PLAINTIFF'S EXHIBIT

UC-4905

MANUAL NUMBER 1 copy

ISSUED TO: R. P. Little
Bldg. 82-713

This manual is the property of Union Carbide Chemicals Company and must be returned on demand. Reproduction in whole or in part requires the permission of the Works Engineering Department.

Changes in mailing address or manual distribution should be sent to Works Engineering Central Files.

DESIGN AND CONSTRUCTION
UNION CARBIDE CHEMICALS COMPANY
Division of
UNION CARBIDE CORPORATION

SPECIFICATIONS

For

Thermal Insulation
Material and Application

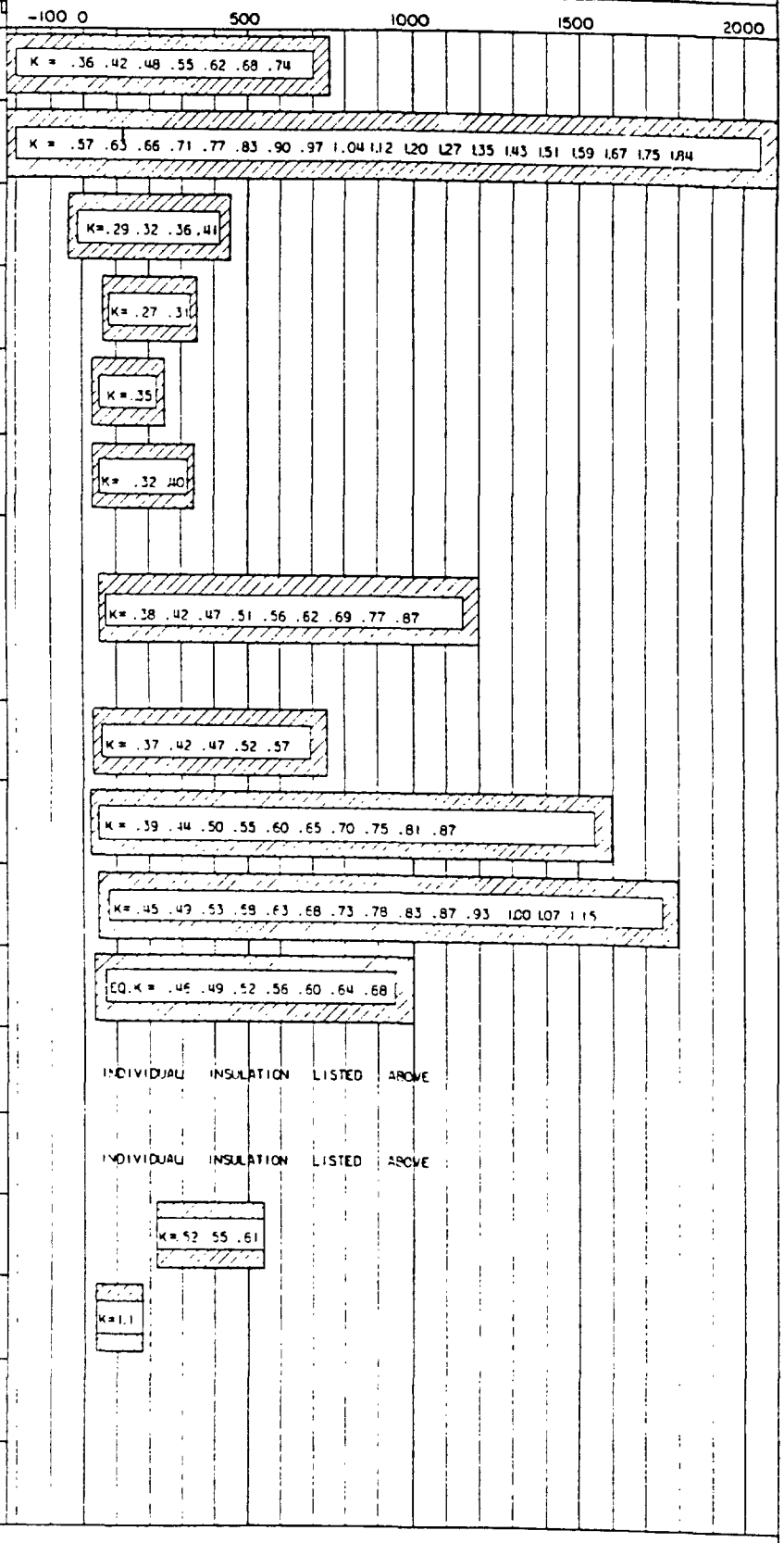
July 1961

J. F. Malloy
M. U. Dorsey
S. H. Smith
W. C. Turner

SOUTH CHARLESTON
WEST VIRGINIA

THERMAL INSULATION PROPERTIES

SPEC. NO.	MATERIAL	MFG.	TRADE NAME	FORM & USE	LBS. CU.FT.
10	CELLULAR GLASS	P.C.	FOAMGLAS	RIGID BOARD & PIPE INSUL. - VAPOR RES. FABRICATES WELL	8 TO 10
11	CELLULAR SILICA	P.C.	FOAMSIL	RIGID BOARD & PIPE INSUL. - VAPOR RES. HEAT SHOCK RES.	12 TO 14
15	GLASS FIBER	O.C.	HEAVY DENSITY SECTIONAL PIPE INSUL.	SEMI - RIGID BOARD & PIPE INSULATION- LOW MECH. STRENGTH	6.5 TO 7.5
16	GLASS FIBER	O.C. G.B. J.M.	LIGHT DENSITY SNAP - ON MICRO - LOK	RESILIENT PIPE INSULATION FOR BLDG. PIPING	3 TO 4
17	GLASS FIBER BLANKET	O.C. G.B. J.M.	DUCT LINER ULTRALITE MICROTEX	FOR LINING AIR COND. DUCT - NOISE & THERMAL INSUL.	3 TO 5
	GLASS FIBER BOARD	O.C. G.B. J.M.	RIGID DUCT G.B. BOARD SPINTEX	EXTERIOR INSUL. FOR DUCTS - LOW MECH. STRENGTH	6 TO 9
20	STANDARD CALCIUM SILICATE	O.C. J.M. B.E.H. PUB. PAR K-M MUN	KAYLO THERMOBESTOS THERMASIL CALSILITE CALTEMP KAYTHERM TRI - CALITE	RIGID BOARD & PIPE INSULATION - FABRICATES WELL - HIGH COMPRESSIVE STRENGTH - VERY ABSORBANT LITTLE VAP. RES.	10 TO 14
21	ASBESTOS FIBERS	UB. HOL.	UNIBESTOS CAPOSITE	RIGID BOARD & PIPE INSULATION - HIGH TENSILE STRENGTH	14 TO 18
22	BONDED EXPANDED SILICA	CAR.	CAREYTEMP	RIGID BOARD & PIPE INSUL.-WATER RES. SAFE FOR OXIDE SER.	9.5 TO 12
25	HYDROUS CALCIUM SILICATE	O.C. PUB.	KAYLO 20 1800 CALSILITE	RIGID BOARD & PIPE INSUL.-SHRINKAGE SMALL AT HIGH TEMP.	11.5 TO 14
31	PREFORMED REFLECTIVE	MIR	MIRROR	PREFORM'D. PIPE & EQUIP. INSUL. -REUSE NON-ABSORBANT.	4 TO 8
32	COMBINATION		HYD. CAL. SIL & STD. CAL.SIL OR CEL. GLASS	FOR FIRE PROTECTION OF EQUIP. AND PIPE	8 TO 14
37	UNDER GROUND CONDUIT	R.W. DU KA.	HEL-COR PRE-SEALED ESKO	OUTER CONDUIT FOR ANY INSULATION	
39	UNDERGR'D. BITUMINOUS FILL	A.G. M.A.I.	GILSULATE INSULFIL	FILL INSULATION FOR HOT UNDER-GROUND LINES	25 TO 41
40	CORK FILLED PVA MASTIC	VI	MC-1 TYPE "C"	DIRECT APPLIED INSUL. MASTIC REDUCE COND.	50 TO 55



MANUFACTURERS:

AG = AMERICAN GILSONITE
BEH = BALDWIN - EHRET - HILL
CAR = THE PHILIP CAREY CO.
DU = DURANT
ER = ELASTIN - ROTON
HOL = HOLMES FOUNDRY
KA = KAISER
K.M = KEASBEY AND MATTISON
MUN = MUNDET CORK
MAI = MIRACLE ADHESIVE - INSULFIL
MIR = MIRROR INSULATION
J.M.= JOHNS - MANVILLE
O.C.= OWENS - CORNING FIBERGLAS
PAB = FIBERBOARD PAPER - PABCO
P.C.= PITTSBURGH - CORNING
RUB = RUBEROID
R.W. = RIC - WIL
U.B. = UNION ASBESTOS
V.I. = VIMASCO

UNION CARBIDE CHEMICALS COMPANY
DEPARTMENT OF DESIGN AND CONSTRUCTION

THERMAL INSULATION SPECIFICATIONS

FOREWORD

A. General

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

They consist of two major parts: I - General Specifications, and II - Individual Specifications. Each Specification is divided into two parts: (A) Materials, and (B) Application. Individual Specifications are identified by a two-digit number, followed by a letter.

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

The General Specification constitutes an integral part of all the Individual Specifications.

B. Definitions

Where the following terms are found in the General and the Individual Specifications, they shall have meaning and significance as defined:

1. Blanket . . . . Insulating material consisting of organic or inorganic fibers, suitably felted, woven, stitched, bonded, or reinforced, into flexible form.

2. By Others . . . . Purchase or installation, or both, of subject material will be made by other than Insulation Contractor or insulation mechanics.

3. Curved Segment . . . . Block insulation of uniform thickness, formed to fit contour of curved surfaces and with longitudinal edges radially beveled.

4. Finish . . . . Material applied to surface of insulation for protection and/or appearance.

5. Firmly . . . . . A section of pipe insulation, when secured in the specified manner to a vertical pipe of corresponding dimension, shall remain at that elevation unsupported except by friction.

6. Fitting Cover . . . . . Block and pipe insulation patterned to fit on flanges, valves, and other fittings, furnished in convenient and matching sections.

7. Lagging . . . . . Relatively narrow, flat block insulation, rectangular in shape, of uniform thickness, and with longitudinal edges radially beveled.

8. Loose Fill . . . . . Thermal insulating material in loose fibrous or powdery form, for application within enclosed spaces.

9. Molded-Type Pipe Insulation . . . A rigid or semi-rigid thermal insulating material, preformed in semi-cylindrical or segmental sections, or both, usually 3 ft in length; for application on pipe or tubing, furnished with or without finish or attachments . . . . (ASTM Standard C 168.)

10. Preformed Thermal Insulating Block . . . . . A rigid or semi-rigid thermal insulating material, either flat or segmental, for application as received, and excluding brick of the 9-in. series . . . (ASTM Standard C 168.)

11. Sectional Pipe Insulation . . . . Two semi-cylinders or pipe insulation combined to form a complete circumference.

12. Segmental Pipe Insulation . . . . . Curved segments of pipe insulation of less than one-half circumference which, when grouped and combined with an odd width, where necessary, form a complete circumference.

13. Shaped Head Segment . . . . Block insulation patterned to fit on spherical, flanged and dished, or other types of vessel heads, usually with but a single radius - furnished in convenient and matching sections.

14. Staggered

    a. Pipe insulation shall be in a staggered position when, upon application, the end joint between two abutting half-sections occurs at least one-third, but preferably one-half, the length of a section, from either end of the opposing half-section.

    b. Block (curved segments, lagging) insulation shall be in a staggered position when the abutting joint between two blocks occurs, upon application, at least one-third the length of a section from joints of adjacent blocks.

    c. Multi-layer insulation shall be considered broken joint when applied so that no two joints coincide except where they cross at right angles.

B. contd

15. Thermal Insulating Cement . . . . A prepared composition, in dry form, comprising granular, flaky, fibrous, or powdery materials, which, when mixed with a suitable proportion of water to develop a plastic consistency, and applied and dried in place, forms a coherent covering that affords substantial resistance to heat transmission . . . (ASTM Standard C 168.)

16. Weather-Barrier (Weatherproofing) . . . . Finish applied for protection from moisture and weather.

17. ASTM . . . . . American Society for Testing Materials. These letters, followed by another letter and a number (example: ASTM C 168), indicate the latest revision of a standard specification or other standard published by ASTM.

C. Letter Designations

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

B . . . . Building construction.

H . . . . Equipment and piping operating at high temperatures (70 F and above).

J . . . . Equipment and piping operating at cyclic temperatures.

L . . . . Equipment and piping operating at low temperatures (below 70 F).

The letter M added to the designation of an individual specification (example: 10-HM) indicates that the insulation shall have a weather-barrier consisting of a metal jacket, as specified in the GENERAL SPECIFICATIONS, Part I. B. 18.

UNION CARBIDE CHEMICALS COMPANY
DEPARTMENT OF DESIGN AND CONSTRUCTION

THERMAL INSULATION SPECIFICATIONS

I. GENERAL SPECIFICATIONS

Scope

These Specifications describe the essential requir . nts for the purch and application of thermal insulation materials. They also constitute an integral part of the Individual Specifications.

A. MATERIAL

1. Types and Dimensions

a. Material furnished under these Specifications shall be of type and thickness listed on Insulation Design Schedules, Insulation Equipment and/or Line Lists, or as otherwise prescribed by the Department of Design and Construction.

b. Pipe insulation shall be furnished in conventional lengths, plus or minus not more than 3/32 inch, with ends cut square. Inside diameter shall fit firmly on specified pipe size and outside diameter shall correspond to an Iron Pipe Size.

2. Sampling and Testing

Where vendor is unavle to provide acceptable test or performance data, to meet the requirements of these Specifications, representative samples of insulating and accessory materials shall be submitted to the Department of Design and Construction in sizes and amounts required for testing. In all instances these samples, which shall be supplied without cost to purchaser, shall be shipped by vendor within seven days following receipt of written request.

3. Packaging

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

4. Marking and Identification

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

5. Attachments

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

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

6. Approved Alternates

Alternate insulating and/or accessory materials may be approved by the Department of Design and Construction, but only where clearly shown that properties involved satisfy all requirements which this Specification prescribes.

