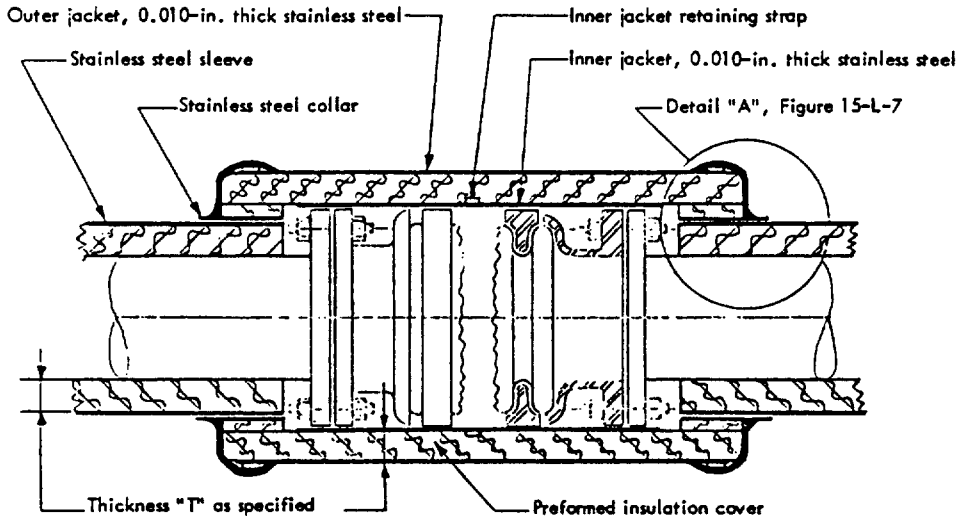
Application of Blanket Insulation to Expansion Joints on Flat Surface

Figure 15-L-5

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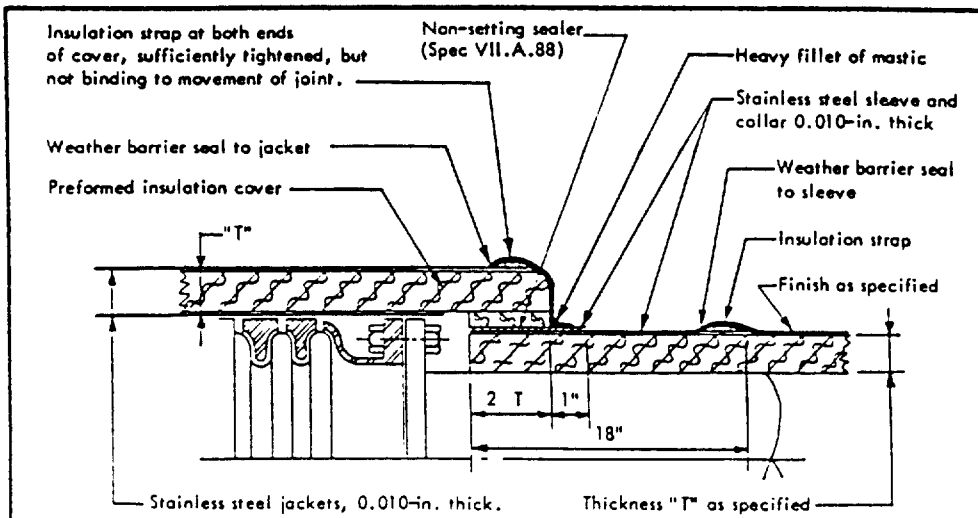
SECTION 8 - APPLICATION - contd

1. EQUIPMENT - contd



Application of Fibrous Glass Insulation to Mechanical Expansion and Contraction Joint

Figure 15-L-6



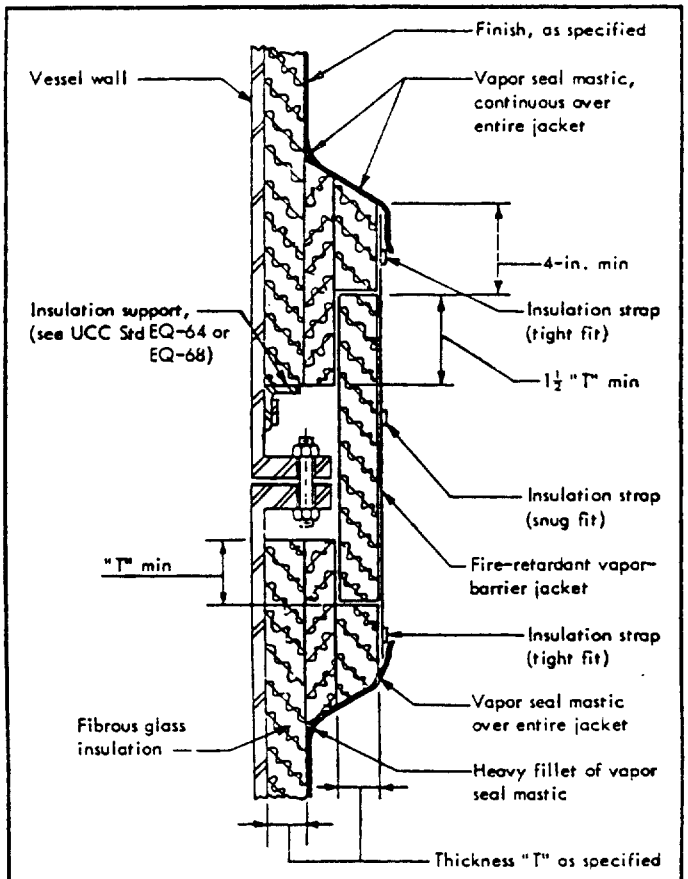
Detail "A"
(Slip Joint Detail for Figure 15-L-6)

Figure 15-L-7

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SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Slip Joint at Vessel Flange

Figure 15-L-8

j. Uninsulated Vessel Flanges. Where vessel flanges are specifically noted to be left uninsulated, the reinforcing cloth of the weather barrier on the adjacent vessel insulation shall be extended to metal of vessel body, coated with vapor seal mastic and banded 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 15-L-9.

k. Vessel Nozzles. Unless otherwise specified, all vessel nozzles shall be insulated as shown in Figure 15-L-10.

l. Vessel Legs

(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 body of vessel.

(2) Channel legs shall be insulated with block which shall extend over channel flanges and down channel legs to fireproofing. Thickness shall be a minimum of one-half that specified for body of vessel.

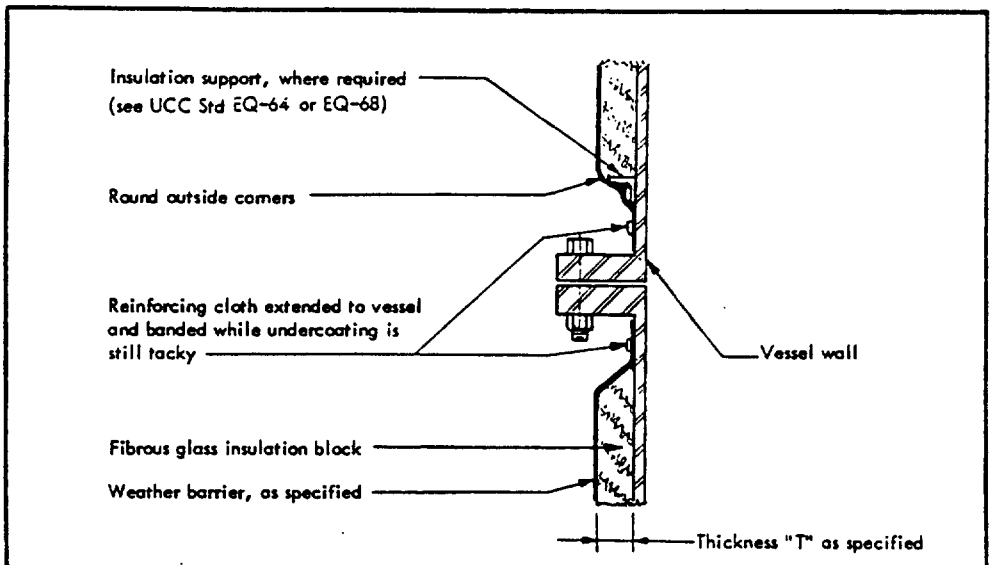
(3) Vessel insulation shall be butted firmly against tank leg flanges. Reentrant space between channel flanges and over channel flanges between body insulation shall be filled with block cemented in place with bonding adhesive. Installation shall be as shown in Figure 15-L-11.

m. 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 Standard's EQ-64 or EQ-70 and EQ-67, respectively. Installation shall be as shown in Figure 15-L-12.

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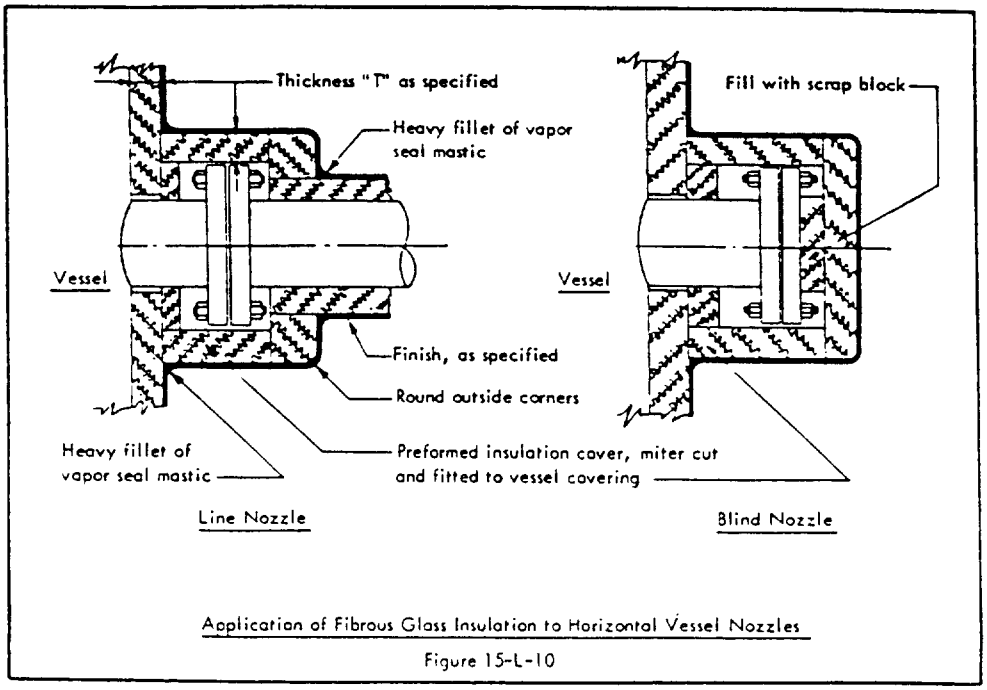
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Fibrous Glass Insulation Adjacent to Uninsulated Flanges

Figure 15-L-9



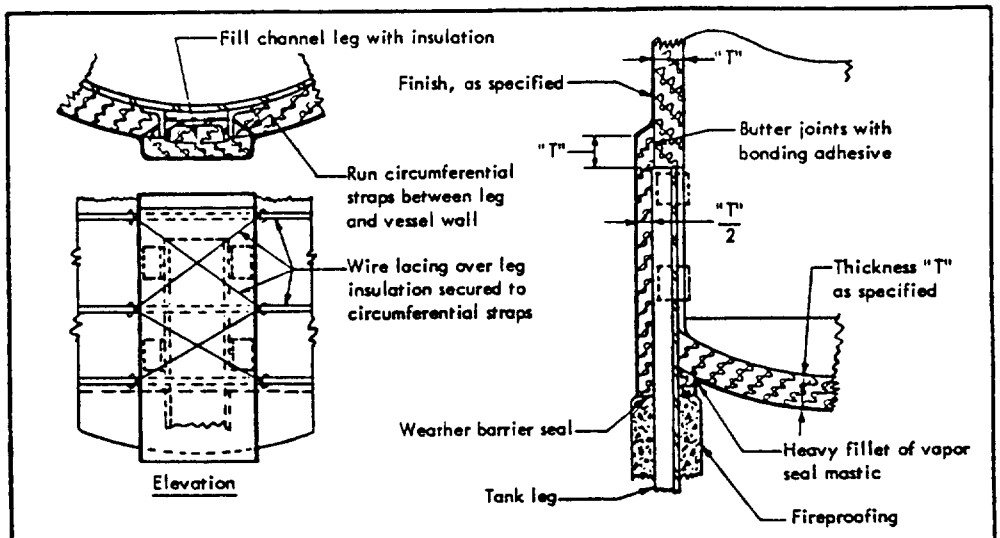
Application of Fibrous Glass Insulation to Horizontal Vessel Nozzles

Figure 15-L-10

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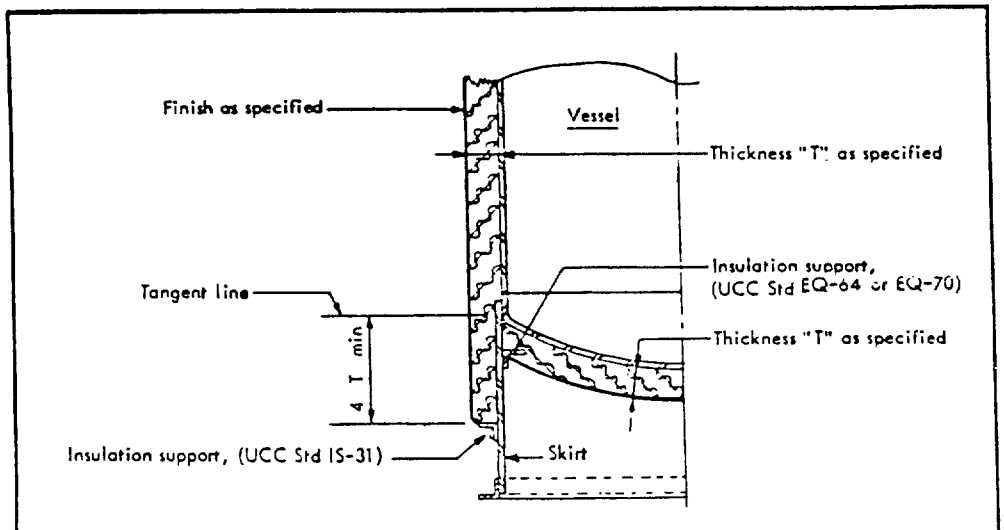
SECTION 8 - APPLICATION - contd

1. EQUIPMENT - contd



Application of Fibrous Glass Insulation to Equipment Leg

Figure 15-L-11



Application of Fibrous Glass Insulation to Equipment Skirt

Figure 15-L-12

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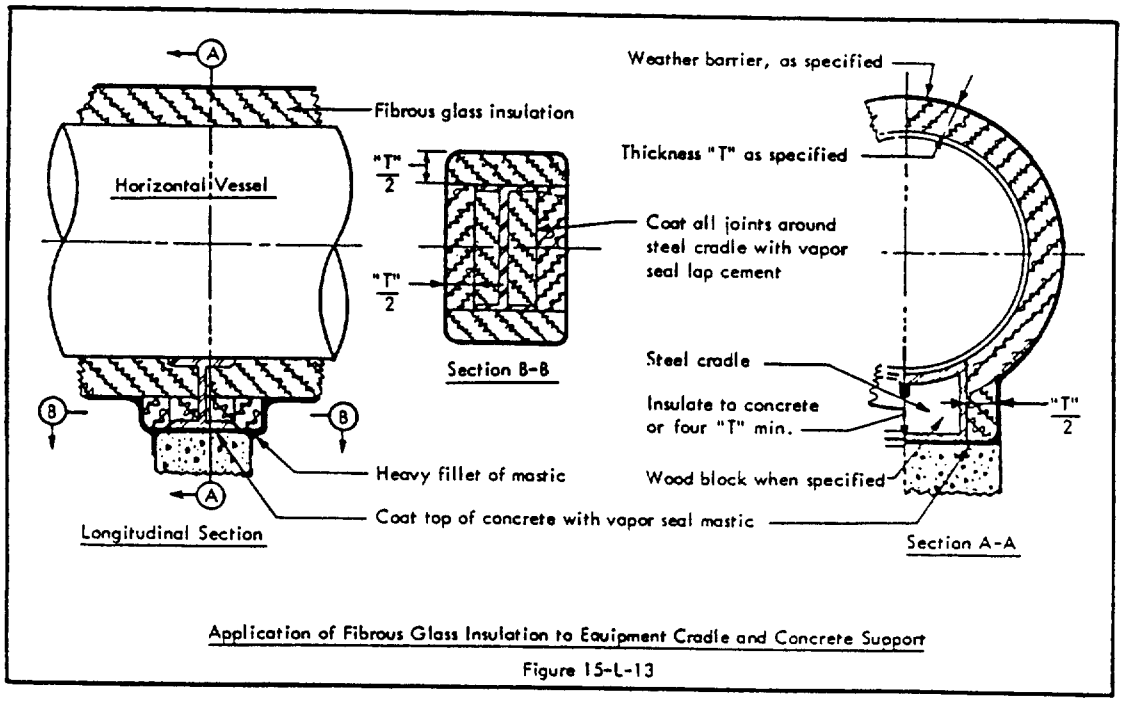
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd

n. Equipment Supports

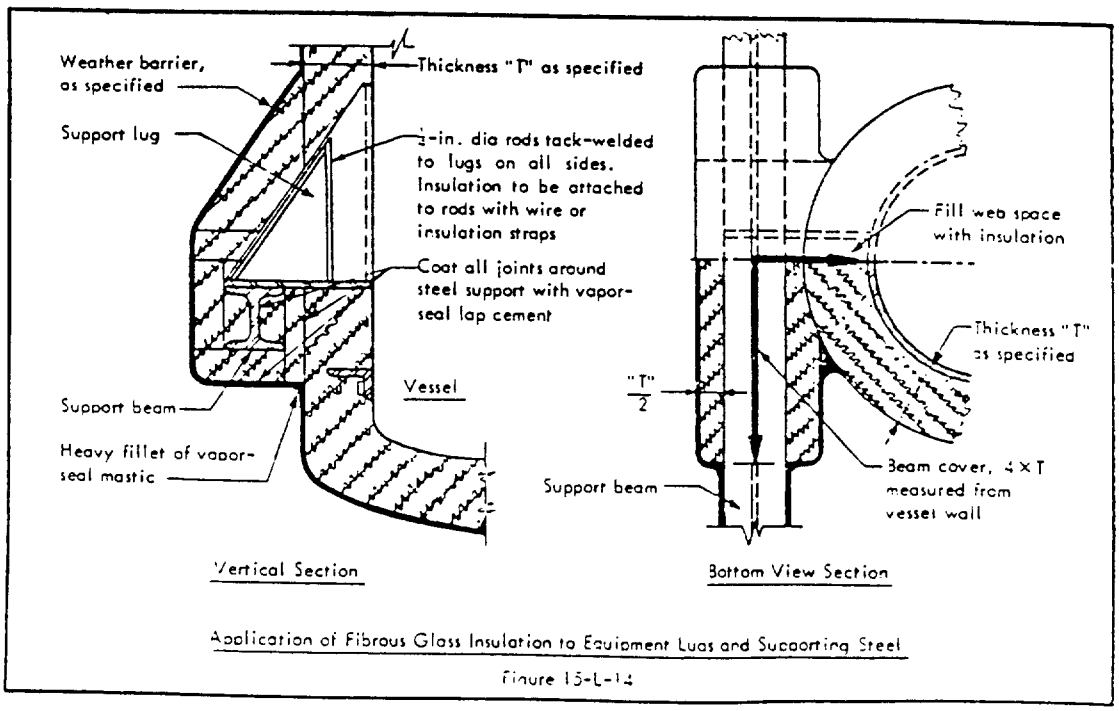
(1) Where equipment is supported on cradles, vessel insulation shall extend over cradles as shown in Figure 15-L-13.

(2) Where equipment is supported by structural steel members, insulation shall extend not less than four times the specified insulation thickne each direction, measured from junction of vessel with insulated support lug. Thickness of insulation over steel supports shall be not less than c half that specified for body of vessel. Thickness of insulation over support lugs shall be the same as that of body insulation. Installation shall as shown in Figure 15-L-14.



Application of Fibrous Glass Insulation to Equipment Cradle and Concrete Support

Figure 15-L-13



Application of Fibrous Glass Insulation to Equipment Lugs and Supporting Steel

Figure 15-L-14

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SECTION 8 - APPLICATION - contd

1. EQUIPMENT - contd

o. Vapor Barrier

(1) All small cracks and depressions in the surface of each layer of pipe or block insulation shall be filled with insulation cement and troweled flush with the surface before application of fire-retardant vapor-barrier jackets or vapor seal mastic.

(2) Fire-retardant vapor-barrier jacket shall be installed smoothly over each layer of cylindrical insulation, using jacket bonding cement to attach it to the insulation surface. Edges shall be overlapped a minimum of two inches and sealed to form a completely tight envelope. Circumferential joints shall be sealed with fire-retardant vapor-barrier butt joint strips centered on and wrapped tightly around joints.

(3) Each layer of block insulation on heads or irregular surfaces, where use of jackets is impracticable, shall be coated with vapor seal mastic applied to a minimum wet film thickness of 3/16 inch. Care shall be taken to form a complete seal between the surface of the mastic-coated block insulation and the jacket surface.

p. Weather Barrier. Weather-barrier coating shall be applied as specified in Article XIV.8 of the GENERAL SPECIFICATIONS.

2. PIPING

a. Pipe Insulation

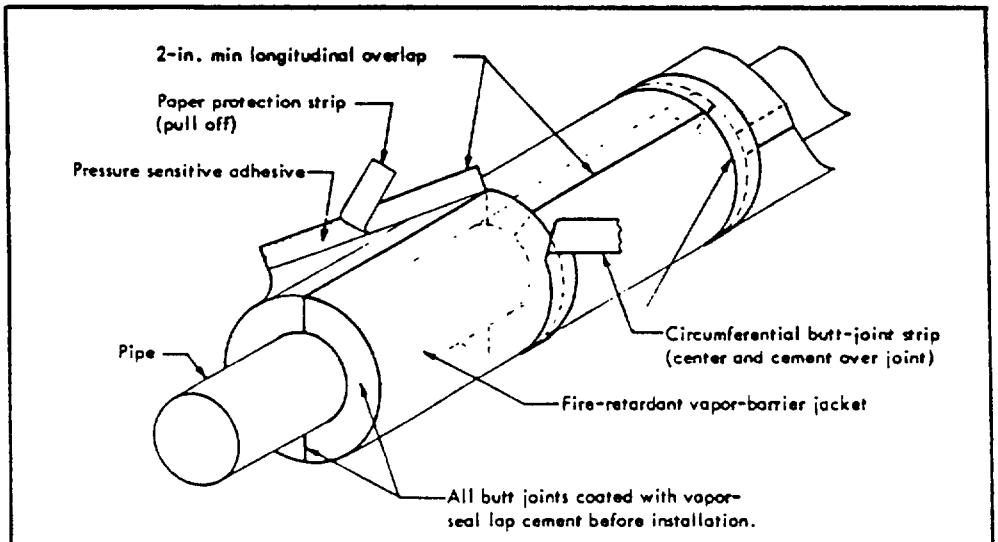
(1) Pipe insulation shall be supported and secured as specified in Article III of the GENERAL SPECIFICATIONS.

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

(3) Pipe insulation furnished with factory-applied fire-retardant vapor-barrier jacket as described in MATERIAL SPECIFICATION 15 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. Typical installation is shown in Figure 15-L-15.

(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 vapor-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.



Application of Fibrous Glass Pipe Insulation with Self-Sealing Lap Jacket

Figure 15-L-15

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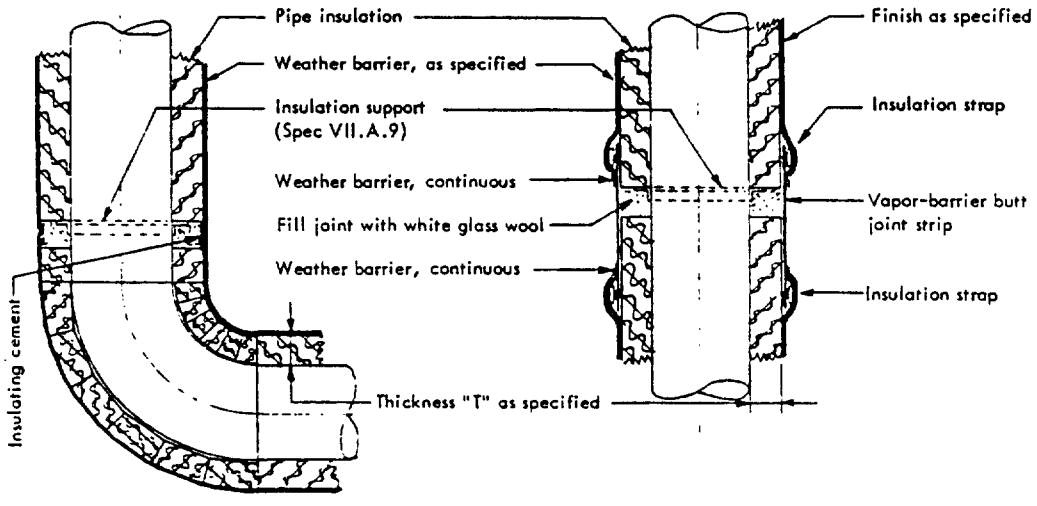
SECTION B - APPLICATION - contd

2. PIPING - contd

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 bottom elbow. Typical installation is shown in Figure 15-L-16. A pipe insulation support shall also be installed abc 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 s ports shall be installed on approximately 15-foot centers to provide for installation of expansion joint as shown in Figure 15-L-16.



Application of Fibrous Glass Insulation to Vertical Lines at Insulation Supports and Expansion Joints

Figure 15-L-16

c. Fitting, Flange, and Valve Covers

(1) All fittings, flanges, and valves in one-inch NPS and smaller piping shall be insulated with insulating cement.

(2) Fitting, flange, and valve covers for piping larger than one-inch NPS shall be factory-molded or prefabricated in accordance with ASTM Recommended Practice C 450, latest revision.

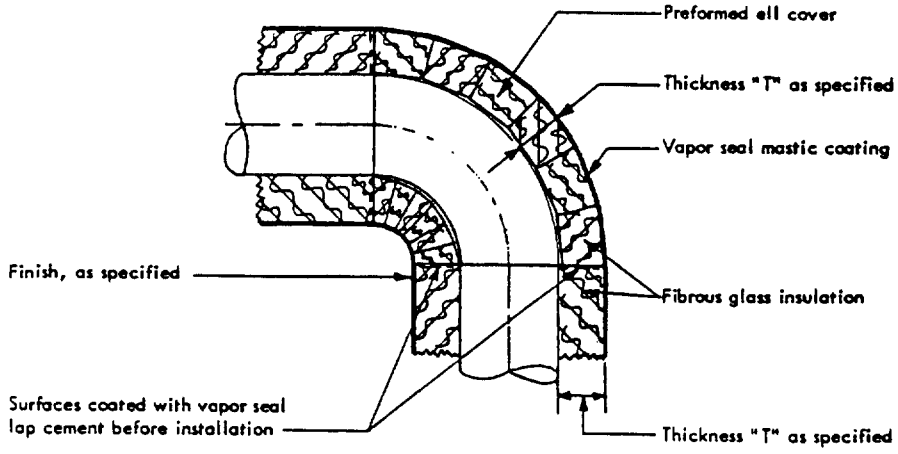
(3) Cementing of shop assemblies shall be done with low-temperature fabricating cement. In all cases the joints shall be as thin as possible wit just sufficient cement to obtain good adhesion and complete closure. In no case will wide cement joints or voids and holes plugged with cemen be permitted.

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SECTION 8 - APPLICATION - contd

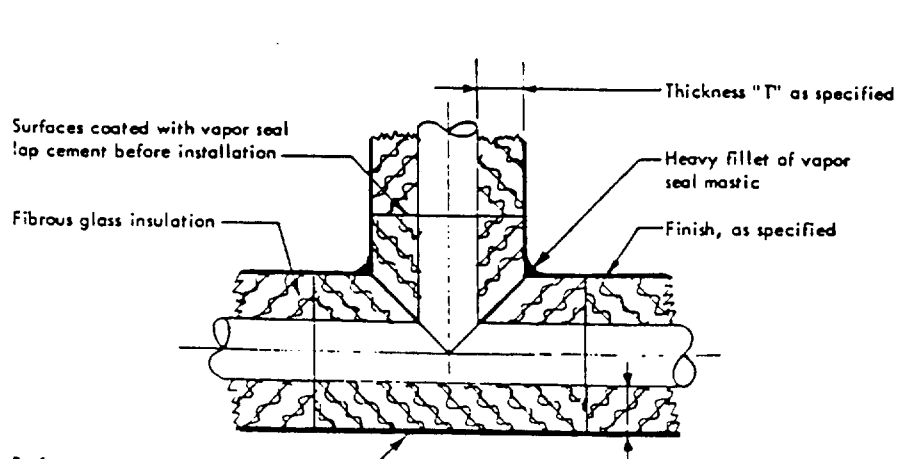
2. PIPING - contd

c. Fitting, Flange, and Valve Covers - contd



Application of Fibrous Glass Insulation to Welded Ell

Figure 15-L-17



Application of Fibrous Glass Insulation to Welded Tee

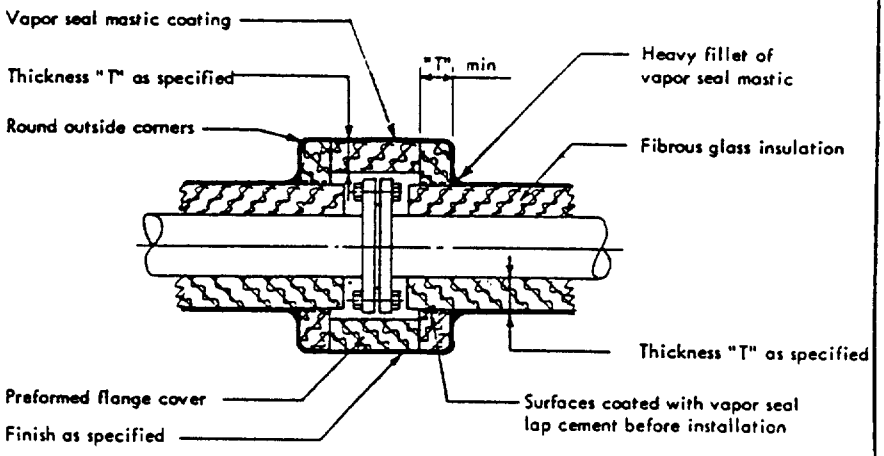
Figure 15-L-18

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SECTION 8 - APPLICATION - contd

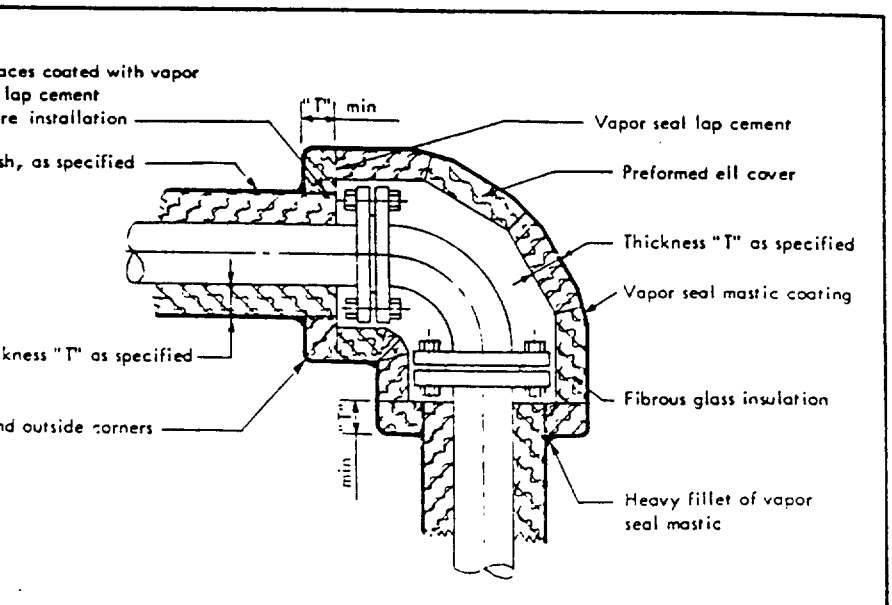
2. PIPING - contd

c. Fitting, Flange, and Valve Covers - contd



Application of Fibrous Glass Insulation to Line Flange

Figure 15-L-19



Application of Fibrous Glass Insulation to Flanged Ell

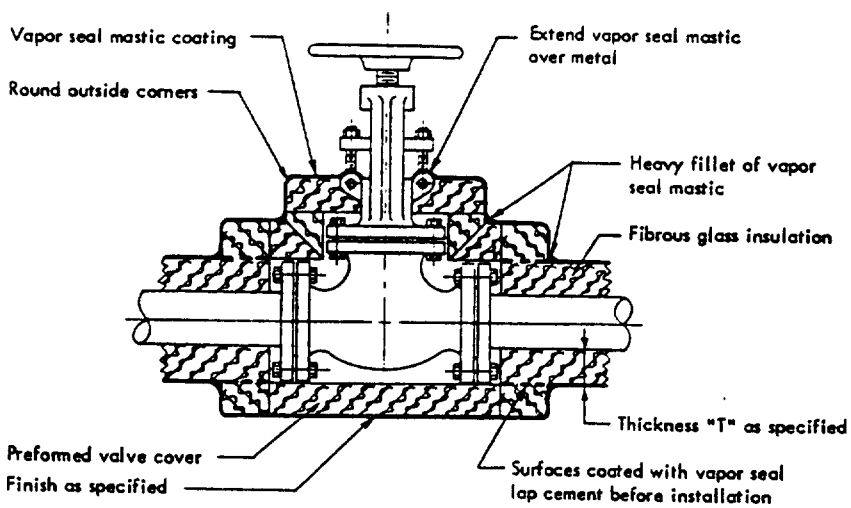
Figure 15-L-20

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SECTION B - APPLICATION - contd

2. PIPING - contd

c. Fitting, Flange, and Valve Covers - contd



Application of Fibrous Glass Insulation to Flanged Valve

Figure 15-L-21

d. Vapor Barrier

(1) All small cracks and depressions in the surface of each layer of pipe insulation, of larger sizes than 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.

(2) 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 two inches and sealed to form a completely tight envelope. Circumferential joints shall be sealed with fire-retardant vapor-barrier butt joint strips centered on and wrapped tightly around joints.

e. Surface Finish

(1) Outdoor Pipe and Fittings

(a) Weather-barrier coating or jacket shall be applied as specified in Articles XIV.B and XV.B, respectively, of the GENERAL SPECIFICATIONS.

(b) Fitting, flange, and valve covers shall be coated with vapor seal mastic applied to a minimum wet film thickness of 3/16 inch, and covered with reinforcing cloth applied as specified in Article XIV.B of the GENERAL SPECIFICATIONS.

(2) Indoor Pipe and Fittings

(a) The surface of the fire-retardant 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.

(b) Fitting, flange, and valve covers shall be vapor sealed as specified in Paragraph (1).(b) above, then coated with PVA finish coating and lagging adhesive (color as specified).

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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 tem tures 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. 9	Vapor Seal Lap Cement	VII.
Strapping Tape	VII.A.33	PVA Finish Coating and Lagging Adhesive	VII.
Fabricating Cement	VII.A.47	Weather-Barrier Mastic (color as specified)	VII.
Fire-Retardant Vapor-Barrier Jacket and Butt Joint Strips	VII.A.72	Reinforcing Cloth	VII.

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 SPECIF TIONS.

(3) Pipe insulation furnished with factory-applied fire-retardant vapor-barrier jacket, as described in MATERIAL SPECIFICATION 15, sha installed on pipe without removing the jacket. The insulation shall be secured and sealed by means of the self-sealing longitudinal lap. Ci ferential 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 c ance with Figures GA-1 and GA-2 of the GENERAL SPECIFICATIONS. Insulation shall be applied with all joints tightly butted and fitted 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 seal lap cement before application. Longitudinal joints and circumferential joints of insulation without jackets shall be sealed with vapor se 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 j strip applied circumferentially in the center of each 3-foot section.

b. Fitting, Flange, and Valve Covers

(1) With exception of ball and plug valves, all fittings, flanges, and valves over three-inch NPS shall be insulated with covers prefabricate accordance 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.

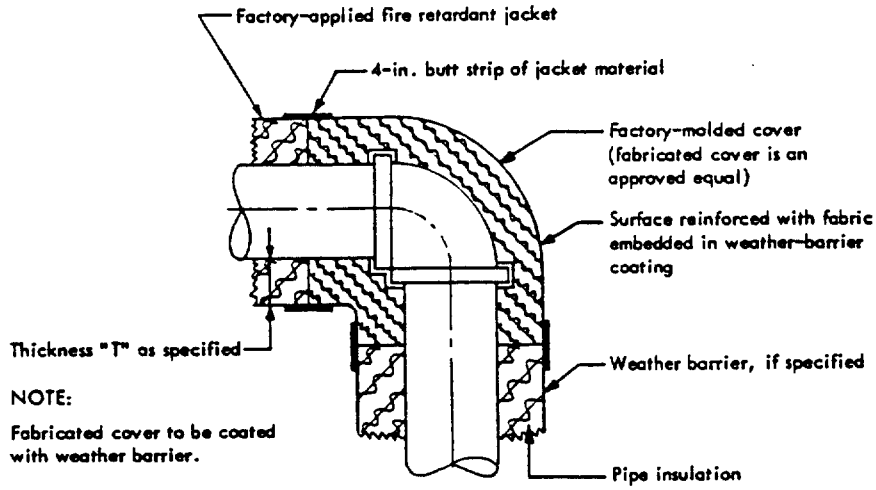
(4) The two halves of factory-molded covers shall be strapped together with strapping tape.