7. Rejections

a. Insulating and/or accessory material will be rejected by purchaser, before or after delivery, where physical and other properties do not meet the requirements specified and no exemption has been granted by the Department of Design and Construction.

b. All costs in connection with rejected material shall be borne by the vendor.

B. APPLICATION

1. All fittings, such as valve, flange, ell, and tee covers, and shapes such as curved segments and head covers, shall be shop prefabricated in accordance with Dimensional Standards Fabrication Manual or ASTM Recommended Fabrication Practice C450 , latest revision.

2. Thickness Schedule

Unless otherwise specified, insulation in excess of 2-1/2 inches total thickness shall be applied in multi-layer construction in accordance with the following table:

Total Scheduled Thickness"	Inner Layer Thickness"	Middle Layer Thickness"	Outer Layer Thickness"
3	1-1/2	None	1-1/2
3-1/2	1-1/2	None	2
4	2	None	2
4-1/2	2	None	2-1/2
5	2-1/2	None	2-1/2
5-1/2	1-1/2	2	2
6	2	2	2
6-1/2	2	2	2-1/2
7	2	2-1/2	2-1/2
7-1/2	2-1/2	2-1/2	2-1/2
8	2-1/2	2-1/2	3
8-1/2	2-1/2	3	3
9	3	3	3

3. Condition of Material

Insulating materials, other than cements and mastics, may be applied only when dry.

4. Condition of Surfaces

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

b. Where insulation is applied to piping and equipment operating in the temperature range of 0 F to 180 F, the metal surfaces of said piping and equipment shall be coated, in accordance with UCCC Coating Specifications, by others, prior to application of insulation.

c. Voids behind name plates and tank legs shall be filled and caulked, in accordance with UCCC Coating Specifications, by others, prior to application of insulation.

5. Insulation Supports

a. Insulation on vertical equipment, exceeding 1'-5" in diameter and 10'-0" in height, shall be supported by metal supports installed approximately every 12'-0" and above each vessel flange, in accordance with UCCC Standard IS-31. Length of horizontal leg or support angle shall be 1/2 inch less than total applied thickness of insulation.

b. Insulation on horizontal equipment, 4'-0" diameter and larger, shall be supported by metal supports installed in accordance with UCCC Standard IS-36.

c. Insulation applied to bottom head, or inside of skirt, on skirt supported vessels, shall be supported on metal supports installed in accordance with UCCC Standard IS-42.

d. Insulation on dished heads of vertical equipment shall be supported by metal supports in accordance with UCCC Standard IS-31.

e. Where necessary to prevent entrance of moisture, uppermost support shall be replaced with a metal protective plate, as described in section I.B.12, entitled "Protective Cover".

f. Insulation on 3 inch IPS and larger vertical pipe shall be supported by stainless steel insulation supports bolted to pipe near bottom of run. Additional supports shall be installed on pipe at intervals of 21 feet of vertical run.

6. Securement

a. Tie-Wire Anchors

Blank nuts, angle clips, and other approved attachments shall be used for insulation tie wire anchors, where shape of vessel prevents normal methods of securement of preformed insulating materials. Blank nuts, where required, shall be attached, standing-edge to vessel surface, by light fillet welds. Installation shall be done by the Insulation Contractor, before application of insulation.

b. Wire

(1) Wire shall be applied to insulation at proper intervals by looping about the circumference, twisting ends tightly together to provide proper securement, and depressing wire ends against insulation to prevent projections.

(2) Where shape of vessel prevents complete encirclement, securement shall be made to other tie-wires, wire cables, or other anchors approved for this purpose.

I. B. 6. contd

c. Insulation Strap

(1) All pipe insulation on traced lines shall be secured with stainless steel insulation strap.

(2) Strap shall be applied to cylindrical insulation at proper intervals by looping strap about the circumference, stretching to suitable tightness with an approved banding machine, and clamping in place at joint. Strap joint shall consist of one double-[illegible]ng clip, or two clips furnished without prongs. Clips shall be located on the vertical side of pipe insulation.

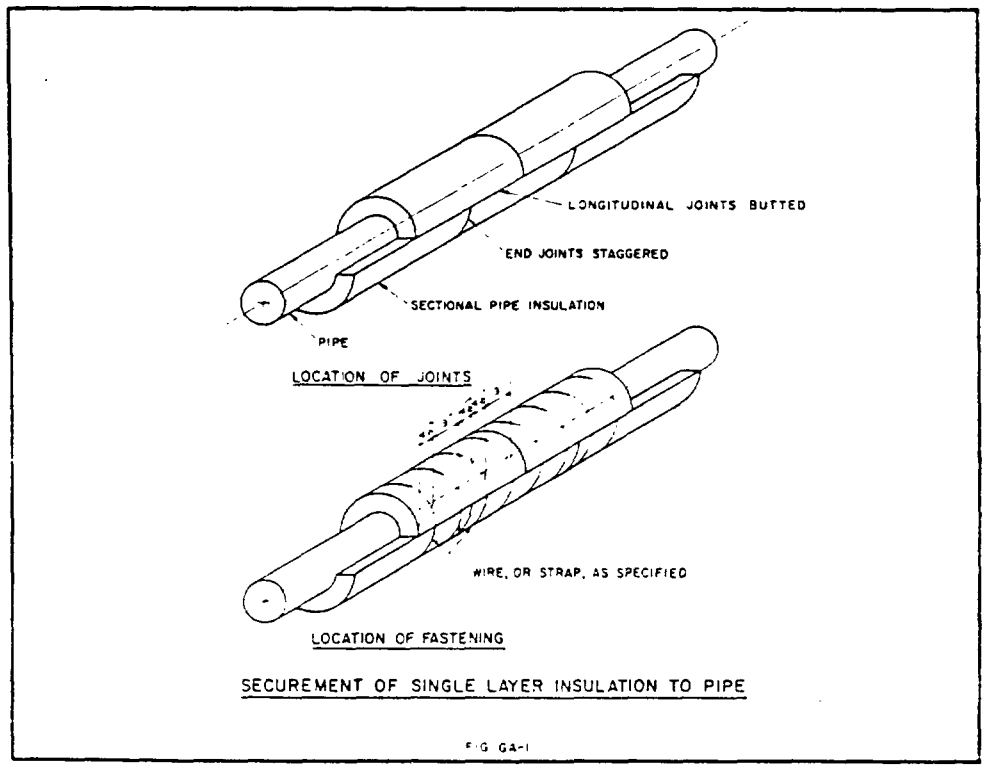
(3) Where shape of vessel prevents complete encirclement of strap, securement shall be made to tie wires, wire cables, or other devices approved for this purpose.

(4) Insulation strap shall be divided into lengths based on one strap joint for the first 15 feet of vessel circumference and one strap joint for each additional 10 feet, or part thereof. These joints shall be spaced at equal distances around the vessel. Vessels over 12 feet in diameter shall be equipped with vertical strap anchor angles spaced as shown on the Supplement to UCCC Standard IS-31.

d. Spacing of Strap and Wire

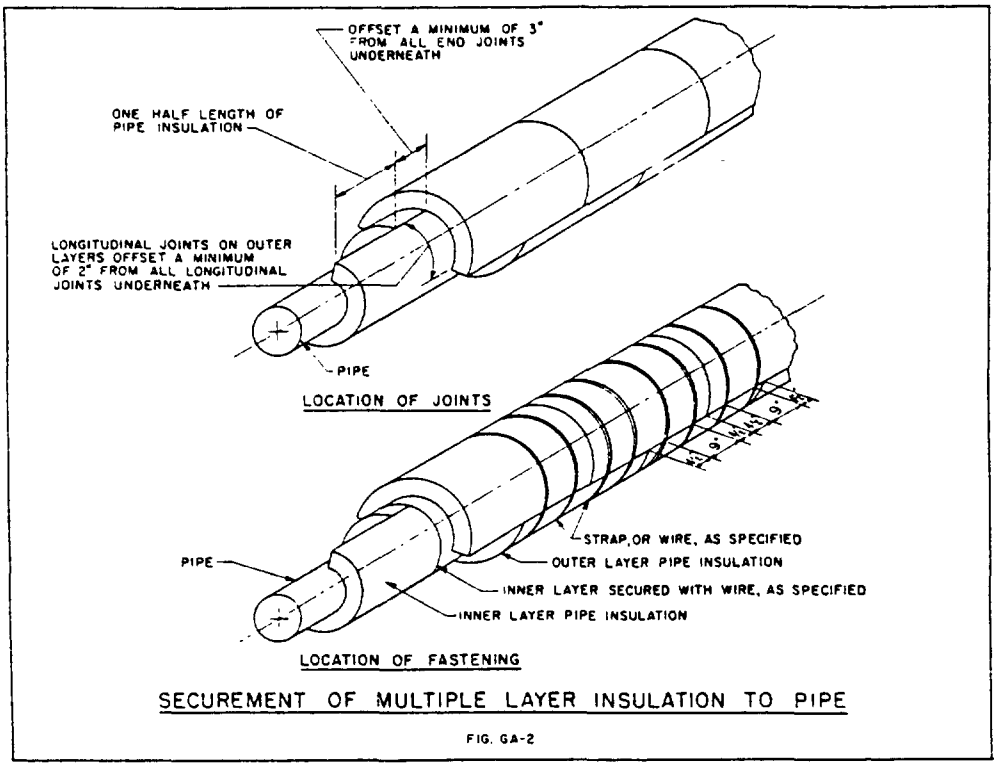
(1) Spacing of insulation strap and wire over equipment and pipe insulation shall be based on length of block or section. Where 36-inch lengths of insulation are applied in staggered arrangement, four loops will be required at average 9-inch intervals, so that no loop is located more than 4-1/2 inches from any end joint. Where 18-inch lengths are applied in staggered arrangement, only two loops per length will be required.

(2) Spacing of strap and wire on pipe insulation shall correspond to Figures GA-1 and GA-2.



SECUREMENT OF SINGLE LAYER INSULATION TO PIPE

FIG GA-1



SECUREMENT OF MULTIPLE LAYER INSULATION TO PIPE

FIG. GA-2

7. Name Plate Clips

Insulation mechanics shall cooperate with others in the placement of name plates and name plate clips.

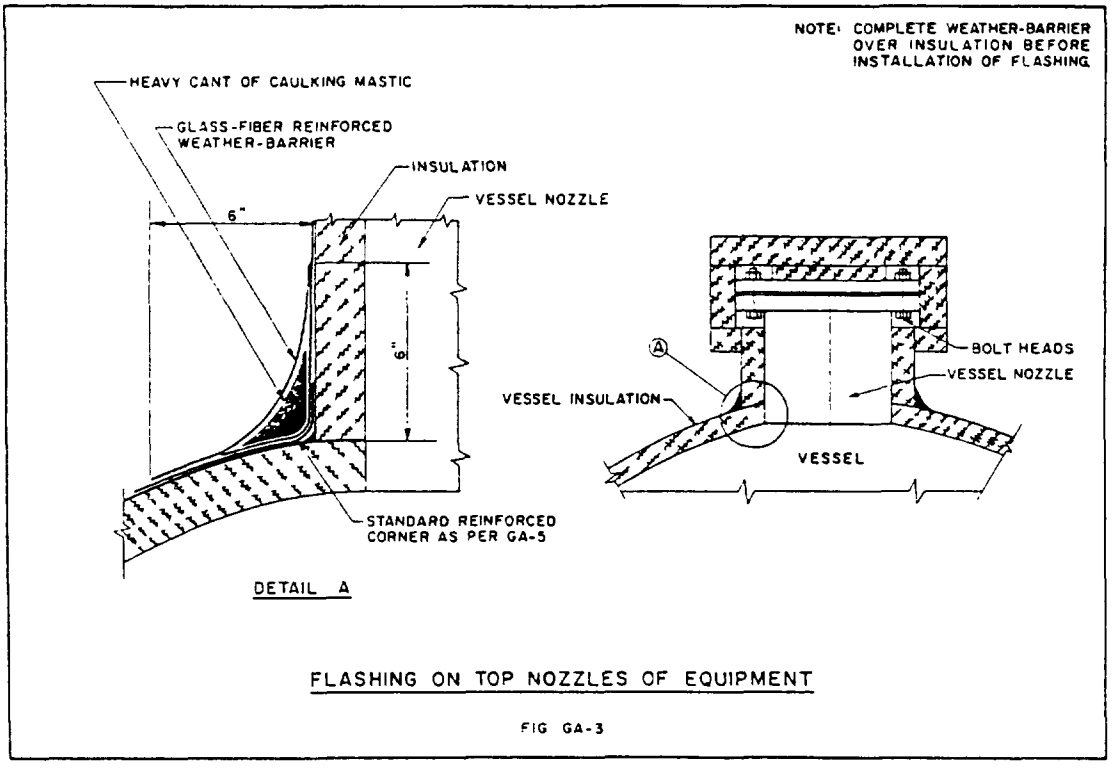
8. Junction of Thermal Insulation with Fire-Resistant Materials

a. Insulation thickness on tank legs, and similar equipment supports, shall be not less than adjoining fire-resistant materials. Where thickness of thermal insulation exceeds that of fire-resistant materials, surface of insulation shall be neatly and uniformly finished with a wide bevel, and feathered to provide the appearance of a continuous surface and eliminate a definite surface joint.

b. Junction of insulation with fire-resistant materials shall be sealed with weather-barrier coating.

9. Flashing

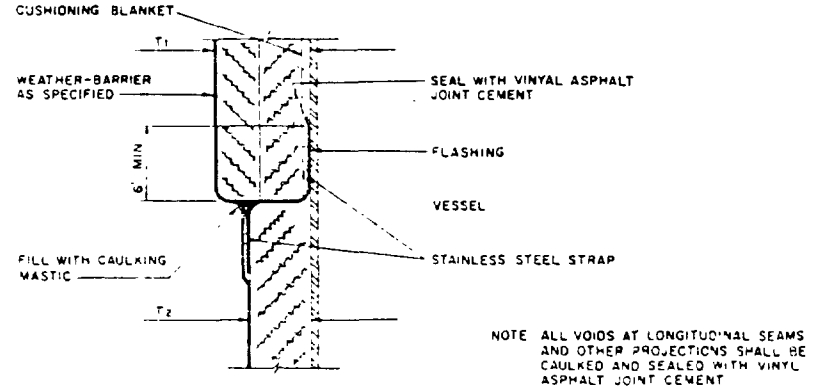
a. All nozzles on top of insulated equipment shall be provided with flashing as shown in Figure GA-3.