(5) The two halves of fabricated covers shall be cemented together with fabricating cement. In all cases the joints shall be as thin as possi with just sufficient cement to obtain good adhesion and complete closure. In no case will wide cement joints, or voids and holes plugged wi cement, be permitted.

(6) The pipe 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 1.a.(3) of this section.

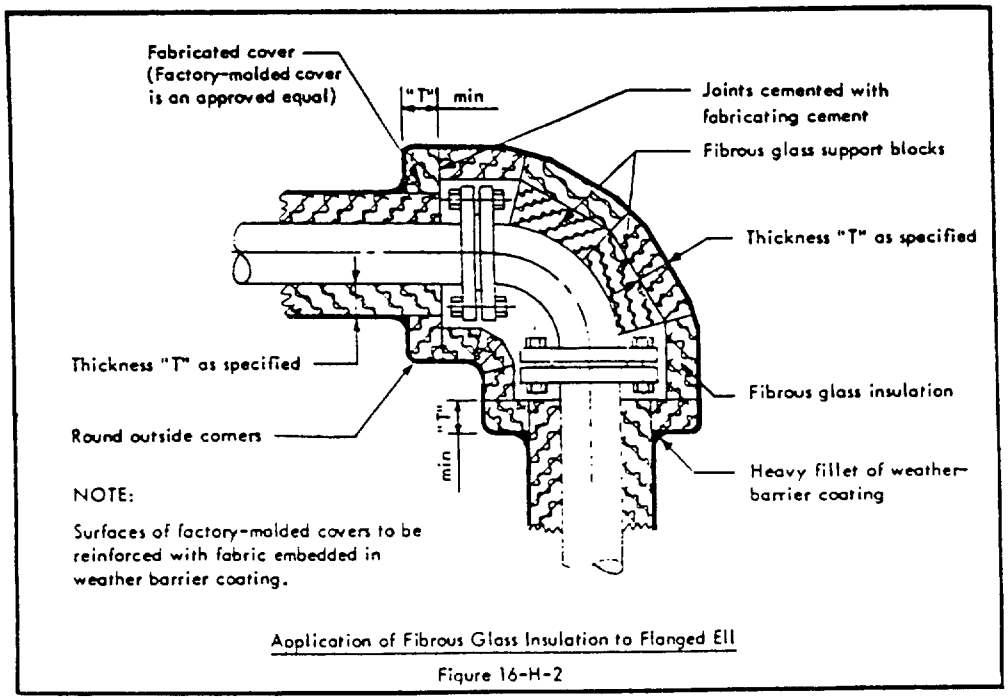
SECTION B - APPLICATION - contd

1. PIPING - contd



Application of Fibrous Glass Insulation to Screwed Ell

Figure 16-H-1



Application of Fibrous Glass Insulation to Flanged Ell

Figure 16-H-2

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SECTION 8 - APPLICATION - contd

2. SURFACE FINISH

a. Outdoor Piping. Weather-barrier coating or jacket shall be applied as specified in Articles XIV.B and XV.B, respectively, of the GENERA 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

This specification describes the 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 as specified in MATERIAL SPECIFICATION 17-RX.

2. ACCESSORY MATERIALS

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

Welding Pin Insulation Fasteners	VII.A. 22	Outer Covering	VII.A.
Pin Clips	VII.A. 23	Joint Sealing Tape	VII.A
Adhesive Type Pins	VII.A. 75	Weather-Barrier Mastic	VII.B.
PVA Finish Coating and Lagging Adhesive	VII.A. 99	Reinforcing Cloth	VII.B.
Fire-Resistant Adhesive	VII.A.100		

SECTION B - APPLICATION

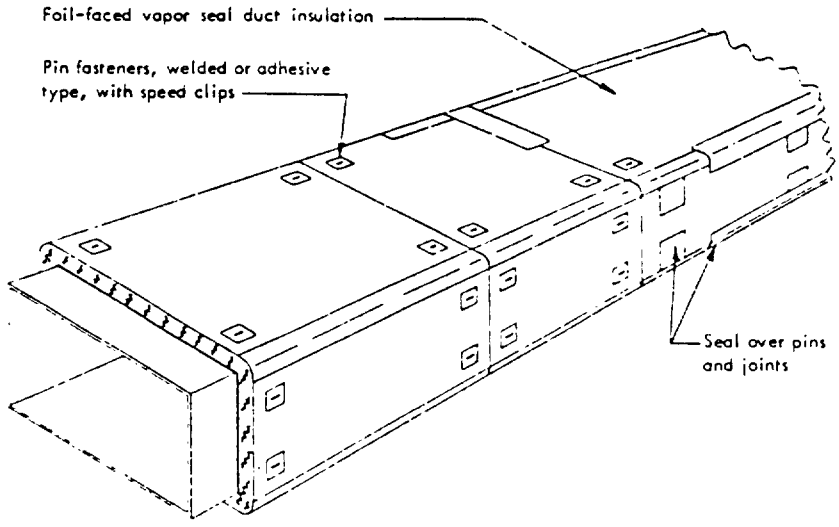
1. THICKNESS OF INSULATION

Thickness of insulation shall be as scheduled.

2. CONCEALED INDOOR DUCTS

a. Joints. Insulation shall be applied with all joints tightly butted.

b. Securement. Where welding is permitted, insulation shall be attached to ducts with welding pins and pin clips. 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 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 ther Pins shall be cut off 1/16 inch from outside of clips or washers. Typical installation is shown in Figure 17-RX-1.



Application of Preformed Fibrous Glass Vapor Seal Rigid-Faced Insulation to Exterior of Duct

Figure 17-RX-1

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SECTION 8 - APPLICATION - contd

2. CONCEALED INDOOR DUCTS - contd

c. Vapor Barrier. All joints, cracks, punctures, and breaks shall be sealed with joint sealing tape to form a continuous vaportight envelope. The tape shall be adhered to the factory-applied vapor barrier with fire-resistant adhesive. Where pins project through insulation, holes shall be sealed with this adhesive.

3. EXPOSED INDOOR DUCTS

a. Joints, Securement, and Vapor Barrier. Joints, securement, and vapor barrier shall be as specified in Item 2 of this section.

b. Outer Covering. Canvas outer covering shall be adhered to the surface of the insulation on exposed indoor ducts with PVA finish coating and lagging adhesive (color as specified), used as an adhesive. After the adhesive has dried, the outer covering shall be coated with this material, used as a coating, to present a uniform color and surface texture.

4. OUTDOOR DUCTS

a. Joints, Securement, and Vapor Barrier. Joints, securement, and vapor barrier shall be as specified in Item 2 of this section.

b. Weather Barrier. Before application of weather barrier, all depressions in the surface of the insulation shall be filled with weather-barrier mastic and troweled smooth. 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

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	PVA Finish Coating and Lagging Ashesive	VII.A.
Pin Clips	VII.A.23	Fire-Resistant Adhesive	VII.A.
Adhesive Type Pins	VII.A.75	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 surfac 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 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 ap 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 sid 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 mas 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 applie 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 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 lag adhesive shall be applied to all interior surfaces of the insulation to reduce friction loss and improve absorption of low-frequency fan noise.

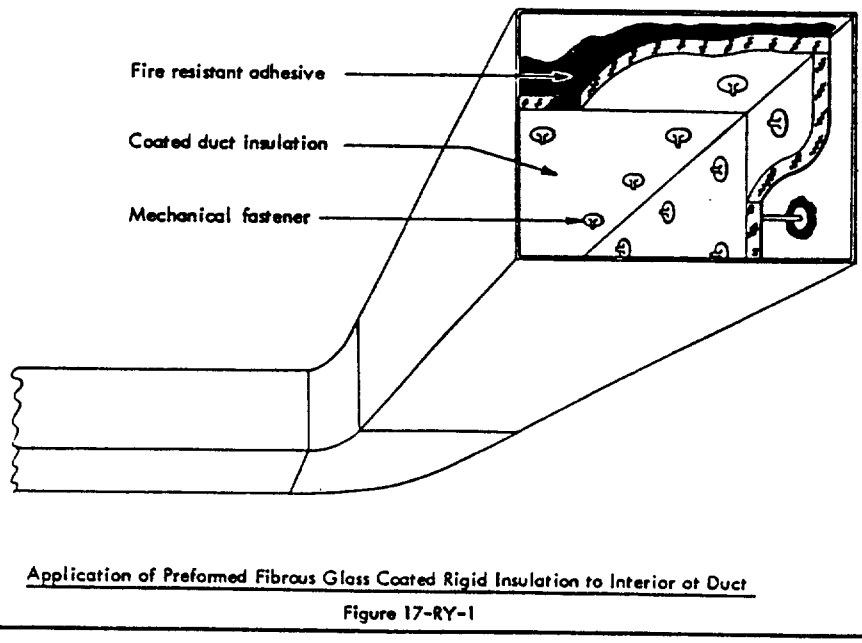
4. TYPICAL INSTALLATION

Typical installation is shown in Figure 17-RY-1.

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SECTION B - APPLICATION - contd

4. 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

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 u 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

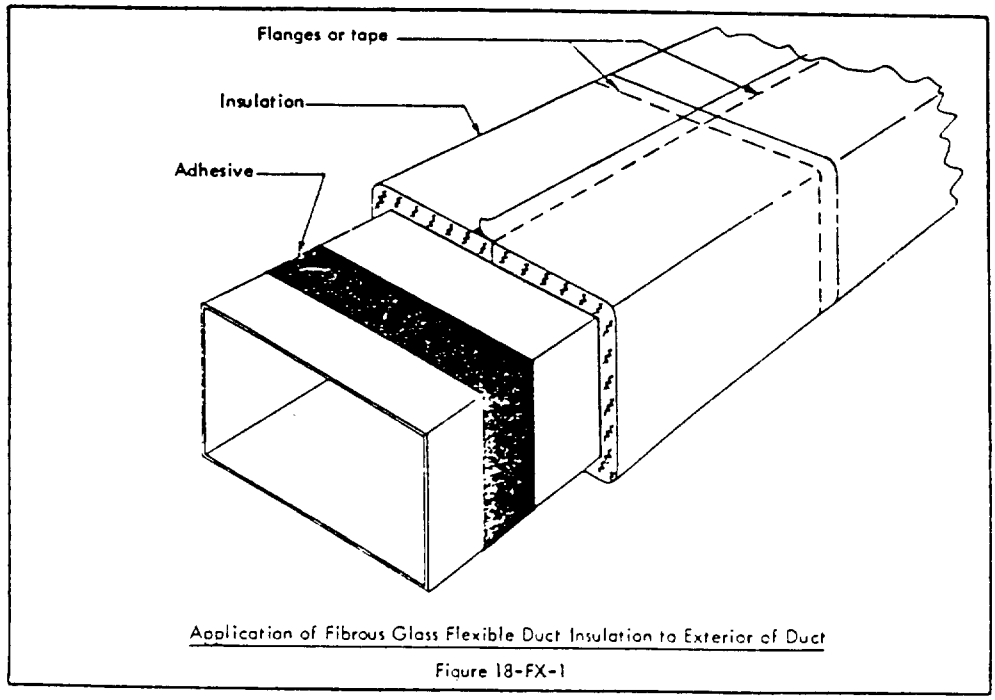
SECTION B - APPLICATION

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-



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 fo supply and return air ducts carrying conditioned and warm air respectively.

SECTION A - MATERIALS

1. INSULATION MATERIAL

Insulation shall be as specified in MATERIAL SPECIFICATION 18-FY.

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
Grip Nails	VII.A.73
Fire-Resistant Adhesive	VII.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 insulation 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 s 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 liner facing the air stream.

b. Methods of Attachment

(1) Air Flow Velocities from 0 to 1500 fpm

(a) Before installing the liner on the metal sheet from which the duct is to be formed, the leading edge of the liner shall be coated wit resistant adhesive. The liner shall be attached to the duct metal with grip nails, applied at each end three inches from the corner, the spaced every six 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 l 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 3

(b) An alternative method of attachment is to adhere the liner to all interior duct surfaces with fire-resistant adhesive, applied at a mi 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 o duct exceeds 12 inches, and on the sides when the height exceeds 24 inches. The pins shall be installed along the longitudinal center of the duct panels, starting 2 to 3 inches from the end of the duct and at a maximum spacing of 16 inches on centers thereafter.

(2) Air Flow Velocities from 1500 to 4000 fpm

(a) Fire-resistant adhesive shall be brushed on all leading edges and 6 inches back under leading edges of the liner to hold it to the du

(b) Grip nails shall be applied as specified in Paragraph (1).(a) above.

(3) Air Flow Velocities from 4000 fpm through 6000 fpm

(a) Before installation, all edges of the duct liner shall be given a heavy coat (1/8-inch thick) of fire-resistant adhesive.

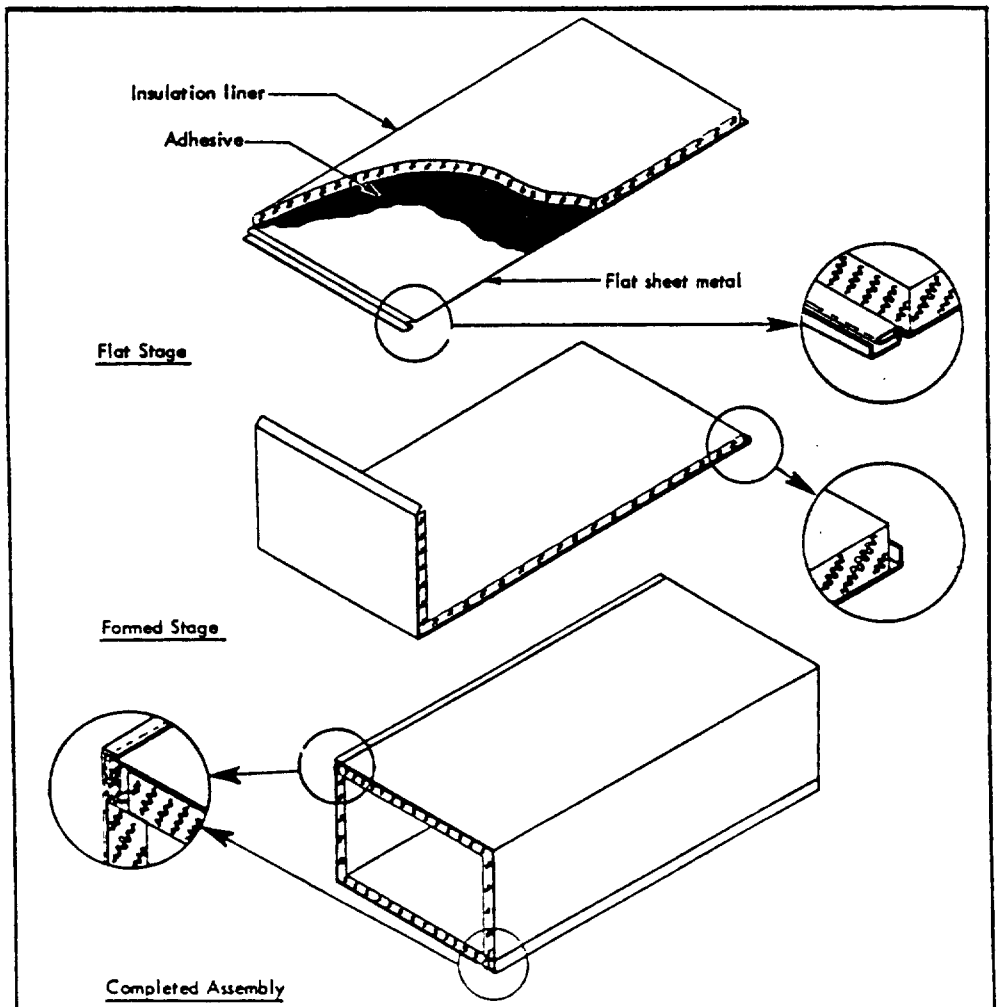
(b) The duct liner shall be attached to the duct by welded pins and pin clips on 12-inch centers and fire-resistant adhesive applied at c mum coverage of 50 percent.

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SECTION B - APPLICATION - contd

4. TYPICAL INSTALLATION

Typical installation of duct liner insulation is shown in Figure 18-FY-1.



Application of Fibrous Glass Flexible Duct Insulation to Interior of Duct

Figure 18-FY-1

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THERMAL INSULATION APPLICATION SPECIFICATIONS
MINERAL FIBER 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, an 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 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 MATERIALS

a. Mineral wool insulation with integral aluminum facing shall be as specified in MATERIAL SPECIFICATION 19.

b. Expanded silica block insulation shall be as specified in MATERIAL SPECIFICATION 22.

2. ACCESSORY MATERIALS

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

Insulating Cement	VII.A. 7	Studs*	VII.A.29
Equipment Insulation Strap	VII.A.11	Stud Nuts*	VII.A.30
Clips for Equipment Strap	VII.A.12	Sheet Metal Screws	VII.A.32
Expansion Springs or Bands	VII.A.15	Aluminum Flashing	VII.A.31
Clips for Expansion Springs or Bands	VII.A.16	High Temperature Fabricating Cement	VII.A.34
Stainless Steel Wire	VII.A.17	Mastic	VII.A.45
Welding Pins (alternative securement in place of welding pin insulation fasteners and pin clips)	VII.A.19	Lap Setting Sealer	VII.A.46
Welding Pin Insulation Fasteners	VII.A.22	Weather-Barrier Mastic	VII.B.1.c
Pin Clips	VII.A.23	Reinforcing Cloth	VII.B.1.b
"S" Clips	VII.A.27	Cellular Glass Insulation - MATERIAL SPECIFICATION 10	

*When punched 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 installe on roof or head shall be as shown on Insulation Schedule.

b. Insulation Supports and Securements

(1) Flat and cone head vessels shall have an angle or plate continuously welded to intersection of vessel top and side walls to provide for insulation securement and water shed. This is shown in Figure 19-H-1.

(2) If panel insulation on side wall of vessel does not extend to base of vessel, an angle with an outstanding leg ½-inch greater in length than insulation thickness 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 pin (Sect. VII.A.22) 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 EQ-67.

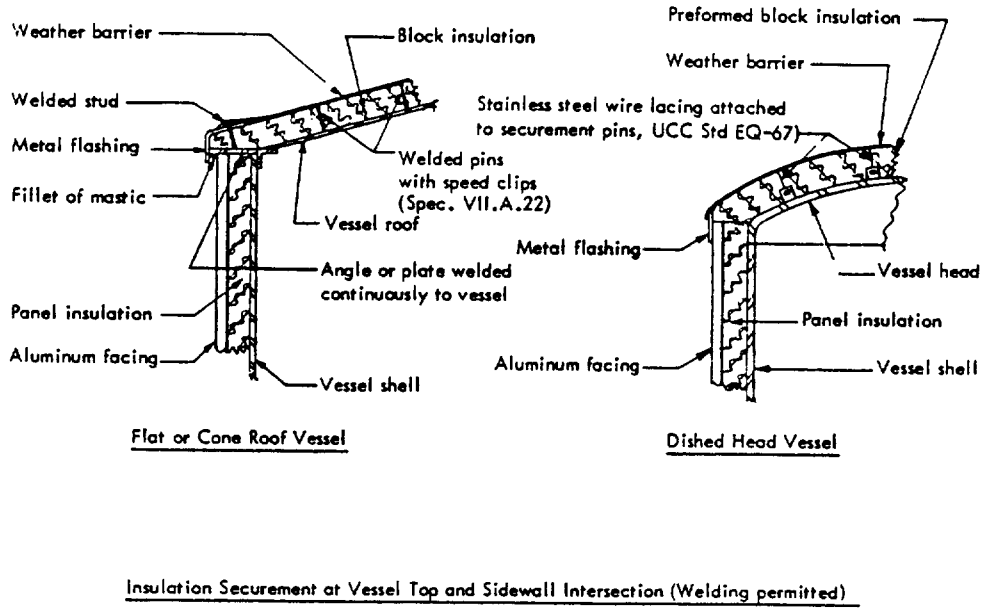
(4) Where welding to vessel is permitted, panels shall be applied to cylindrical section of vessel by studs, welded to vessel, that extend throu factory-punched holes in aluminum facing; and secured in place with aluminum nuts and Hypalon washers. Dimensions of panel and stud arrang ment are shown in Figure 19-H-2.

(5) Where welding to vessel is not permitted, insulation supports, and attachments for insulation straps to secure head insulation, shall be installed in accordance with Owner's Standards EQ-68 or EQ-69.

SECTION 8 - PREPARATION AND APPLICATION

1. PREPARATION - contd

b. Insulation Supports and Securements - contd



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 of 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) Cutouts for nozzles located at the same elevation may be simplified by arranging for horizontal lap to occur at this elevation so that top and bottom of panels 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 horizontal lap.

(c) Panels shall be installed with joints parallel to vertical axis of vessel.

(3) When vessel is on a low pad where level of rain or drainage water can reach bottom edge of panel, the fibrous insulation shall be cut and stripped from the bottom of the first course of panels to an elevation greater than the highest water level. In no case shall this be less than nine inches. This amount of stripped-out fibrous insulation shall be replaced with cellular glass insulation of equal thickness cut to fit the diameter of the vessel.

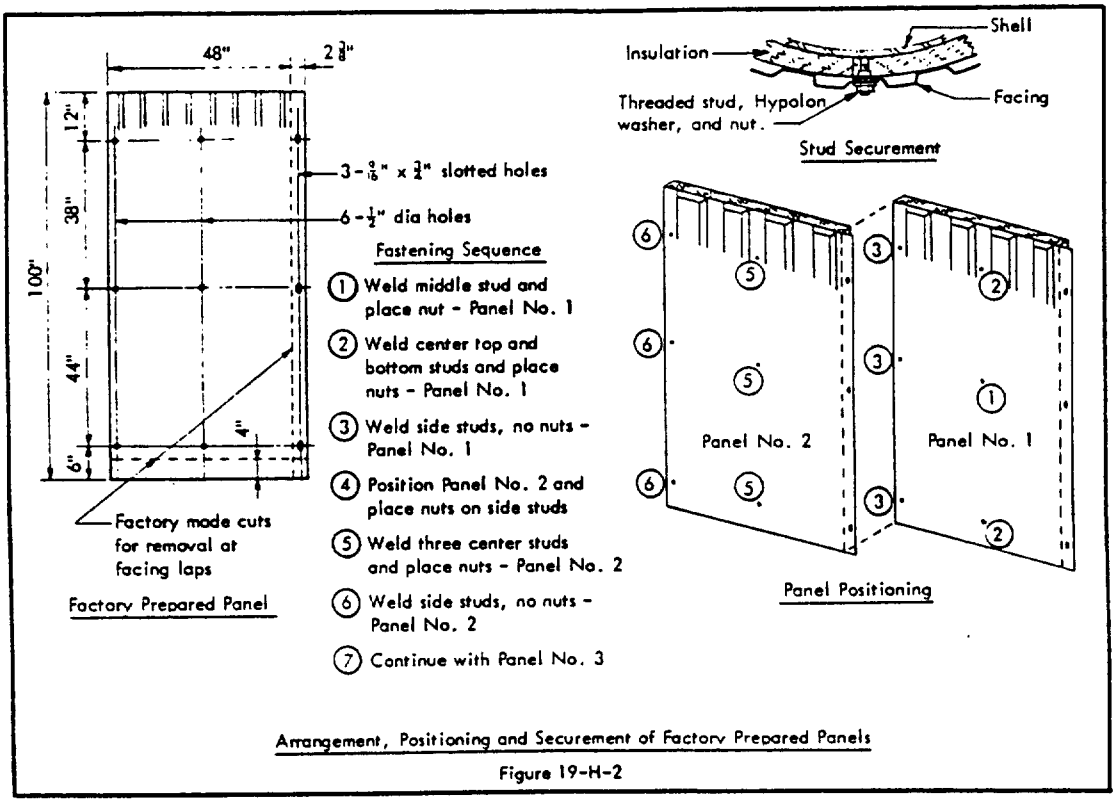
(4) When secured by studs, panels shall be positioned in accordance with predetermined arrangement reference lines. Then a stud shall be welded in the middle hole and the panel held to the vessel by washers and nuts. After final positioning, additional studs shall be welded to the vessel, and the panel secured in position. Before overlapping edges of the first panel and the second panel are bolted together, 2.3 inches of insulation shall be removed from the overlapping panel. A bead of lap sealer shall be placed between the overlapped aluminum sheets before bolting the two firmly together. "S" clips shall be installed on the top edge of the bottom course panels to support the next course of panels. "S" clips shall have sufficient length to provide two inches to four inches of overlap, depending on the panel layout. A strip of insulation, width of overlap, shall be removed from the bottom of the second course panel. The second course shall be positioned with edges lined up with edges of first course, then secured with studs and nuts as previously specified. Care shall be taken that no studs go through both sheets of overlapping ends of panels, as each course of panels must be free of other courses so as to provide a slip expansion joint. Fastening sequence and stud details are shown in Figure 19-H-2.

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SECTION B - PREPARATION AND APPLICATION - contd

2. APPLICATION - contd

a. Side Walls - contd



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 place as called for in Paragraph (2) of this subsection. Insulation on overlapping edge of overlapping panels shall be remov and a bead of lap sealer placed between the overlapping faces. The panels shall be secured by straps on approximately 24-inch centers. Sh metal screws shall be spaced at required intervals, below bands, installed with heads slightly protruding to prevent band from slipping downw 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 s and following courses. This provides the overlap. The second course shall be positioned, with edges lined up with edges of the first course, 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 clip. Bands at the midsection of the panel shall be installed as previously specified. The following courses shall be installed in identical m 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 sp assembly installed at approximately 30-foot intervals in each band (springs are four inches in length unstretched). Straps shall be tightened s ficiently to stretch each spring approximately three inches. The overlapped ribbed facing joint shall be held tightly together with sheet met screws on approximately 24-inch centers. Care shall be taken that sheet metal screws do not fasten two courses of panels together so that pa supported by "S" clips are free to slip to provide an expansion joint. Details are shown in Figure 19-H-3.

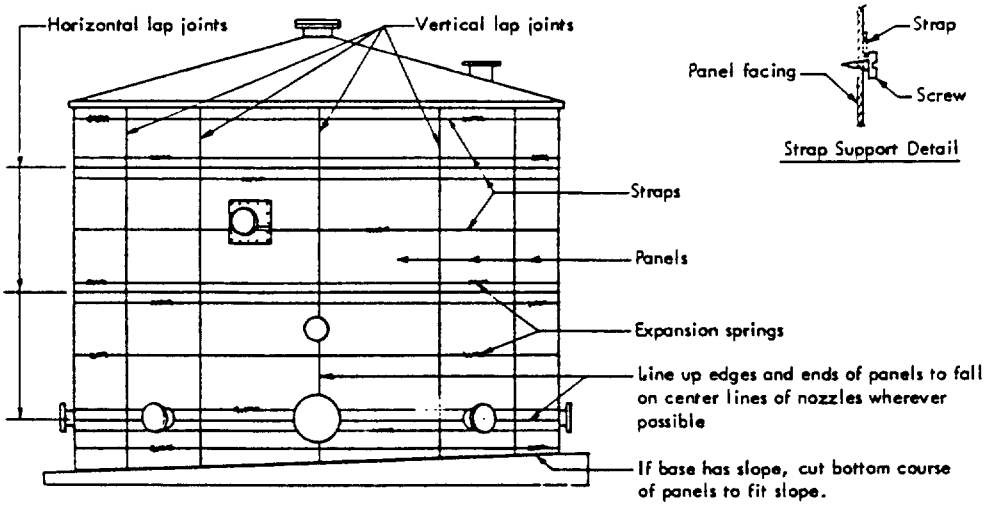
(6) Wherever possible, cutouts for manholes and nozzles shall be located at the intersection of two panels. Where it is necessary to cut out panel to fit over a manhole or nozzle, the opening shall be closed by one or two sections of panel cut to fit around the manhole or nozzle, t sealed to panel facing with lap sealer and secured in place with sheet metal screws. All cutouts shall be cut to fit around bare nozzles or th insulation cover of insulated nozzles or flanges. The junction shall be sealed with mastic. Details of application are shown in Figure 19-H-

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SECTION B - PREPARATION AND APPLICATION - contd

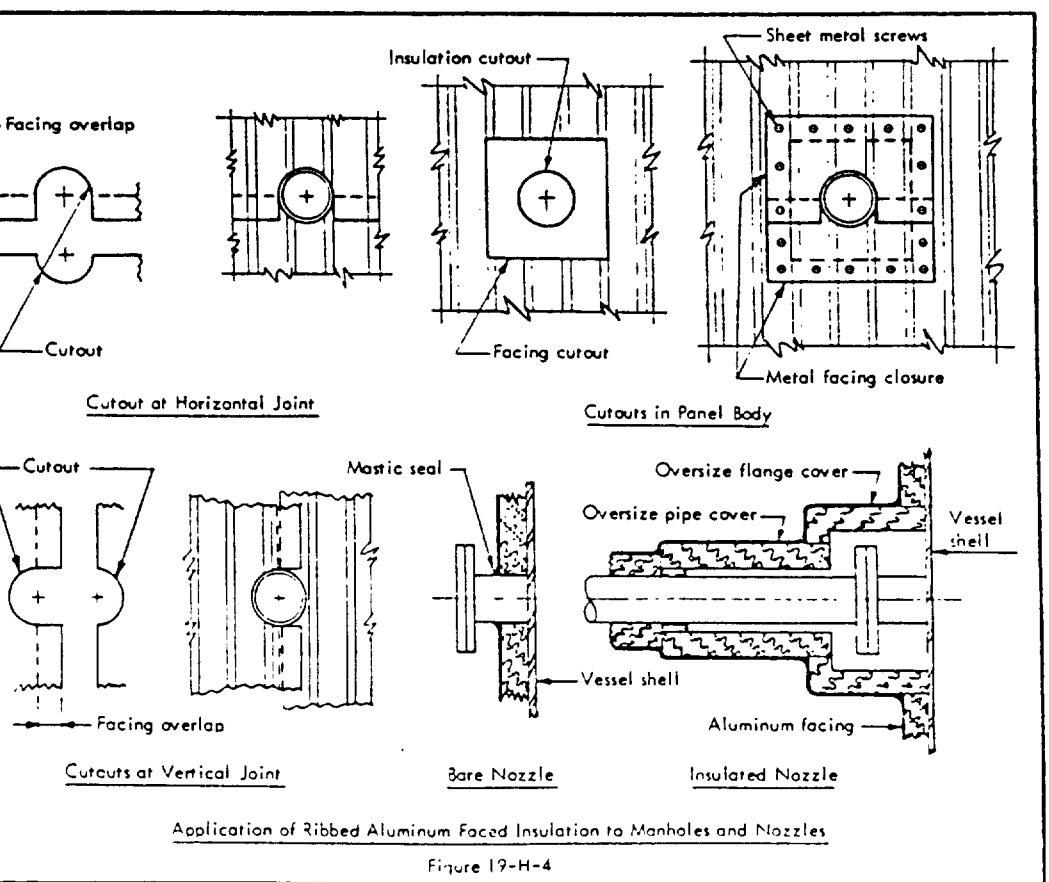
2. APPLICATION - contd

a. Side Walls - contd



Arrangement of Insulation Panels with Strap Securement Method

Figure 19-H-3



Application of Ribbed Aluminum Faced Insulation to Manholes and Nozzles

Figure 19-H-4

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SECTION B - PREPARATION AND APPLICATION - contd

2. APPLICATION - contd

b. 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 t the roof or head.

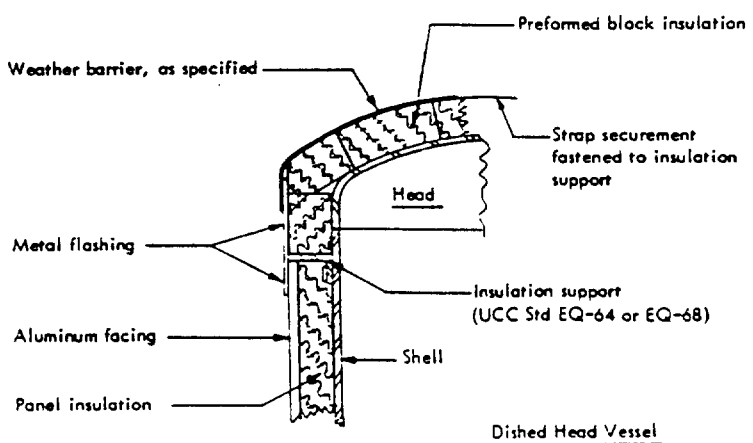
(a) Where rectangular securement pins are used, they shall be welded to vessel roof or head in accordance with Owner's Standard EQ-67 Stainless steel wires for lacing shall be passed through holes in rectangular pins. Blocks of insulation shall be installed in broken joint con struction with all joints tightly butted. 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 on th welded pin. Pins extending beyond pin clips shall be clipped off flush with surface. Depressions caused by clips pushed into insulation, a any cracks, 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 butted, then secured in pla by insulation strap fastened to insulation supports installed in accordance with Owner's Standard EQ-68 and EQ-69, and as shown on Figure 19-

(4) Insulation cement shall be used only where necessary to fill unadvoidable large voids in the insulation and, where necessary, to taper off t 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 Intersection (Welding not permitted)

Figure 19-H-5

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SECTION B - PREPARATION AND APPLICATION - contd

2. APPLICATION - contd

c. Flashings

(1) Metal flashings on flat or cone roof vessels, as shown on Figure 19-H-1, shall be formed of aluminum sheet to fit the circumference and curvature of the roof. 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 steel wire. The junction of flashing with the underside of the shell angle or plate shall be caulked with mastic.

(2) Metal flashings on dished head vessels shall be supported by "S" clips hooked over top of the aluminum panel jackets. The ends of flashings shall be overlapped and joined together with sheet metal screws.

d. Weather Barrier on Roof or Head - Mastic

(1) Weather barrier installed on cone or flat roof vessels shall extend over the top surface of the flashing.

(2) Weather barrier installed on top of dished head vessels shall extend down over the flashing a minimum of three inches.

(3) 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.3
Insulating Cement	VII.A. 6	Heat-Resistant Sealer	VII.A.4
Pipe Insulation Support	VII.A. 9	Mastic	VII.A.4
Pipe Insulation Strap	VII.A.13	Weather-Barrier Mastic (color as specified)	VII.B.1.
Clips for Pipe Strap	VII.A.14	Reinforcing Cloth	VII.B.1.
Stainless Steel Wire	VII.A.17	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

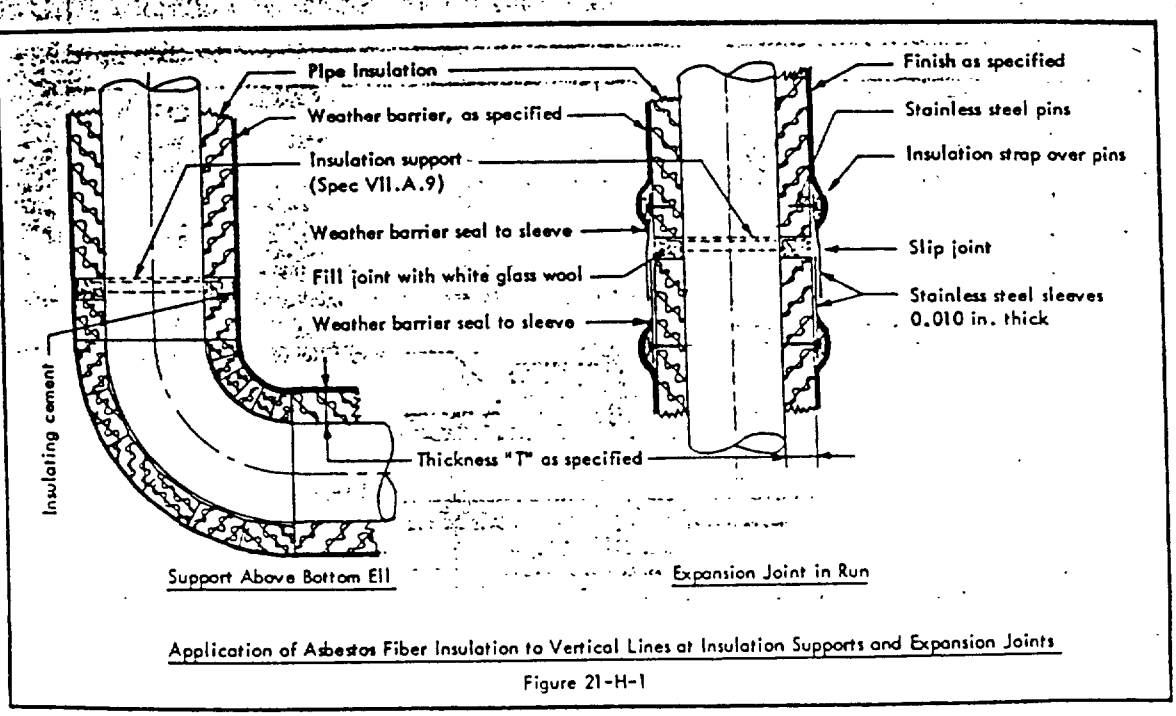
1. PIPE INSULATION

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 SPECIFICATI

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

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



Application of Asbestos Fiber Insulation to Vertical Lines at Insulation Supports and Expansion Joints

Figure 21-H-1

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SECTION 8 - APPLICATION - contd

1. PIPE INSULATION - contd

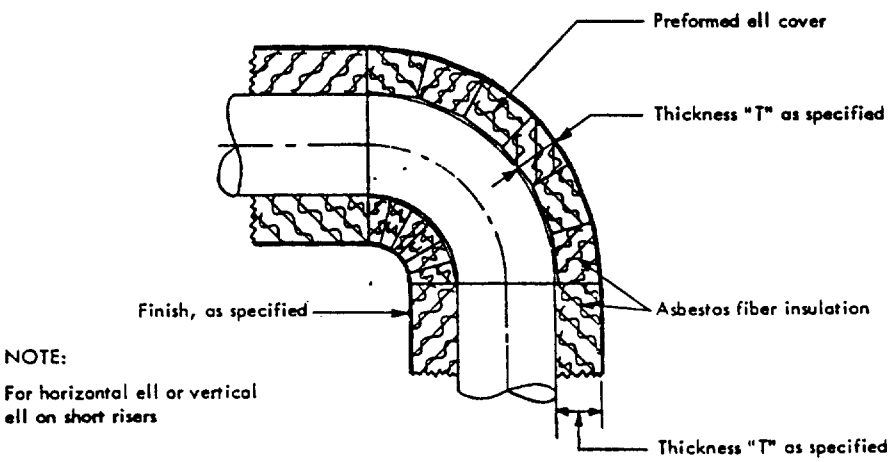
e. Factory-attached sheeting, where furnished, shall be removed from insulation before application.

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

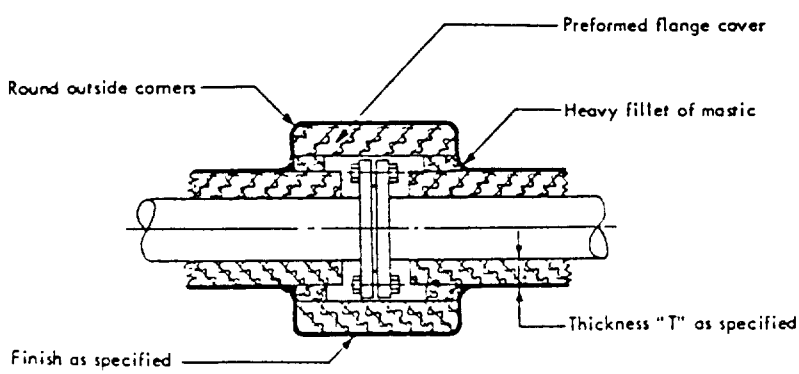
a. Insulation on 4-inch NPS and larger pipe extending more than 15 feet above bottom elbow, shall be supported by a pipe insulation support located directly above the elbow. Typical installation is shown in Figure 21-H-1. A pipe insulation support shall also be installed above each pair of flanges or 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

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SECTION B - APPLICATION - contd

3. FITTING, FLANGE, AND VALVE COVERS

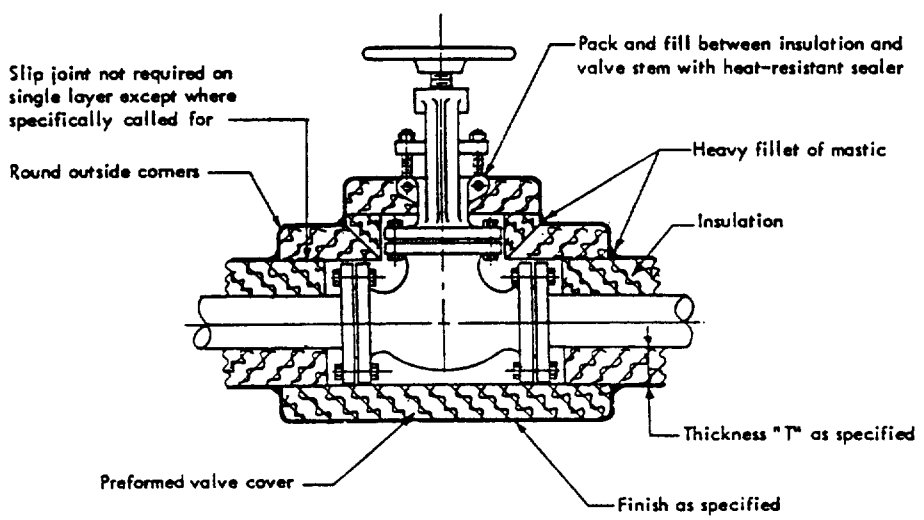
a. With exception of ball and plug valves, all fittings, flanges, and valves over three-inch NPS shall be insulated with covers prefabricated in accordance with ASTM Recommended Practice C 450, latest revision.

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.

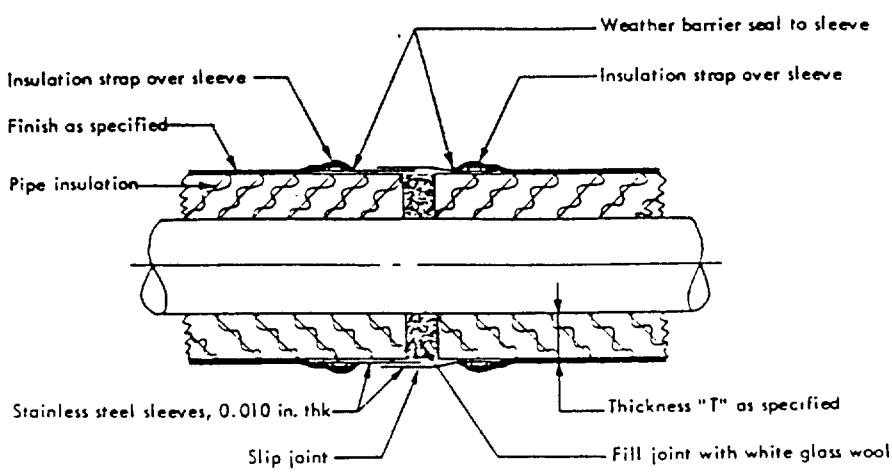
d. All valves shall be packed around valve stem and packing gland assembly with heat-resistant sealer to eliminate water pockets.

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 cemer 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 - contd

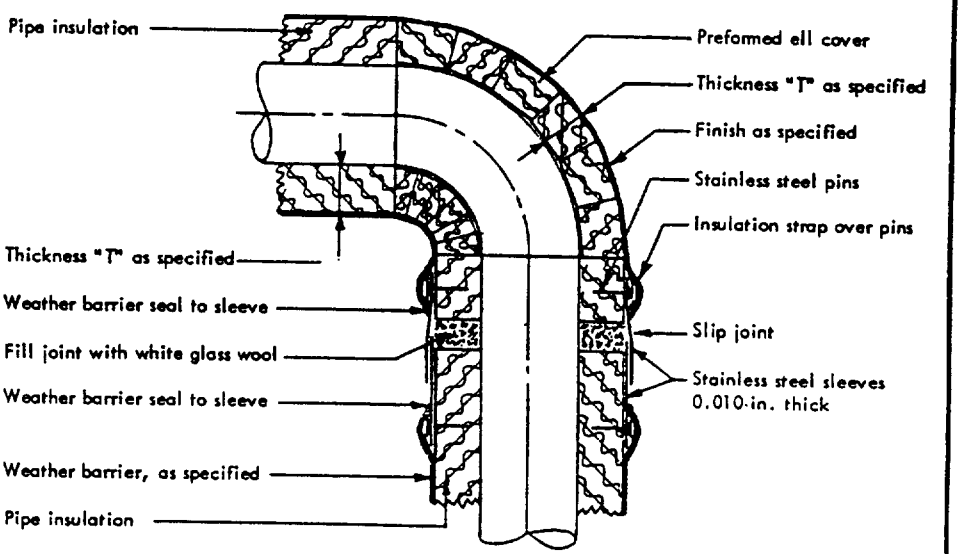
4. EXPANSION AND CONTRACTION JOINTS

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.

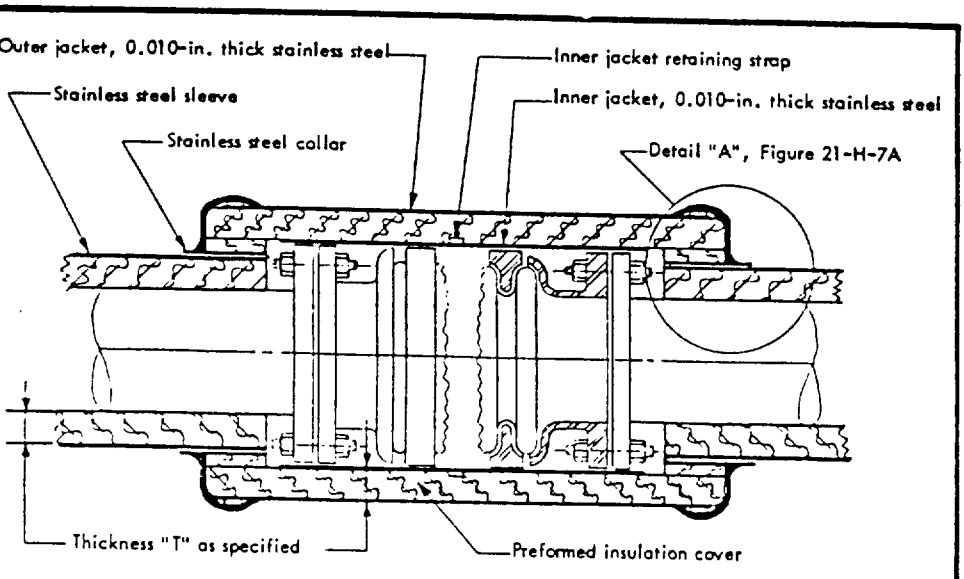
c. Expansion slip joints shall be installed at the insulation support in vertical piping, as shown in Figure 21-H-1.

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 pipe 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

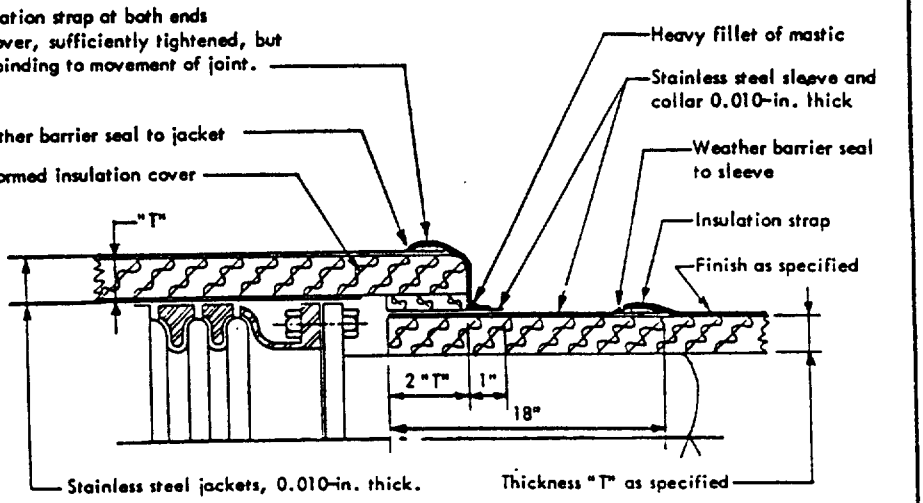
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SECTION B - APPLICATION - contd

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-7 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 exp joint, placed 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 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 b 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 c the expansion joint cover and carried down and sealed to the collar band. Weather barrier mastic shall overlap the stainless steel weather jacket o 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 faste to the pipe covering.



Detail "A"
(Slip Joint Detail for Figure 21-H-7)

Figure 21-H-7A

6. TRACED INSTALLATIONS

Tracing and insulation on 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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UNION CARBIDE STANDARD
CHEMICALS AND PLASTICS OPERATIONS DIVISION
AND UNION CARBIDE CANADA LIMITED

THERMAL INSULATION APPLICATION SPECIFICATIONS

BONDED EXPANDED SILICA

1. SCOPE

This specification describes the essential requirements for application of preformed bonded and reinforced expanded silica (perlite) insulation for use 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.

Cushion Blanket (For Equip. Oper. 400F to 1000F)	VII.A. 1	Stainless Steel Skewers	VII.A.
Cushion Blanket (For Equip. Oper. below 400F)	VII.A. 2	Welding Pin Insulation Fasteners	VII.A.
Mineral Wool Blanket (wire netting on both sides)	VII.A. 5	Pin Clips	VII.A.
Insulating Cement	VII.A. 7	Fabricating Cement	VII.A.
Pipe Insulation Support	VII.A. 9	Heat-Resistant Sealer	VII.A.
Equipment Insulation Strap	VII.A.11	Mastic	VII.A.
Clips for Equipment Strap	VII.A.12	Mineral Wool Blanket (wire netting on one side,	
Pipe Insulation Strap	VII.A.13	expanded metal lath on the other side)	VII.A.
Clips for Pipe Strap	VII.A.14	Weather-Barrier Mastic (color as specified)	VII.B.
Stainless Steel Wire	VII.A.17	Reinforcing Cloth	VII.B.
Wire Netting	VII.A.18	Stainless Steel Weather-Barrier Jacket (Designation M)	VII.B.
Welding Pins	VII.A.19	Treated Steel Weather-Barrier Jacket (Designation MT)	VII.B.
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 construc 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 1-inch thick cushioning blanket shall be applied over the entire surface before application of the expanded silica insulation. On equipment operating up to 400 F cushion blanket VII. A.2, above 400 F 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 insulation thickness for thermal design. Insulation Schedule shall state total thickness of cushion blanket and insulation.

d. Curved Surfaces. On all equipment, insulation block shall be properly cut in curved sectors and rectangular blocks, as required to fit ves surfaces, with a 1-inch space allowed for cushioning blanket where used, and applied to vessel sides and heads in staggered position, with all 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 inst is shown in Figure 22-H-1.

e. Flat Surfaces

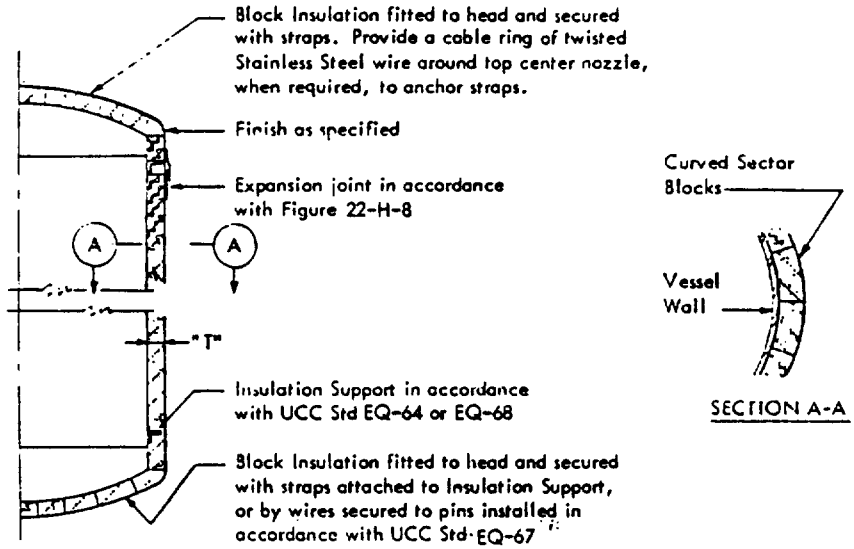
(1) Block insulation shall be applied to flat surfaces in staggered position with all joints tightly butted. It shall be secured with wire attc to welding pins as shown in Owner's Standard, EQ-67or other approved securement. On rectangular equipment, the welding pins, or othe approved securements, shall 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. Where specified in the Insulation Schedule, block may be applied 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 tie wires 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.

Do not cushion blanket is required

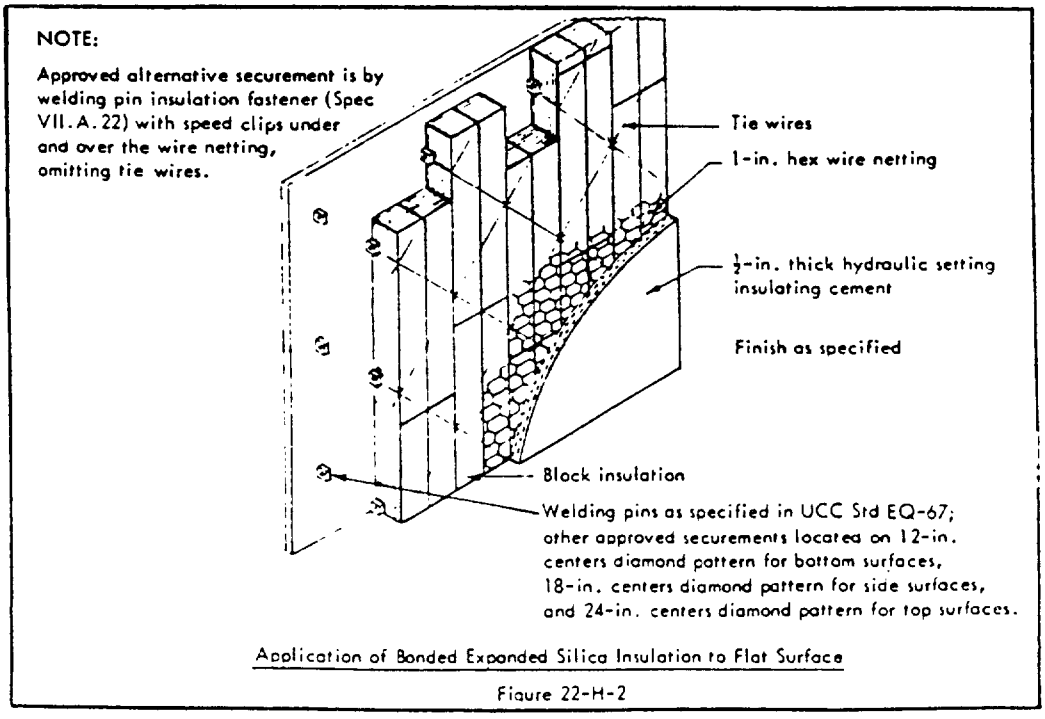
SECTION B - APPLICATION - contd

1. 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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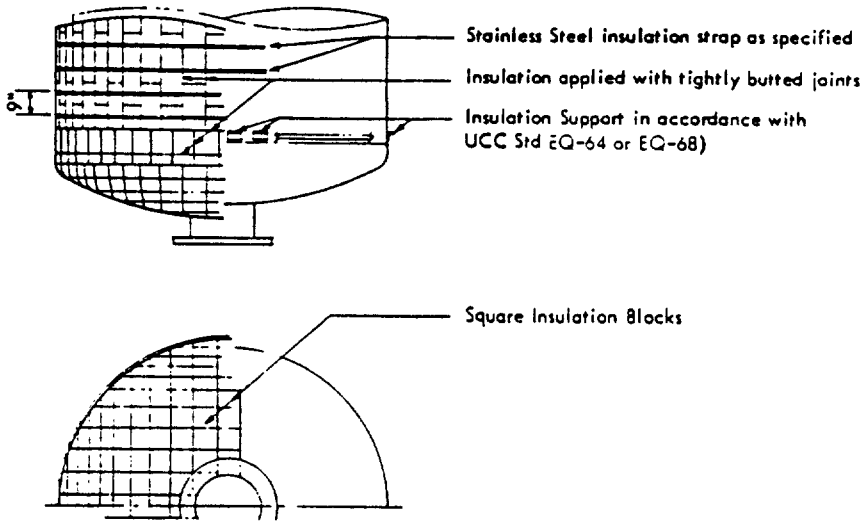
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd

f. Securement

(1) All layers of insulation shall be secured with insulation strap where contour of vessel permits firm and effective attachment. Where insulation strap shall be attached to strap anchor angles as shown in Owner's Standard EQ-64 or EQ-68. Insulation applied to irregular where use of strap is impracticable, shall be secured with wire, fastened to welding pins, (Owner's Standard EQ-67) drawn taut, ends 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 wi to welding pins or with insulation strap attached to insulation support, as shown in Owner's Standards EQ-64, EQ-65, EQ-68, EQ-69 c and Figure 22-H-3.



Application of Bonded Expanded Silica Insulation to Bottom Vessel Head

Figure 22-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 shov 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 a 22-H-5A. A slip joint shall be provided by applying an 18-inch long sleeve of 0.010-inch thick stainless steel over the pipe insulation each end of the expansion joint, placed flush with the butt end of the pipe covering. The sleeve shall be secured with strap at one end c that farthest from the expansion joint cover. A collar band of 0.010-inch thick stainless steel, of sufficient width to project 1-inch beyc the expansion joint insulation cover, shall be applied over the sleeve and held in place by the expansion joint cover which is then secure 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 v Weather-barrier mastic shall be applied to the ends of the expansion joint cover and carried down and sealed to the collar band. Weathe barrier mastic shall overlap the stainless steel weather jacket on the expansion joint cover.

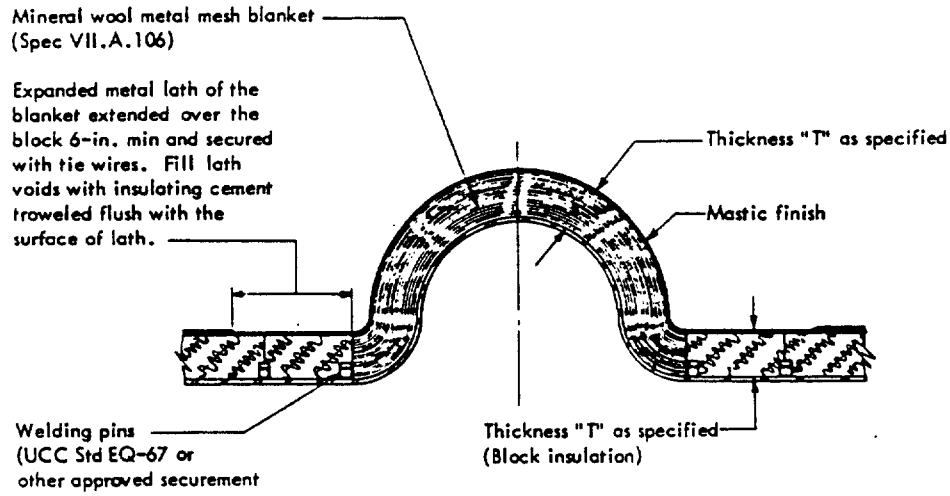
Where expansion joints are installed vertically in piping, the slip joint at the top shall be omitted and the expansion joint cover shall be securely fastened to the pipe covering.

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SECTION B - APPLICATION - contd

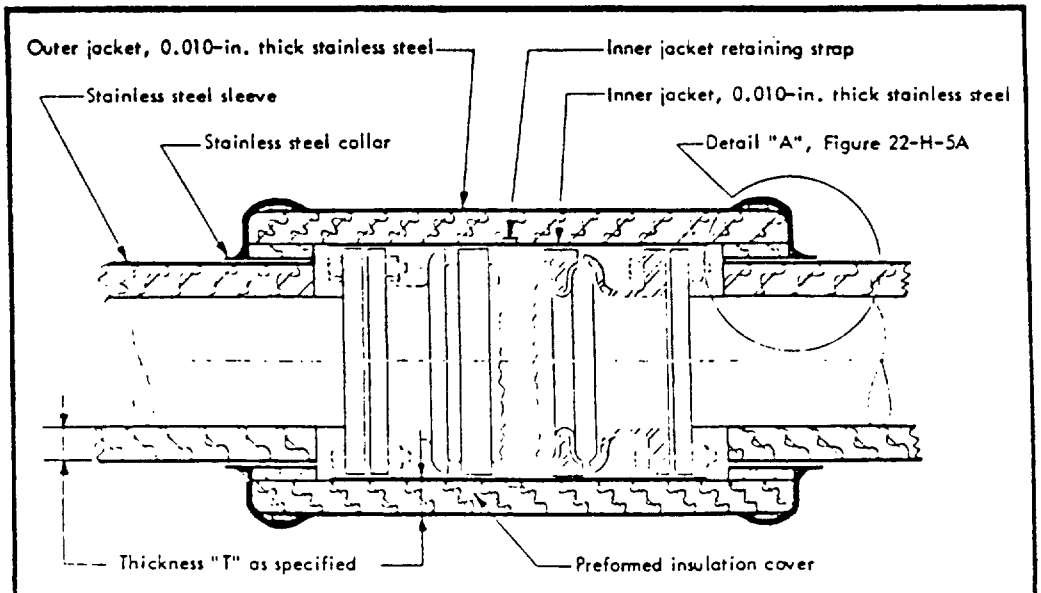
1. EQUIPMENT - contd

h. Expansion Joints - contd



Application of Blanket Insulation to Expansion Joints on Flat Surface

Figure 22-H-4



Application of Bonded Expanded Silica Insulation to Mechanical Expansion and Contraction Joint

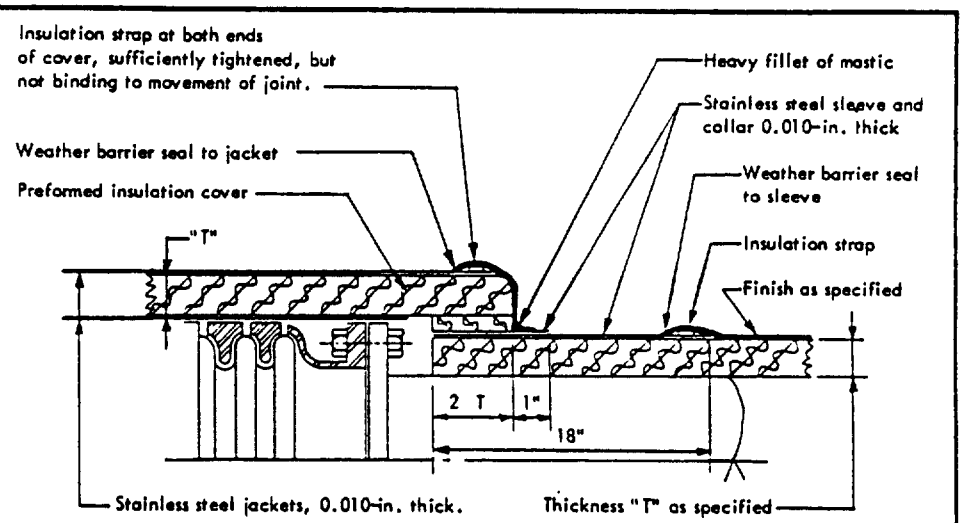
Figure 22-H-5

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SECTION R - APPLICATION - contd

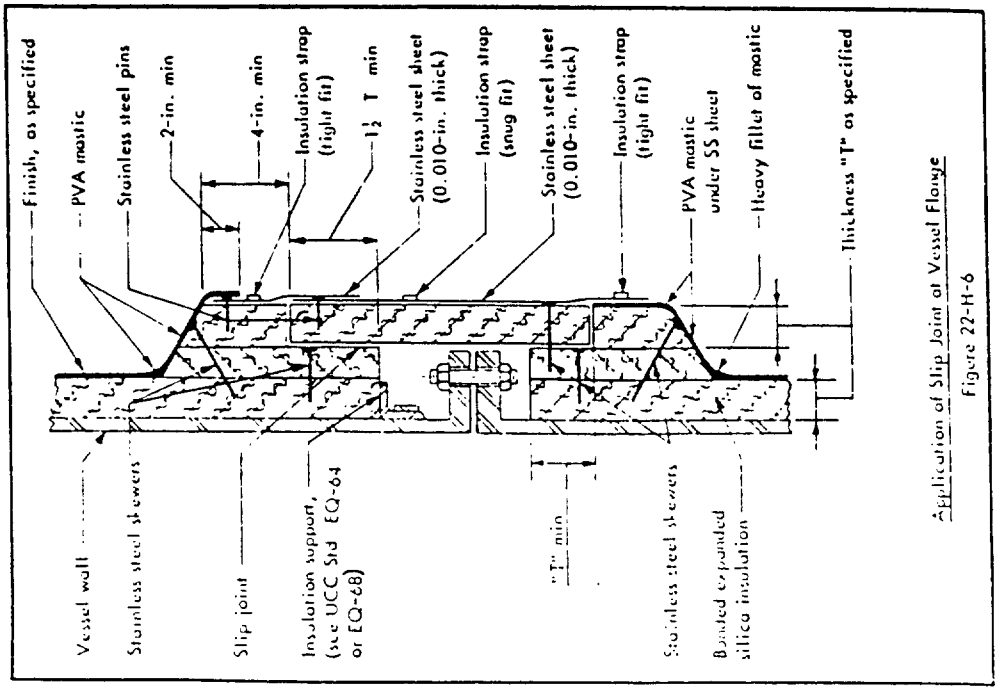
1. EQUIPMENT - contd

i. Insulated Vessel Flanges. Vessel flanges shall be insulated with preformed insulation assembly and weather protected by stainless steel jacke 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

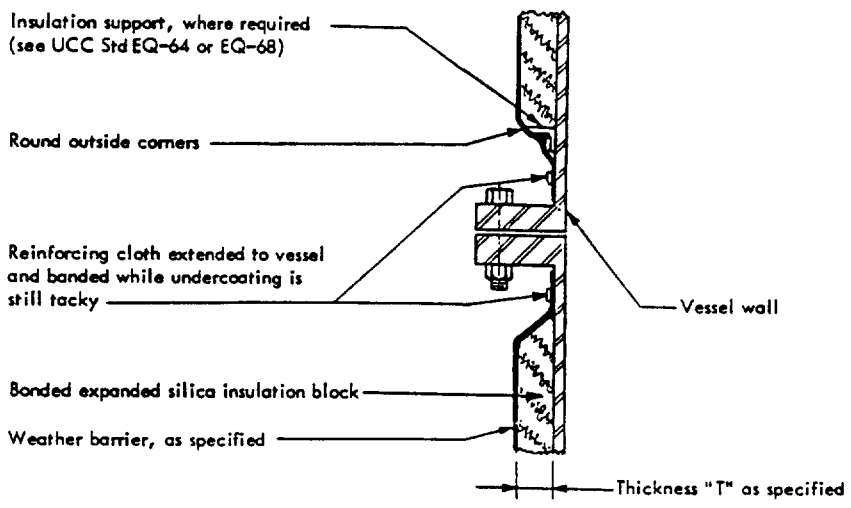
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SECTION B - APPLICATION - contd

1. EQUIPMENT - contd

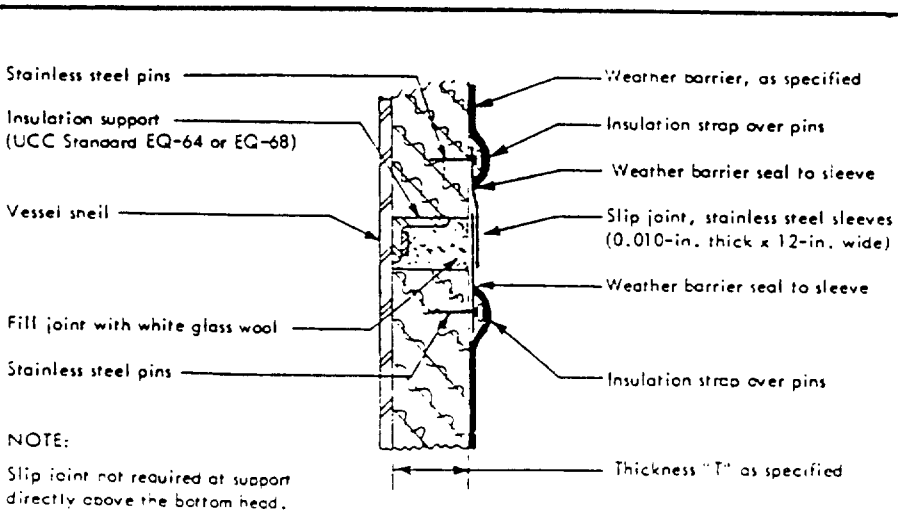
j. Uninsulated Vessel Flanges. Where vessel flanges are uninsulated, the reinforcing cloth of the weather barrier, on the adjacent vessel insulation, shall be extended to metal of vessel body, coated with weather-barrier coating, and banded while coating is still tacky. A second application of weather-barrier coating shall then be applied over the reinforcing cloth and securement. Typical installation is shown in Figure 22-H-7.

k. 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 to Vessel Wall at Insulation Supports

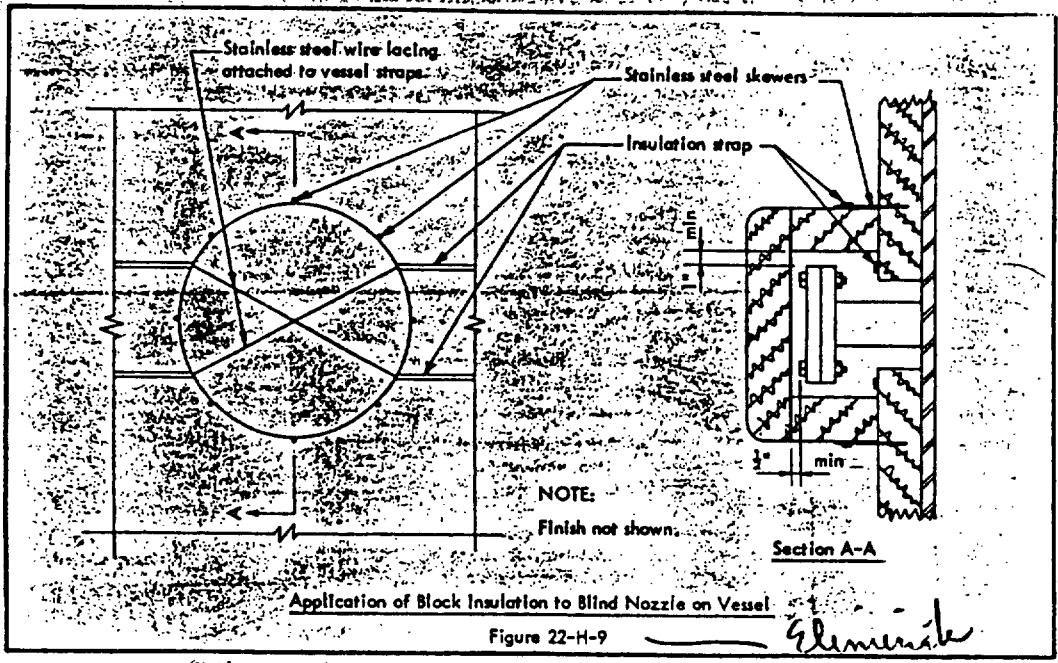
Figure 22-H-8

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SECTION B – APPLICATION – contd

1. EQUIPMENT – contd

1. Vessel Nozzles: Vessel nozzles shall be insulated as shown in Figures 22-H-9 and 22-H-10.

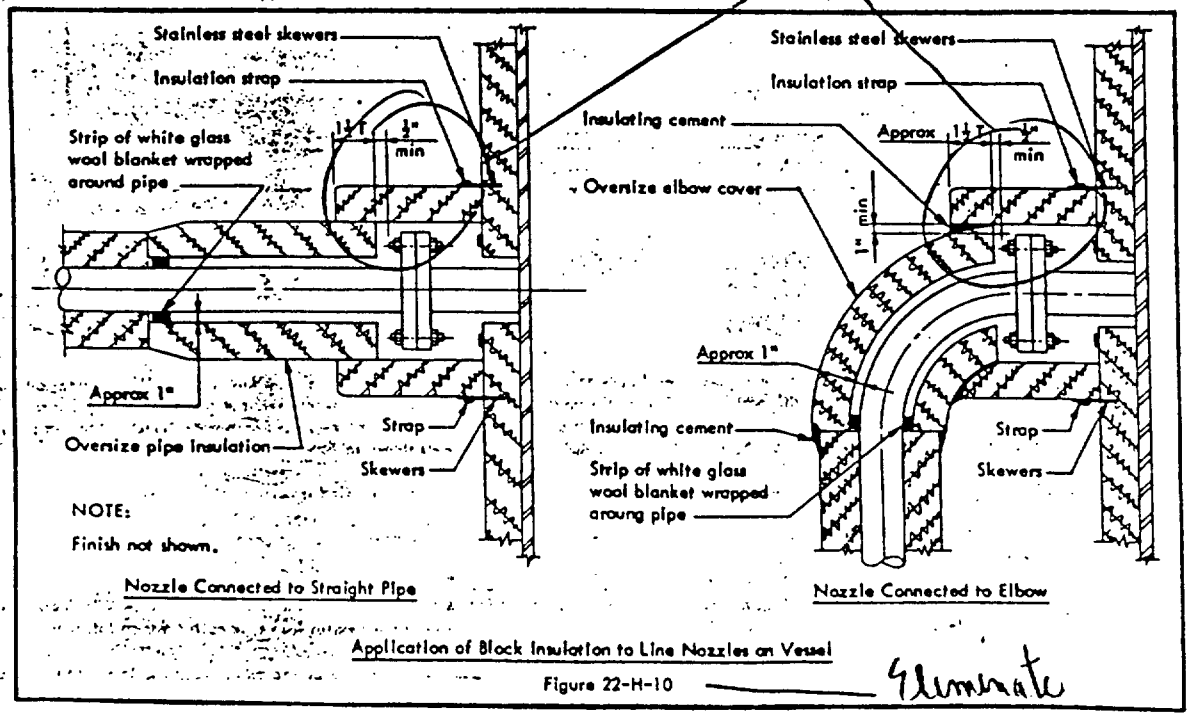


Application of Block Insulation to Blind Nozzle on Vessel

Figure 22-H-9

Eliminate

Eliminate



Application of Block Insulation to Line Nozzles on Vessel

Figure 22-H-10

Eliminate

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SECTION B - APPLICATION - contd

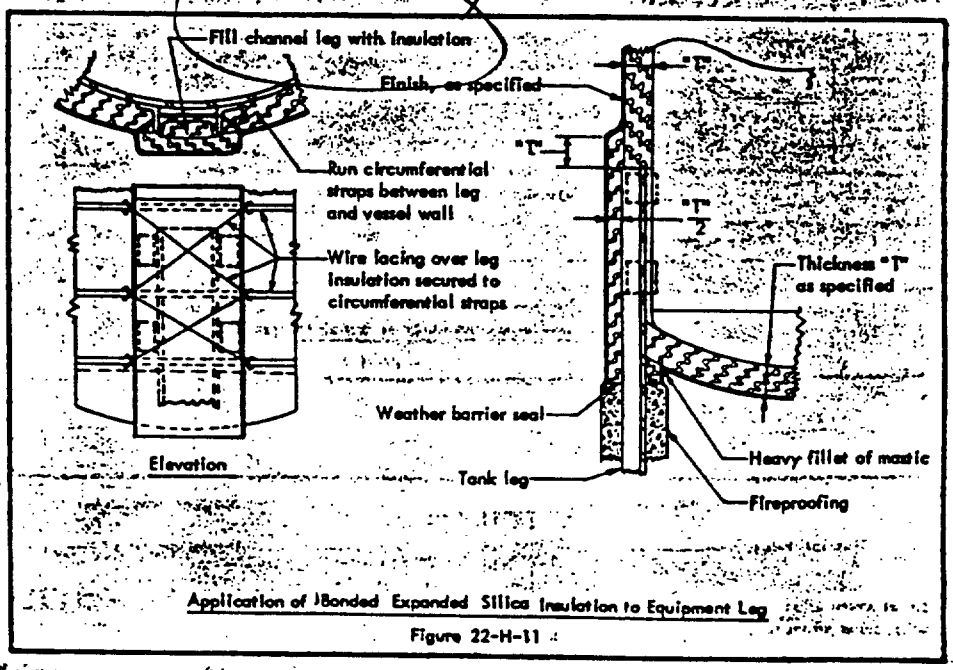
1. EQUIPMENT - contd

m. 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 block which shall extend over channel flanges 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 body insulation shall be filled with block. Installation shall be as shown in Figure 22-H-11.