FLASHING ON TOP NOZZLES OF EQUIPMENT

FIG GA-3

b. Where a vertical vessel such as a column is insulated for gradient temperatures, with the low temperature above, a flashing shall be installed between different thicknesses of insulation where noted in schedule, to prevent condensate from entering the insulation on the lower side of the joint. Flashing material shall be Lexsuco F62 Flexible Flashing, as manufactured by Lexsuco, Inc, or approved alternate. It shall be secured to the vessel and the outside of the insulation with 1/2-inch by 0.0157-inch Type 304 stainless steel straps. All voids at longitudinal seams and other projections shall be caulked and sealed with vinyl asphalt joint cement. Typical installation is shown in Figure GA-3A.



FLASHING AT BUTT JOINTS OF DIFFERENT THICKNESSES OF INSULATION

FIG GA-3A

10. Protection of Flammable Surfacings

When applying sheeting jacket, flammable surfacings shall be stopped at least 6 inches from brackets, hangers, and other hot projections, to avoid possibility of scorching or ignition. Where located indoors, such areas shall be surfaced with insulating cement to provide drainage. For other locations, a minimum 1/16-inch thick coat of heat resistant sealer shall be applied.

11. Painting

Painting of bare and insulated surfaces, where required, will be done by others.

12. Protection from Abuse

a. Insulation subject to mechanical abuse, such as abrasion or crushing, or where otherwise required, as designated by the Department of Design and Construction, shall be protected with a covering jacket of not thinner than No. 26 gage sheet metal, or other approved media, as per UCCC Standard M-100. Jacket shall be secured firmly in place with insulation strap, spaced not greater than 10 inches on centers, or sheet metal screws where use of strap is impracticable. Sheet metal screws shall not be used on jackets over low temperature insulation where possibility exists of piercing weather-vapor barrier membrane.

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

13. Protective Cover

Insulation terminating at an intermediate point on the side of a vessel shall be protected from physical abuse and moisture penetration by installation of a continuous metal plate attached to vessel by means of a continuous weld immediately above insulation. This protection will be provided by the Owner.

14. Appearance

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

15. Insulation for Safety

a. Where it is required to insulate piping or equipment for safety, only that portion shall be insulated which is located not more than 6'-0" above operating levels, or where there exists possibility of human contact. Piping in trenches, unless otherwise specified, shall not be insulated for safety below grating level. Exposed ends of insulation shall be beveled to provide proper seal and drainage.

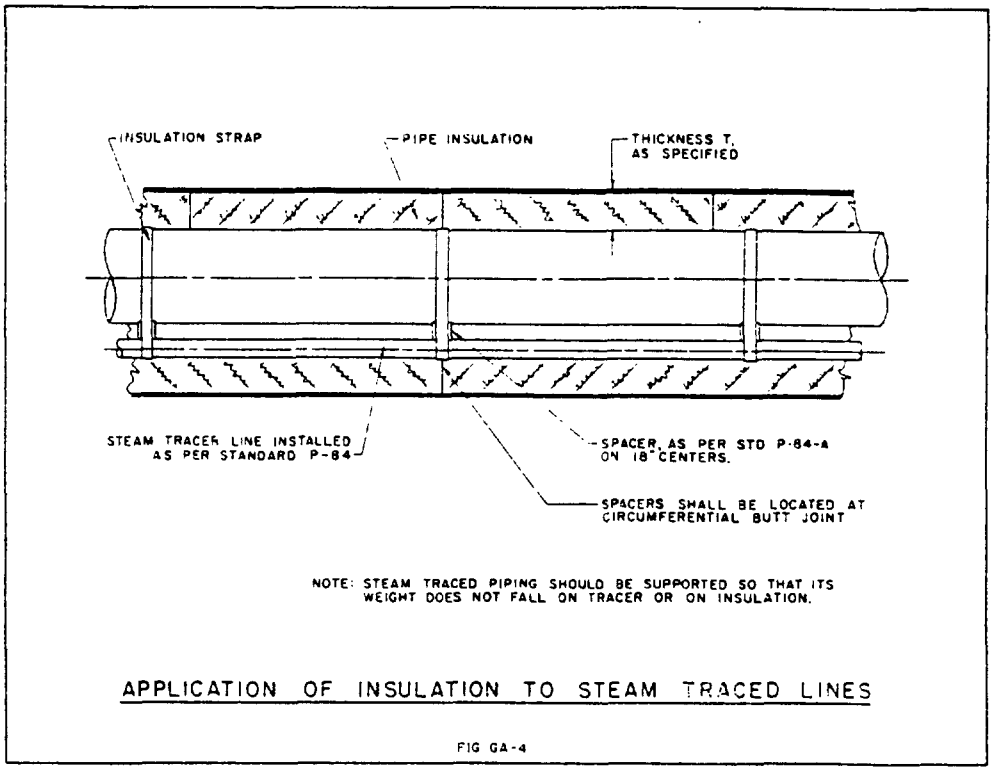
b. Where specified, thermal insulation shall be omitted and protection provided by erection of a suitable safety guard. This guard will be provided by the Owner.

16. Steam or Electrical Traced Installations

a. Air Convection Tracing System

(1) Accessories - Pressed steel spacers shall be of No. 16 Gage (.0598"), constructed according to UCCC Standard P-84A, as manufactured by A. J. Gerrard. These spacers shall be furnished by the Insulation Contractor.

(2) Assembly - Type and size of tracer lines, methods of clamping, hanging and supporting them, and size of pipe insulation to be applied, shall be in accordance with UCCC Standards P-84, P-84A and GA-4, supplemented by Insulation Design Schedules, where required. In addition to assembly directions contained in Standards P-84 and P-84A, pressed steel spacers (and pressed steel clamps, where installed) shall be spaced on 18-inch centers for copper tracer lines. Temporary installation of assembly will be done by others.



APPLICATION OF INSULATION TO STEAM TRACED LINES

FIG GA-4

(3) Pipe insulation shall be applied in required sizes and carefully fitted to heated companion lines in manner prescribed in these Specifications and in the Individual Specifications. Tracer assembly shall be firmly and permanently secured in place by insulation mechanic during application of insulation, adding or relocating spacers where required to insure firmness of contact.

(4) Protective Wrapping - When aluminum piping is to be steam traced, or where elsewhere required, aluminum piping shall be separated from tracer assembly by insertion of not less than two wrappings of Mystik Adhesive 7000 G or approved alternate glass fiber tape. Care shall be exercised that tracer line does not contact aluminum line at any point. Where tracer may touch, the aluminum line shall be wrapped with glass tape at the point of contact.

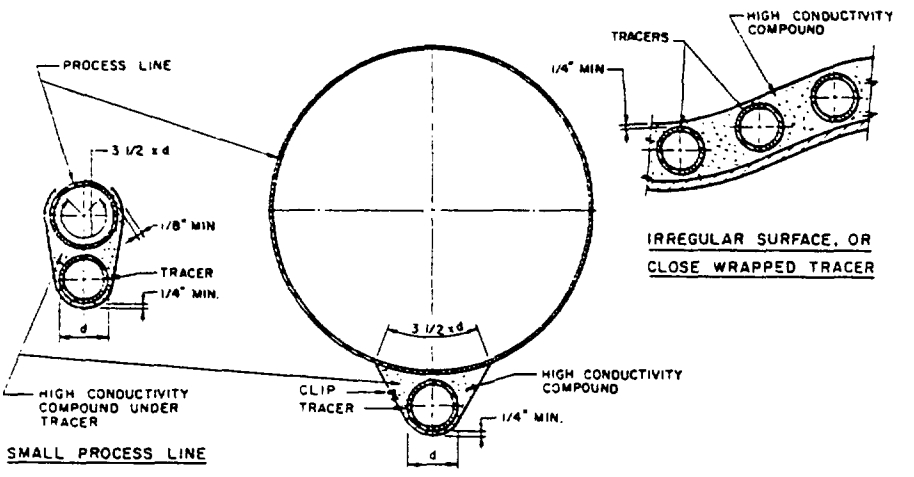
b. High Conductivity Compound Tracing System

(1) Accessories - High conductivity non-metallic plastic compound, Thermon, as manufactured by the Thermon Manufacturing Co., or approved alternate.

(2) Surface Preparation - Surface of pipe (or equipment) to which high conductivity compound is to be applied shall be cleaned of dirt, rust, scale, oil, or varnish film. Galvanized or aluminum surfaces shall be coated with Thermon ALP Primer, or approved alternate, after cleaning.

(3) Type and size of tracer lines, size and thickness of insulation to be applied shall be as scheduled. Tracers shall be secured to process lines with insulation strapping on 12 inch centers. If high conductivity compound is to be applied to galvanized or aluminum surfaces, Thermon ALP aluminum primer shall be applied to the surface prior to the installation of the tracer of compound. When aluminum piping is to be traced (or where elsewhere required), insulation strapping shall be separated from the aluminum by not less than two wrappings of glass fiber tape - Hi-Low Temperature Glass Cloth Tape, 7000 G, as manufactured by Mystik Adhesive Products, Inc., or approved alternate. Care shall be exercised that tracer does not contact aluminum line at any point. Where tracer may touch, the aluminum pipe shall be wrapped with glass tape at the point of contact.

(4) Application - High conductivity compound shall be applied over tracer to thickness of approximately 1/4 inch and into void between tracer and process pipe (or equipment). Care shall be exercised to force the compound under the tracer to ensure maximum surface contact. Area of surface contact to process pipe shall be approximately 3-1/2 times the diameter of the tracer. Over irregular surfaces (pumps, valves, etc.), and where tracers are closely spaced, compound may be trowelled over tracers in solid layer, covering tracer by about 1/4 inch. If thickness in excess of 3/4 inch is required, high conductivity compound should be installed in two layers. The first layer should be cured before the second layer is applied. Application details are shown in Figure GA-4A.



APPLICATION OF HIGH CONDUCTIVITY COMPOUND

FIG. GA-4A

(5) Curing - After application the high conductivity compound shall be allowed to air set for a minimum of 8 hours before heat curing. Air setting time may be several weeks without detrimental effects to the compound. Heat curing shall be accomplished by gradually raising temperature of tracer to between 200 and 225 F. This temperature shall be maintained for a minimum of 8 hours. Examination of the high conductivity compound to determine its dryness will indicate when curing is complete.

(a) Steam system curing procedure is: Open trap end of tracers to atmosphere, then open valve at steam header just sufficiently to allow condensate, but not steam to enter the tracing system.

(b) Electric tracing system curing procedure is: Set thermostat at 200 F.

(6) Weather Protection - High conductivity compound is soluble in water; therefore, it must be protected from rain, snow, and water by temporary jackets, or other means, until the insulation and its weather barrier is applied. High conductivity compound shall not be installed and allowed to freeze before curing. In cold weather it may be necessary to heat the lines and equipment in order to apply. It is also necessary to keep the material warm before application. Wherever high conductivity compound is used, and is not covered by insulation, it shall be coated, after heat curing, with a weather-barrier coating in accordance with Part I. B. 17.

17. Weather-Barrier Coating

a. Insulation shall be coated with a weather-barrier at time of installation.

b. Coating shall not be applied when atmospheric temperature is below 32 F, and/or when temperature is expected to be less than 25 F within the next 24 hours after application.

c. Where sprayed weather-barrier is to be applied, adjacent areas not to be coated, such as valve stems, handles, gauge glasses, instruments, and other adjacent equipment or structures, shall be masked or otherwise protected.

d. A heavy fillet of caulking mastic shall be applied at all inside corners of insulation, and at all junctions of insulation and metal, before application of weather-barrier coating.

e. Weather-barrier membrane shall be carried out 6 inches onto metal, beyond termination of insulation at supports, skirts or other projections, and sealed to the metal.

f. All weather-barrier coatings shall be [illegible] applied to insulation surface and reinforced with glass fiber cloth thoroughly embedded into the mastic coating. Joints of reinforcing cloth shall be uniform in width

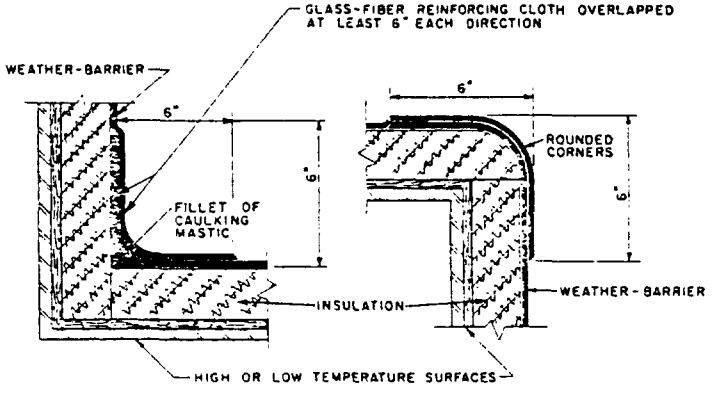
and have a smooth unbroken surface. Care shall be taken that openings in weave of cloth are completely sealed.

g. Where flame-resistant, modified polyvinyl acetate emulsion weather-barrier is specified, it shall be applied by either cold spray, palming or troweling.

h. The combined thickness of the weather barrier coating and reinforcing cloth shall be not less than 1/16 inch when dry.

i. Unless otherwise specified, weather-barrier coating shall be the same for indoor and outdoor service.

j. All outside corners of insulation shall be rounded and the weather-barrier coating provided with a double layer of reinforcing cloth, as shown in Figure GA-5.



APPLICATION OF WEATHER-BARRIER COATING AT CORNERS

FIG GA-5

k. On outside installations, insulation of flat surfaces, and at outside corners, where necessary, shall be beveled before application of coating, to provide drainage.