Application of Bonded Expanded Silica Insulation to Equipment Leg

Figure 22-H-11

n. 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, or to bottom of skirt if that distance is less than 12 inches. Thickness shall be as specified for body of vessel. The bottom head insulation shall be supported in accordance with Owner's Standard EQ-64 or EQ-70. Installation shall be as shown in Figure 22-H-12.

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

p. 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.

q. 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:

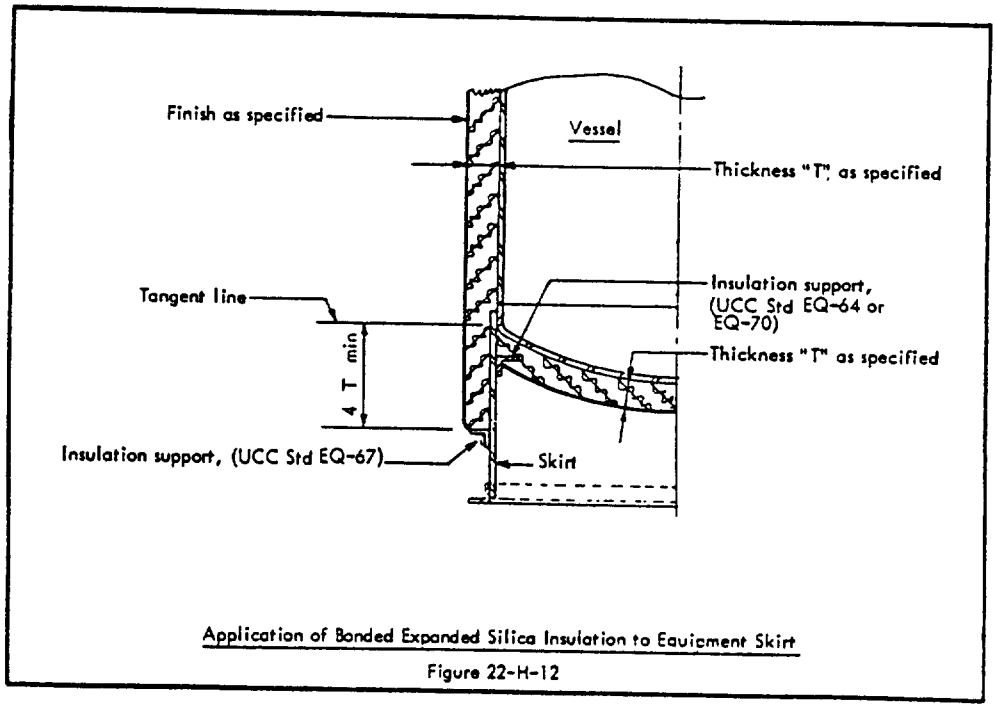
(1) Weather barrier consisting of stainless steel jacketing, where required, shall be called for by the addition of the letter M to the specification designation, thus 22-HM or 22-HSSM.

(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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SECTION 8 - APPLICATION - contd

1. EQUIPMENT - contd



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

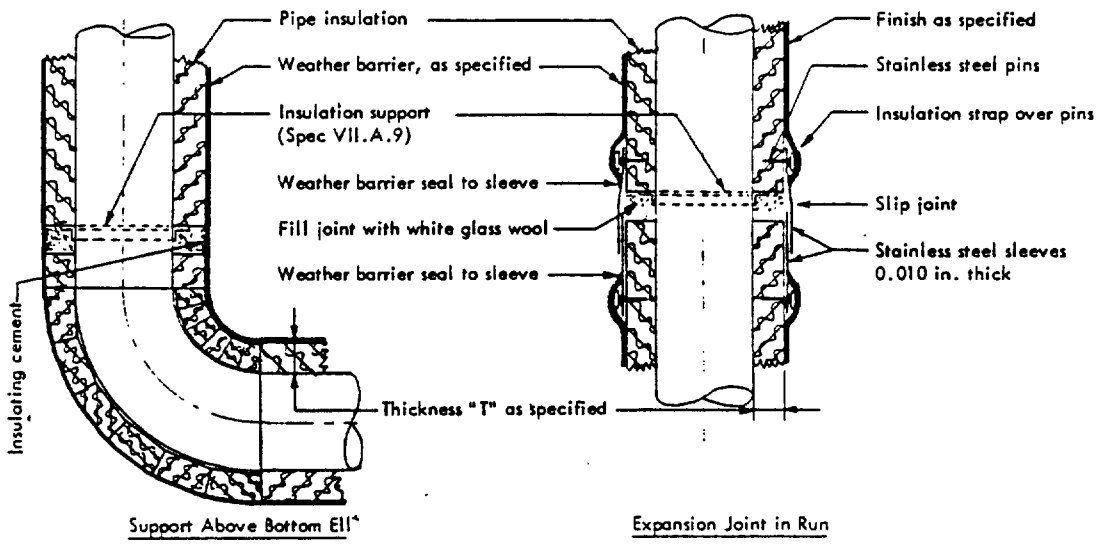
(a) Insulation on 4-inch NPS pipe and larger, extending more than 15 feet above the bottom elbow, shall be supported by a pipe insulation support located directly above the elbow. Typical installation is shown in Figure 22-H-13. A pipe insulation support shall also be installed above each pair of flanges or flanged valve in vertical pipe.

(b) When pipe extends more than 15 feet above pipe insulation supports located directly above 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 - contd

2. PIPING - contd



Application of Bonded Expanded Silica Insulation to Vertical Lines at Insulation Supports and Expansion Joints

Figure 22-H-13

b. Fitting, Flange, and Valve Covers

(1) 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.

(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.

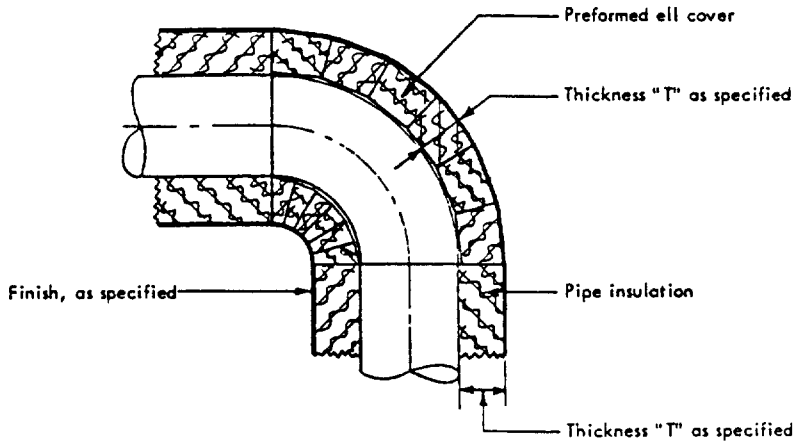
(4) Fitting insulation shall be secured with wire or strap as required.

(5) Insulation for all fittings shall be fitted and assembled with tight joints. Cementing of prefabricated 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 22-H-14, 22-H-15, and 22-H-16.

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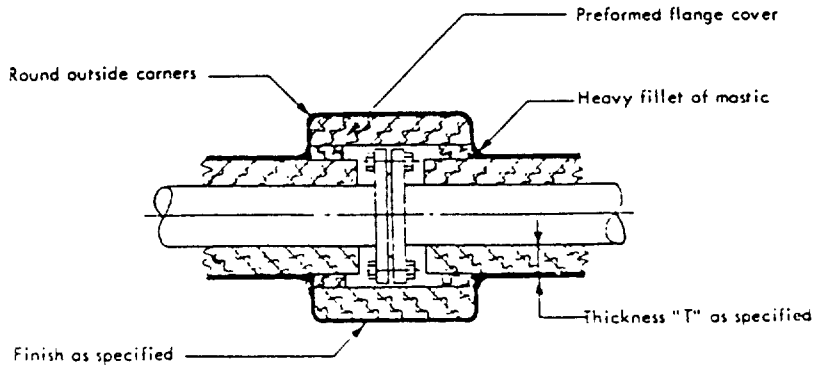
SECTION B - APPLICATION - contd

2. PIPING - contd



Application of Bonded Expanded Silica Insulation to Horizontal Welded Ell

Figure 22-H-14



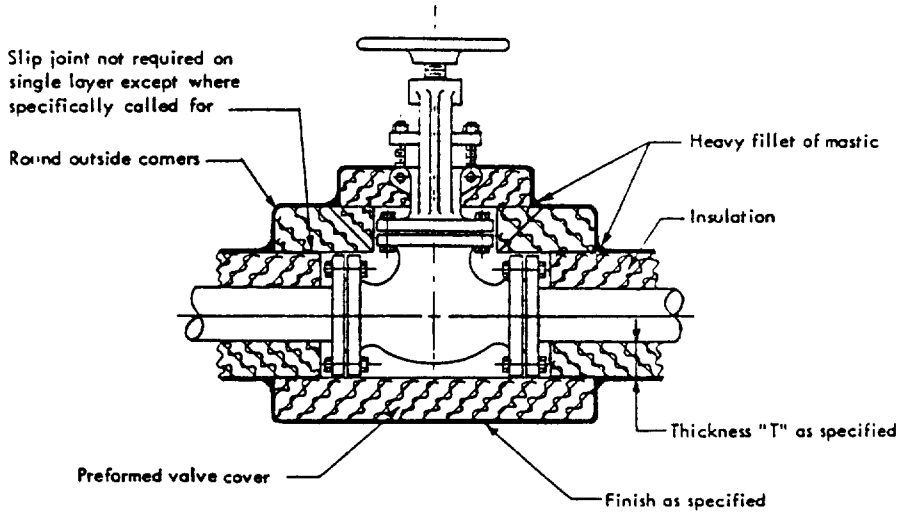
Application of Bonded Expanded Silica Insulation to Line Flange

Figure 22-H-15

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SECTION B - APPLICATION - contd

2. PIPING - contd

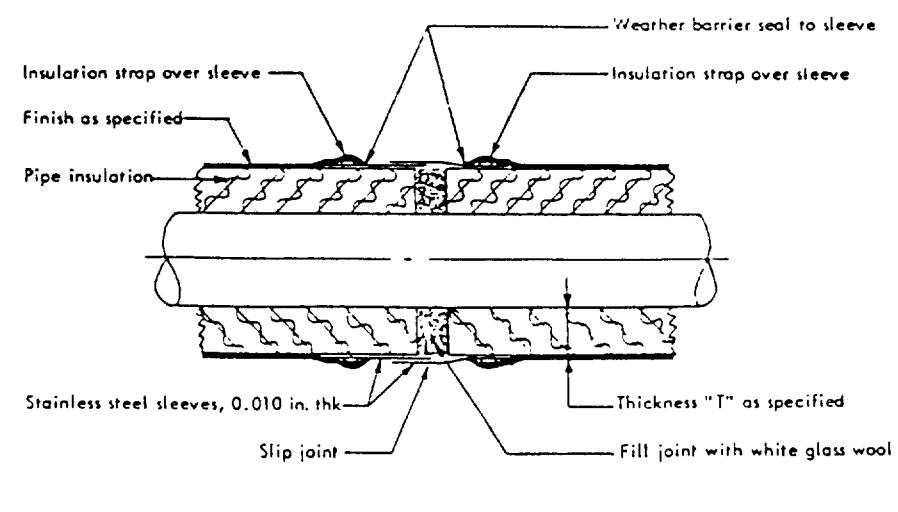


Application of Bonded Expanded Silica Insulation to Flanged Valve

Figure 22-H-16

c. 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-17. 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 Contraction Joint to Bonded Expanded Silica Insulation on Horizontal Piping

Figure 22-H-17

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SECTION 8 - APPLICATION - contd

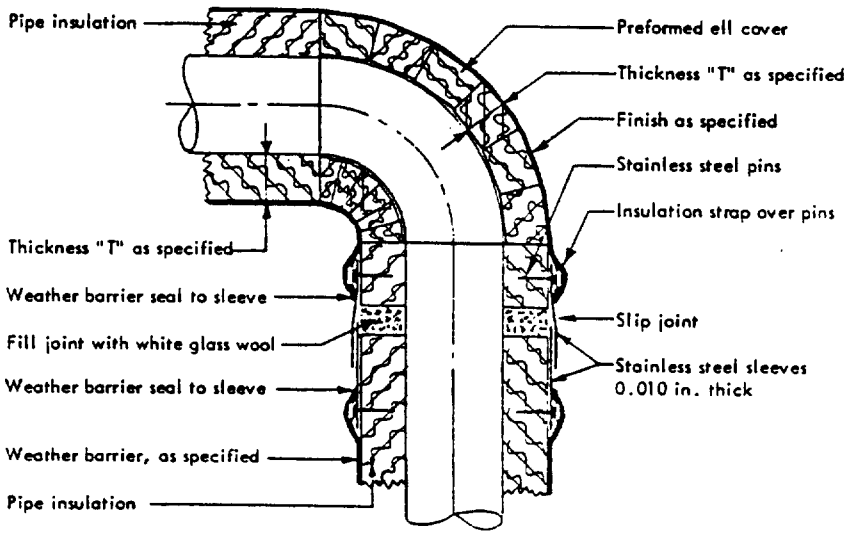
2. PIPING - contd

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 exceec 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 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

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

e. Surface Finish. Where present, small cracks and depressions shall be filled and smoothed with insulating cement before application of weather barrier.

f. Weather Barrier. Weather-barrier coating and jackets, 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 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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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 (color as specified)	VII.B.1.a.
Wire Netting	VII.A.18	Reinforcing Cloth	VII.B.1.b.
Welding Pin Insulation Fasteners	VII.A.22	Treated Steel Weather-Barrier Jacket (designation MT)	VII.B.3
Pin Clips	VII.A.23		
Stainless Steel Skewers	VII.A.21		

SECTION B - APPLICATION

1. EQUIPMENT - SPHERE

a. Surface Preparation. Sphere body and legs shall be prepared as called for in Article I, GENERAL SPECIFICATIONS.

b. Thickness Schedule. Unless otherwise specified, insulation shall be single layer. Where insulation thickness greater than 3 inches is required, special engineering design is necessary.

c. 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 the 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.

d. Water Stops. Water stops shall be provided on spheres operating between 70F and 220F at approximately even 12' intervals of insulated surface, starting at bottom of vessel. These water stops shall be of a coat of mastic which extends into the vessel and reinforced cloth. A second coat of mastic shall be installed over the reinforcing cloth. This water seal shall extend 3" over the vessel, over the edge of the block, and 3" down the outer surface of the insulation as shown in Figure 22-HSP-2.

e. Vessel Manholes and Line Nozzles. Vessel manholes and nozzles shall be insulated as shown in Figures 22-HSP-3 and 22-HSP-4.

f. Vessel Legs

(1) Concrete filled legs shall be insulated as specified in Article V.C. of the GENERAL SPECIFICATIONS.

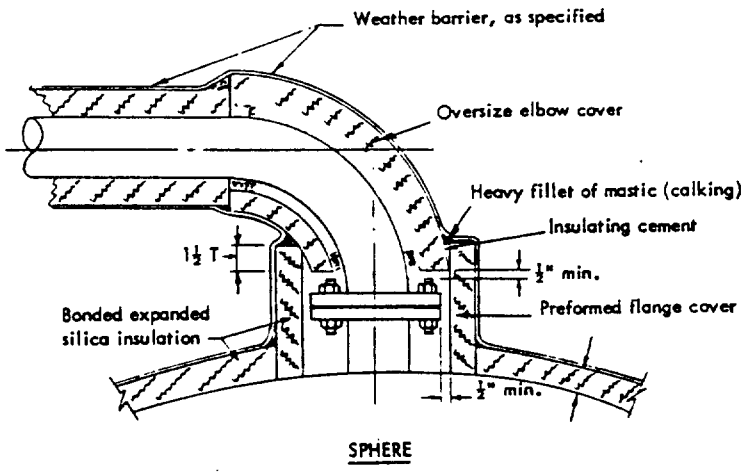
(2) Legs not concrete filled, or not fire protected, shall be insulated with 2 inches of bonded expanded silica to base or to fire protected part of leg. Insulation shall be installed in accordance with STANDARD SPECIFICATION NO. 22-H.

g. Tie Rods and Tie Rod Anchors. Tie rods and tie rod anchors shall be insulated with 2 inch thick bonded expanded silica in accordance with STANDARD SPECIFICATION NO. 22-H.

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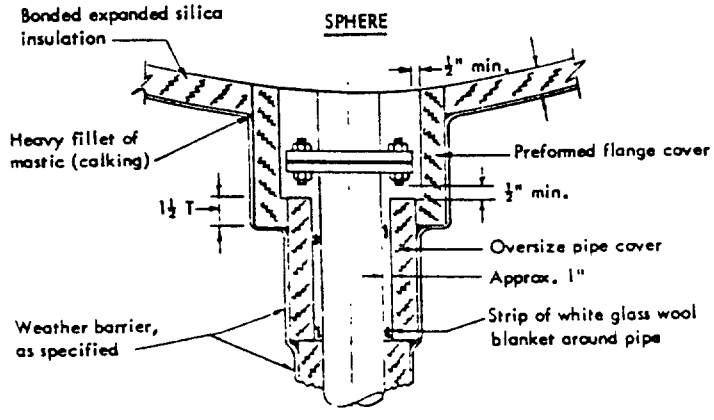
SECTION B - APPLICATION - Contd

g. Tie Rods and Tie Rod Anchors - Contd



SPHERE

Nozzle Connected to Elbow



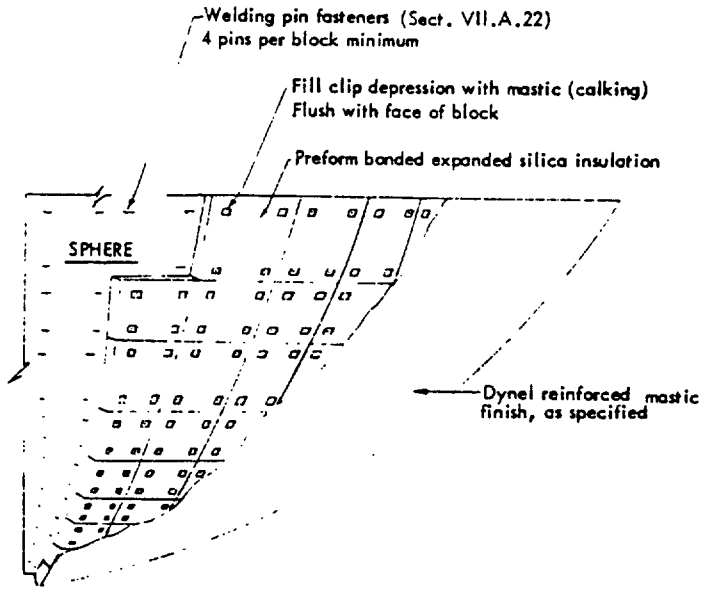
Nozzle Connected to Straight Pipe Application of Cellular Glass to Line Nozzles on Spheres

Figure 22-H SP-3

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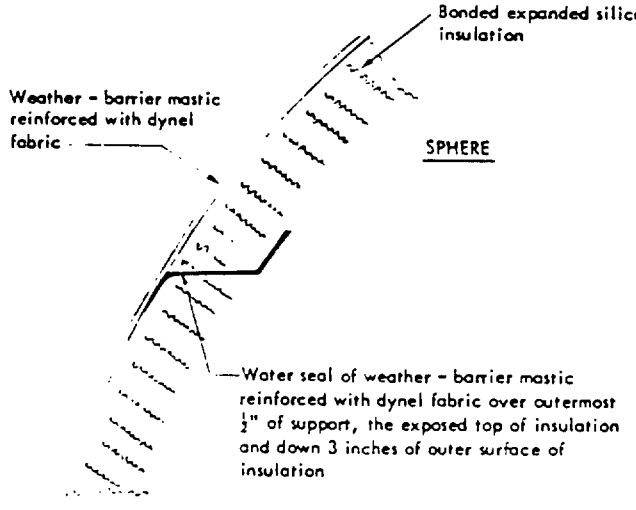
SECTION B - APPLICATION - Contd

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

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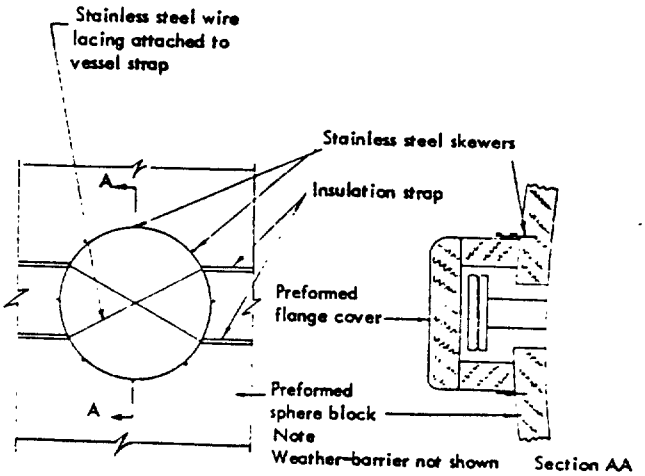
SECTION B - APPLICATION - Contd

h. 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

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. Surface Preparation. Sphere body and legs shall be prepared as called for in Article I, GENERAL SPECIFICATIONS.

b. Thickness Schedule. Unless otherwise specified, insulation shall be single layer. Where insulation thickness greater than 3 inches is required, special engineering design is necessary.

c. 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 the 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.

d. Water Stops. Water stops shall be provided on spheres operating between 70F and 220F at approximately even 12' intervals of insulated surface, starting at bottom of vessel. These water stops shall be of a coat of mastic which extends into the vessel and reinforced cloth. A second coat of mastic shall be installed over the reinforcing cloth. This water seal shall extend 3" over the vessel, over the edge of the block, and 3" down the outer surface of the insulation as shown in Figure 22-HSP-2.

e. Vessel Manholes and Line Nozzles. Vessel manholes and nozzles shall be insulated as shown in Figures 22-HSP-3 and 22-HSP-4.

f. Vessel Legs

(1) Concrete filled legs shall be insulated as specified in Article V.C. of the GENERAL SPECIFICATIONS.

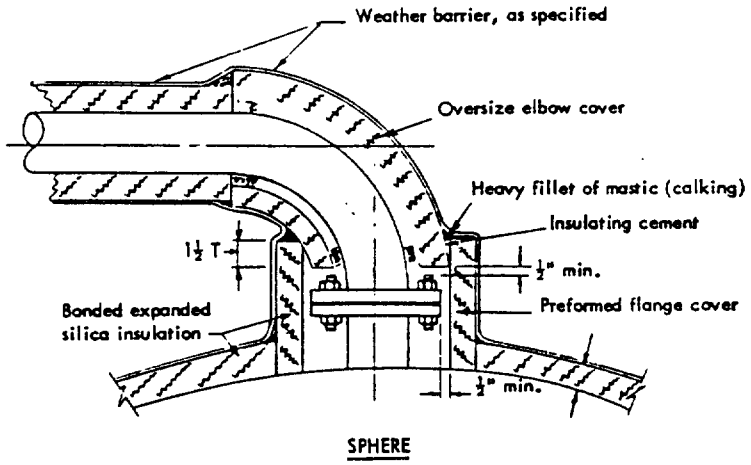
(2) Legs not concrete filled, or not fire protected, shall be insulated with 2 inches of bonded expanded silica to base or to fire protected part of leg. Insulation shall be installed in accordance with STANDARD SPECIFICATION NO. 22-H.

g. Tie Rods and Tie Rod Anchors. Tie rods and tie rod anchors shall be insulated with 2 inch thick bonded expanded silica in accordance with STANDARD SPECIFICATION NO. 22-H.

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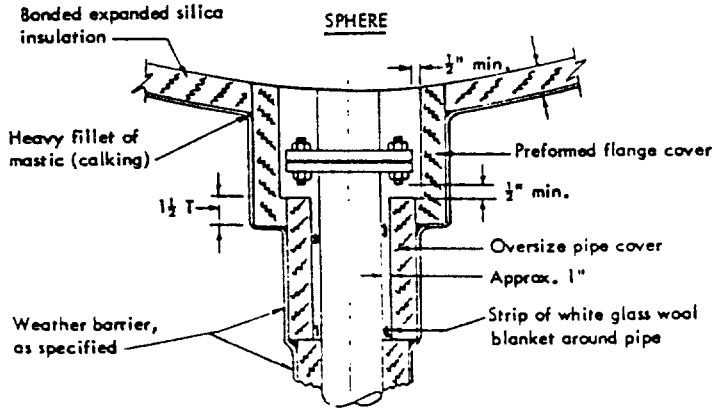
SECTION B - APPLICATION - Contd

g. Tie Rods and Tie Rod Anchors - Contd



SPHERE

Nozzle Connected to Elbow



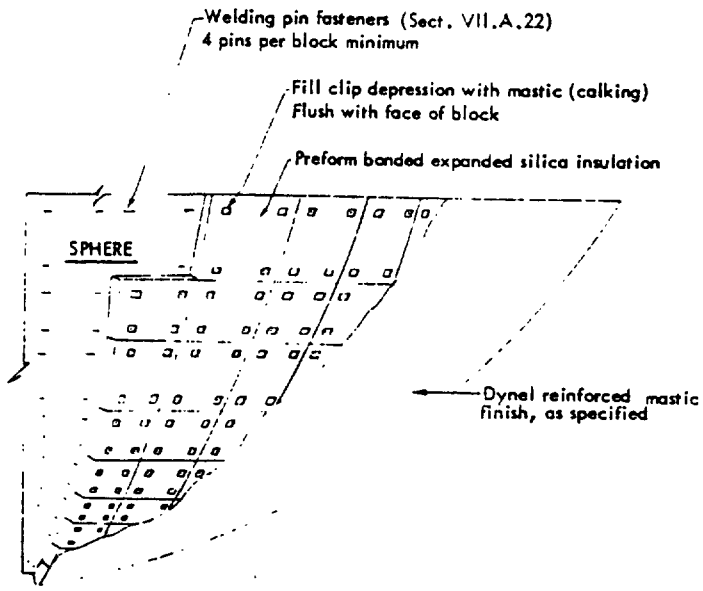
Nozzle Connected to Straight Pipe Application of Cellular Glass to Line Nozzles on Spheres

Figure 22-H SP-3

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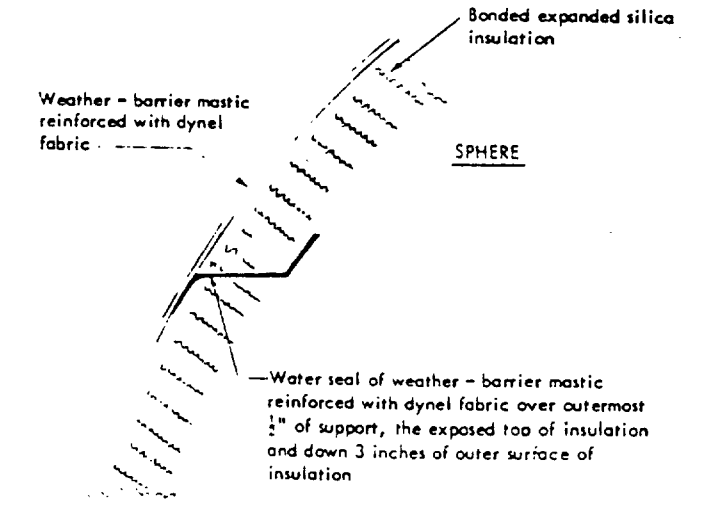
SECTION B - APPLICATION - Contd

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

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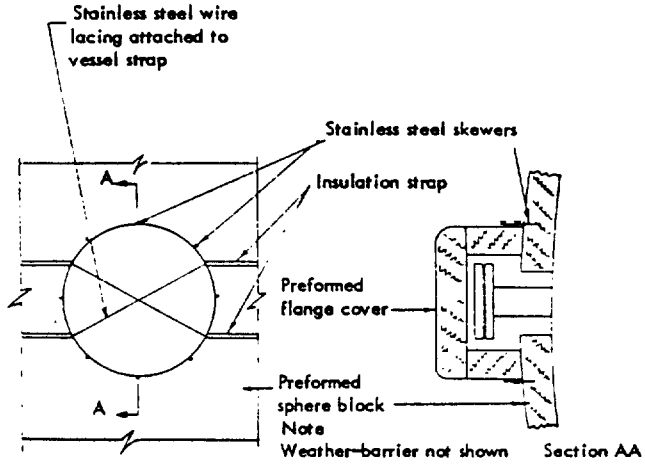
SECTION B - APPLICATION - Contd

h. 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 (For Equip. Oper. above 400F)	VII.A. 1		
Cushioning Blanket (For Equip. Oper. below 400F)	VII.A. 2	Stainless Steel Skewers	VII.A
Mineral Wool Blanket (wire netting on both sides)	VII.A. 5	Welding Pin Insulation Fasteners	VII.A
Insulating Cement	VII.A. 7	Pin Clips	VII.A
Pipe Insulation Support	VII.A. 9	Fabricating Cement	VII.A
Equipment Insulation Strap	VII.A.11	Heat-Resistant Sealer	VII.A
Clips for Equipment Strap	VII.A.12	Mastic	VII.A
Pipe Insulation Strap	VII.A.13	Mineral Wool Blanket (wire netting on one side, expanded metal lath on the other side)	VII.A
Clips for Pipe Strap	VII.A.14	Weather-Barrier Mastic (color as specified)	VII.B
Stainless Steel Wire	VII.A.17	Reinforcing Cloth	VII.B
Wire Netting	VII.A.18	Stainless Steel Weather-Barrier Jacket (Designation M)	VII.B
Welding Pins	VII.A.19	Treated Steel Weather-Barrier Jacket (Designation MT)	VII.B
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 layer constru 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 1-inch thick cushioning blanket shall be applied over the entire surface before application of the calcium silicate insulation. On equipment operating up to 400 F Cushioning Blanket VII. A.2 shall be used, above 400 F Cushioning Blanket VII. A.1 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 insulation thickness for thermal design. Insulation Schedule shall state total thickness of cushion blanket and insulation.

d. Curved Surfaces. On all equipment insulation block shall be properly cut in curved sectors and rectangular blocks, as required, to fit vessel faces with a one-inch space allowed for cushioning blanket where used and applied to vessel sides and heads in staggered position with all joints t 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 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 attache welding pins as shown in Owner's Standard EQ-67, or other approved securement. On rectangular equipment, the welding pins, or other appr securements, shall be placed on 12-inch centers, diamond pattern, for bottom surfaces; and on 18-inch centers, diamond pattern, for side sur and on 24-inch centers, diamond pattern, for top surfaces. Where specified in the Insulation Design Schedule, block may be applied to flat faces with an approved adhesive.

(2) When specified thickness of insulation has been applied, wire netting shall be stretched tightly over block and secured with tie wires or 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.

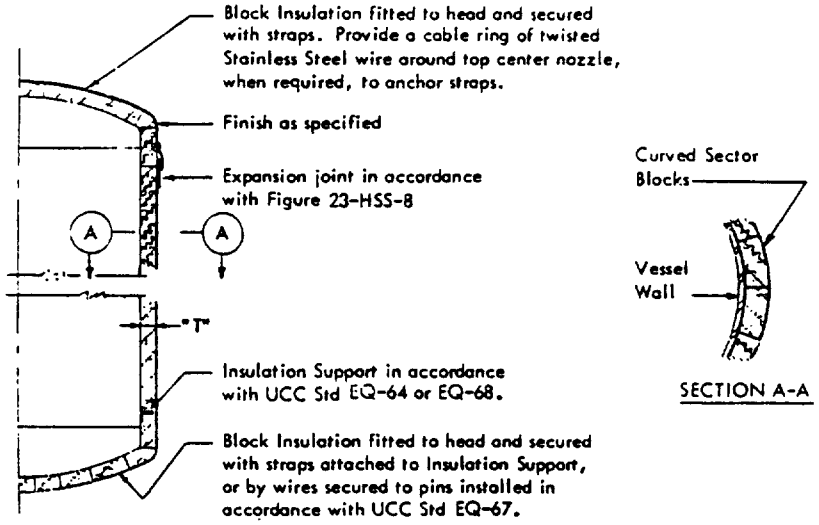
f. Securement

(1) All layers of insulation shall be secured with insulation strap where contour of vessel permits firm and effective attachment. Where requir insulation strap shall be attached to strap anchor angles as shown in Owner's Standard EQ-64 or EQ-68. Insulation applied to irregular s where use of strap is impracticable, shall be secured with wire fastened to welding pins, drawn taut, ends twisted and embedded in insula (In accordance with Owner's Standard EQ-67)

(2) All layers of insulation on bottom heads of vertical equipment and heads of horizontal equipment shall be secured in place with wire atta to welding pins or with insulation strap attached to insulation support as shown in Owner's Standards EQ-64, EQ-65, EQ-68, EQ-69, E

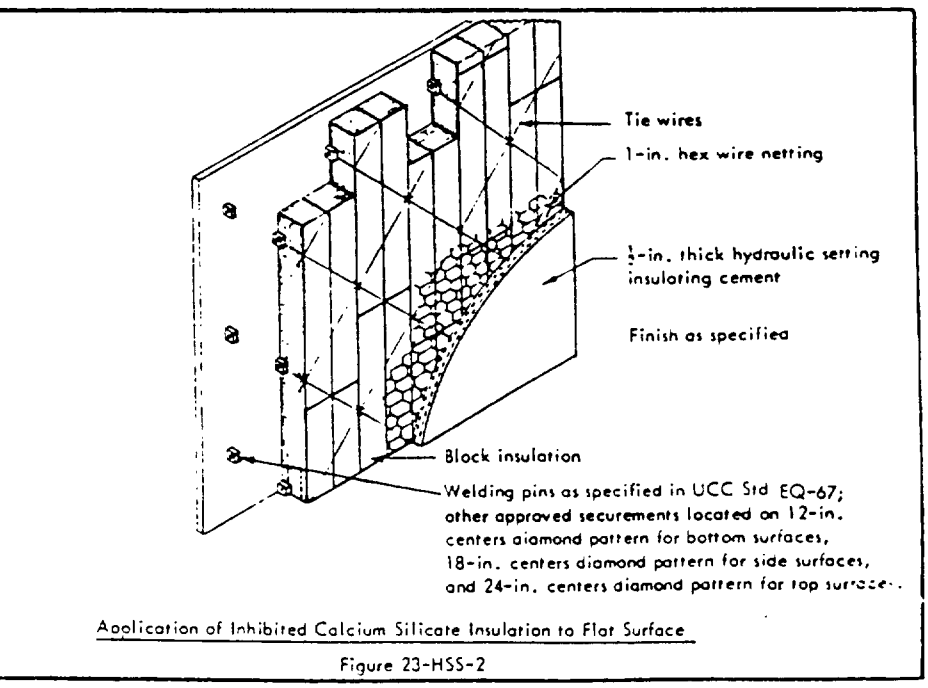
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Inhibited Calcium Silicate Insulation to Vessel Shell and Heads

Figure 23-HSS-1



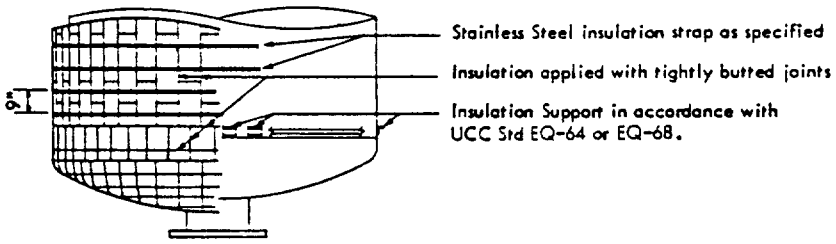
Application of Inhibited Calcium Silicate Insulation to Flat Surface

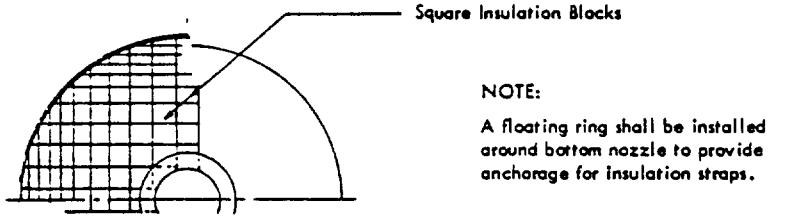
Figure 23-HSS-2

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SECTION B - APPLICATION - contd

1. EQUIPMENT - contd





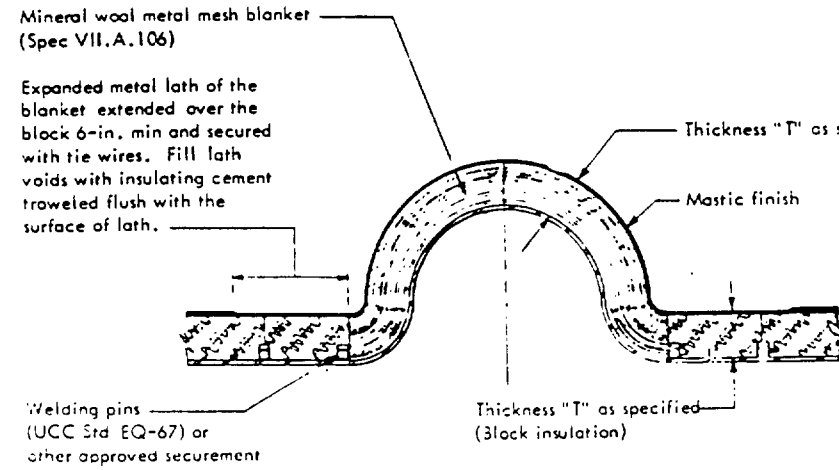
Application of Inhibited Calcium Silicate Insulation to Bottom Vessel Head

Figure 23-HSS-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 23-HSS-4.



Application of Blanket Insulation to Expansion Joints on Flat Surface

Figure 23-HSS-4

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SECTION B - APPLICATION - contd

1. EQUIPMENT - contd

h. Expansion Joints - contd

(2) Corrugated mechanical expansion joints in piping (usually listed as equipment items) shall be insulated as shown in Figures 23-HSS-5 and 23-HSS-5A. 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 strap 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 which is then secured with insulation strap. The longitudinal laps of the stainless steel bands shall be a minimum of two 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.

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.

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 allow movement of insulation and weather-barrier jacket. Typical installation is shown in Figure 23-HSS-6.

j. 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 vessel body, coated with weather-barrier coating, and banded 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 23-HSS-7.

k. 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 23-HSS-8.

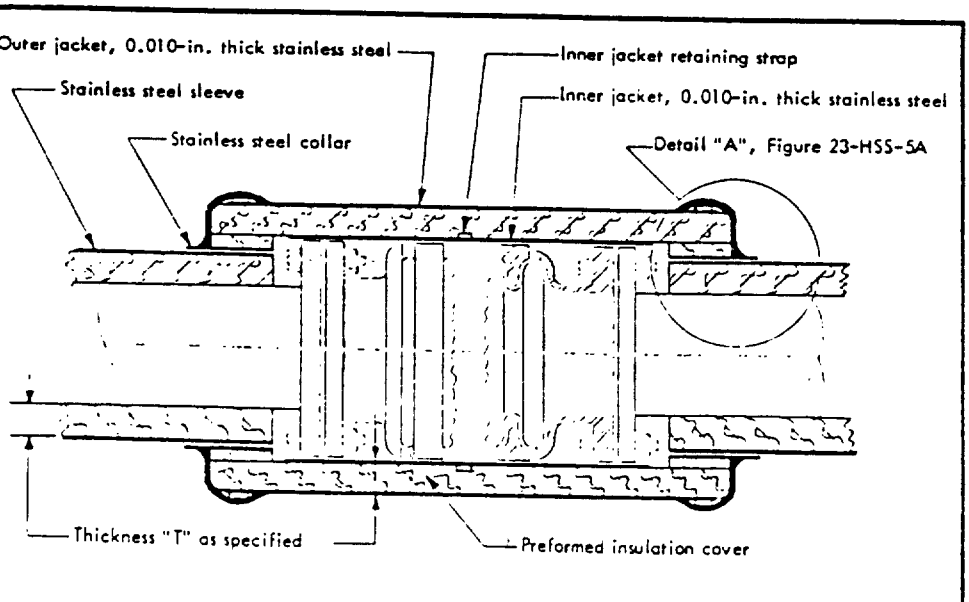
l. Vessel Nozzles. Vessel nozzles shall be insulated as shown in Figure 23-HSS-9 and 23-HSS-10.

m. 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 block which shall extend over channel flanges 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. Reentrant space between channel flanges and over channel flanges between body insulation shall be filled with block. Installation shall be as shown in Figure 23-HSS-11.



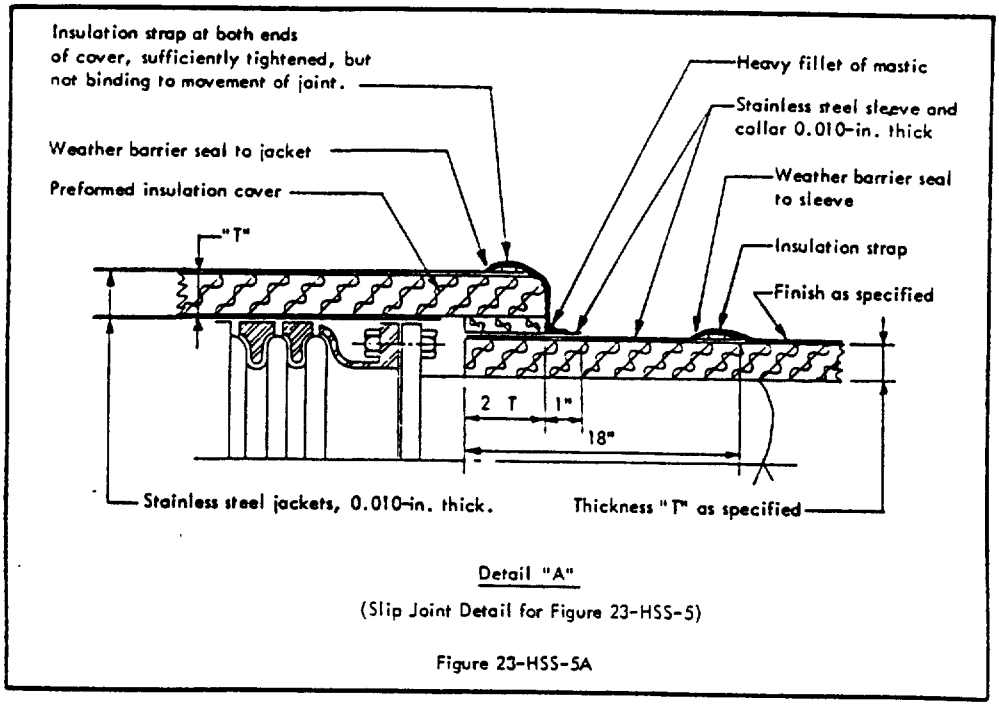
Application of Inhibited Calcium Silicate Insulation to Mechanical Expansion and Contraction Joint

Figure 23-HSS-5

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SECTION B - APPLICATION - contd

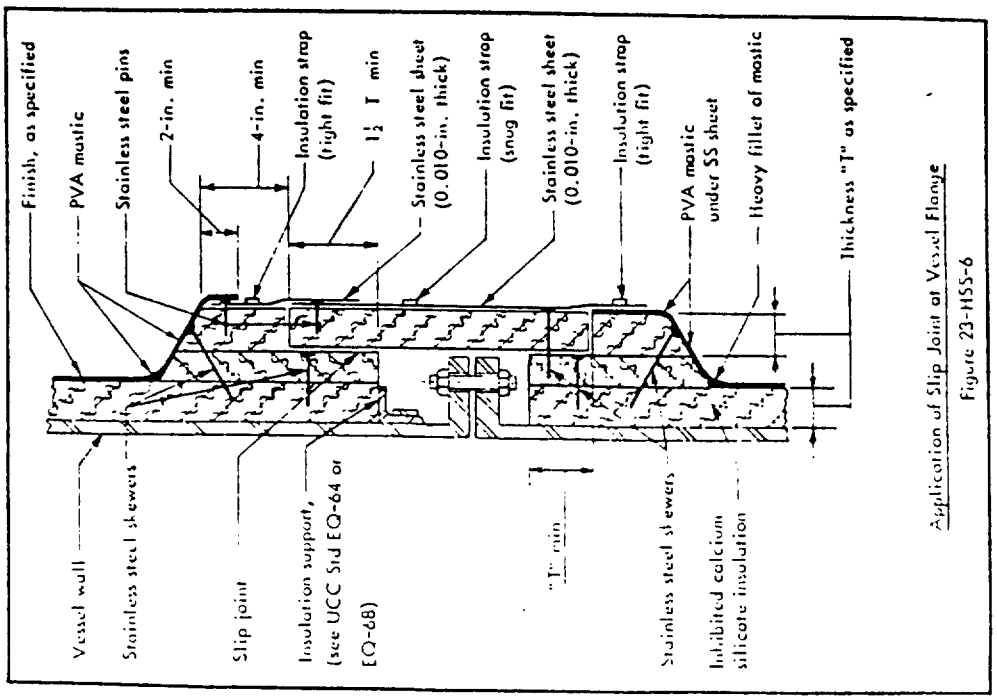
1. EQUIPMENT - contd



Detail "A"

(Slip Joint Detail for Figure 23-HSS-5)

Figure 23-HSS-5A



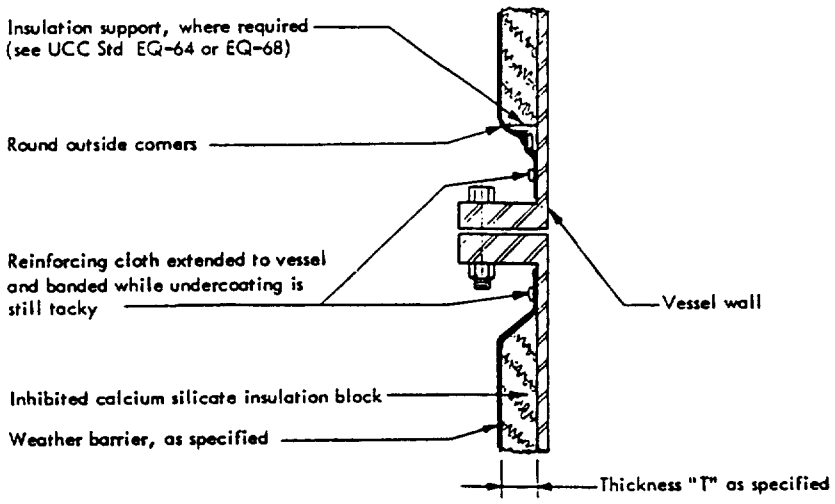
Application of Slip Joint at Vessel Flange

Figure 23-HSS-6

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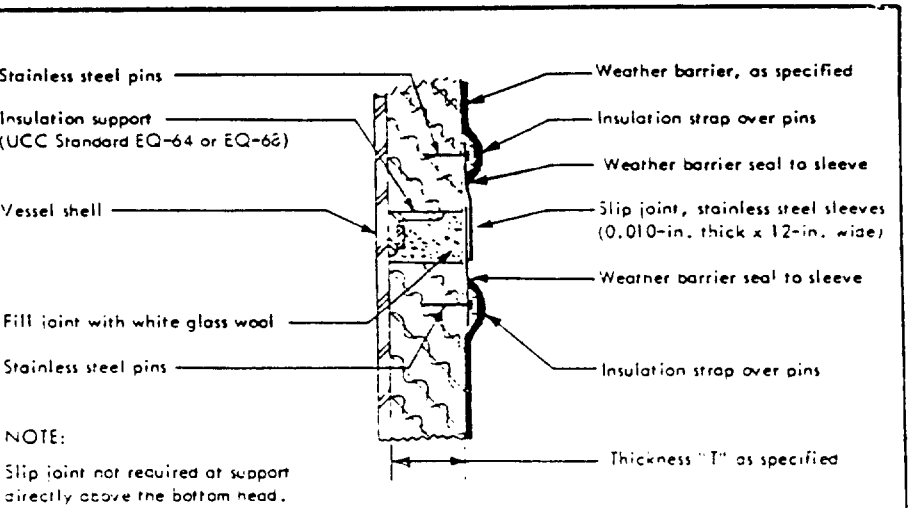
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Inhibited Calcium Silicate Insulation Adjacent to Uninsulated Flanges

Figure 23-HSS-7



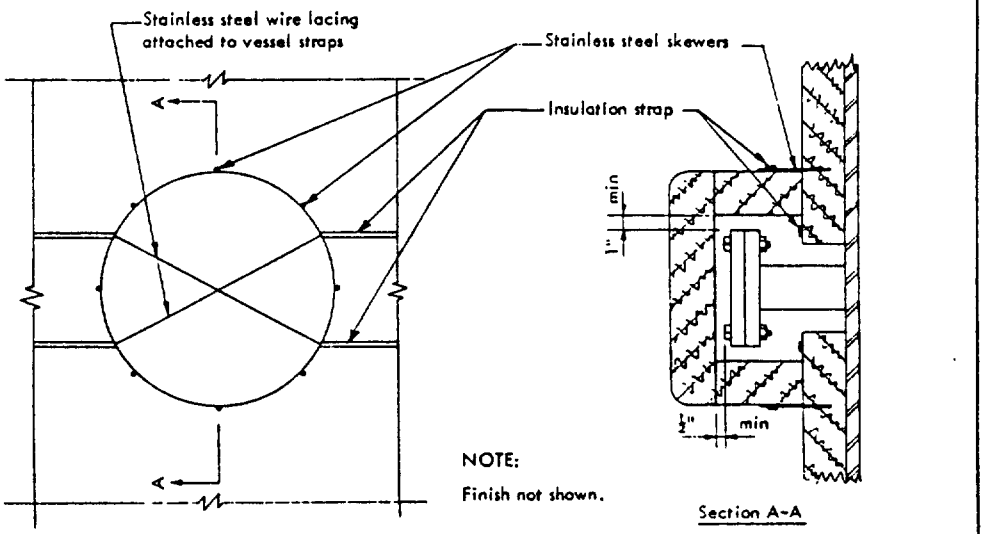
Application of Slip Joint to Vessel Wall at Insulation Supports

Figure 23-HSS-8

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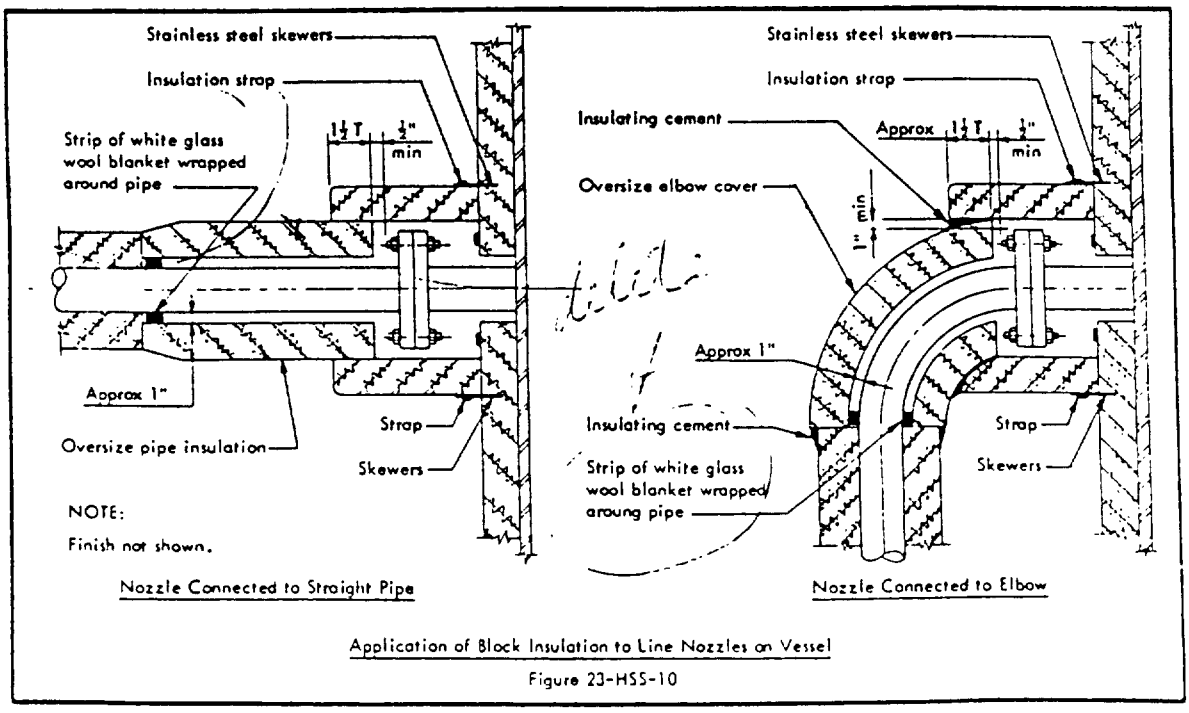
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Block Insulation to Blind Nozzle on Vessel

Figure 23-HSS-9.



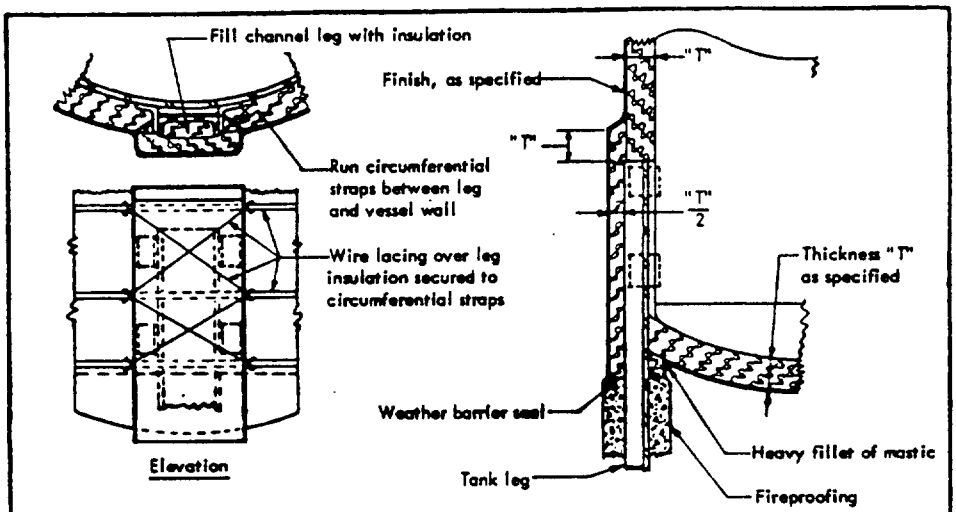
Application of Block Insulation to Line Nozzles on Vessel

Figure 23-HSS-10

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SECTION B - APPLICATION - contd

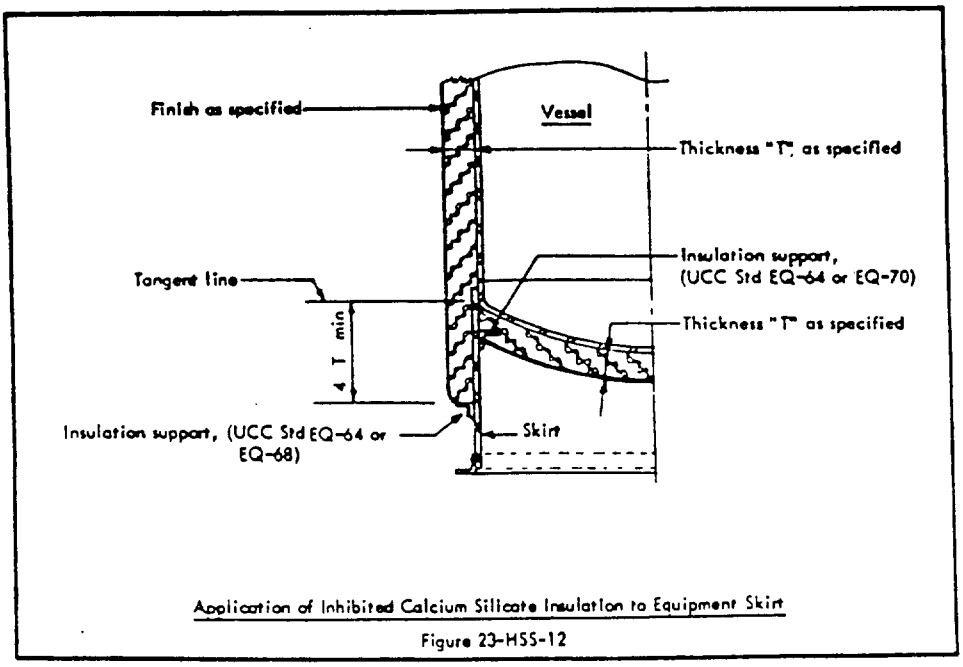
1. EQUIPMENT - contd



Application of Inhibited Calcium Silicate Insulation to Equipment Leg

Figure 23-HSS-11

n. 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, or to bottom of skirt if that distance is less than 12 inches. Thickness shall be as specified for body of vessel. The bottom head insulation shall be supported in accordance with Owner's Standard EQ-64 or EQ-70. Installation shall be as shown in Figure 23-HSS-12.



Application of Inhibited Calcium Silicate Insulation to Equipment Skirt

Figure 23-HSS-12

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SECTION B - APPLICATION - contd

1. EQUIPMENT - contd

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

p. Surface Finish. When specified thickness of insulation has been applied, any small cracks or depressions shall be pointed up with insulation cem and troweled flush with surface of insulation.

q. Weather Barrier. Weather-barrier coating or jacket, whichever is called for, shall be applied as specified in Articles XIV.B and XV.B, respec 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 d tion, 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 specificati designation, thus 23-HMT or 23-HSSMT.

2. PIPING

a. Pipe Insulation

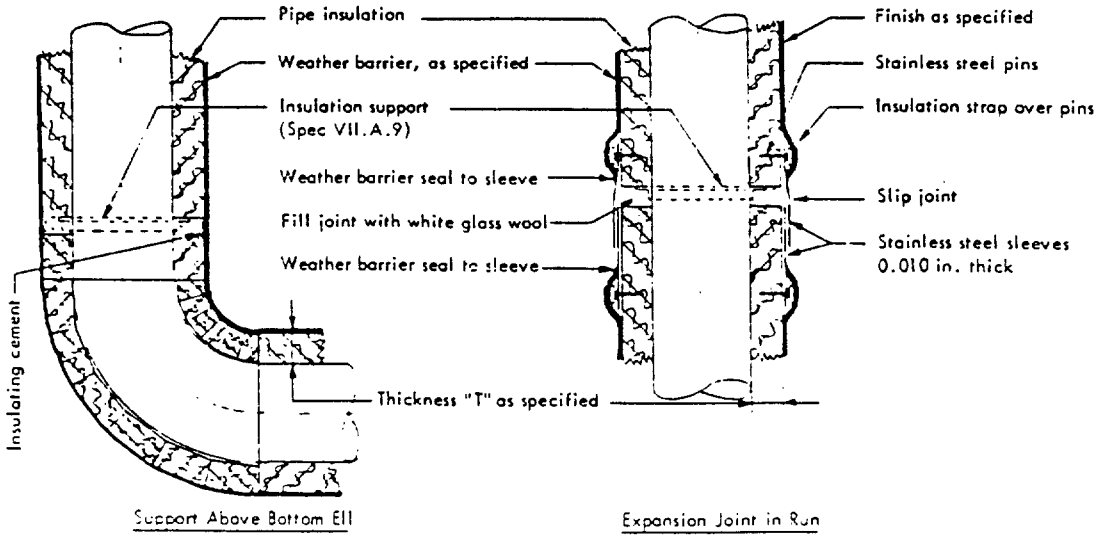
(1) Insulation Supports. Pipe insulation shall be supported and secured as specified in Article III of the GENERAL SPECIFICATIONS.

(2) Thickness Schedule. Unless otherwise specified, insulation in excess of three inches total thickness shall be applied in multiple layer const tion 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 su port 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, additionc supports shall be installed on approximately 15-foot centers to provide for installation of expansion joint as shown in Figure 23-HSS-13.



Application of Inhibited Calcium Silicate Insulation to Vertical Lines at Insulation Supports and Expansion Joints

Figure 23-HSS-13

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SECTION 8 - APPLICATION - contd

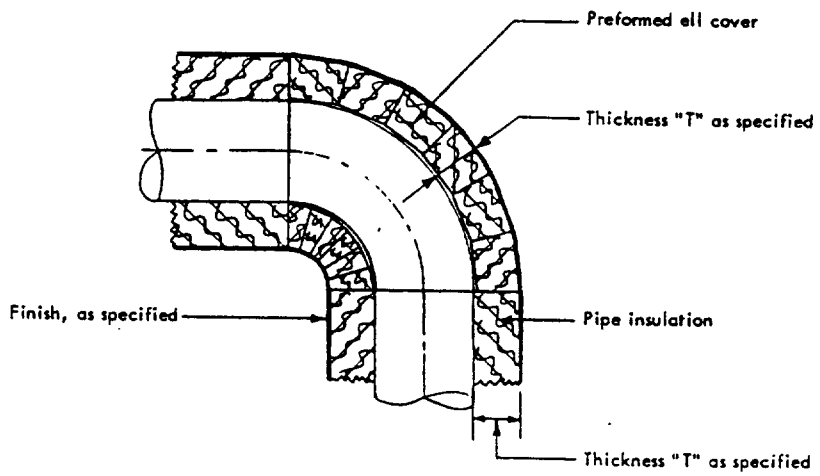
2. PIPING - contd

b. Fitting, Flange, and Valve Covers

(1) 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.

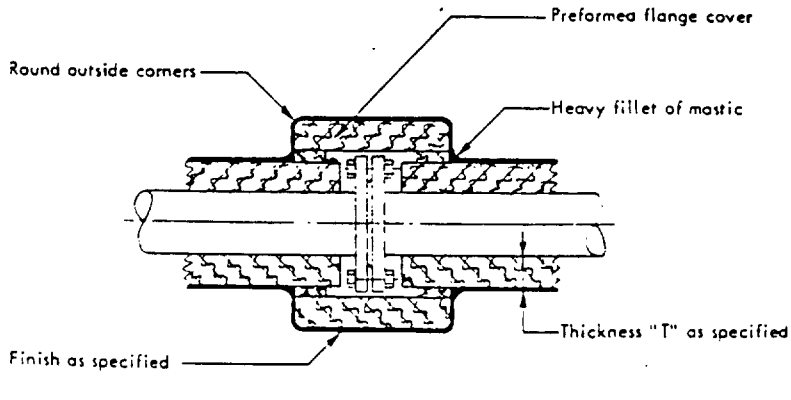
(2) Ball and plug valve covers shall be field fabricated of proper sized pipe covering.

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



Application of Inhibited Calcium Silicate Insulation to Horizontal Welded Ell

Figure 23-HSS-14



Application of Inhibited Calcium Silicate Insulation to Line Flange

Figure 23-HSS-15

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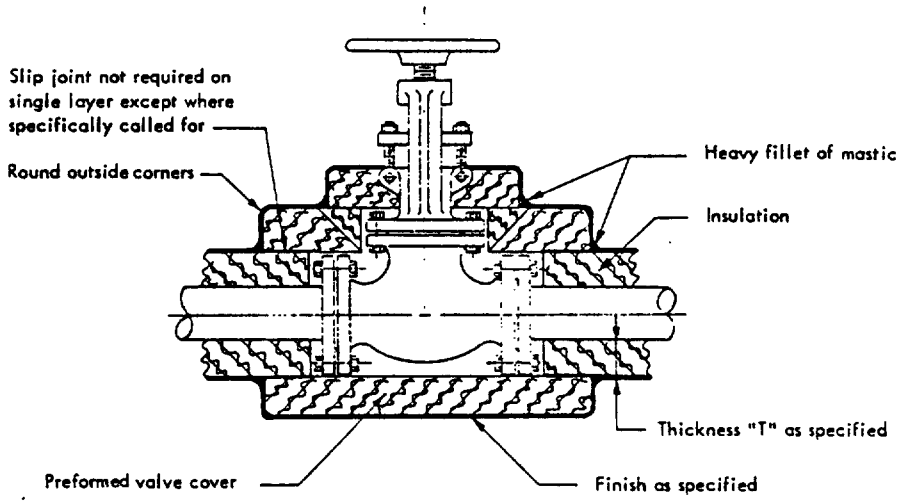
SECTION B - APPLICATION - contd

2. PIPING - contd

b. Fitting, Flange, and Valve Covers - contd

(4) Fitting insulation shall be secured with wire or strap as required.

(5) Insulation for all fittings shall be fitted and assembled with tight joints. Cementing of prefabricated 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 23-HSS-14, 23-HSS-15, and 23-HSS-16.



Application of Inhibited Calcium Silicate Insulation to Flanged Valve

Figure 23-HSS-16

c. 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 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 line has been pu 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 23-HSS-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 fee in height and pipe is 4-inch NPS or larger, for multiple layer applications. Typical installation is shown in Figure 23-HSS-18.

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

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

e. Surface Finish. Where present, small cracks and depressions shall be filled and smoothed with insulating cement before application of weather barrier.

f. Weather Barrier. Weather barrier coating and jackets, 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:

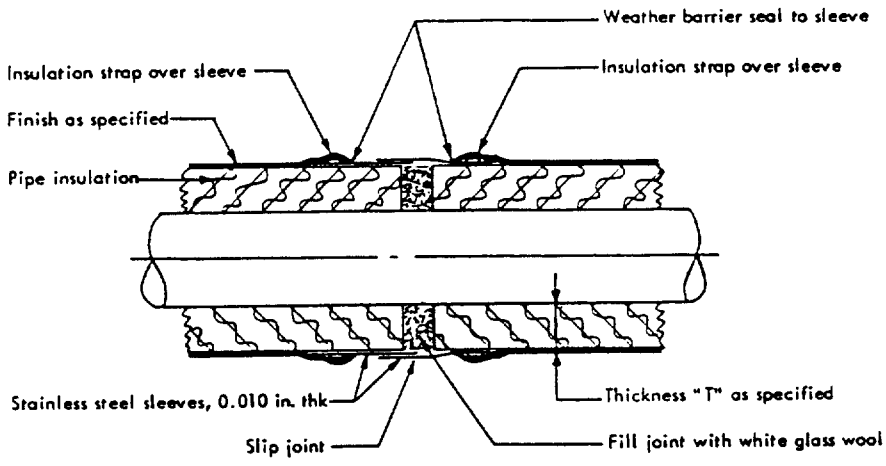
(1) Weather barrier consisting of stainless steel jacketing, where required, shall be called for by the addition of the letter M to the specification designation, thus 23-HM or 23-HSSM.

(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.

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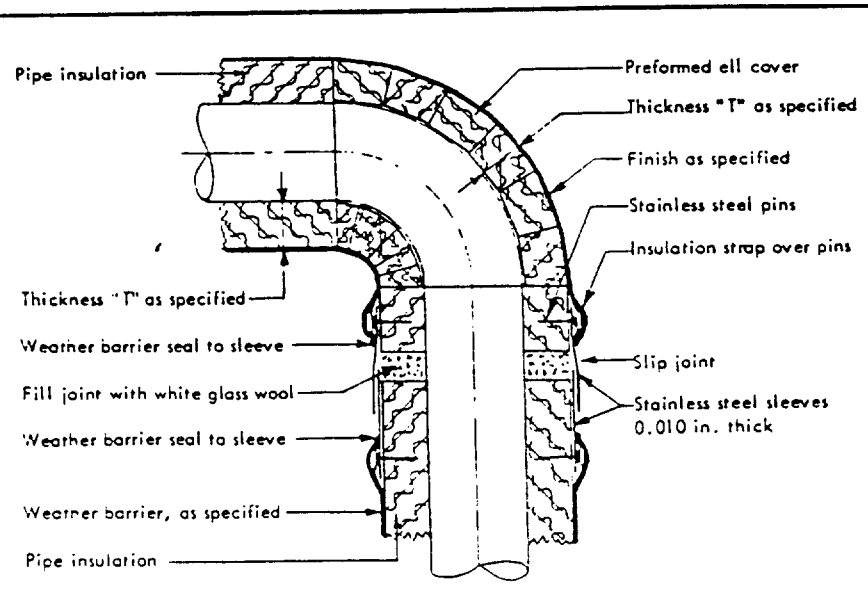
SECTION B - APPLICATION - contd

2. PIPING - contd



Application of Expansion and Contraction Joint to Inhibited Calcium Silicate Insulation on Horizontal Piping

Figure 23-HSS-17



Application of Inhibited Calcium Silicate Insulation to Welded Ell with Slip Joint at Top of Vertical Line

Figure 23-HSS-18

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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 calc 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.
Insulating Cement	VII.A. 7	Welding Pin Insulation Fasteners	VII.A.
Pipe Insulation Support	VII.A. 9	Pin Clips	VII.A.
Equipment Insulation Strap	VII.A.11	Fabricating Cement	VII.A.
Clips for Equipment Strap	VII.A.12	Heat-Resistant Sealer	VII.A.
Pipe Insulation Strap	VII.A.13	Mastic	VII.A.
Clips for Pipe Strap	VII.A.14	Mineral Wool Blanket (wire netting on one side expanded metal lath on the other side)	VII.A.
Stainless Steel Wire	VII.A.17	Weather-Barrier Mastic (color as specified)	VII.B.
Wire Netting	VII.A.18	Reinforcing Cloth	VII.B.
Welding Pins	VII.A.19	Stainless Steel Weather-Barrier Jacket (Designation M)	VII.B.
Stainless Steel Pins	VII.A.20	Treated Steel Weather-Barrier Jacket (Designation MT)	VII.B

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 construc as specified in Article III.B of the MATERIAL SPECIFICATIONS, except that outer layer shall be calcium silicate insulation per MATERIAL SPECIF TION 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, shall be secured in place with a minimum amount of stainless steel wire. Cushioning blanket shall not be considered as part of the insulation thickne thermal design. Insulation Schedule shall state total thickness of cushion blanket and insulation.

d. Curved Surfaces. On all equipment, insulation block shall be properly cut in curved sectors and rectangular blocks, as required, to fit vessel faces with a one-inch space allowed for cushioning blanket where used and applied to vessel sides and heads in staggered position with all joints tig 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 sh 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 welding pins as shown in Owner's Standard, or other approved securement. On rectangular equipment the welding pins or other approved secur ments shall be placed on 12-inch centers, diamond pattern, for bottom surfaces, on 18-inch centers, diamond pattern, for side surfaces, and on inch centers, diamond pattern, for top surfaces.

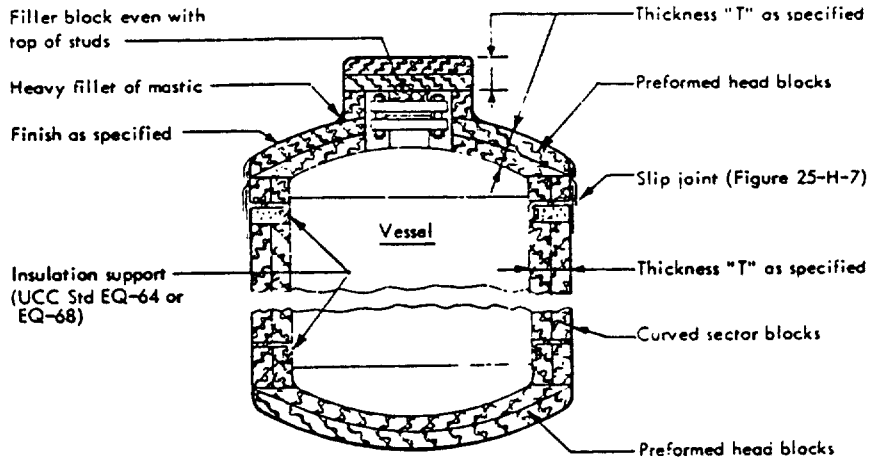
(2) When specified thickness of insulation has been applied, wire netting shall be stretched tightly over block and secured with tie wires or oth approved securement. Entire surface shall be given a 1/2-inch thick, smooth and uniformly applied trowel coat of insulating cement. Typical installation is shown in Figure 25-H-2.

f. Securement

(1) All layers of insulation shall be secured with insulation strap where contour of vessel permits firm and effective attachment. Where require insulation strap shall be attached to strap anchor angles as shown in Owner's Standard EQ-64, EQ-65, EQ-68, EQ-69, or EQ-70. Insulation applied to irregular surfaces, where use of strap is impracticable, shall be secured with wire fastened to welding pins, in accordance with Ow Standard EQ-67, drawn taut, ends twisted and embedded in insulation.

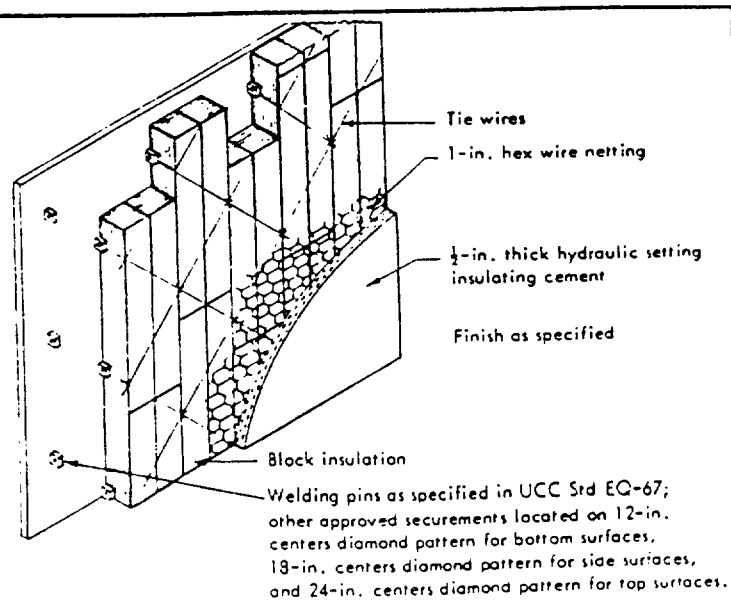
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



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

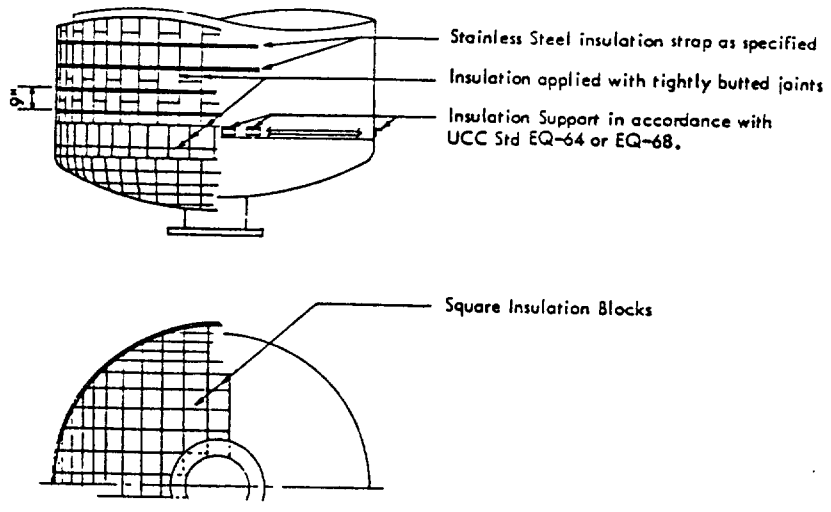
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SECTION B - APPLICATION - contd

1. EQUIPMENT - contd

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 attac to welding pins, in accordance with Owner's Standard EQ-67, or with insulation strap attached to insulation support as shown in Owner's Star EQ-64, EQ-65, EQ-68, EQ-69 and EQ-67, 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 sle 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 cove 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" pl 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 e 2 x "T" 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 mini 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 jack 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 securely fasten the pipe covering.