18. Metal Jackets

a. The letter M added to the regular designation of an application specification (examples: 10-HM, 10-JM, etc.) indicates that the weather-barrier shall consist of a metal jacket furnished and installed as specified in this part. Weather-barrier coatings described in such specifications shall be disregarded except where they are used as supplements to the metal jackets.

b. Weather-Barrier Jacket - Austenitic stainless steel, not less than 0.008 inch in thickness, supplied in coil form at least 36 inches wide, or applied to the insulation at the factory.

c. Sheet Metal Screws - Austenitic stainless steel, type A, pan head, gimlet point, self-tapping, No. 7 by 3/8 inch. For outdoor service, all screws shall be furnished with neoprene washers attached.

d. Heat Resistant Coating - Benjamin Foster No. 37X50 or approved alternate.

e. Equipment

(1) On vertical vessels, jacketing shall be installed working from bottom up, and sufficient stainless steel S clips shall be placed around each circumferential joint to prevent slippage. Laps of circumferential and vertical joints shall be at least 2 and 3 inches, respectively. Vertical joints shall be secured with sheet metal screws on 6-inch centers.

(2) On horizontal vessels, laps of circumferential and horizontal joints shall be at least 2 and 3 inches,

respectively. Jacketing shall be secured by stainless steel bands placed directly over circumferential joints of jacketing, and at the mid-points between the joints (approximately 16 inches on centers).

(3) All vertical and circumferential joints shall be sealed with the specified heat-resistant coating. Screws shall be eliminated on a circumferential expansion joint where so designated by the Resident Associate.

(4) All outlets, cutouts, etc., shall be flashed with a 3/32-inch thick (minimum) layer of weather-barrier coating reinforced with glass fabric reinforcing cloth.

Piping

(1) Insulation with Factory-Applied Jacketing

(a) On straight horizontal or vertical piping, circumferential joints shall be made with special stainless steel joint closures and bands furnished with the jacketed insulation. The inside surface of the closure is coated with sealer protected by paper backing. Care shall be exercised to ensure that the paper is removed before the closure is installed.

(b) Longitudinal joints of jacketed insulation are of the preformed Z type, and shall be fastened by snapping the ends into place. Longitudinal joints on horizontal piping shall be located on the lower half of the pipe, with the open side of the joint pointed down to ensure run-off of water. Heat-resistant coating is not required for these joints.

(2) Field-Applied Jacketing

(a) On straight horizontal or vertical piping, circumferential and longitudinal joints shall be lapped a minimum of 2 inches.

(b) On horizontal piping, longitudinal joints shall be located on the lower half of the pipe, and so overlapped as to ensure run-off of water.

(c) On vertical piping, jacketing shall be installed working from bottom up. Stainless steel S clips shall be placed at each circumferential joint to prevent slippage.

(d) Jackets shall be secured with one band at each circumferential joint, and one band at each mid-point between the joints.

(e) Lapped longitudinal joints shall be fastened with stainless steel sheet metal screws on 6-inch centers.

(f) All lapped joints shall be sealed with the specified heat resistant coating.

(g) Jackets shall be cut back from pipe insulation where flange, ell, tee, and valve covers fit over the pipe insulation.

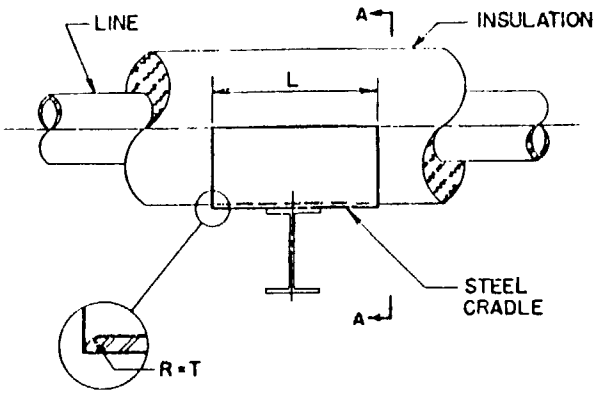
(h) Flange covers shall be protected from weather by stainless steel jacketing, installed in a manner similar to that specified for piping. Side openings shall be sealed with weather-barrier coating having a minimum thickness of 1/16 inch, reinforced with glass fabric reinforcing cloth. This barrier shall be carried over fillet of caulking compound and a minimum of 3 inches over adjacent metal pipe jacket, and a minimum of 3 inches over top metal jacket flange cover.

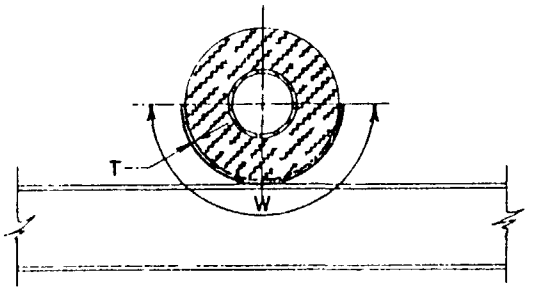
(i) Ells, valve covers, and other irregular shapes shall be protected from weather as specified in Part I. B. 17.

NOMINAL PIPE SIZE	INSULATION THICKNESS	T, CRADLE THICKNESS	L, LENGTH OF CRADLE				
			10-FT SPAN	12-FT SPAN	15-FT SPAN	18-FT SPAN	20-FT SPAN
1/2 & 3/4	1 TO 2	14 GA	10	-	-	-	-
	2-1/2 TO 4	1/8	10	-	-	-	-
	4-1/2 & 5	3/16	10	-	-	-	-
1 TO 1-1/2	1 TO 2	14 GA	10	10	-	-	-
	2-1/2 TO 4	1/8	10	10	-	-	-
	4-1/2 TO 6	3/16	10	10	-	-	-
2 TO 3-1/2	1 & 1-1/2	14 GA	10	10	10	-	-
	2 - 3	1/8	10	10	10	-	-
	3-1/2 TO 5	3/16	10	10	10	-	-
	5-1/2 & 6	1/4	10	10	10	-	-
4 & 5	1 TO 2	1/8	10	10	10	12	-
	2-1/2 TO 4	3/16	10	10	10	12	-
	5 TO 7	1/4	10	10	10	12	-
6 & 8	1-1/2 & 2	3/16	10	12	16	16	20
	2-1/2 & 3	3/16	10	12	16	16	20
	3-1/2 TO 5-1/2	1/4	10	12	16	16	20
	6 TO 7	5/16	10	12	16	16	20
10 & 12	1-1/2 TO 3-1/2	1/4	12	16	20	24	24
	4 TO 6	5/16	12	16	20	24	24
	6-1/2 TO 8	3/8	12	16	20	24	24
14 & 16	1-1/2 TO 2-1/2	1/4	16	20	24	36	36
	3 TO 4	5/16	16	20	24	36	36
	4-1/2 TO 7	3/8	16	20	24	36	36
	7-1/2 & 8	7/16	16	20	24	36	36
18 & 20	1-1/2 TO 2-1/2	5/16	20	24	30	36	36
	3 TO 5	3/8	20	24	30	36	36
	5-1/2 TO 7-1/2	7/16	20	24	30	36	36
	8	1/2	20	24	30	36	36
24	1-1/2 TO 3	3/8	24	30	36	42	42
	3 1/2 TO 5-1/2	7/16	24	30	36	42	42
	6 TO 8	1/2	24	30	36	42	42
30	1-1/2 TO 4-1/2	1/2	30	36	42	48	54
	5 TO 9	5/8	30	36	42	48	54
36	1-1/2 TO 6-1/2	5/8	36	42	42	54	60
	7 TO 9	3/4	36	42	48	54	60

ALL DIMENSIONS GIVEN IN INCHES EXCEPT AS OTHERWISE INDICATED

REVISED: 1-18-57





SECTION "A-A"

NOTE: W = WIDTH OF SADDLE BEFORE FORMING = OD OF INSULATION X 1.57

THIS STANDARD IS MANDATORY ONLY WHEN INCORPORATED, WHOLLY OR WITH EXCEPTIONS, INTO DESIGN REPORTS, DESIGN DRAWINGS OR OTHER DESIGN DATA, OR INTO BILLS OF MATERIAL OR PURCHASE ORDERS.

ENGINEERING DEPARTMENT
CARBIDE AND CARBON CHEMICALS COMPANY
A DIVISION OF
UNION CARBIDE AND CARBON CORPORATION
SOUTH CHARLESTON, WEST VIRGINIA

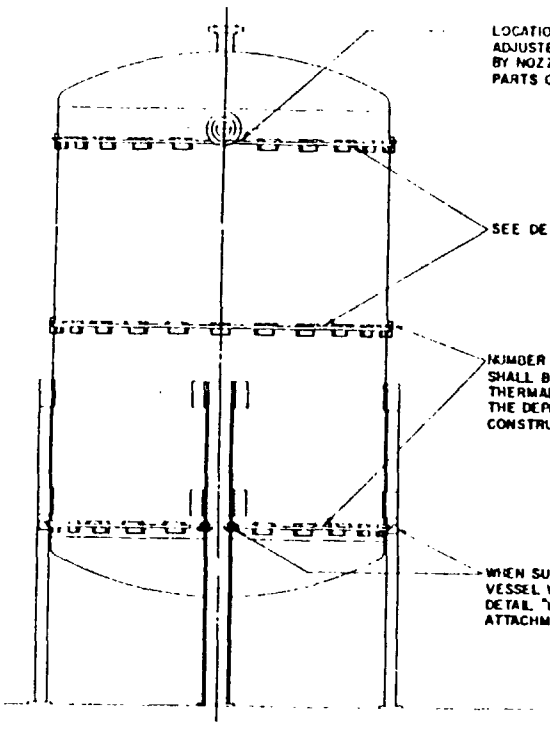
STANDARD CRADLES FOR SEMI-RIGID PIPE INSULATION

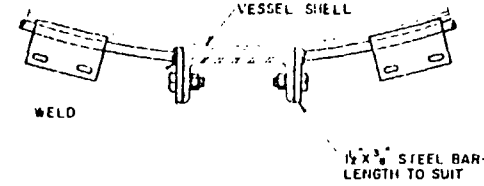
Nº 15-19

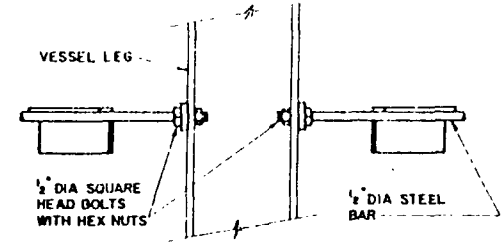
CLASSIFICATION: DETAIL

SPONSOR: 936 BY: R.J.L. DATE: 1-16-57

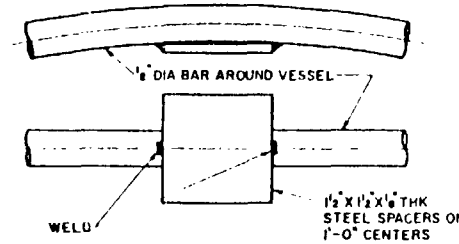
APPROVED: DATE: 5-25-51







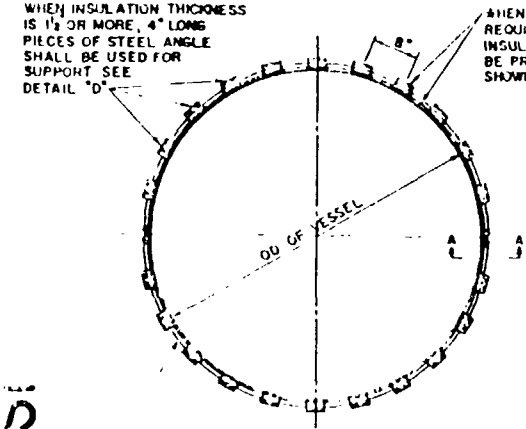
DETAIL "B"



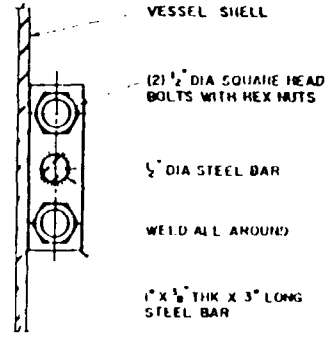
DETAIL "C"

NOTE:

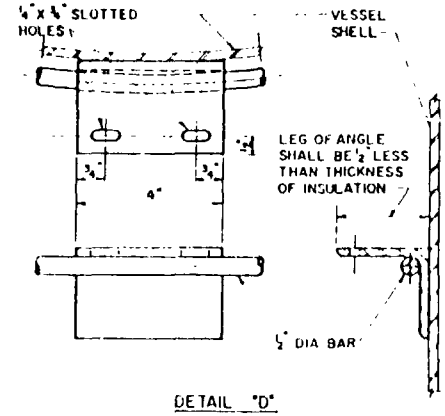
INSULATION SUPPORTS IN ACCORDANCE WITH THIS STANDARD (STD IS-31) SHALL BE FURNISHED FOR ALL HIGH AND LOW TEMPERATURE SERVICE VERTICAL VESSELS



DETAIL "A"



SECTION "A-A"

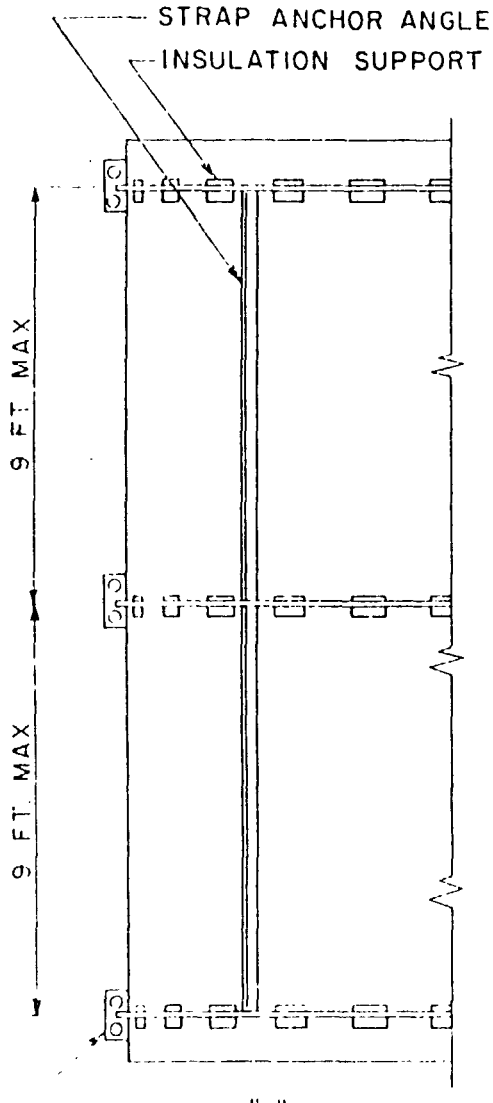


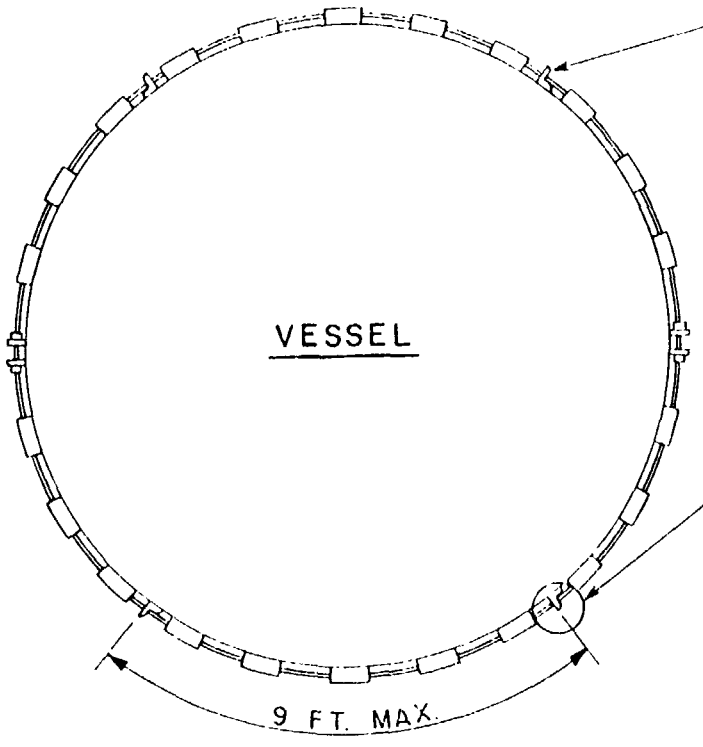
DETAIL "D"

THIS STANDARD IS MANDATORY ONLY WHEN INCORPORATED WHOLLY OR WITH EXCEPTIONS INTO DESIGN REPORTS, DESIGN DRAWINGS OR OTHER DESIGN DATA, OR INTO BILLS OF MATERIAL OR PURCHASE ORDERS

ENGINEERING DEPARTMENT
CARBIDE AND CARBON CHEMICALS COMPANY
A DIVISION OF
UNION CARBIDE AND CARBON CORPORATION
SOUTH CHARLESTON, WEST VIRGINIA

STANDARD INSULATION SUPPORTS-VERTICAL VESSELS	Nº IS-31
CLASSIFICATION DETAIL	
SPONSOR 936 BY	DATE
APPROVED	DATE





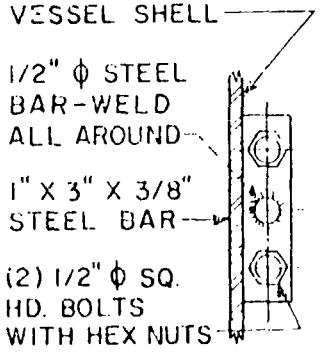
1/4" THICK STRUCTURAL STRAP ANGLES WITH 1/4" X 3/4" SLOTTED HOLES ON 3" CENTERS IN STANDING LEG.

LENGTH OF ANGLE LEGS TO VARY WITH THICKNESS OF INSULATION.

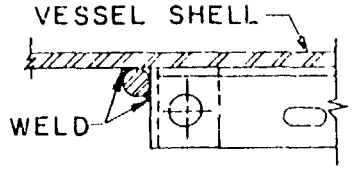
ANGLES TO BE SPACED EQUALLY, AS NEARLY AS POSSIBLE, AROUND CIRCUMFERENCE OF VESSEL.

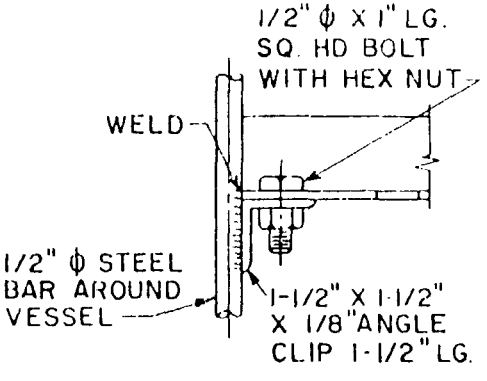
SEE DETAIL "B"

O.D. OF VESSEL	NO. OF ANGLES REQUIRED
15'-0 TO 27'-0	4
27'-1 TO 36'-0	6
OVER 36'-0	ONE ANGLE FOR EACH 9-FT. OR FRACTION THEREOF



DETAIL "A"

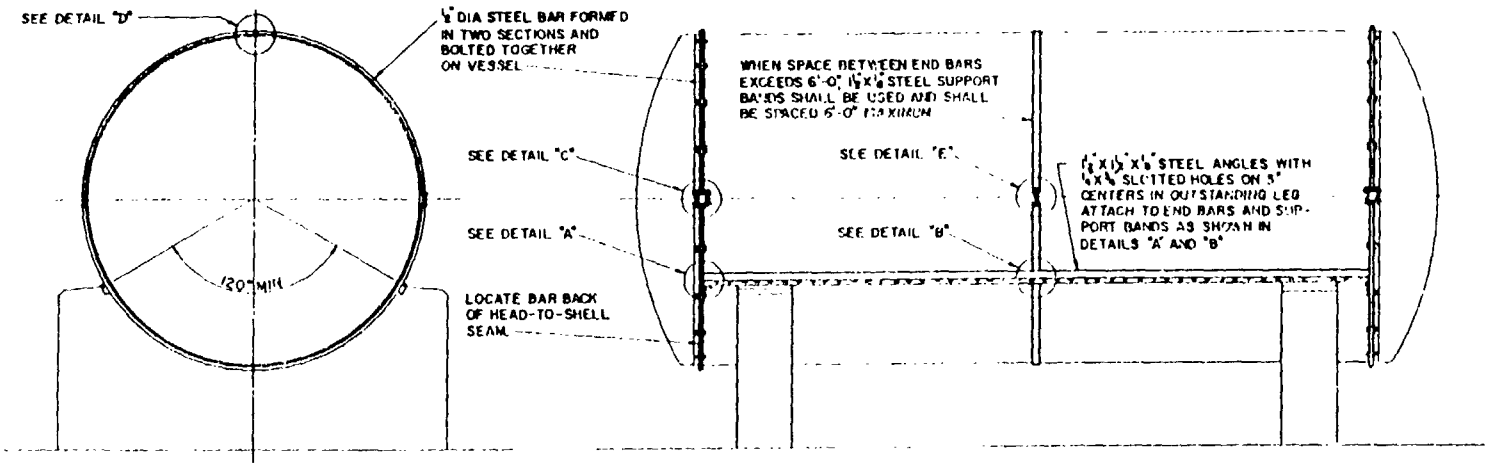




DETAIL "B"

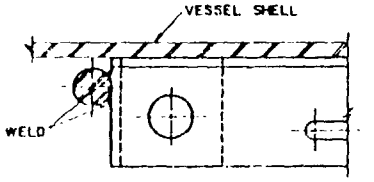
STRAP ANCHOR ANGLES

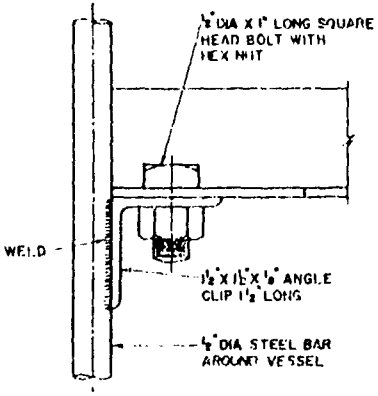
SUPPLEMENT TO STANDARD IS-31



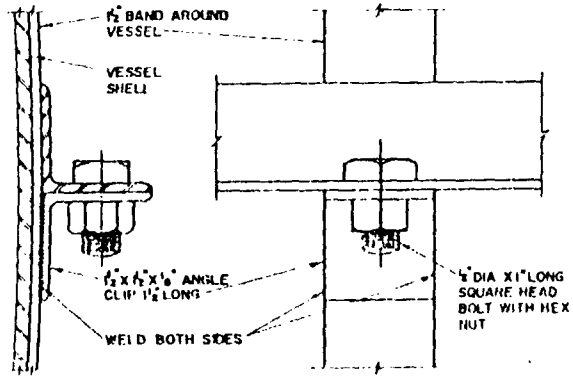
NOTE:

INSULATION SUPPORTS IN ACCORDANCE WITH THIS STANDARD (STD IS-36) SHALL BE FURNISHED FOR ALL HIGH AND LOW TEMPERATURE SERVICE HORIZONTAL VESSELS 4'-0" DIAMETER AND LARGER.

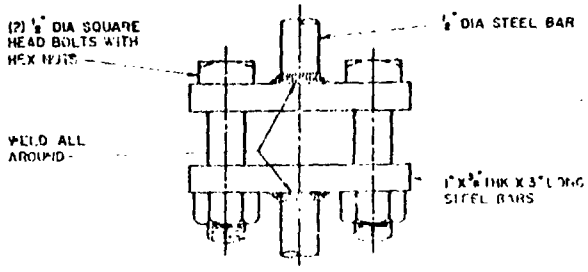




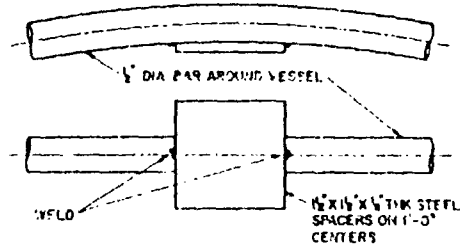
DETAIL "A"



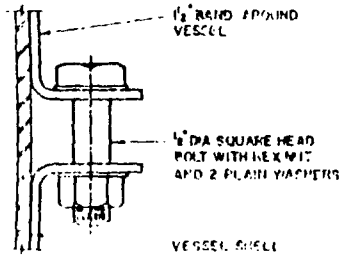
DETAIL "B"



DETAIL "C"



DETAIL "D"



DETAIL "E"

THIS STANDARD IS MANDATORY ONLY WHEN INCORPORATED WHOLLY OR WITH EXCEPTIONS INTO DESIGN REPORTS OF SUCH DRAWINGS OR OTHER DESIGN DATA OR INTO BILLS OF MATERIAL OR PURCHASE ORDERS.

ENGINEERING DEPARTMENT
CARBIDE AND CARBON CHEMICALS COMPANY
A DIVISION OF
UNION CARBIDE AND CARBON CORPORATION
SOUTH CHARLESTON, WEST VIRGINIA

STANDARD	NO.
INSULATION SUPPORTS - HORIZONTAL VESSELS	IS-36

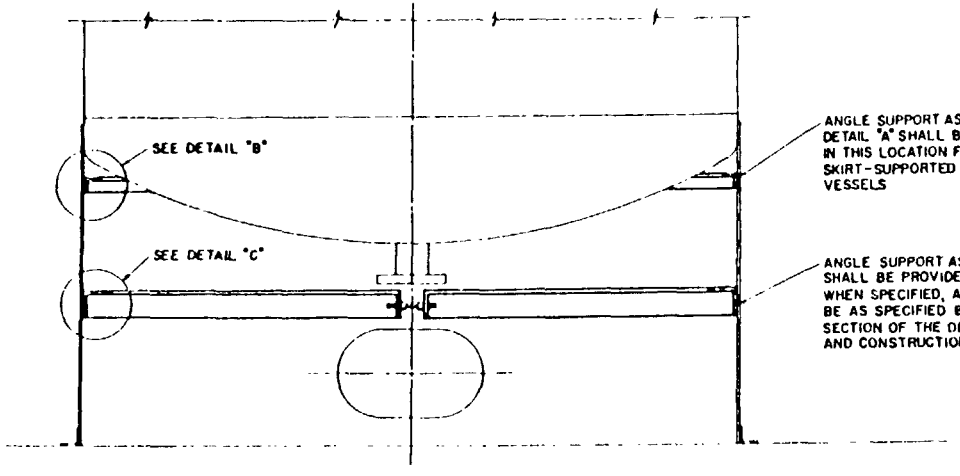
CLASSIFICATION DETAIL

SPONSOR 936 BY [illegible] DATE [illegible]

APPROVED [illegible] DATE 4-25-56

IS-36

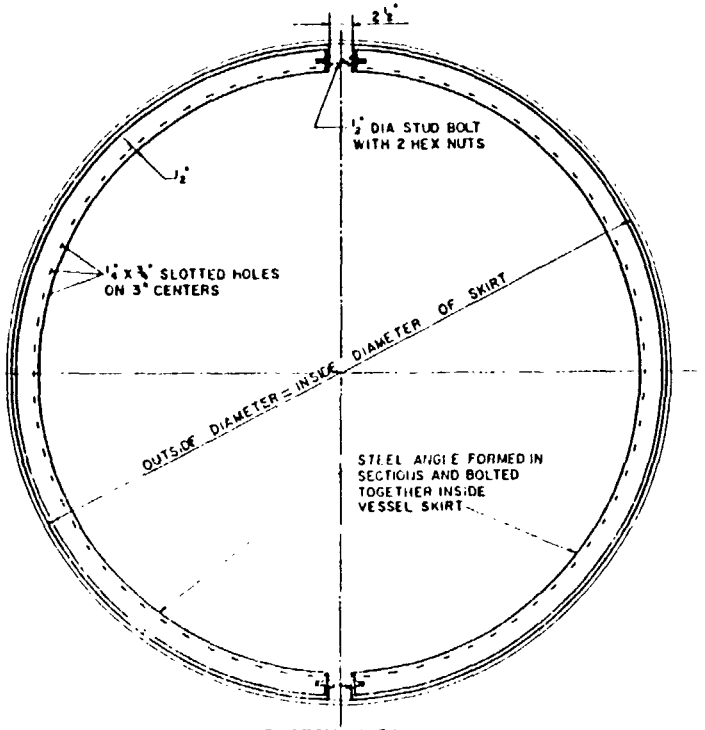
REVISED:



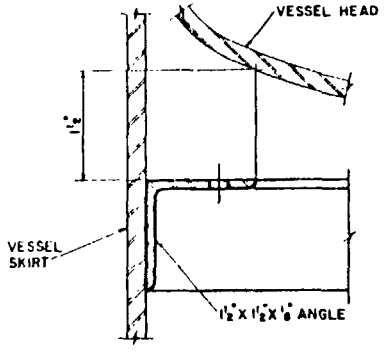
INSULATION SUPPORT ANGLES INSIDE OF VESSEL SKIRT

NOTE:

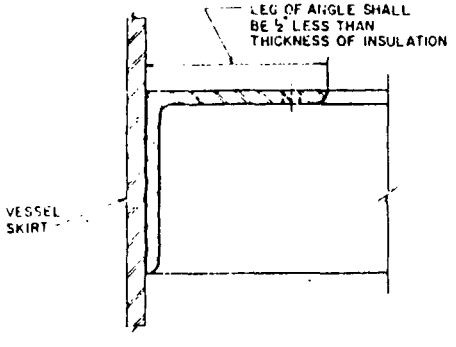
INSULATION SUPPORTS IN ACCORDANCE WITH THIS STANDARD (STD IS-42) SHALL BE FURNISHED FOR ALL SKIRT-SUPPORTED HIGH OR LOW TEMPERATURE SERVICE VESSELS.