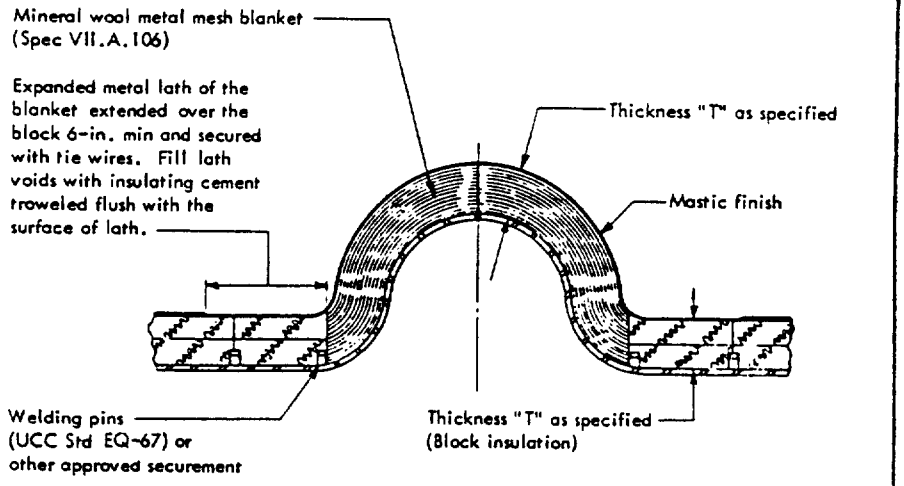
i. Insulated Vessel Flanges. Vessel flanges shall be insulated with preformed insulation assembly and weather protected with stainless steel jacket insulation support shall be provided immediately above vessel flange. Assembly shall be installed so as to provide slip joints which will allow moven of insulation and weather-barrier jacket. The top of projecting flange insulation shall be sloped to shed water. Typical installation is shown in Fig 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 insula 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-8 and 25-H-9.

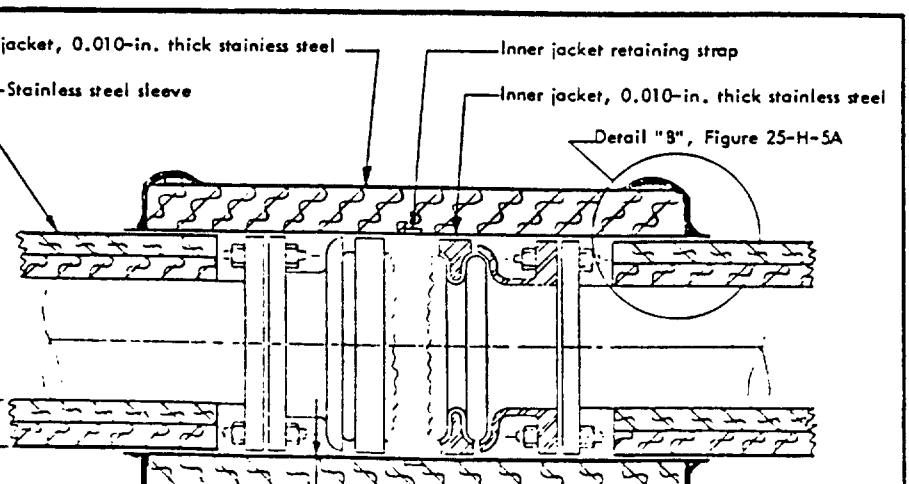
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Blanket Insulation to Expansion Joints on Flat Surface

Figure 25-H-4



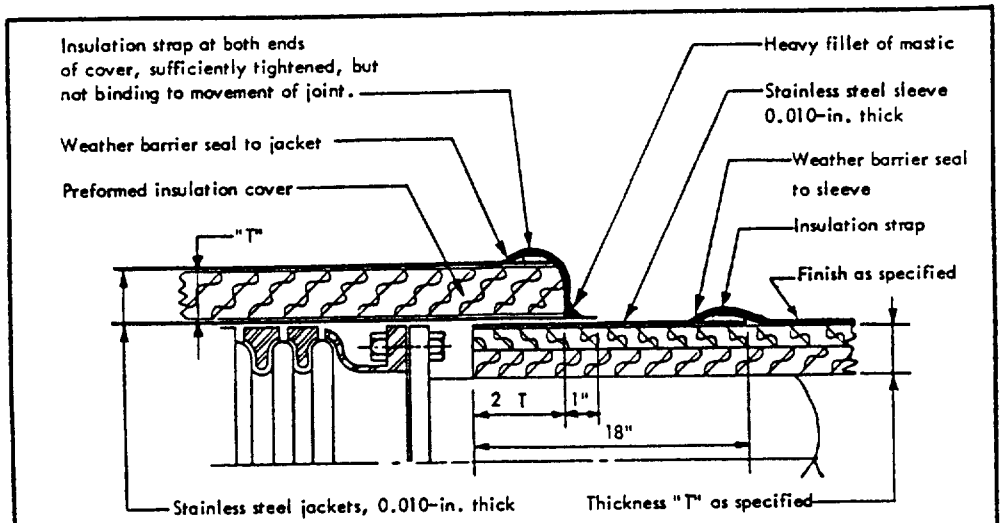
Application of Hydrous Calcium Silicate Insulation to Mechanical Expansion and Contraction Joint

Figure 25-H-5

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SECTION B - APPLICATION - contd

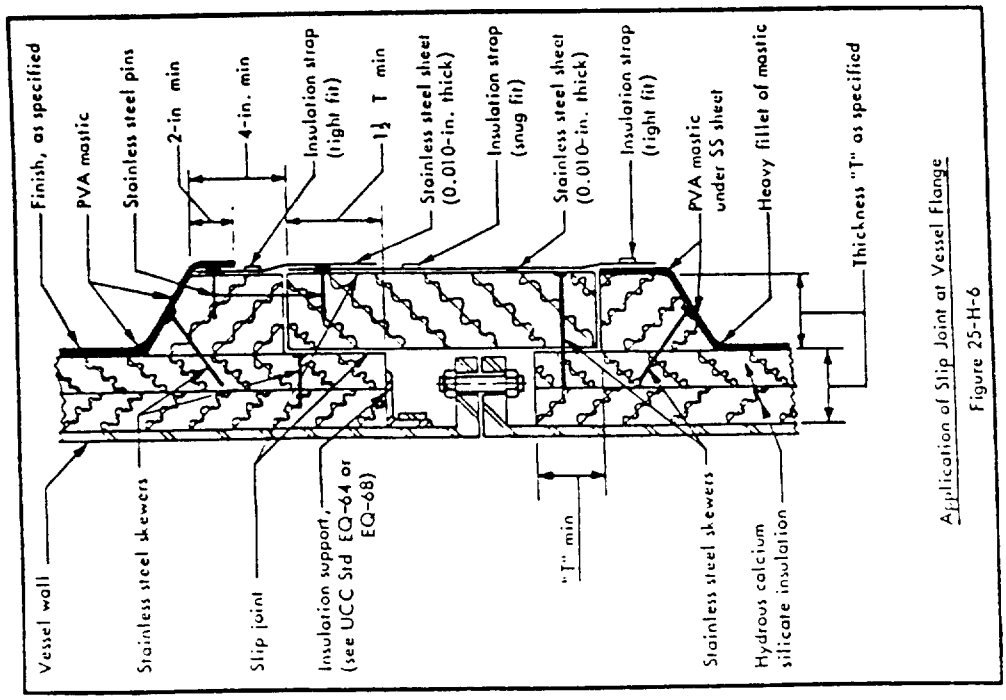
1. EQUIPMENT - contd



Detail "B"

(Slip Joint Detail for Figure 25-H-5)

Figure 25-H-5A



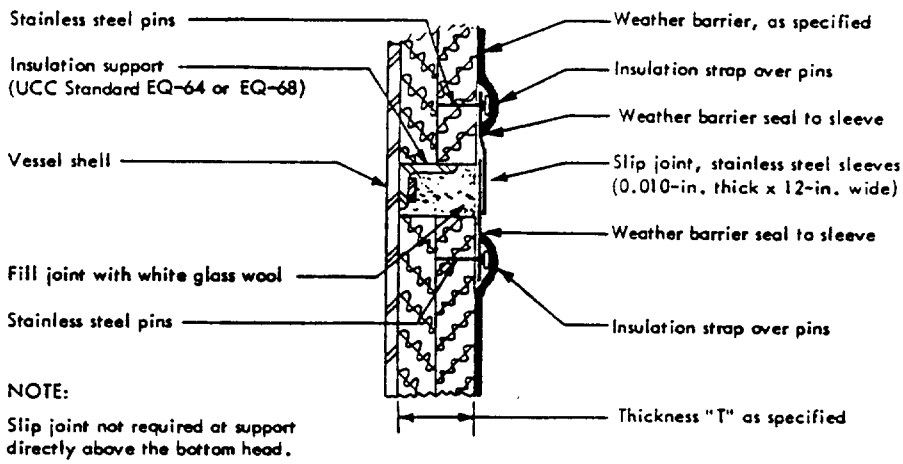
Application of Slip Joint at Vessel Flange

Figure 25-H-6

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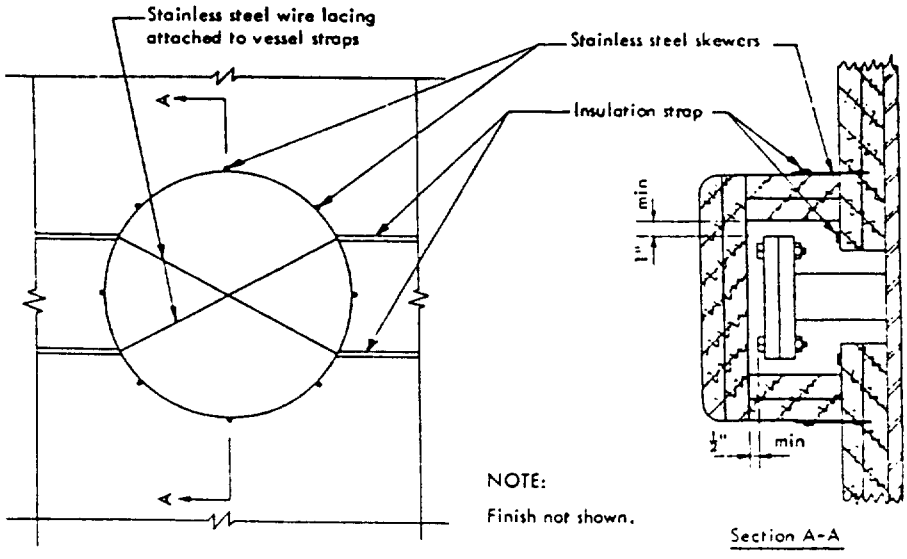
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Slip Joint to Vessel Wall at Insulation Supports

Figure 25-H-7



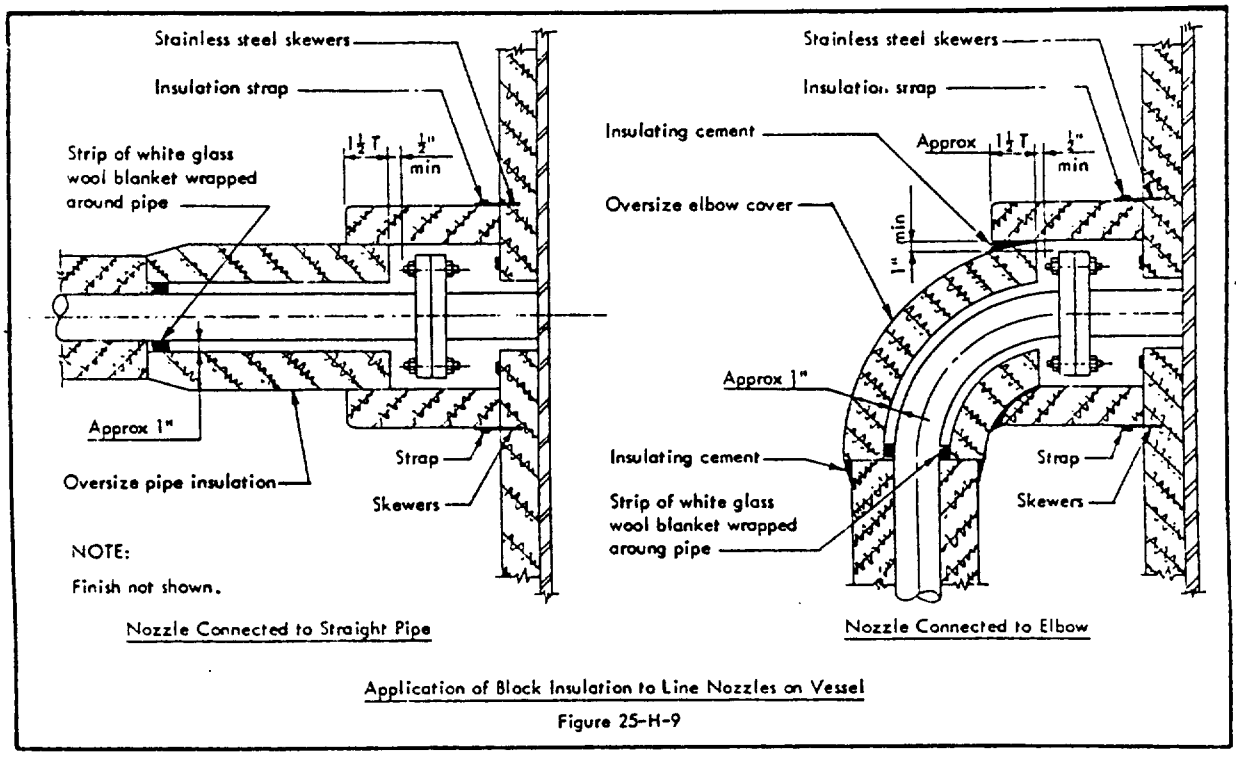
Application of Block Insulation to Blind Nozzle on Vessel

Figure 25-H-8

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SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Block Insulation to Line Nozzles on Vessel

Figure 25-H-9

l. 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 block which shall extend over channel flanges and down channel legs to fireproofing. Thickness shall b a minimum of one-half that specified for body of vessel.

(3) Vessel insulation shall be butted firmly against tank leg flange. Reentrant space between channel flanges and over channel flanges between body insulation shall be filled with block. 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, or to bottom of skirt, that distance is less than 12 inches. Thickness shall be as specified for body of vessel. The bottom head insulation shall be supported in accordance v Owner's Standard EQ-64, EQ-70 or EQ-67. 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 SPECIFICATIC

o. Surface Finish. When specified thickness of insulation has been applied, any small cracks or depressions shall be pointed up with insulation cem and troweled 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 XIV.B and XV.B, respectively, of the GENERAL SPECIFICATIONS. Mastic weather barrier shall be used unless metal jacket is called for as follows:

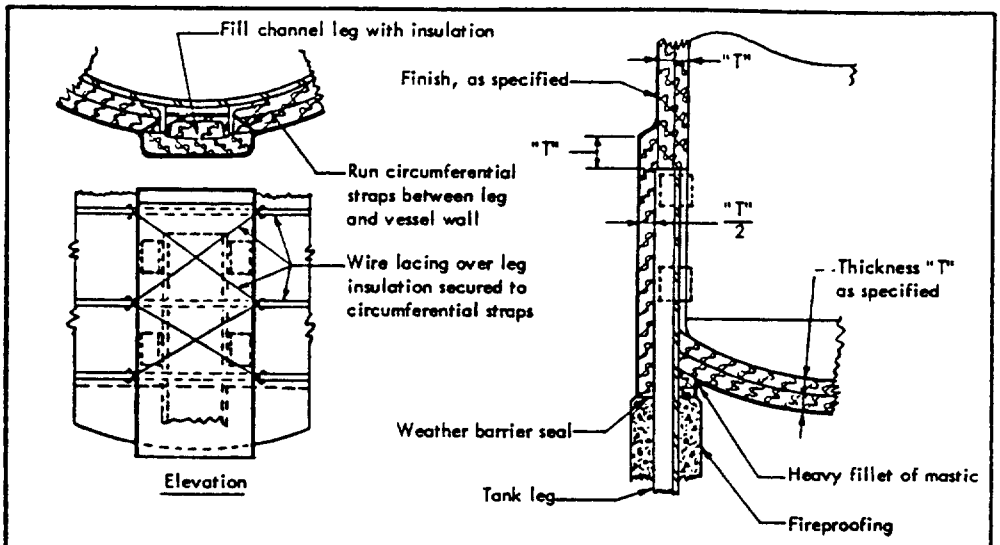
(1) Weather barrier consisting of stainless steel jacketing, where required, shall be called for by the addition of the letter M to the specification designation, thus 25-HM.

(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 25-HMT.

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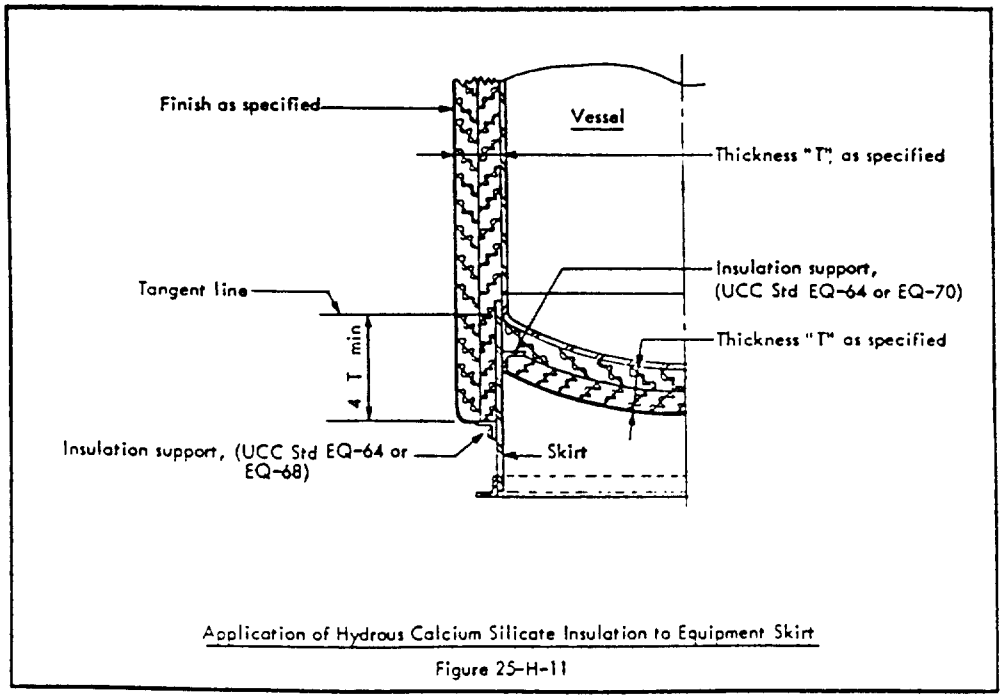
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Hydrous Calcium Silicate Insulation to Equipment Leg

Figure 25-H-10



Application of Hydrous Calcium Silicate Insulation to Equipment Skirt

Figure 25-H-11

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SECTION B - APPLICATION - contd

2. PIPING

a. Pipe Insulation

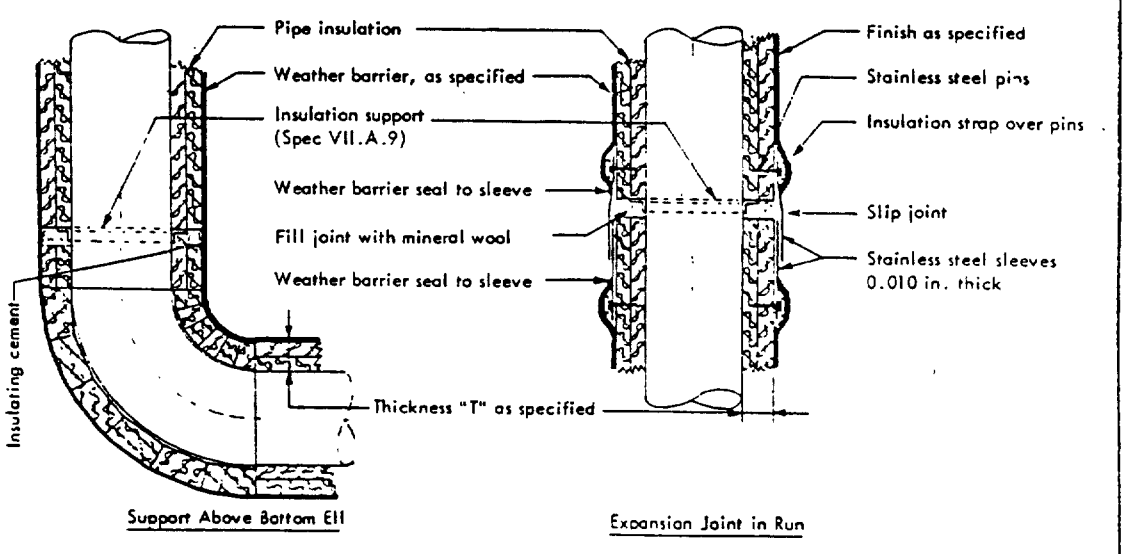
(1) Insulation Supports. Pipe insulation shall be supported and secured as specified in Article III of the GENERAL SPECIFICATIONS.

(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 alse be installec 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, additionc 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. Fitting, 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) Insulation for all fittings shall be fitted and assembled with tight joints. Cementing of prefabricated 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 25-H-13, 25-H-14, and 25-H-15.

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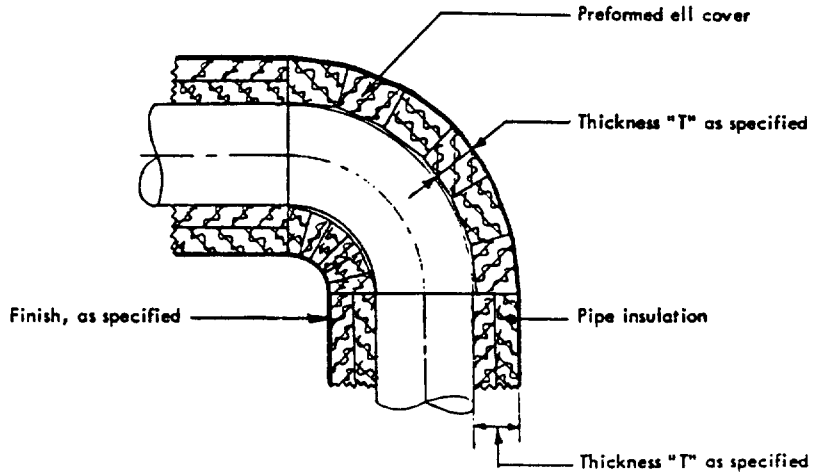
SECTION B - APPLICATION - contd

2. PIPING - contd

b. Fitting, Flange, and Valve Covers - contd

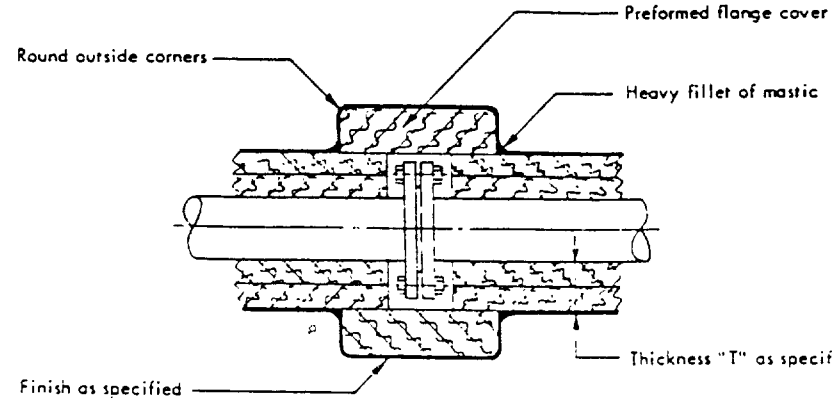
(4) Fitting insulation shall be secured with wire or strap as required.

(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

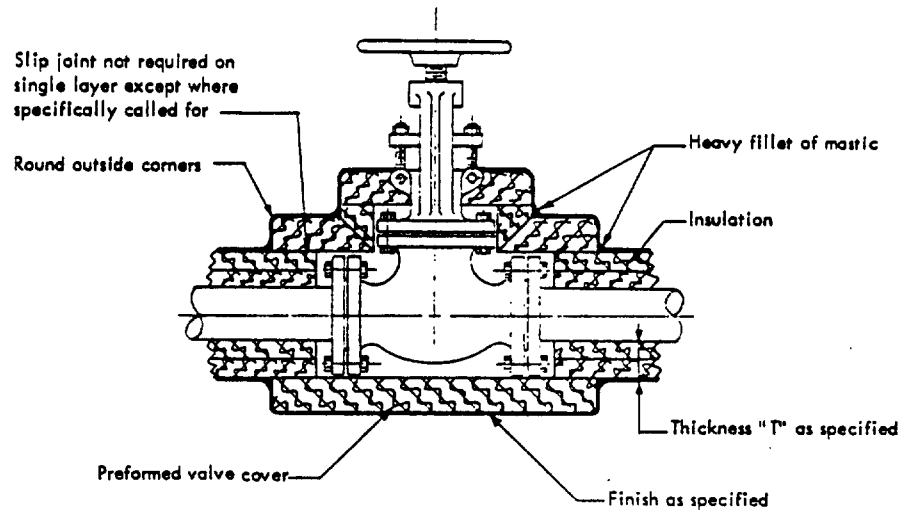
Figure 25-H-14

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SECTION B - APPLICATION - contd

2. PIPING - contd

b. Fitting, Flange, and Valve Covers - contd



Application of Hydrous Calcium Silicate Insulation to Flanged Valve

Figure 25-H-15

c. 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 each 15 feet of straight piping not interrupted by flanges, valves, or fittings and insulated with multiple layer insulation and each 30 feet insulated with single layer insulation. Typical installation is shown in Figure 25-H-16. If an expansion crack occurs after the line is put in servic 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 25-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 12 fe in height and pipe is 4-inch NPS and larger. Typical installation is shown in Figure 25-H-17.

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

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

e. Surface Finish. Where present, small cracks and depressions shall be filled and smoothed with insulating cement before application of the weath barrier.

f. Weather Barrier. Weather-barrier coating and jackets, whichever is called for, shall be applied as specified in Articles XIV.B and XV.B, resp 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 specificatio designation, thus 25-HM.

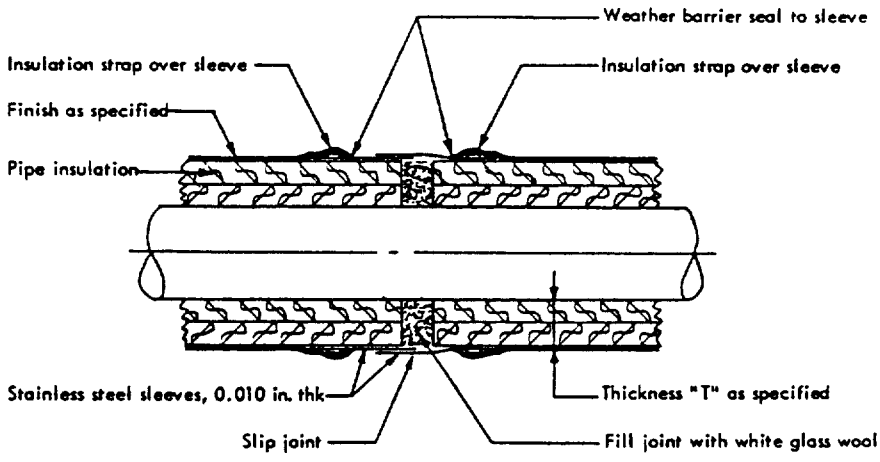
(2) Weather barrier consisting of treated steel jacketing, where required, shall be called for by the addition of the letters MT to the specificati designation, thus 25-HMT.

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SECTION 8 - APPLICATION - contd

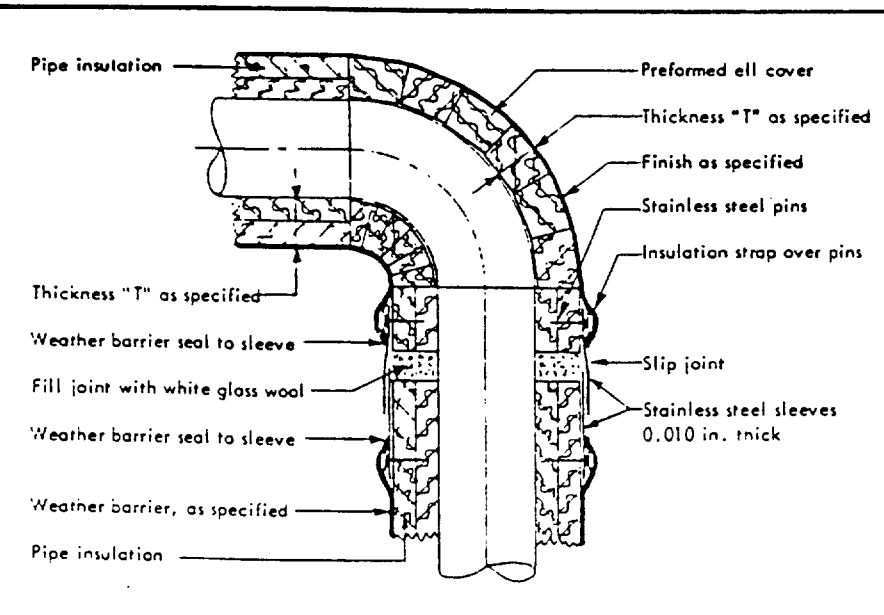
2. PIPING - contd

c. Expansion Joints - contd



Application of Expansion and Contraction Joint to Hydrous Calcium Silicate Insulation on Horizontal Piping

Figure 25-H-16



Application of Calcium Silicate Insulation to Welded Ell with Slip Joint at Top of Vertical Line

Figure 25-H-17

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THERMAL INSULATION APPLICATION SPECIFICATIONS

PREFABRICATED STAINLESS-CASED ALUMINUM

SCOPE

This specification describes the essential requirements for application of prefabricated stainless-cased aluminum reflective insulation for use on piping a 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

   Insulation shall be as specified in MATERIAL SPECIFICATION 31.

2. ACCESSORY MATERIALS (furnished by manufacturer)

   a. Stainless Steel 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, ove 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 sur 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 sections. The extended longitudinal eages of each section shall be lapped over flush edges of opposing 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. Securement. 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 outer

      (2) Where any field cutting or fitting around supports or nozzles is required, care shall be exercised to insure good workmanship, and to seal individual air chambers in the insulation.

      (3) Where equipment or piping is located outdoors, or where otherwise required, joints or openings in outer shell of the insulation shall be fi to form a watershed.

      (4) Provision shall be made in the assembly of the insulation units to allow for expansion and contraction of the surfaces insulated without da to the insulation.

      (5) Tracing and insulation on traced lines, where specified, shall be installed as specified in Article XIII of the GENERAL SPECIFICATIO

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UNION CARBIDE **STANDARD**

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THERMAL INSULATION APPLICATION SPECIFICATIONS

BONDED AND REINFORCED EXPANDED SILICA

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SCOPE

This specification describes the essential requirements for application of preformed bonded and reinforced expanded silica (perlite) insulation for us 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

1. INSULATION MATERIAL

Insulation shall be as specified in MATERIAL SPECIFICATION 22.

2. ACCESSORY MATERIALS

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

Cushioning Blanket (For Equip. Oper. 400 F to 1000 F	VII.A.1	
Cushioning Blanket (For Equip. Oper. below 400 F)	VII.A.2	Stainless Steel Skewers
Mineral Wool Blanket (wire netting on both sides)	VII.A.5	Welding Pin Insulation Fasteners
Insulating Cement	VII.A.7	Pin Clips
Pipe Insulation Support	VII.A.9	Fabricating Cement
Equipment Insulation Strap	VII.A.11	Heat-Resistant Sealer
Clips for Equipment Strap	VII.A.12	Mastic
Pipe Insulation Strap	VII.A.13	Adhesive Type Pins
Clips for Pipe Strap	VII.A.14	Mineral Wool Blanket (wire netting on one side,
Stainless Steel Wire	VII.A.17	expanded metal lath on the other side)
Wire Netting	VII.A.18	Weather-Barrier Mastic (color as specified)
Welding Pins	VII.A.19	Reinforcing Cloth
Stainless Steel Pins	VII.A.20	Stainless Steel Weather-Barrier Jacket (Designation M)
		Treated Steel Weather-Barrier Jacket (Designation MT)

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 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 1-inch thick cushioning blanket shall be applied over the entire surface before application of the expanded silica insulation. On equipment operating up to 400 F Cushioning Blanket VII. A.2 shall be used, 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 secured in place with a minimum amount of stainless steel wire. Cushioning blanket shall not be considered as part of the insulation thickness for thermal design. Insulation Schedule shall state total thickness of cushioning blanket and insulation.

d. Curved Surfaces. On all equipment insulation block shall be properly cut in curved sectors and rectangular blocks, as required to fit vesse faces, with a one-inch space allowed for cushioning blanket where used, and applied to vessel sides and heads in staggered position with all joint 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 install 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 EQ-67, or other approved securement. On rectangular equipment, the welding pins or othe approved securements shall be placed on 12-inch centers, diamond pattern, for bottom surfaces on 18-inch centers, diamond pattern, for side surfa and on 24-inch centers, diamond pattern for top surfaces. Typical installation is shown in Figure 32-H-2.

f. Securement

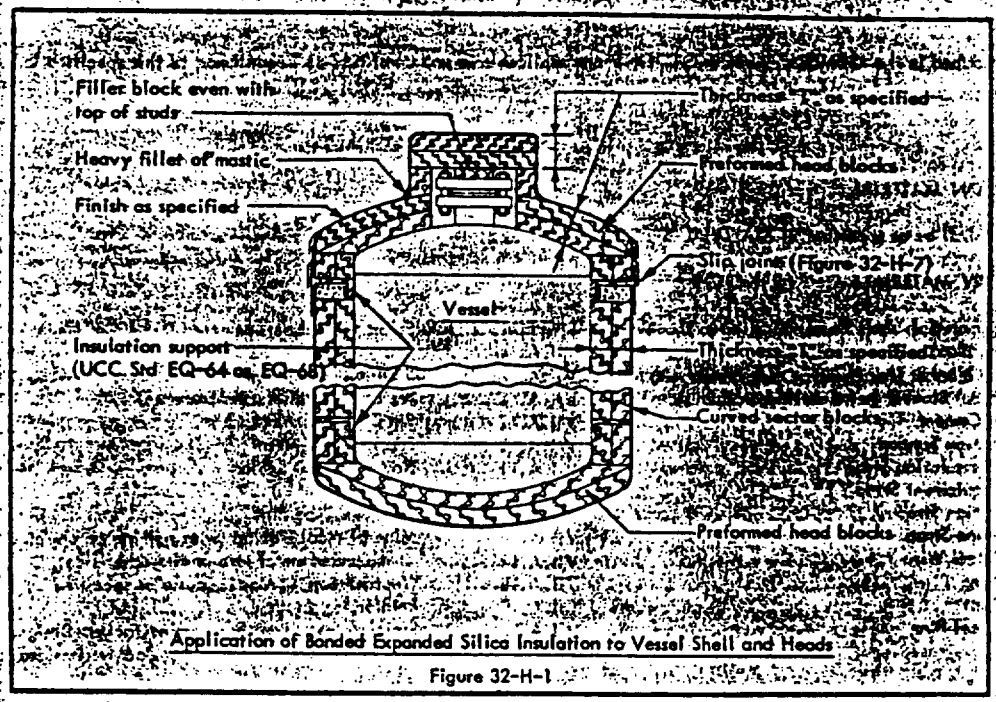
(1) All layers of insulation shall be secured with insulation strap where contour of vessel permits firm and effective attachment. Where requir Insulation strap shall be attached to strap anchor angles as shown in Owner's Standard EQ-64, EQ-65, EQ-68, EQ-69, or EQ-70. Insulation applied to irregular surfaces, where use of strap is impracticable, shall be secured with wire fastened to welding pins, drawn taut, ends twiste 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 attac to welding pins, in accordance with Owner's Standard EQ-67, or insulation strap attached to insulation support as shown in Owner's Standard or EQ-70 and in Figure 32-H-3.