BOTTOM VIEW
DETAIL "A"



DETAIL "B"



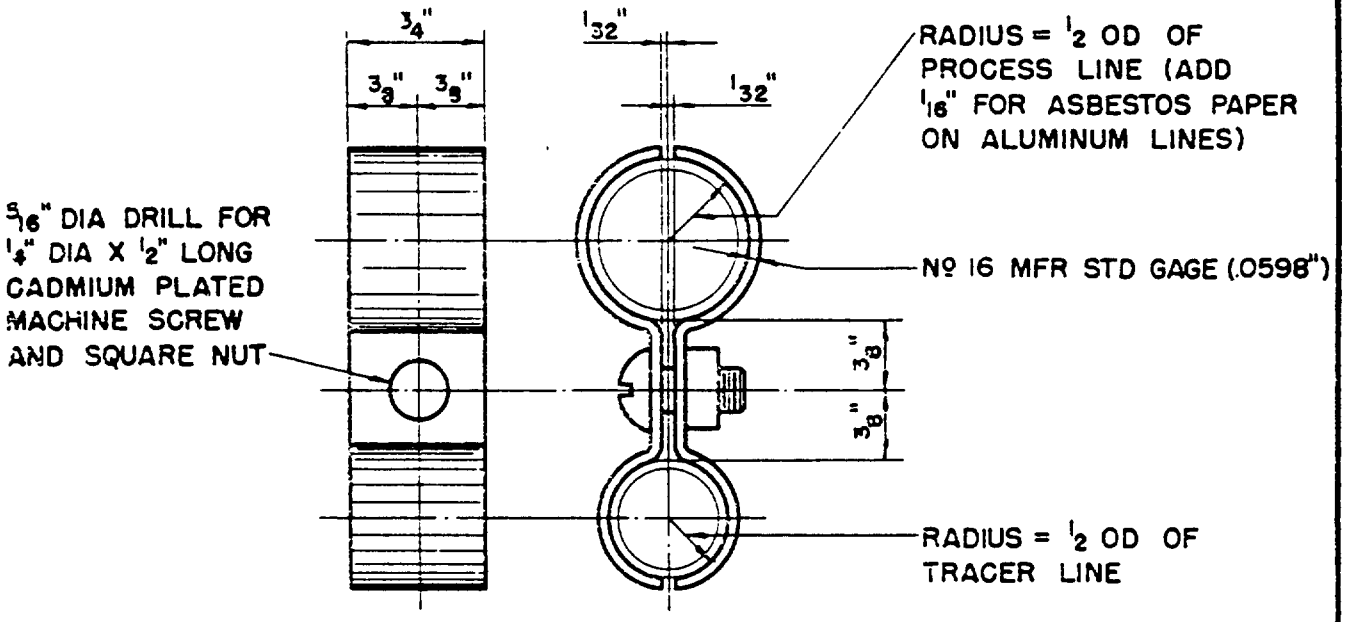
DETAIL "C"

THIS STANDARD IS MANDATORY ONLY WHEN INCORPORATED, WHOLLY OR WITH EXCEPTIONS, INTO DESIGN REPORTS, DESIGN DRAWINGS OR OTHER DESIGN DATA, OR INTO BILLS-OF-MATERIAL OR PURCHASE ORDERS

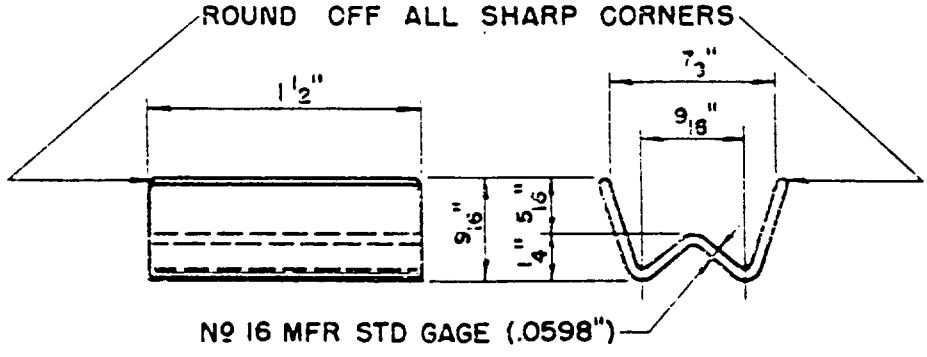
ENGINEERING DEPARTMENT
CARBIDE AND CARBON CHEMICALS COMPANY
A DIVISION OF
UNION CARBIDE AND CARBON CORPORATION
SOUTH CHARLESTON WEST VIRGINIA

STANDARD INSULATION SUPPORTS INSIDE OF VESSEL SKIRT	Nº IS-42
CLASSIFICATION: DETAIL	
SPONSOR: 936 BY: [illegible] DATE: [illegible]	
APPROVED: [signature] DATE: 1-24-56	

IS-42
REVISED



PRESSED STEEL CLAMP FOR PROCESS LINES 7/8" OD AND SMALLER



PRESSED STEEL SPACER

NOTE:

MATERIAL SHALL BE ASTM A7 CARBON STEEL.

THIS STANDARD IS MANDATORY ONLY WHEN INCORPORATED, WHOLLY OR WITH EXCEPTIONS, INTO DESIGN REPORTS, DESIGN DRAWINGS OR OTHER DESIGN DATA, OR INTO BILLS-OF-MATERIAL OR PURCHASE ORDERS.

ENGINEERING DEPARTMENT
CARBIDE AND CARBON CHEMICALS COMPANY
A DIVISION OF
UNION CARBIDE AND CARBON CORPORATION
SOUTH CHARLESTON, WEST VIRGINIA

STANDARD CLAMPS AND SPACERS FOR STEAM TRACED LINES	Nº P-84A
CLASSIFICATION: DETAIL	
SPONSOR: H28 BY: GTF	DATE: 8/7/53
APPROVED: [signature]	DATE: 4-17-47

REVISED: 8-3-53

II. SPECIFICATION 10-B — Cellular Glass

Scope

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

A. MATERIAL

1. Composition

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

2. Properties

Cellular glass insulation shall have the following properties:

Alkalinity	pH shall be between 6.9 and 7.5
Capillarity	After 7 days on wet surface, gain in weight shall be 0%.
Coefficient of Expansion	Shall average 4.6×10^{-6} per degree F.
Combustibility	Shall be incombustible.
Compressive Strength	Shall be not less than 100 psi when tested in accordance with ASTM C 240, latest revision.
Density	Shall be not less than 8 lb per cu ft, nor more than 11 lb per cu ft, when tested in accordance with ASTM C 303, latest revision.
Flexural Strength	Shall be not less than 75 psi when tested in accordance with ASTM C 203, latest revision.
Hygroscopicity	Two-inch cubes dried at 220 F to constant weight, then exposed to air at 70 F and 90% relative humidity for 14 days, shall not gain any weight.
Resistance to Acids	Shall be impervious to common acids and fumes except hydrofluoric and hot phosphoric.
Shear Strength	Shall be not less than 65 psi.
Specific Heat	Shall average 0.20 Btu per lb per degree F.
Temperature Limit	Maximum temperature without mechanical, thermal, or chemical failure shall be not less than 800F.
Tensile Strength	Shall be not less than 75 psi.
Thermal Conductivity	When tested in accordance with ASTM C 177, latest revision, or ASTM C 335, latest revision, the thermal conductivity at the given mean temperatures shall not exceed the following values:

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

Thermal Diffusivity	Shall average 0.42 sq ft per day.
Water Absorption	After 24-hour submersion, shall not exceed 0.2% by volume (surface only).
Vapor Transmission	When tested in accordance with ASTM C 355, latest revision, shall have a WVT of zero grains per sq ft per hour.

3. 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 to be 1-1/2 inch, or a multiple of 1 1/2 inch, as specified.

4. ccessory Materials

a. Adhesive Cement - Pittsburgh Corning Pittcote 300 Trowel Grade, or approved equal.

b. Vapor Barrier - Philip Carey Fire-Chex Vapor Barrier Sheet, or approved equal.

c. Fire-Resistant Adhesive - Philip Carey Fire-Chex No. 400, or approved equal.

d. Asphalt - Philip Carey Steep Manco Asphalt, or approved equal.

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

f. Joint Sealer - Philip Carey Joint Sealer, or approved equal.

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

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

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

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

k. Wire Mesh - Keystone Wire and Wheel Company "Keymesh", or approved equal.

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

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

n. Ceiling Cement - Minnesota Mining and Manufacturing Company CTA-11 Soft Rubber Based Adhesive, or approved equal.

o. Anti-Adhering Solution - one part starch, 24 parts calcium chloride, 91 parts water (by volume).

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.

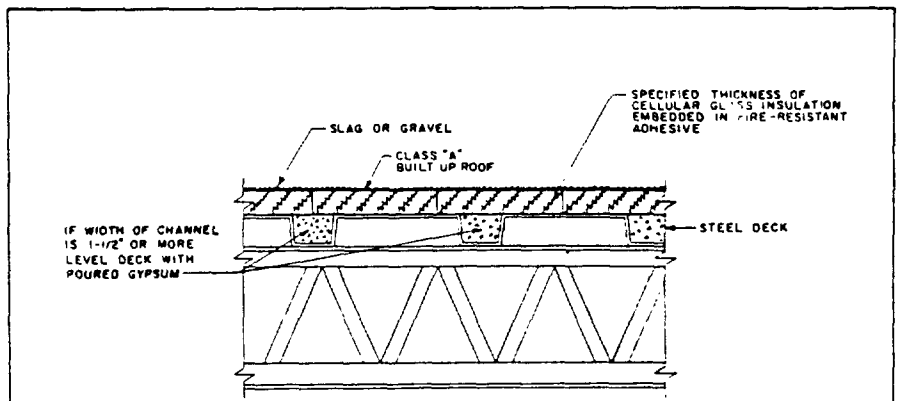
c. Fire-resistant adhesive shall be applied to deck in ribbons approximately 6 inches on centers and 1/4 inch in diameter, at a rate of approximately 0.4 gal per 100 sq ft.

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 beneath.

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.



METAL ROOF DECK

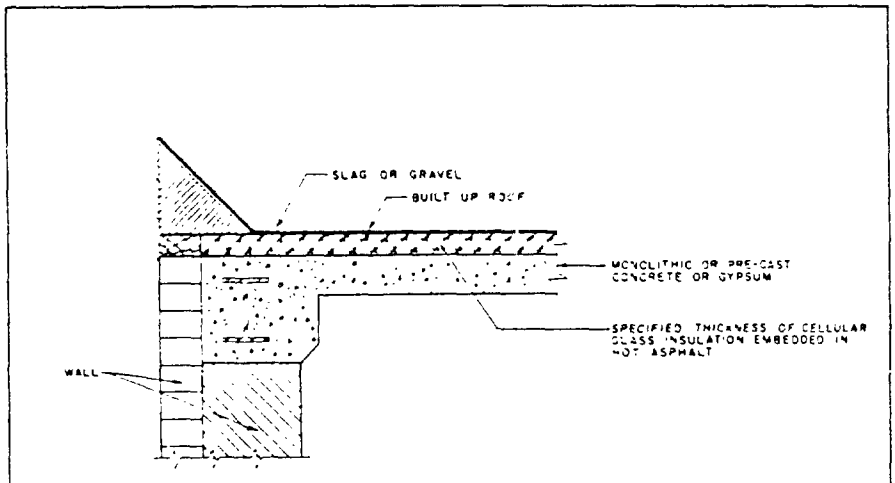
FIG 10-B-1

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 Parts II. B. 1. c, d, e, and f, and as shown in Figure 10-B-2.



MONOLITHIC OR PRECAST ROOF DECK

FIG 10-B-2

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.

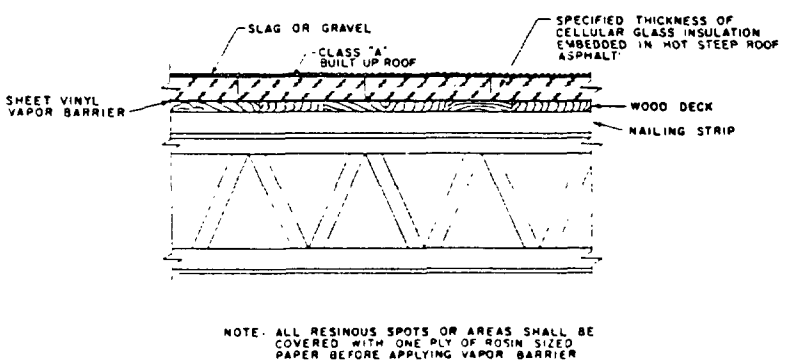
d. If the humidity of the interior is excessive, two plies of 15-lb felt shall be applied with mopping of hot steep roof asphalt. Felt shall be applied by lapping each sheet 19 inches, leaving 17 inches exposed, and mopping hot steep roof asphalt between felts so that at no place shall felt touch felt.