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

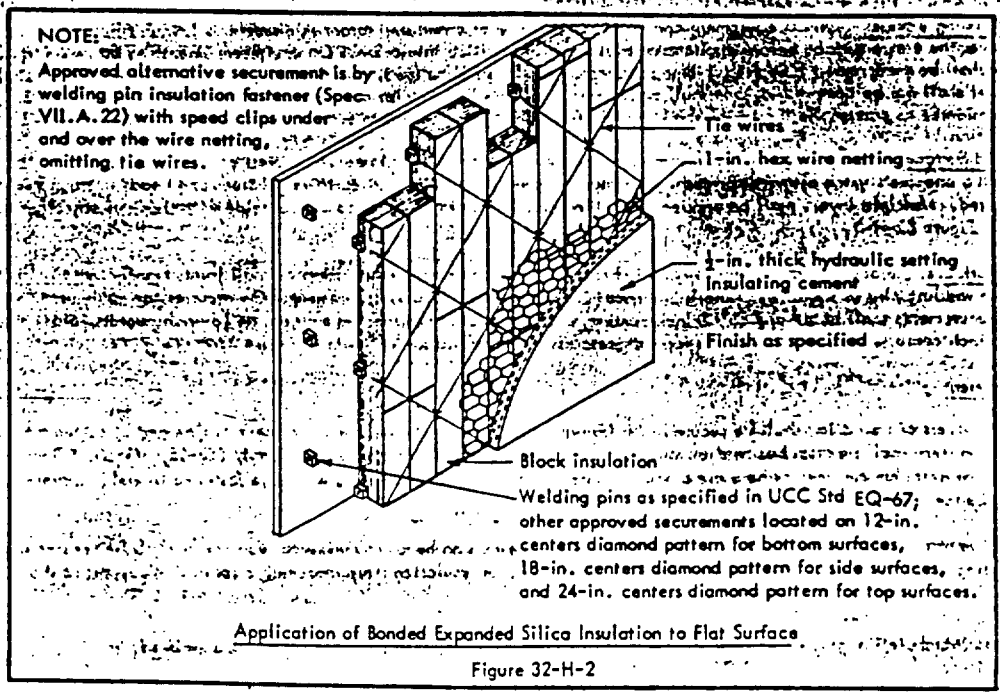
SECTION H—APPLICATION (cont'd)

I. EQUIPMENT – cont'd



Application of Bonded Expanded Silica Insulation to Vessel Shell and Heads

Figure 32-H-1



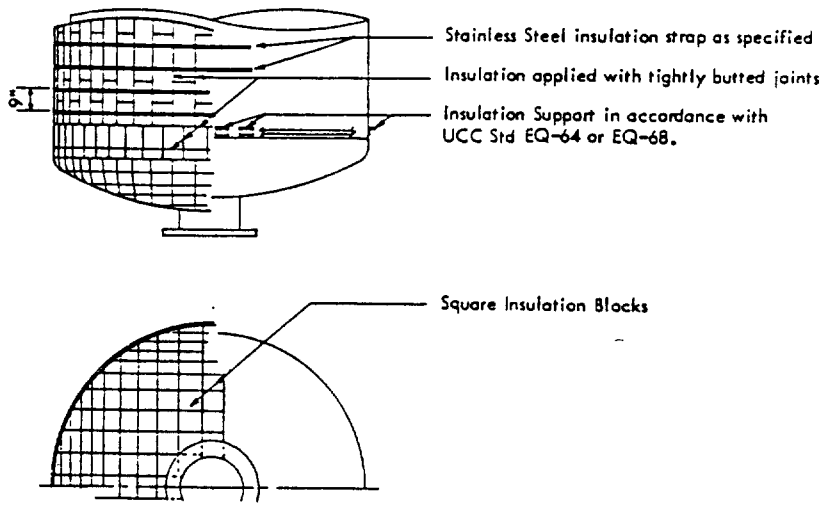
Application of Bonded Expanded Silica Insulation to Flat Surface

Figure 32-H-2

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SECTION B - APPLICATION - contd

1. EQUIPMENT - contd

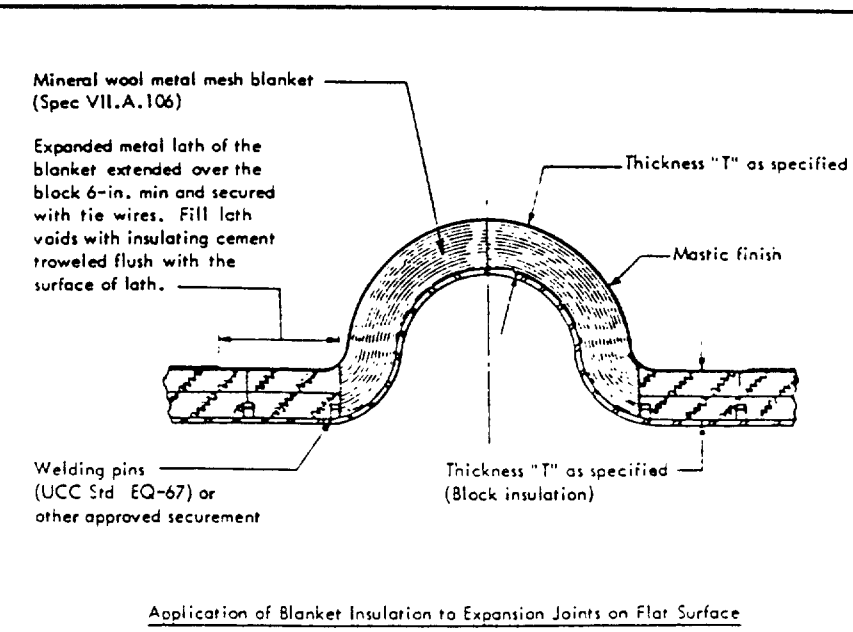


Application of Bonded Expanded Silica Insulation to Bottom Vessel Head

Figure 32-H-3

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 32-H-4.



Application of Blanket Insulation to Expansion Joints on Flat Surface

Figure 32-H-4

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SECTION B - APPLICATION - contd

1. EQUIPMENT - contd

h. Expansion Joints - contd

(2) Corrugated mechanical expansion joints in piping (usually listed as equipment items) shall be insulated as shown in Figures 32-H-5 and 32-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 coverinc 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 × "T" plus 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 exte 2 × "T" 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 minimur 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 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 securely fastened to the pipe covering.

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 32-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 32-H-7.

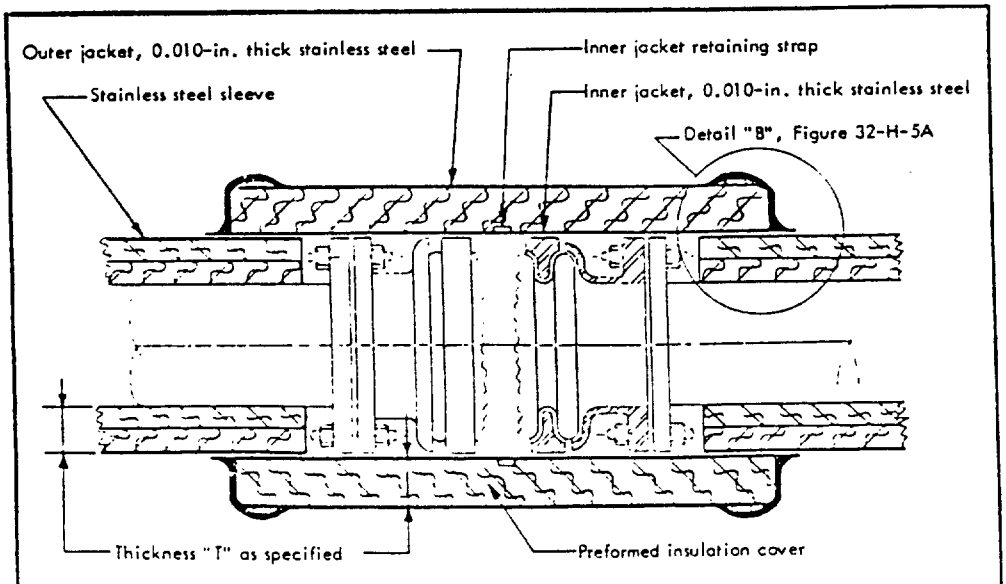
k. Vessel Nozzles. Vessel nozzles shall be insulated as shown in Figures 32-H-8 and 32-H-9.

l. 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 block which shall extend over channel flanges and down legs to the standard fireproofing on legs. Insulation thickness on legs shall be equal to that of vessel.

(3) Vessel insulation shall be butted firmly against tank leg flange. Reentrant space between channel flanges and over channel flanges between body insulation shall be filled with block. Installation shall be as shown in Figure 32-H-10.



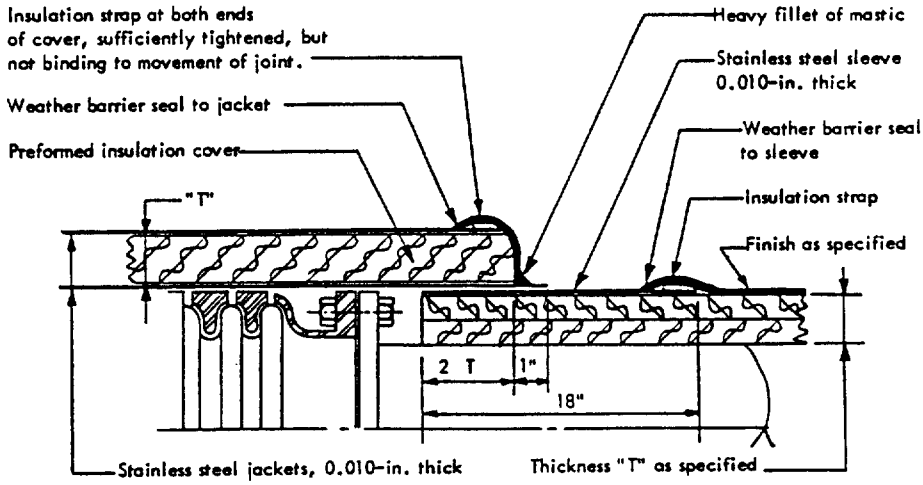
Application of Banded Expanded Silica Insulation to Mechanical Expansion and Contraction Joint

Figure 32-H-5

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SECTION B - APPLICATION - contd

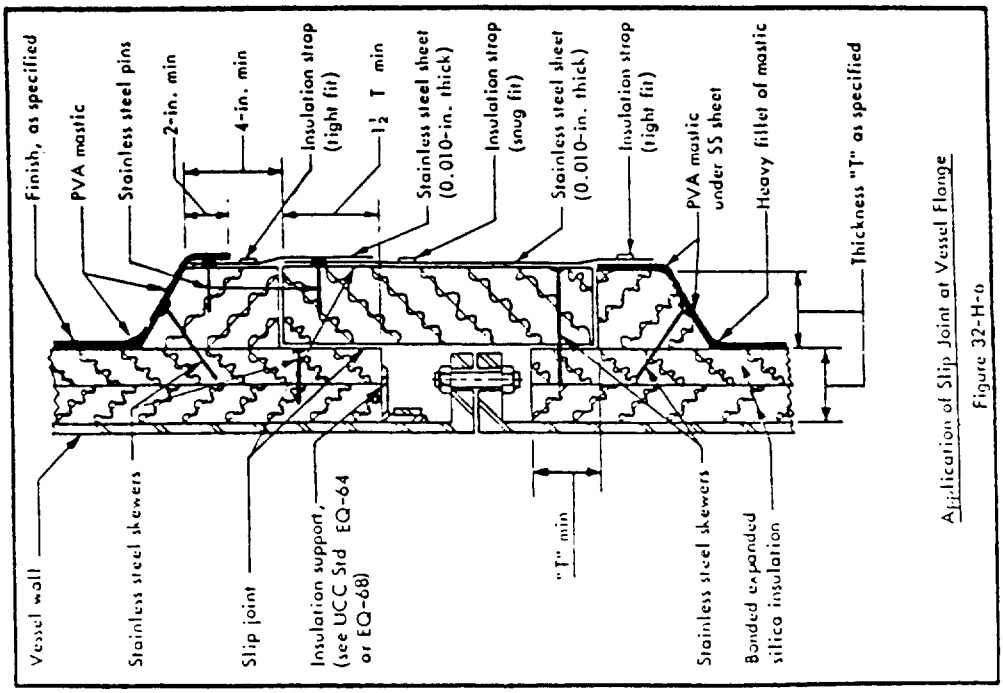
1. EQUIPMENT - contd



Detail "B"

(Slip Joint Detail for Figure 32-H-5)

Figure 32-H-5A



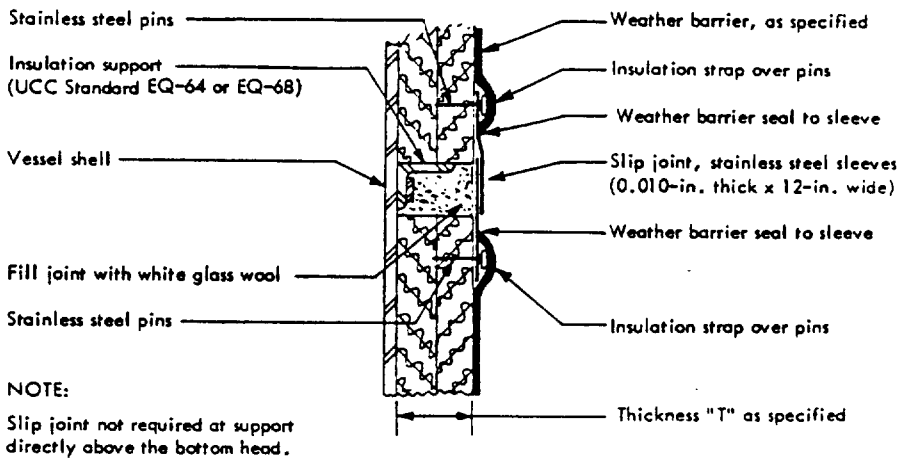
Application of Slip Joint at Vessel Flange

Figure 32-H-6

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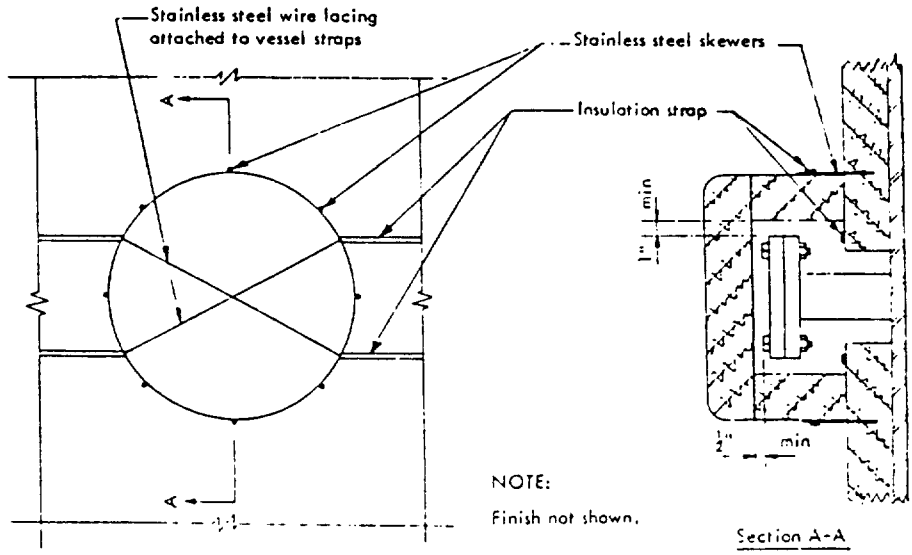
SECTION 8 - APPLICATION - contd

1. EQUIPMENT - contd



Application of Slip Joint to Vessel Wall at Insulation Supports

Figure 32-H-7



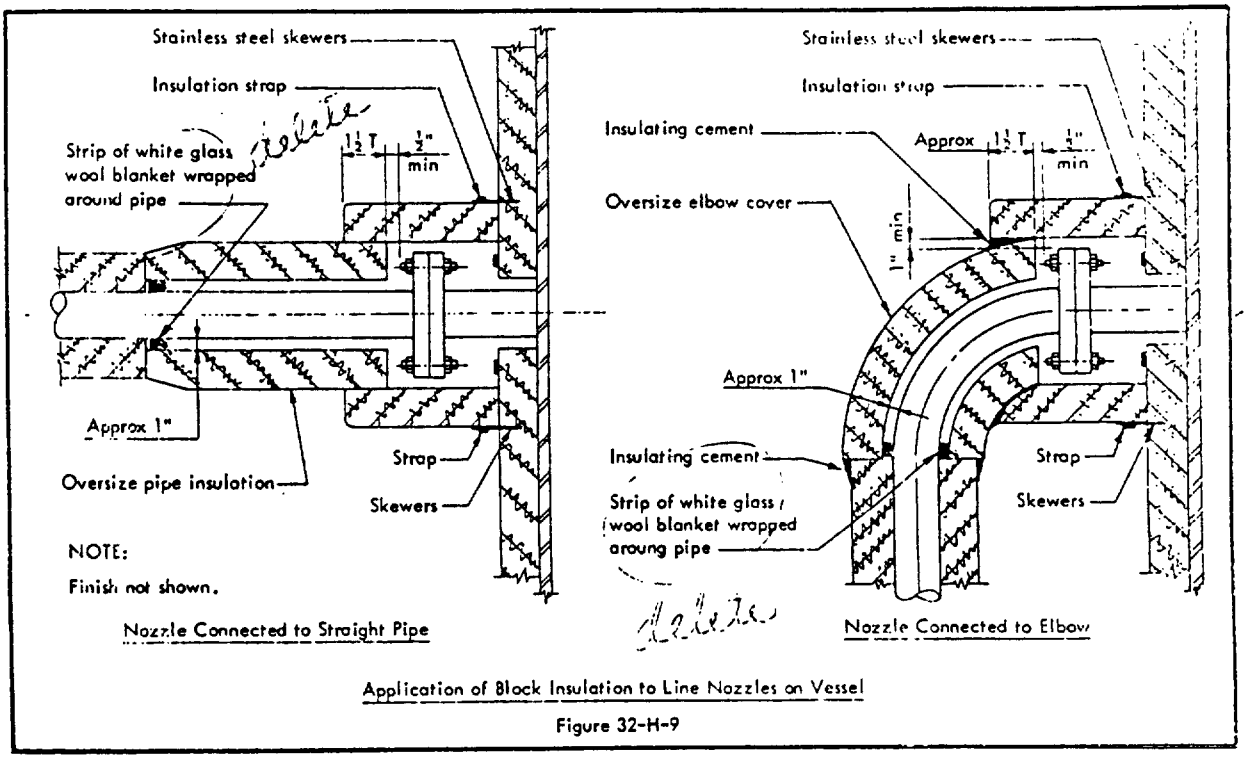
Application of Block Insulation to Blind Nozzle on Vessel

Figure 32-H-8

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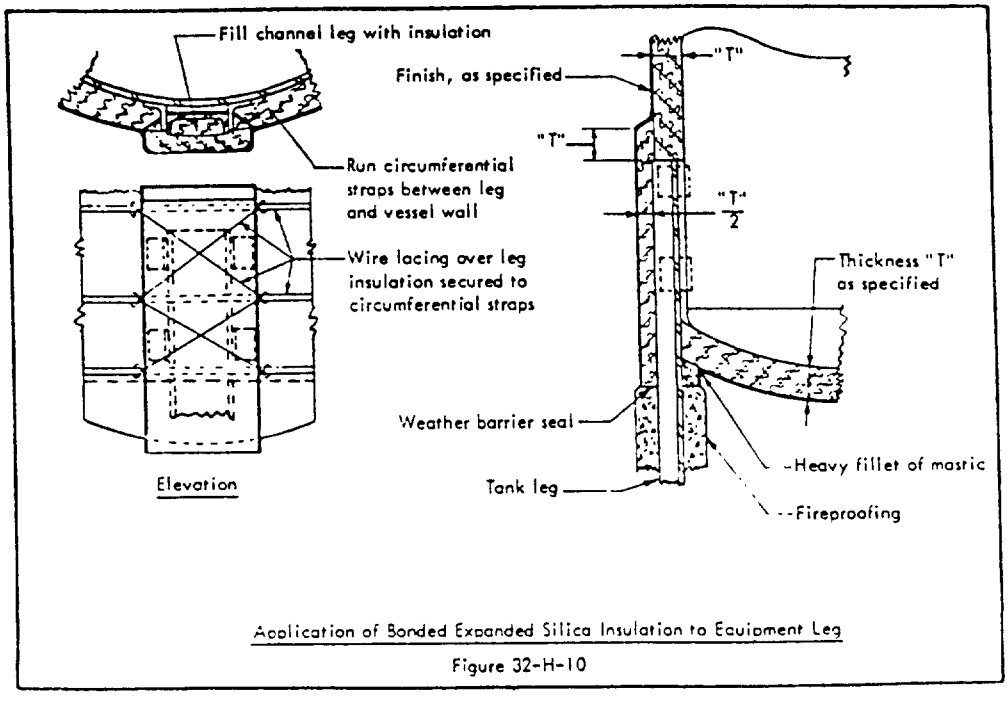
SECTION B - APPLICATION - contd

1. EQUIPMENT - contd



Application of Block Insulation to Line Nozzles on Vessel

Figure 32-H-9



Application of Bonded Expanded Silica Insulation to Equipment Leg

Figure 32-H-10

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SECTION 8 - APPLICATION - contd

1. EQUIPMENT - contd

m. Vessel Skirts. Skirts supporting vertical equipment shall have their outer surfaces insulated. Unless otherwise specified, insulation shall extend from junction of skirt with bottom head to standard fireproofing or to foundation as shown in Figure 32-H-11.

Thickness shall be as specified for body of vessel. The bottom head insulation shall be supported in accordance with Owner's Standard IS-40 or IS-42. Installation shall be as shown in Figure 32-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 cemen and troweled flush with surface of insulation.

p. Weather Barrier. Weather-barrier coating or jacket, whichever is called for, shall be applied as specified in Articles XIV.B and XV.B, respectiv 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-HFPM.

(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-HFPMT.

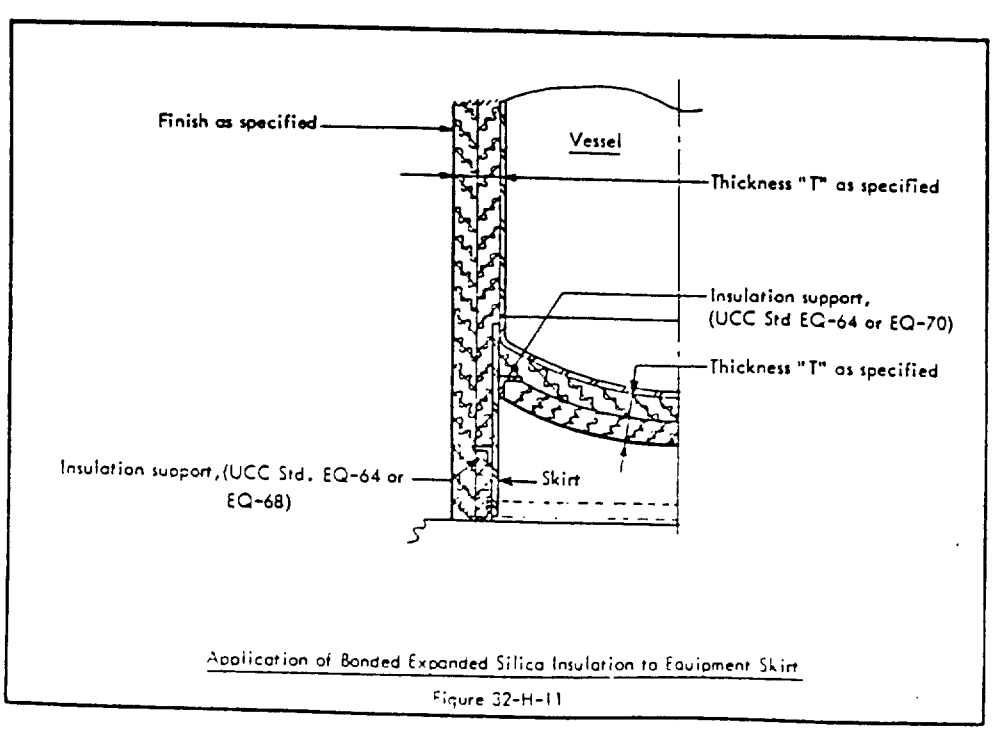
2. PIPING

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, pipe insulation shall be applied in accordance with the following table and as shown in Figures GA-1 and GA-2 of the GENERAL SPECIFICATIONS.

NPS Pipe Size	Total Scheduled Thickness, Inches	Inner Layer, Inches	Outer Layer, Inches
Up to and including 6-inch	1	-	1
Up to and including 6-inch	1½	-	1½
Up to and including 4-inch	2	1	1
5-inch and over	2	-	2
Up to and including 6-inch	2½	1	1½
7-inch and over	2½	-	2½
All Sizes	3	1½	1½
All Sizes	3½	1½	2
All Sizes	4	2	2



Application of Bonded Expanded Silica Insulation to Equipment Skirt

Figure 32-H-11

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SECTION B - APPLICATION - contd

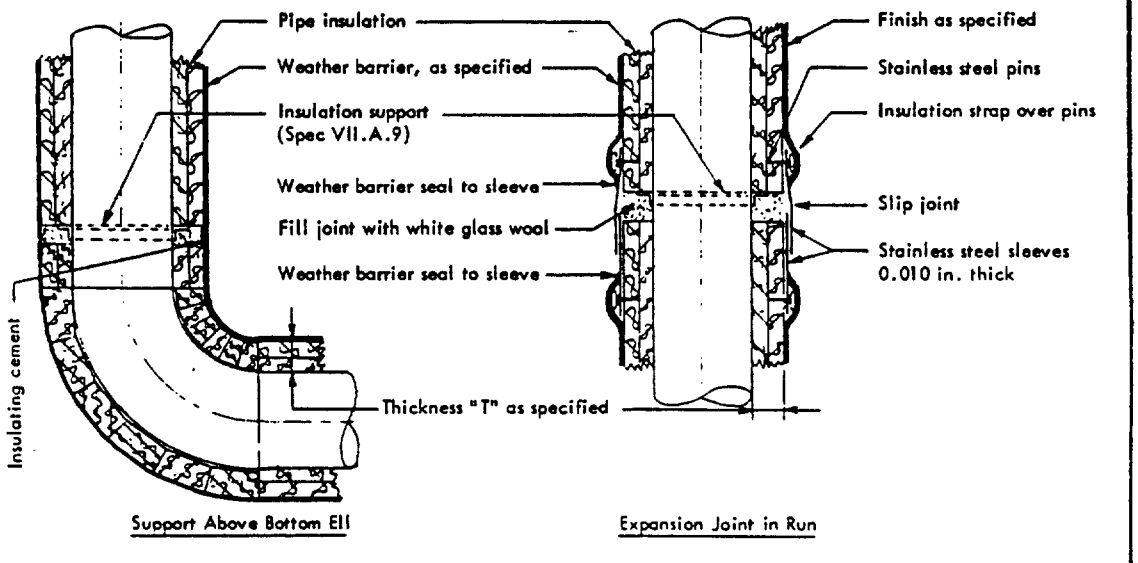
2. PIPING - contd

a. Pipe Insulation - contd

(3) Vertical Pipe

(a) Insulation on 4-inch NPS pipe and larger extending more than 15'-0 above bottom elbow shall be supported by a pipe insulation supp located directly above the bottom elbow. Typical installation is shown in Figure 32-H-12. A specified pipe insulation support shall be installed above each pair of flanges or flanged valve in vertical pipe.

(b) When pipe extends more than 15'-0 above pipe insulation supports located directly above elbow, flanges or flanged valves, addition supports shall be installed on approximate 15'-0 centers to provide for installation of expansion joint as shown in Figure 32-H-12.



Application of Bonded Expanded Silica Insulation to Vertical Lines at Insulation Supports and Expansion Joints

Figure 32-H-12

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SECTION B – APPLICATION – contd

2. PIPING – contd

b. Fitting, 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.

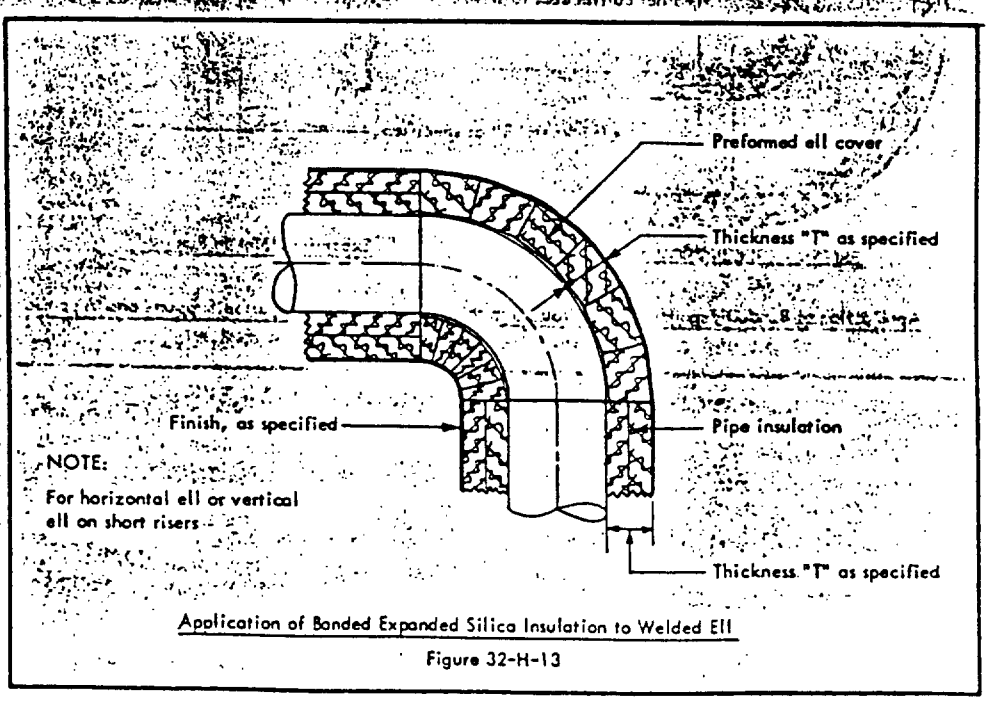
c. Expansion Joints

(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 feet of straight piping not interrupted by flanges, valves, or fittings and insulated with multiple 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 15 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 joints in the insulation will not be required.

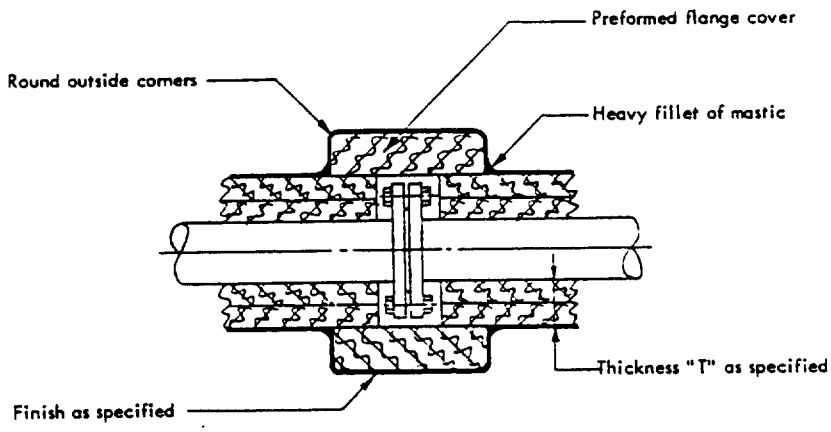


Application of Bonded Expanded Silica Insulation to Welded Ell

Figure 32-H-13

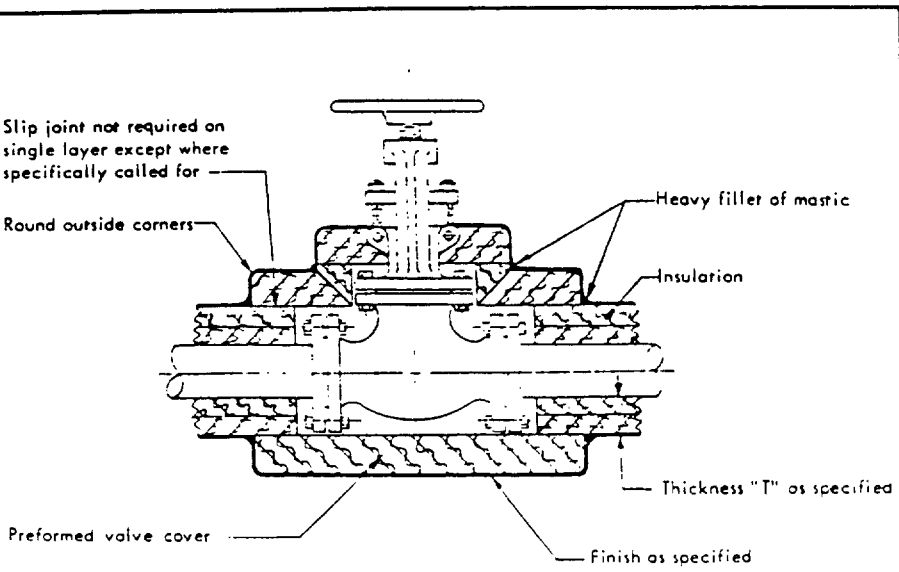
SECTION 8 - APPLICATION - contd

2. PIPING - contd



Application of Bonded Expanded Silica Insulation to Line Flange

Figure 32-H-14



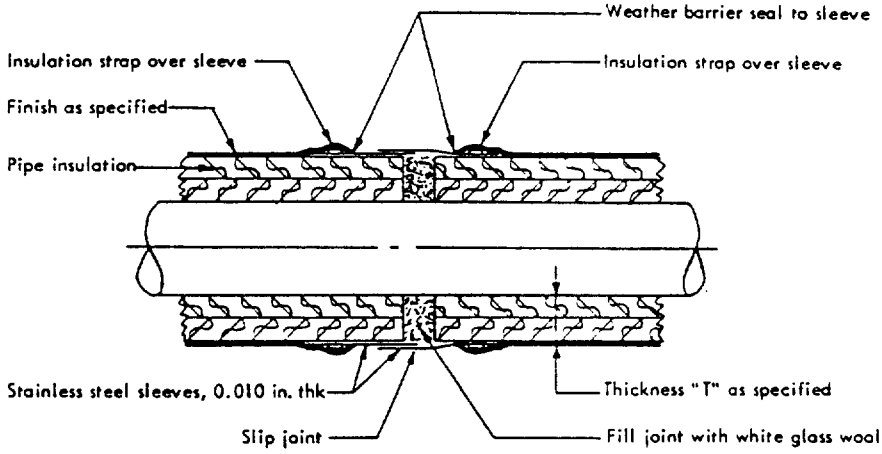
Application of Bonded Expanded Silica Insulation to Flanged Valve

Figure 32-H-15

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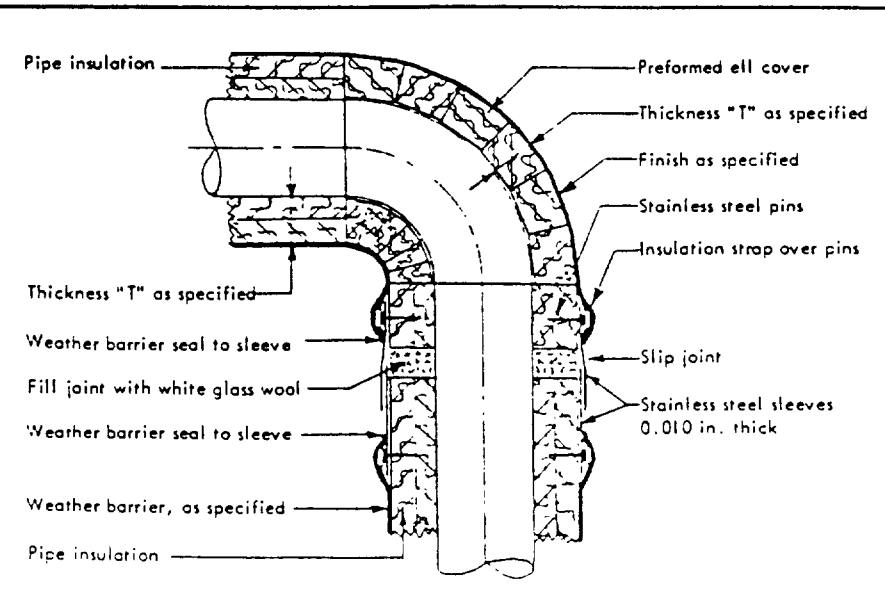
SECTION 8 - APPLICATION - contd

2. PIPING - contd



Application of Expansion and Contraction Joint to Bonded Expanded Silica Insulation on Horizontal Piping

Figure 32-H-16



Application of Bonded Expanded Silica Insulation to Welded Ell with Slip Joint at Top of Vertical Line

Figure 32-H-17

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SECTION B — APPLICATION — cont'd

2. PIPING — cont'd

d. Surface Finish

(1) Small cracks and depressions, where present, shall be filled and smoothed with insulating cement.

(2) Where specifically noted, fittings, flanges and valves shall be given a skin coat only of specified hard surface finishing cement before application of coating.

e. Polyethylene Tubing in Conduit or Trough, Junction Boxes, and Copper Tubing

(1) Where specified in insulation schedule or instrumentation schedule, polyethylene tubing (placed in metal conduit or trough) and copper tubing, for a distance of 3 feet from the junction boxes shall be insulated for fire protection.

(2) Unless otherwise specified, insulation shall be of minimum of 1½-inch thickness.