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 beneath.

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.



WOOD ROOF DECK

FIG 10-B-3

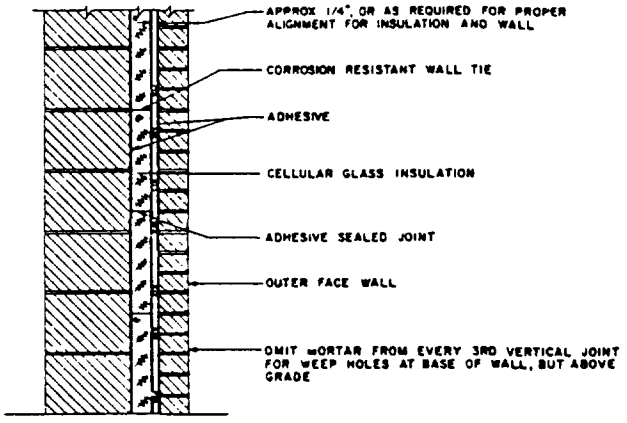
4. Insulation for Core Walls

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

FIG 10-B-4

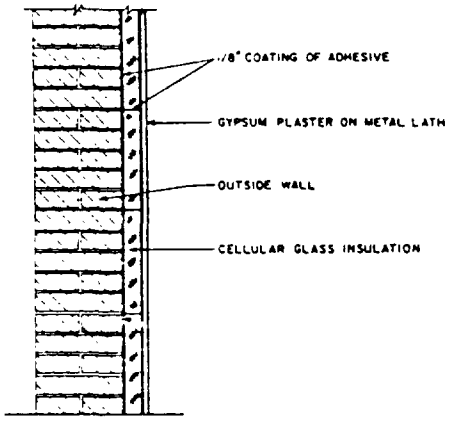
5. Insulation for Masonry Wall Lining

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 glass 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.



APPLICATION OF CELLULAR GLASS INSULATION FOR WALL LINING

FIGURE 10-B-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.

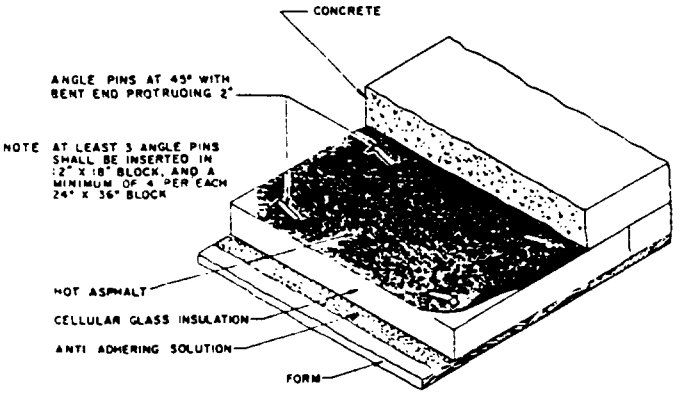
7. Insulation for New Concrete Ceilings

   a. Forms for conrete 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 reinforcing rods are placed, angle pins shall be inserted into 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-B-6.



APPLICATION OF CELLULAR GLASS INSULATION FOR CONCRETE PLACED ON THE INSULATION

FIG. 10-B-6

   e. Concrete shall then be placed over the insulation.

8. Wall and Ceiling 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 and on 12-inch staggered centers on the ceiling. Inside corners shall be reinforced with strip lath, and outside corners with corner bead.

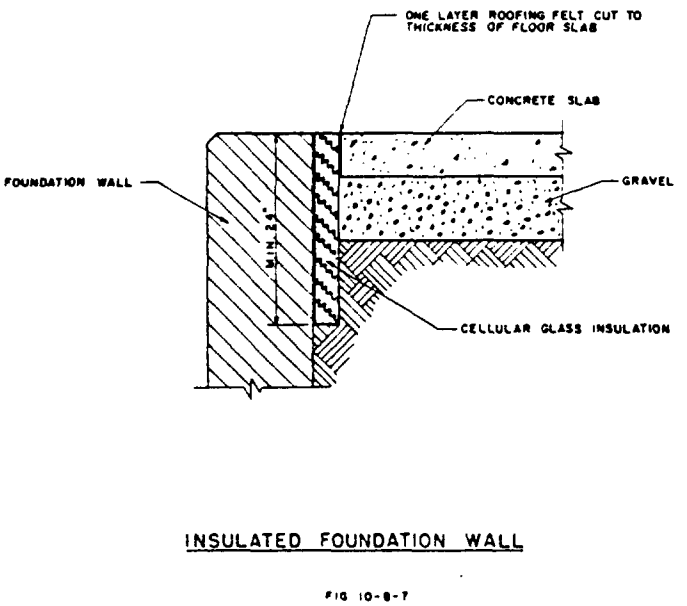
   c. Gypsum plaster, mixed on thejob, shall be applied to the wire mesh in two coats having a maximum total thickness of 1/2 inch.

   d. Paint shall be vinyl emulsion as specified in the 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-B-7.



INSULATED FOUNDATION WALL

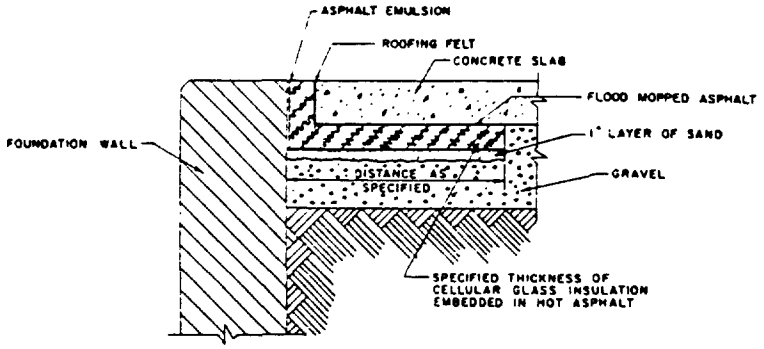
FIG 10-B-7

(2) Insulation shall be installed in inside surface of foundation wall with 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-B-8.



INSULATED FLOOR SLAB

FIG 10-B-8

(2) Insulation surfaces around the perimeter shall be separated from the slab edge and foundation with a layer of roofing felt cemented to the insulation block with hot asphalt.

(3) 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.

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

(5) 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.

II. SPECIFICATION 10-H — Cellular Glass
10-HSS (For Stainless Steel)

Scope

This Specification describes the essential requirements for the purchase and application of preformed cellular glass insulation, for use on equipment and piping normally operating at temperatures above 70 F and up to 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, this Specification shall be subject to the use of accessory materials specified for stainless steel.

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

A. MATERIAL

1. Composition

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

2. Properties

Alkalinity	pH shall be between 6.9 and 7.5.
Capillarity	After 7 days on wet surface, gain in weight shall be 0%.
Coefficient of Expansion	Shall average 4.6×10^{-6} per degree F.
Combustibility	Shall be incombustible.
Compressive Strength	Shall be not less than 100 psi when tested in accordance with ASTM C 240, latest revision.
Density	Shall be not less than 8 lb per cu ft, nor more than 11 lb per cu ft, when tested in accordance with ASTM C 303, latest revision.
Flexural Strength	Shall be not less than 75 psi when tested in accordance with ASTM C 203, latest revision.
Hygroscopicity	Two-inch cubes dried at 220 F to constant weight, then exposed to air at 70 F and 90% relative humidity for 14 days, shall not gain any weight.
Resistance To Acids	Shall be impervious to common acids and fumes except hydrofluoric and hot phosphoric.
Shear Strength	Shall be not less than 65 psi.
Specific Heat	Shall average 0.20 Btu per lb per degree F.
Temperature Limit	Maximum temperature without mechanical, thermal, or chemical failure shall be not less than 800 F.
Tensile Strength	Shall be not less than 75 psi.
Thermal Conductivity	When tested in accordance with ASTM C 177, latest revision, or ASTM C 335, latest revision, the thermal conductivity at the given mean temperatures shall not exceed the following values:

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

Thermal Diffusivity	Shall average 0.42 sq ft per day.

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

Vapor Transmission . . . When tested in accordance with ASTM C 355, latest revision, shall have a WVT of zero grains per sq ft per hour.

3. Accessory Materials - Specification 10-H

a. Cushioning Material:

Equipment - TWL Fiberglas glass wool blanket 1 inch thick. Piping 350 F and below - Ultralite, Superfine, Mono-Kover, 1/2 inch thick. Piping above 350 F - TWL Fiberglas glass wool blanket 1 inch thick.

b. Stainless Steel Wire - 0.0475-inch diameter, Type 304, cold drawn, bright annealed, 18 gage.

c. Stainless Steel Insulation Strap - 1/2-inch by 0.020-inch, Type 304 or approved equal.

d. Stainless Steel Clips - Double-pronged, Type 304, A. J. Gerrard, Techalloy double-pronged seal, or approved equal.

e. Strapping Tape - Glass filament, vinyl backed, Dutch Brand No. 400 or approved equal.

f. Strap Anchor Clip - A. J. Gerrard's strap hanger.

g. Pipe Insulation Support - Techalloy insulation support strap or approved equal.

h. Anti-Abrasion Coating - Keene's Cement or approved equal.

i. Weather-Barrier Coating (Color as specified) - PVA-Vimasco No. WC-1, Pittsburgh-Corning Pittcote 500C, or approved equal.

j. Reinforcing Cloth - Glass fabric, 10 by 10 thread count, Perma-Glas Mesh, Glass Mesh 10S, Benjamin Foster Open Weave No. 10, or approved equal.

k. Staples - 5/8-inch by 1/2-inch, stainless steel, A. J. Gerrard or approved equal.

l. Adhesive Cement - Miracle Adhesive Type H or approved equal.

m. Fabricating Cement - Miracle Adhesive RT-1000 P or approved equal.

n. Heat-Resistant Sealer - Benjamin Foster No. 30-43 or approved equal.

o. Glass Wool Metal Mesh Blanket - White glass wool, expanded metal lath on one side - Fiberglas Metal Mesh Blanket TWL Style 1, or approved equal.

p. Insulating Cement - Hydraulic setting - Baldwin-Ehret-Hill Powerhouse, Eagle-Picher One Coat, Detrick Utility, or approved equal.

4. Accessory Materials - Specification 10-HSS

Accessory materials for Specification 10-HSS shall be the same as those listed in Part II. A. 3., with the following exceptions:

Cushioning Material for Equipment and Piping - 2-1/2 lb per cu ft density TWL Fiberglas or approved equal white glass wool blanket 1 inch thick.

Anti-Abrasion Coating - Dampney No. 70 Black.

B. APPLICATION - SPECIFICATIONS 10-H and 10-HSS

1. Equipment

a. Insulation Supports

Equipment shall be provided with insulation supports as called for in the GENERAL SPECIFICATIONS, Part I. B. 5.

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 the GENERAL SPECIFICATIONS, Part I. B. 2.

c. Cushioning Blanket

(1) On vertical equipment, except stainless steel, two layers of the specified cushioning blanket shall be applied over the top head and compressed to 1-inch thickness, and one layer to the sides and bottom head and compressed to 1/2-inch thickness, before application of the cellular glass insulation. Blanket

shall be secured in place with a minimum amount of stainless steel wire. Cellular glass insulation shall then be applied over the blanket in the manner described in this Specification. Cushioning blanket shall not be considered as part of the specified insulation thickness.

(2) On horizontal equipment, except stainless steel, one layer of the specified cushioning blanket shall be applied over the entire surface and compressed to 1/2-inch thickness, and secured in the same manner as that called for in Part II. B. 1. c. (1).

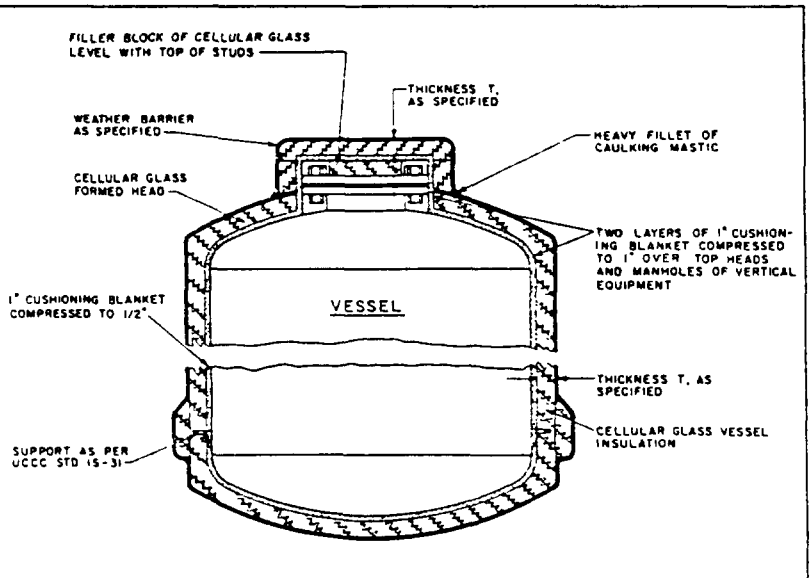
(3) On stainless steel vertical or horizontal equipment, the specified white glass wool blanket shall be applied in the same manner as that called for in Part II. B. 1. c. (1) or (2).

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 HEAD & NOZZLE

FIG 10-H-1

e. Flat Surfaces

Flat block shall be applied to flat surfaces in the same manner as previously specified for curved surfaces when operating temperature of equipment is in excess of 150 F. When operating temperature of equipment is 150 F or below, cushioning material shall be omitted and block applied directly to metal surfaces. Securement shall be as specified in the Insulation Design Schedule and/or Line List.

f. 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. Insulation applied to irregular surfaces where use of insulation strap is impracticable, shall be secured with stainless steel wire.