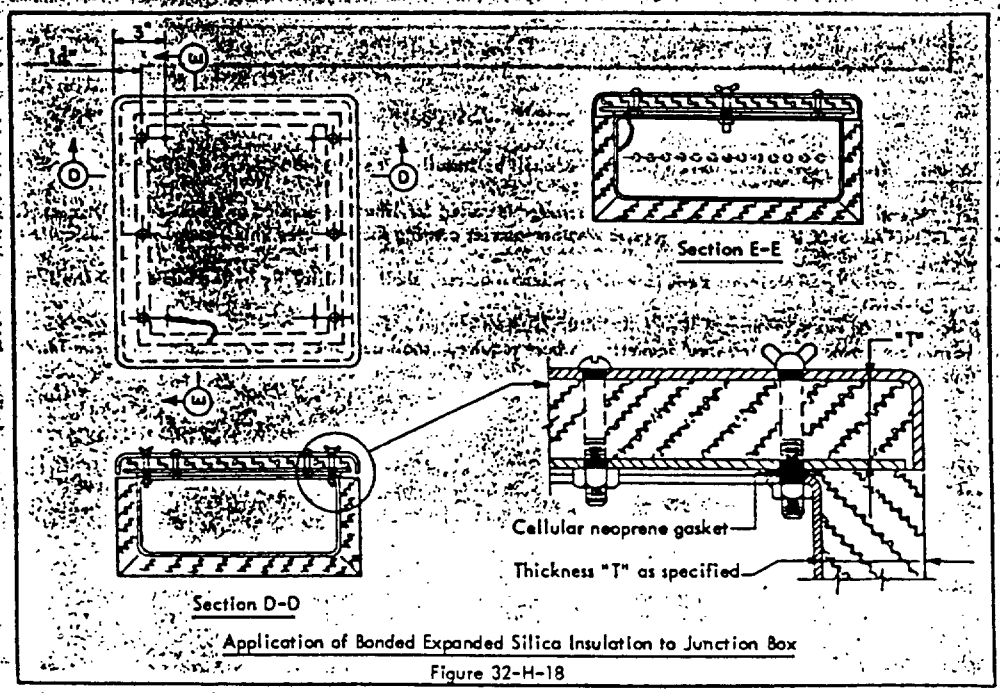
(3) Insulation shall be applied to conduit, junction boxes and troughs in staggered position, where possible, and with all joints tightly butted.

(4) Insulation on conduit and copper tubing shall be secured with stainless steel insulation straps.

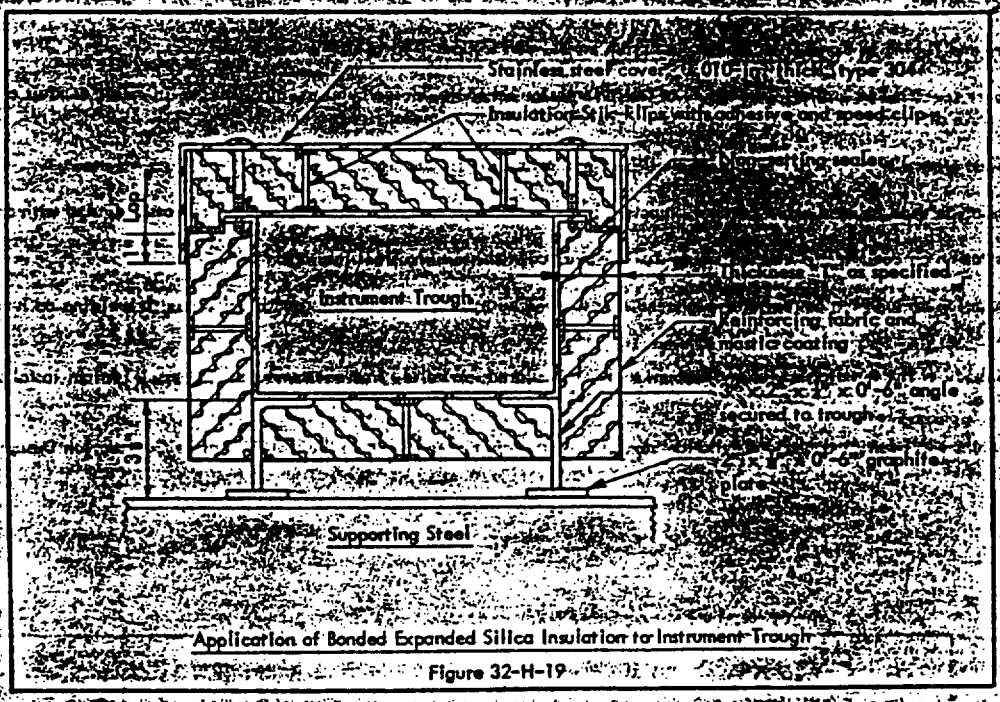
(5) Insulation on junction boxes and troughs shall be secured with stainless steel wire and blanket nuts. If welding on junction boxes and cover is prohibited, adhesive type pins shall be used.

(6) The body of the junction boxes and troughs shall be insulated separately from the removable covers. Typical installation is shown in Figures 32-H-18 and 32-H-19.

(7) Aluminum conduit, trough, and junction boxes shall be coated as specified in the Union Carbide Corporation Design and Construction Coatings Specifications.



Application of Bonded Expanded Silica Insulation to Junction Box
Figure 32-H-18



Application of Bonded Expanded Silica Insulation for Instrument Trough
Figure 32-H-19

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

g. 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 coating 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-HFPM.

(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-HFPMT.

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

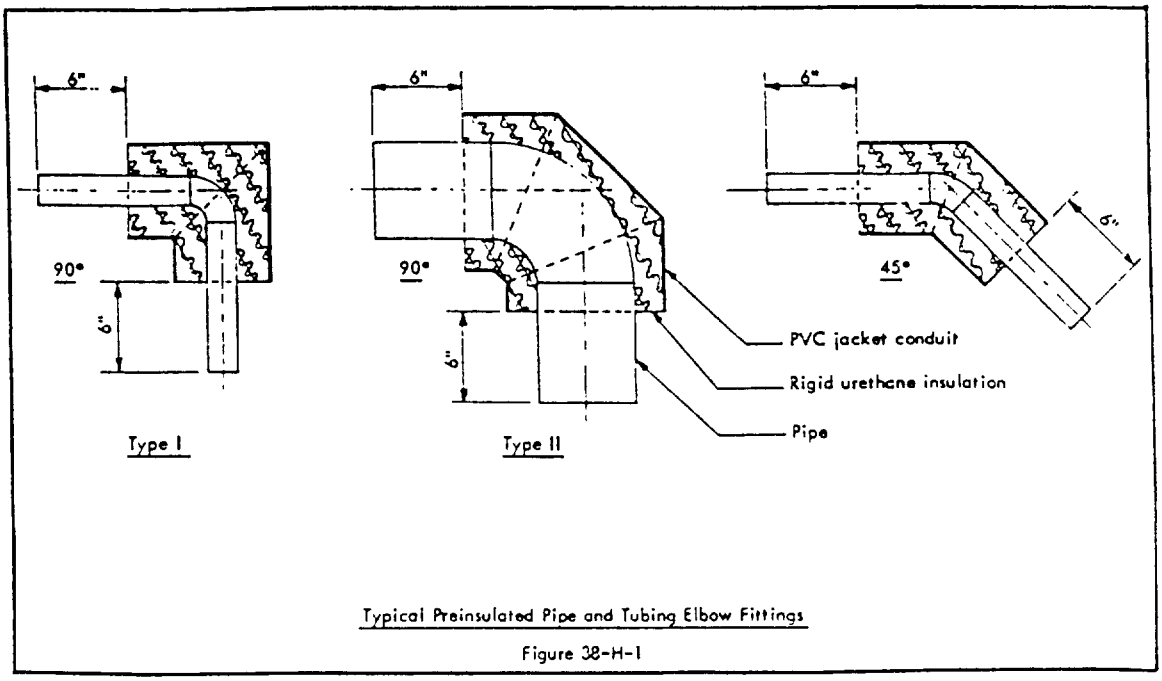
   a. Lines shall be installed in accordance with piping drawings.

   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

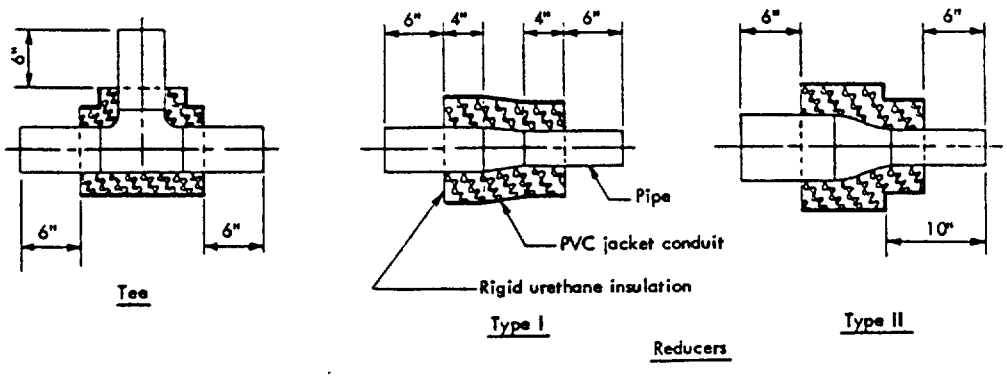
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SECTION B - APPLICATION - contd

2. PROCESS PIPING - contd

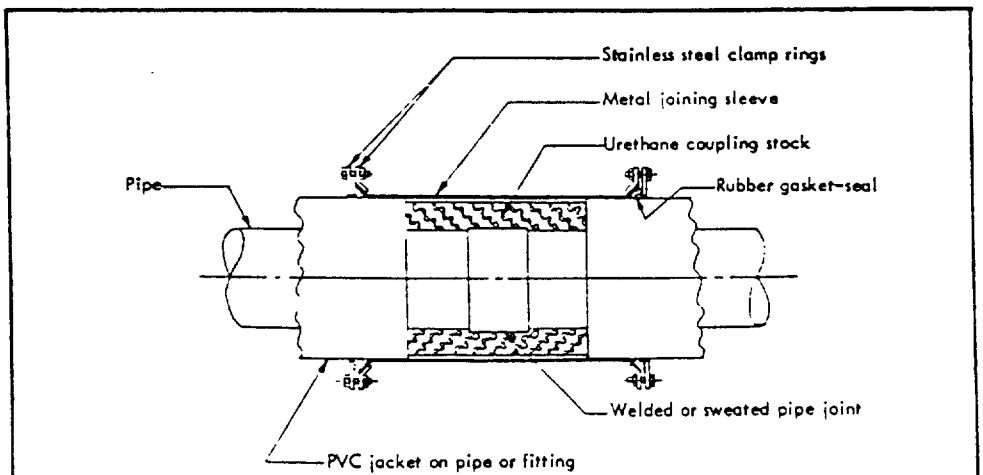
c. Remove all loose paint, dirt, grease, scale and other extraneous materials from the exposed ends of the pipe, finish the welding and testing, then apply the urethane coupling stock insulation to the uninsulated joints.

d. The joining sleeves shall then be slid into position over the insulated joints and the rubber gaskets compressed to 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 Urethane Compression Coupling - Field Applied

Figure 38-H-3

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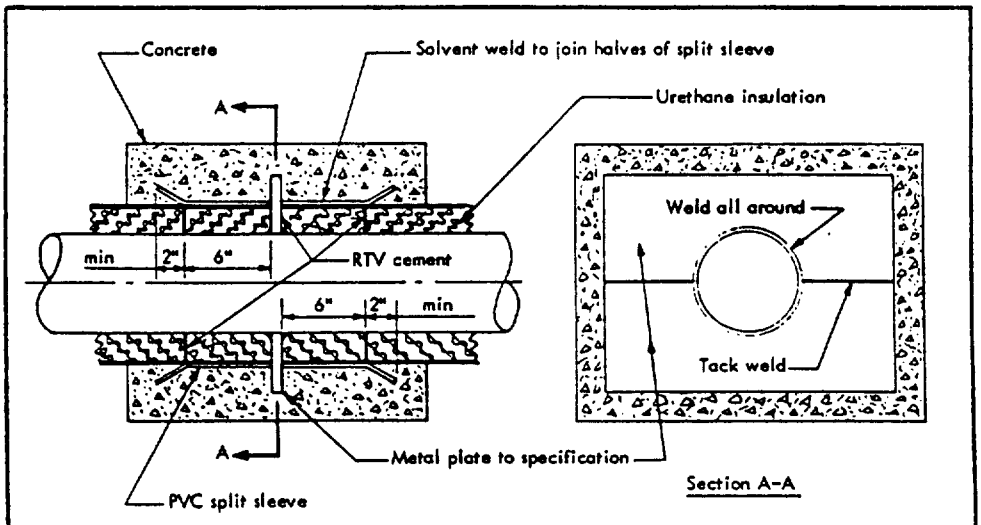
SECTION B - APPLICATION - contd

3. PIPE ANCHOR

Underground pipe anchors are constructed in the preinsulated pipe as shown in Figure 38-H-4.

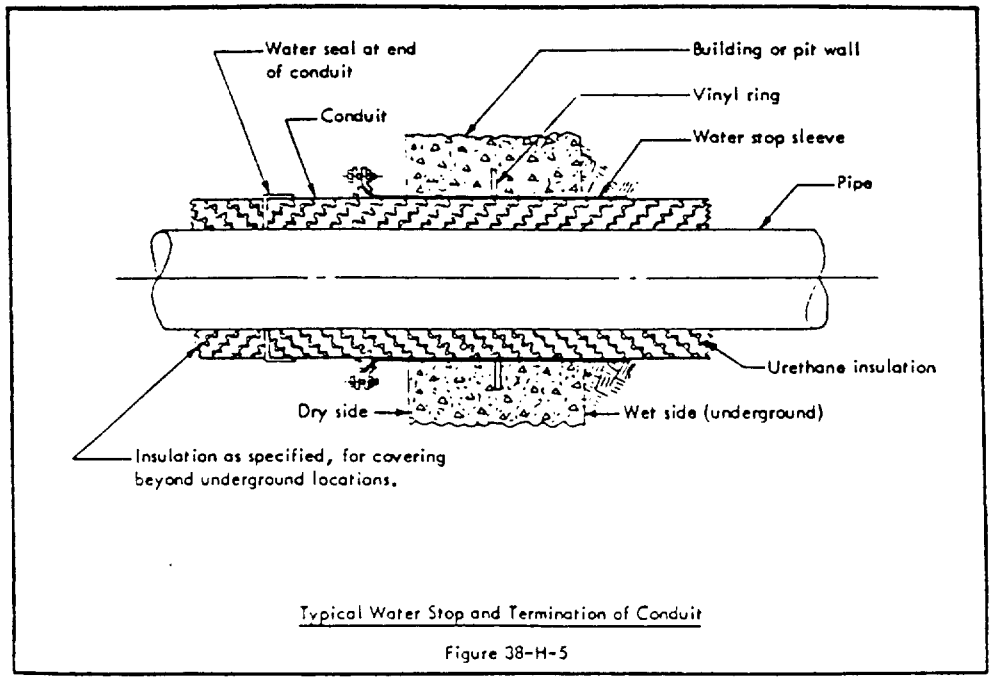
4. CONDUIT TERMINALS

a. Where the conduit terminates at a building, manhole, or pit, it shall extend through the concrete to the inner face. A seal shall be constructed of 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 - contd

4. CONDUIT TERMINALS - contd

b. A water seal shall be applied to the butt end of the exposed conduit insulation, 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 backfill materials.

b. Backfilling shall be done on both sides of the conduit simultaneously.

c. The soil shall be carefully deposited in uniform layers, not over 6 inches thick, tamped solidly and cautiously so as not to injure or disturb the conduit.

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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 MATERIALS

Sprayable Amosite and Crocidolite asbestos fiber insulations shall be as specified in MATERIAL SPECIFICATIONS 41-H and 42-H, respectively.

2. ACCESSORY MATERIALS

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

Equipment Insulation Strap	VII.A.11	Finishing Cement	VII.A. 78
Clips for Equipment Strap	VII.A.12	Split Welding Pins	VII.A. 79
Expansion Springs	VII.A.15	Asbestos Paper	VII.A. 80
Stainless Steel Wire	VII.A.17	Asbestos Paper Adhesive	VII.A. 81
Wire Netting	VII.A.18	"S" Clips	VII.A.107
Welding Pin Insulation Fasteners	VII.A.22	Weather-Barrier Mastic (color as specified)	VII.B.1.a
Pin Clips	VII.A.23	Reinforcing Cloth	VII.B.1.b
Sheet Metal Screws	VII.A.32	Stainless Steel Weather Barrier (Designation M)	VII.B.2
Lap Sealer	VII.A.46	Treated Steel Weather Barrier (Designation MT)	VII.B.3
		Cellular Glass Insulation	Material Specification 10

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 fc 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 ha 10 gage 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 su 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 b welded around vessel at level where insulation is to terminate.

(4) The sides and bottom of vessels and equipment such as turbine casings to be insulated 2½ inches thick and over shall have split pins welded 18 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 wires for fastening 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. Installation of Sprayed Insulation

(1) Thickness of installed insulation, consolidated and compressed, shall be as called for on the Insulation Schedule.

(2) When a vessel is on a low pad where level of rain or drainage water can reach bottom edge of insulation, a course of cellular glass insulatic preformed to the diameter of the vessel, and of specified thickness, shall be installed to an elevation greater than highest expected water level. no case shall this be less than nine inches.

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SECTION B - PREPARATION AND APPLICATION - contd

2. APPLICATION - contd

a. Installation of Sprayed Insulation - contd

(3) Layers of the sprayable insulation shall be applied to the surface by suitable spray machinery adjusted for correct material and water mixture.

(a) Thicknesses up to one and one-half inches shall be applied in sufficient quantity so that when consolidated to specified thickness density of insulation after drying will be between eight and thirteen pounds per cubic foot.

(b) On high temperature items such as steam turbines, which require thicknesses over 1½ inches, the insulation shall be applied in two layers. First layer shall be applied and consolidated with edge of flat trowel forming a cross pattern to 55 percent of its applied thickness. Split pins shall be spread apart before application of last sprayed layer which is consolidated to the final thickness. Each layer shall be applied within 30 minutes after application of preceding layer.

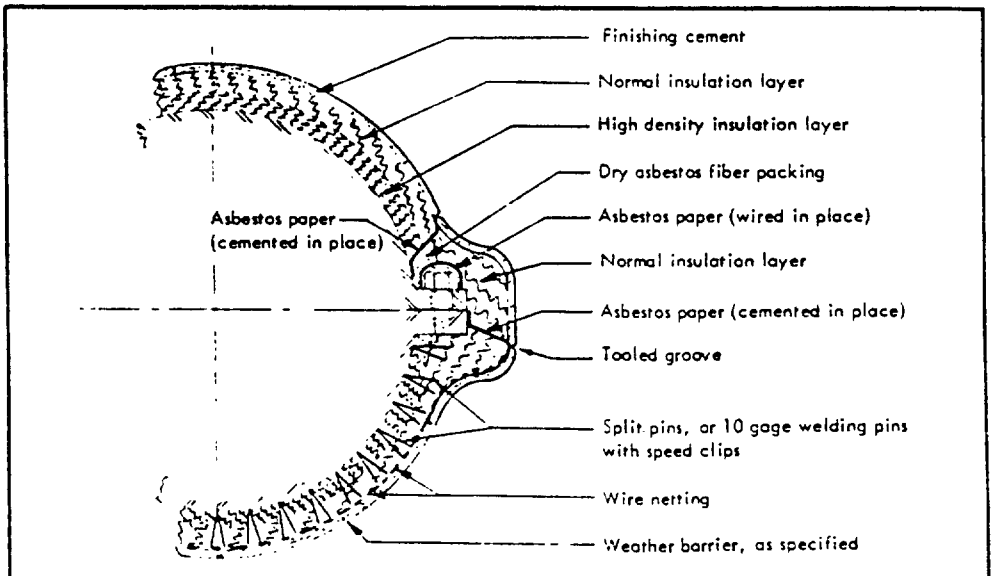
(4) On top heads of vertical vessels and the top quadrant of horizontal cylindrical vessels the sprayed insulation shall be consolidated to approximately 20-lb density and dried so its compressive strength is sufficient to permit it to be walked upon without mechanical damage.

b. Insulation of Flanges and Flange Bolts

(1) Flange bolts or studs shall be wrapped with asbestos paper and secured with wire. Space between bolts or studs shall be packed with dry asbestos fiber.

(2) Sprayed insulation shall be tapered inward to vessel surface at flange. Asbestos paper shall be adhered to the tapered edge with asbestos paper adhesive. The paper shall be extended over the entire bolt area and flange.

(3) Asbestos insulation shall be sprayed onto paper in layer or layers as specified in Subsection a.(3).(a) and (b) above. Typical installation is shown in Figure 41-H - 42-H-1.



Application of Sprayed Asbestos Insulation to Steam Turbine

Figure 41-H/42-H-1

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SECTION B – PREPARATION AND APPLICATION – contd

2. APPLICATION – contd

c. Finish

(1) Where asbestos insulation is to be covered with metal jacket it requires no finish cement. The consolidated asbestos insulation shall be a to dry 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 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 8 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 con cracking.

d. Weather Barrier

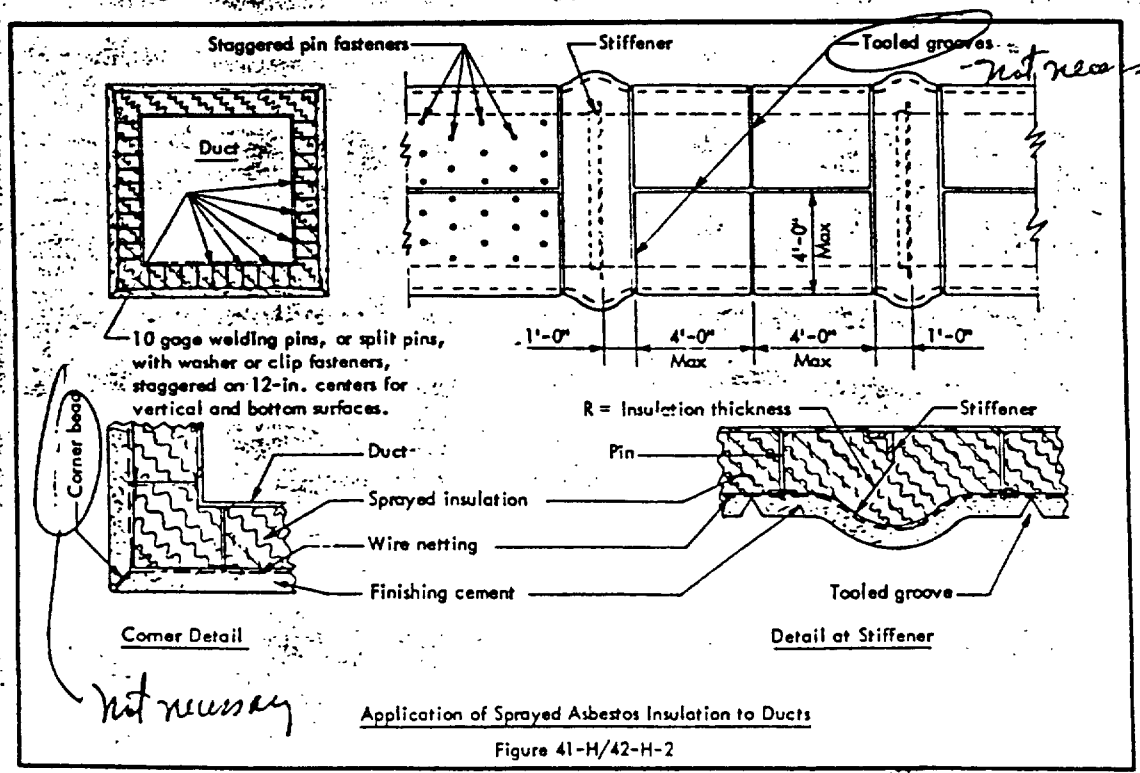
(1) Vessels over six feet in diameter, insulated for conservation of heat, and where fire protection of the vessel is not a major factor, shall h the cylindrical section of the vessel jacketed with treated steel as specified in Article XV.B of the GENERAL SPECIFICATIONS.

(2) Vessels over two feet in diameter, insulated for fire protection, shall have the cylindrical section of the vessel jacketed with stainless ste as specified in Article XV.B of the GENERAL SPECIFICATIONS.

(3) Equipment, vessels smaller than those mentioned above, vessel heads, ducts, and irregular surfaces shall have weather-barrier coating ap 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 specific 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 specific designation, thus 41-HMT or 42-HMT.



Application of Sprayed Asbestos Insulation to Ducts

Figure 41-H/42-H-2

Pins on 12" Centers on bottom, 18 c.c on sides, 24" c.c on top pin arrangement should be in diamond fashion.

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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 [illegible] and not at [illegible]

SECTION A - MATERIALS

1. INSULATION MATERIAL

Insulation material shall be as specified in the MATERIAL SPECIFICATIONS, article number as noted. MATERIAL SPECIFICATION NO. 12

2. ACCESSORY MATERIALS

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

Asbestos Paper	VII.A.80
Stainless Steel Wire	VII.A.17
Equipment Insulation Strap	VII.A.11
Clips for Equipment Strap	VII.A.12
Contact Adhesive	VII.A.65 or 66
Aluminum Jacket	VII.B
Weather Barrier Mastic (color as specified)	VII.B.1.a
Designation WB	Spec. No. 22
Bonded Expanded Silica Insulation	

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 Thermalox 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 buildup 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 II – APPLICATION – Contd

E. EQUIPMENT – Contd

d. 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.

(6) 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.

(7) Cured insulation shall have properties as specified in MATERIAL SPECIFICATION NO. 43-

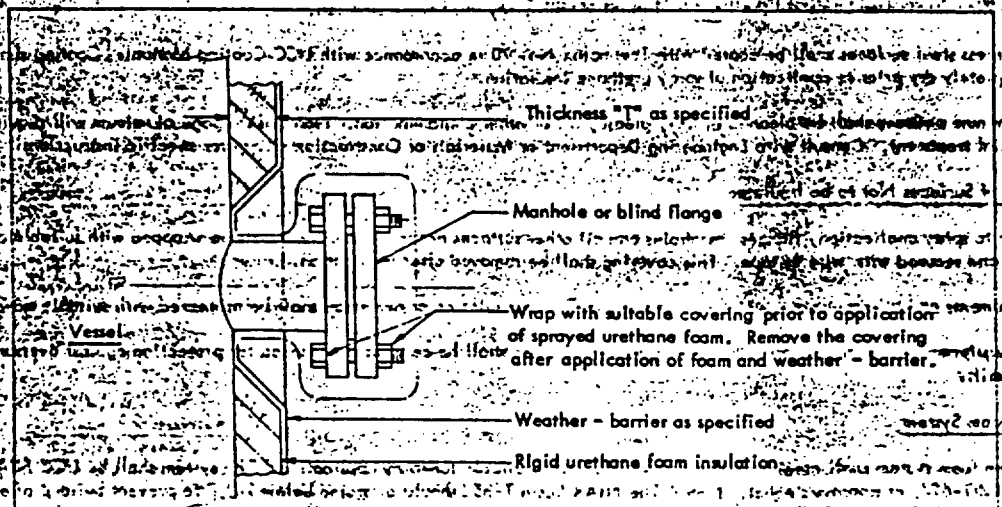
e. Surfaces to be Insulated

(1) Curved, flat, heads, and irregular equipment surfaces shall be insulated to specified thickness in accordance with Subsection d.

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

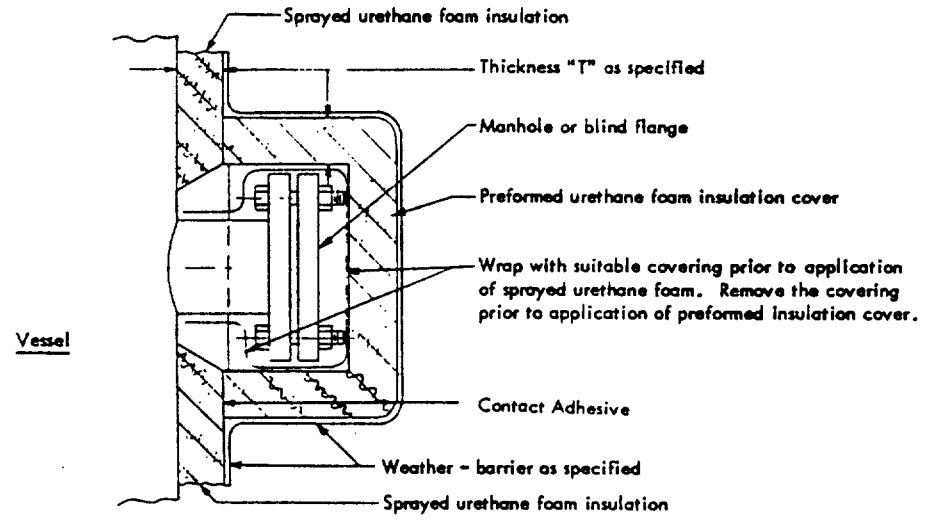
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SECTION B - APPLICATION - Contd

1. EQUIPMENT - Contd

f. Flanges

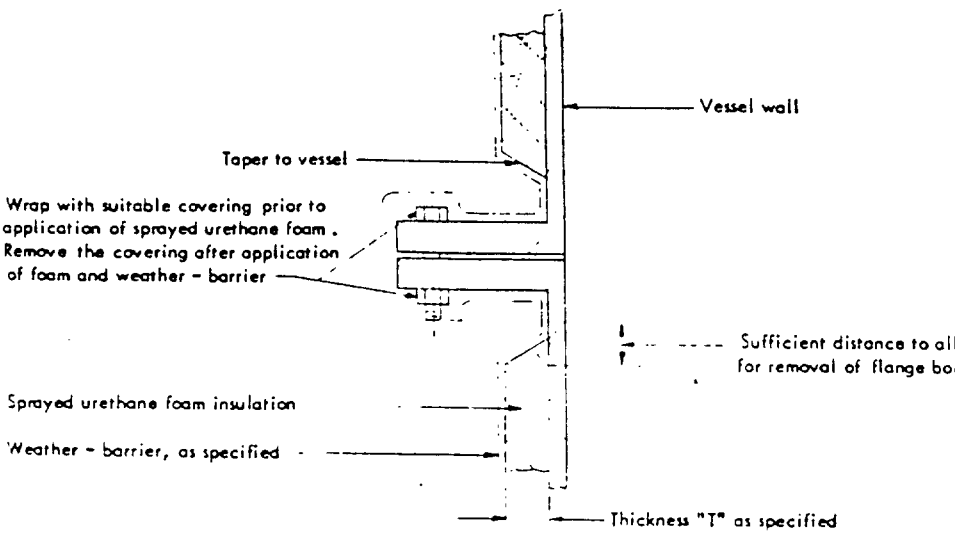
(3) Insulated manhole and blind flanges shall be insulated as shown in Figure 43-H-2



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

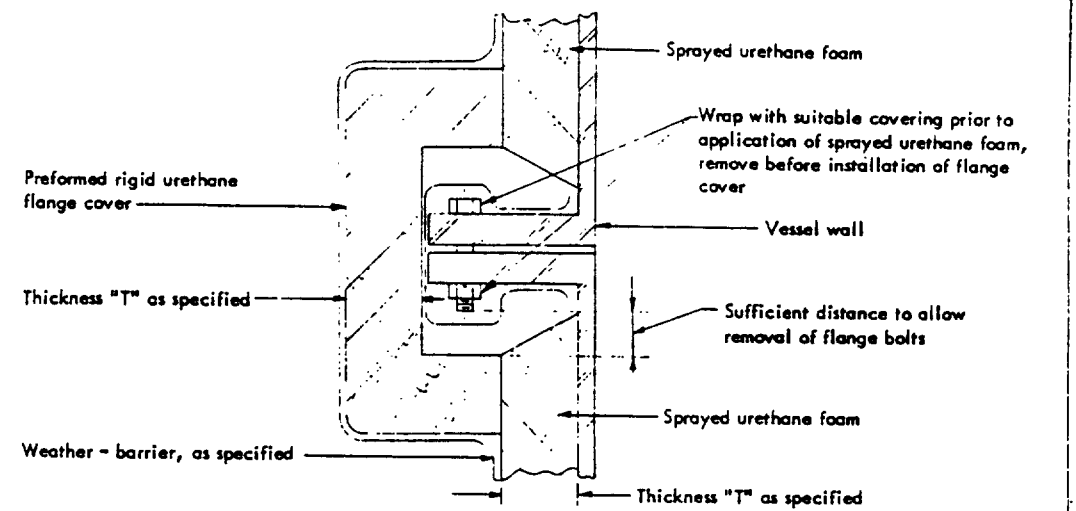
Figure 43-H-3

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SECTION B - APPLICATION - Contd

1. EQUIPMENT - Contd

f. (5) Insulated vessel flanges shall be insulated as shown in Figure 43-H-4.



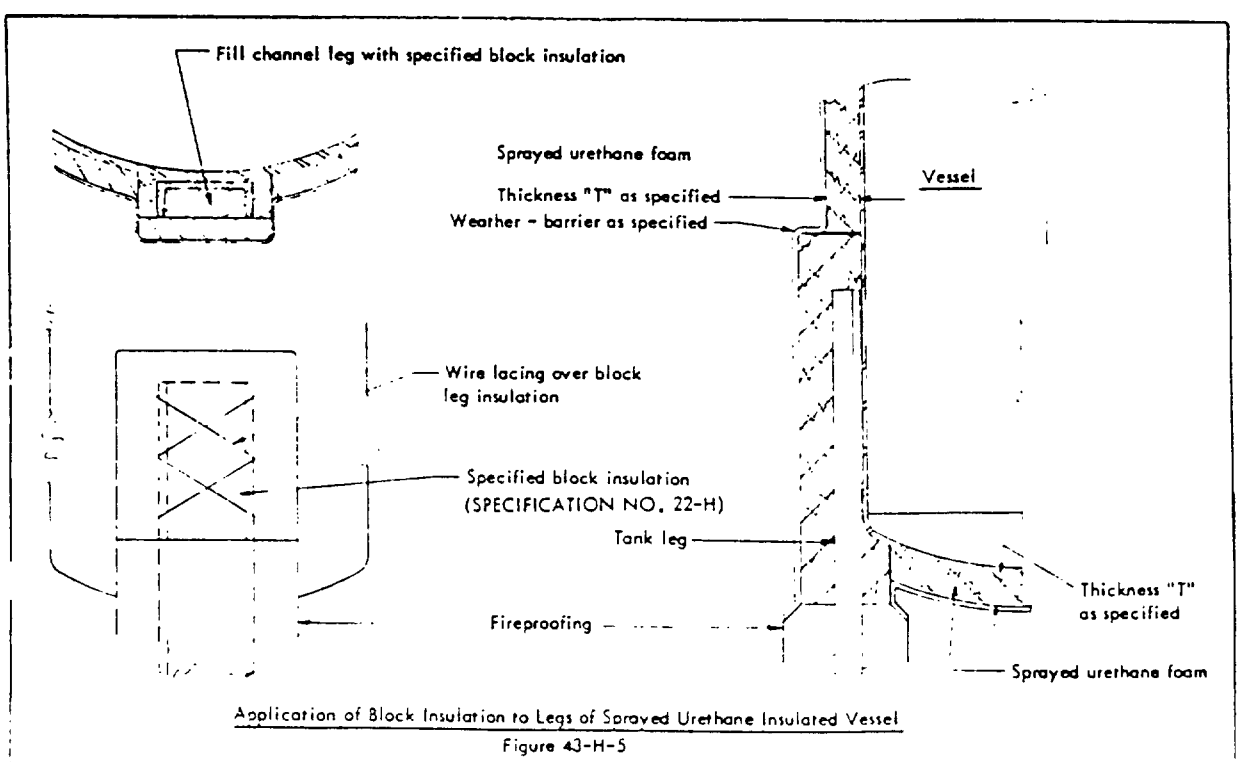
Application of Sprayed Urethane Foam Insulation to Insulated Flanges
Figure 43-H-4

g. 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

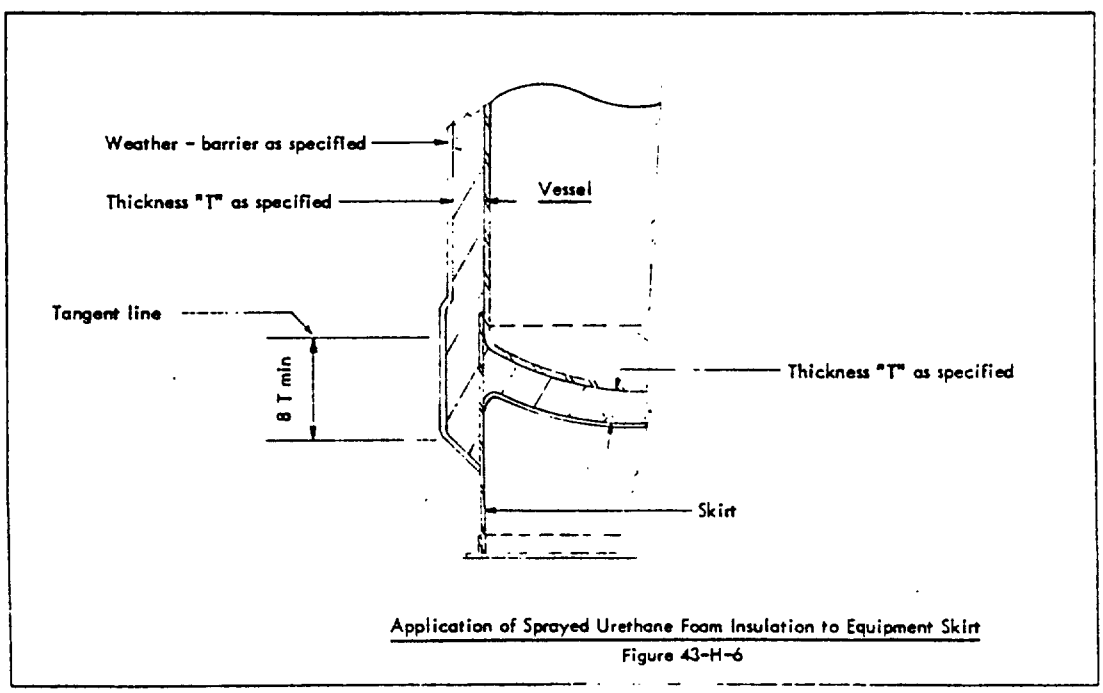
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SECTION B - APPLICATION - Contd

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 sanded 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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