(2) Inner layer or layers of cellular glass insulation on bottom heads of vertical equipment or heads of horizontal equipment shall be held in place with specified stainless steel strap secured to support as shown in UCCC Standards IS-21, IS-36, and IS-42. 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-H-2.

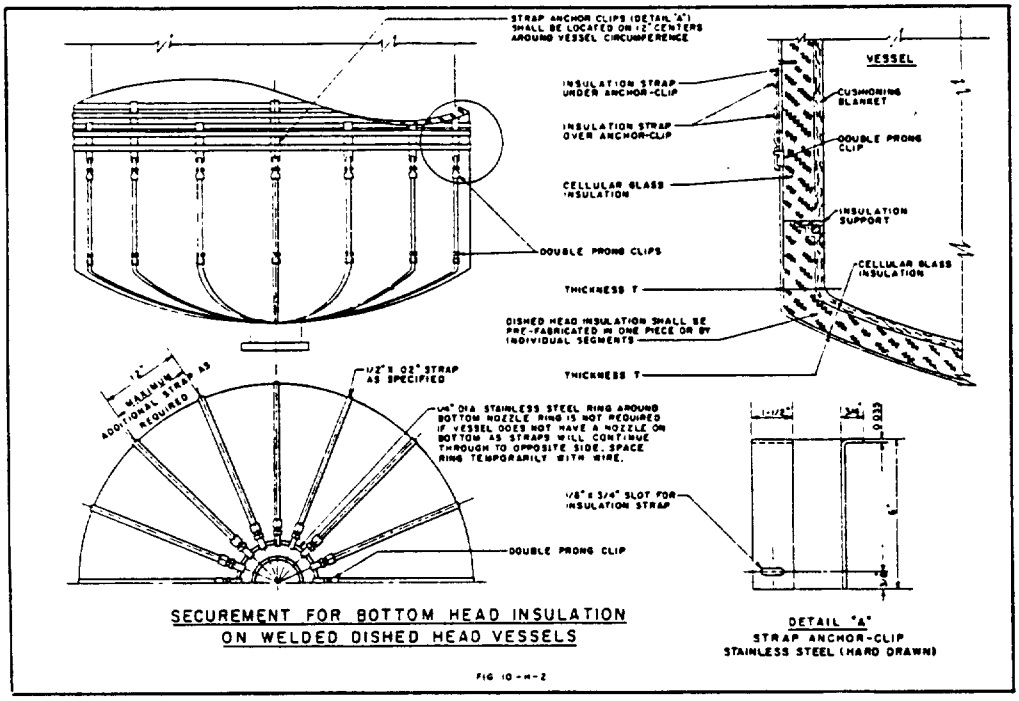


FIG 10-H-2

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

g. Expansion Joints

(1) Cellular glass applications shall be provided with expansion joints at vessel flanges, constructed as shown in Figure 10-H-3.

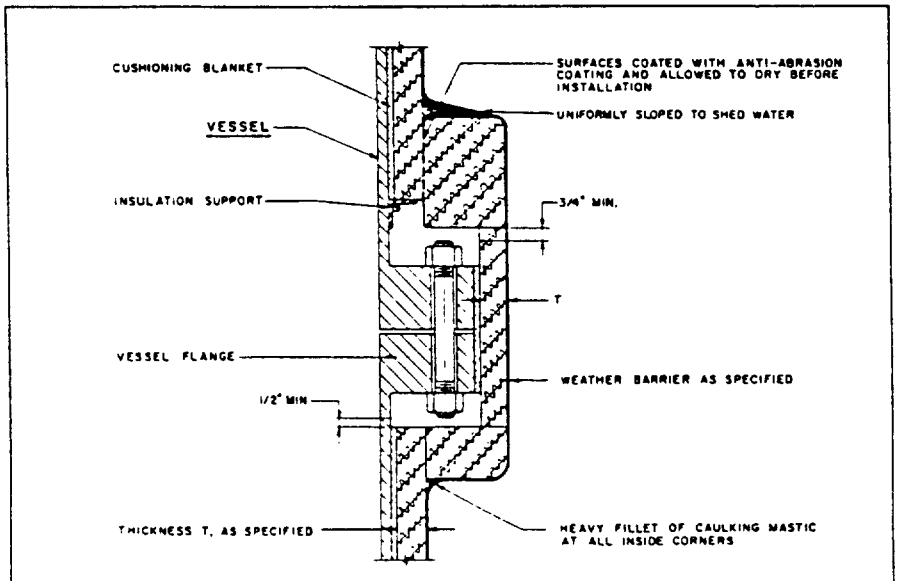
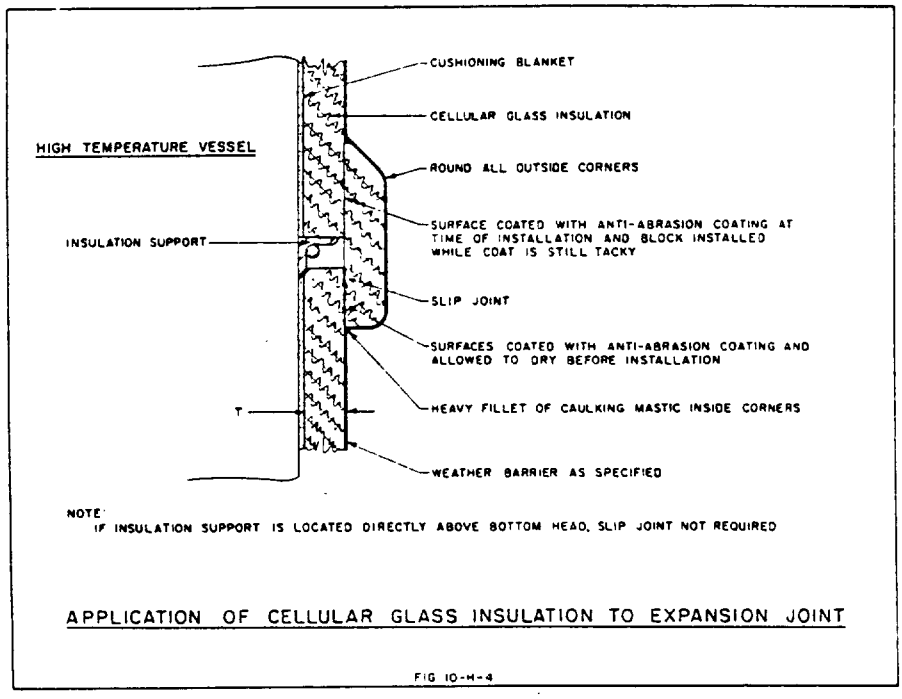
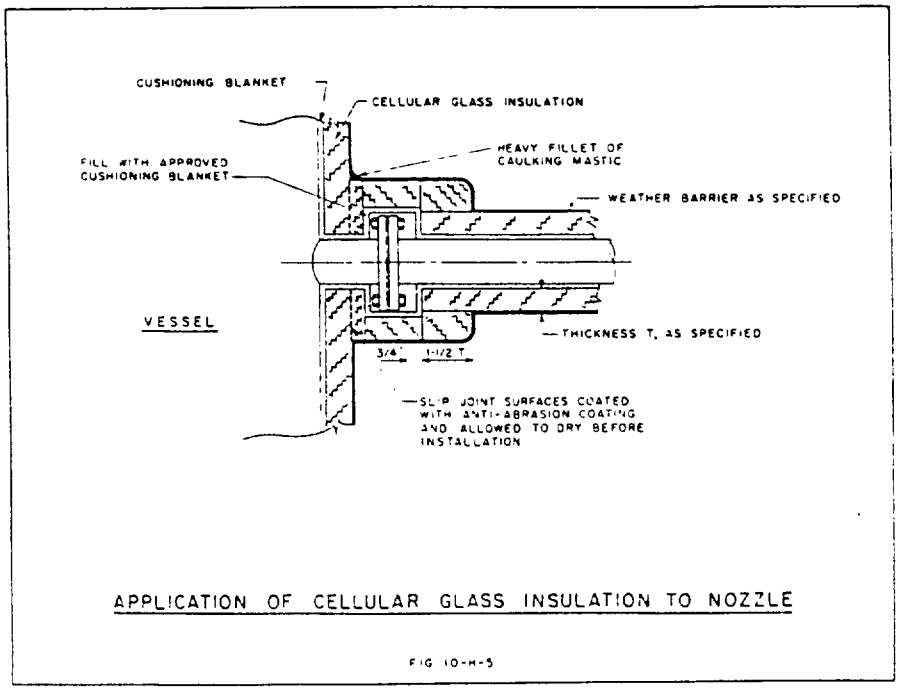


FIG 10-H-3

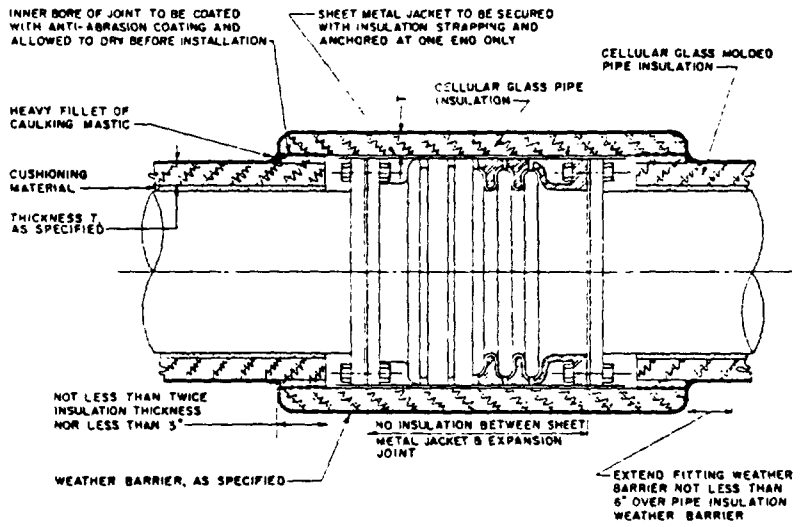
(2) Longitudinal expansion of vessels shall be provided for by installing expansion joints at the insulation supports, as shown in Figure 10-H-4. When more than one thickness is specified for a vessel, an insulation support shall be provided at the junction of two different thicknesses and insulated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



(3) One inch of cushioning material shall be packed around nozzles and projections where they extend through the insulation, to prevent crushing of the insulation by contraction and expansion of the vessel. Typical application is shown in Figure 10-H-5.



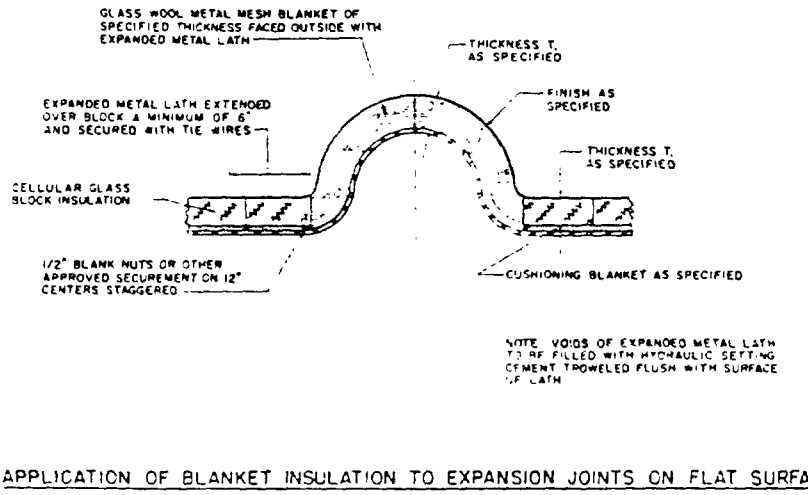
(4) Corrugated mechanical expansion joints on piping (usually listed as equipment items) where cellular glass products are specified shall be insulated as shown in Figure 10-H-6.



APPLICATION OF CELLULAR GLASS INSULATION TO A MECHANICAL EXPANSION JOINT

FIG. 10-H-6

(5) Expansion joints in flat surfaces or cylindrical vessels shall be insulated with flexible blanket insulation to permit movement of the expansion joint. Typical installation is shown in Figure 10-H-7.



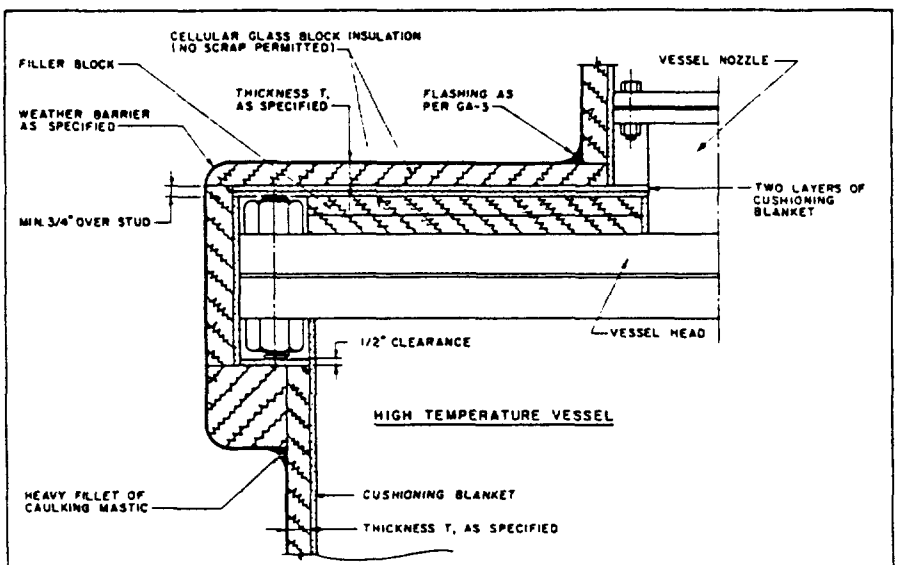
APPLICATION OF BLANKET INSULATION TO EXPANSION JOINTS ON FLAT SURFACE

FIG 10-H-7

II. B. 1. 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. Water pockets shall be eliminated and proper drainage provided as shown in Figure 10-H-8.



APPLICATION OF CELLULAR GLASS INSULATION TO FLAT EQUIPMENT HEAD

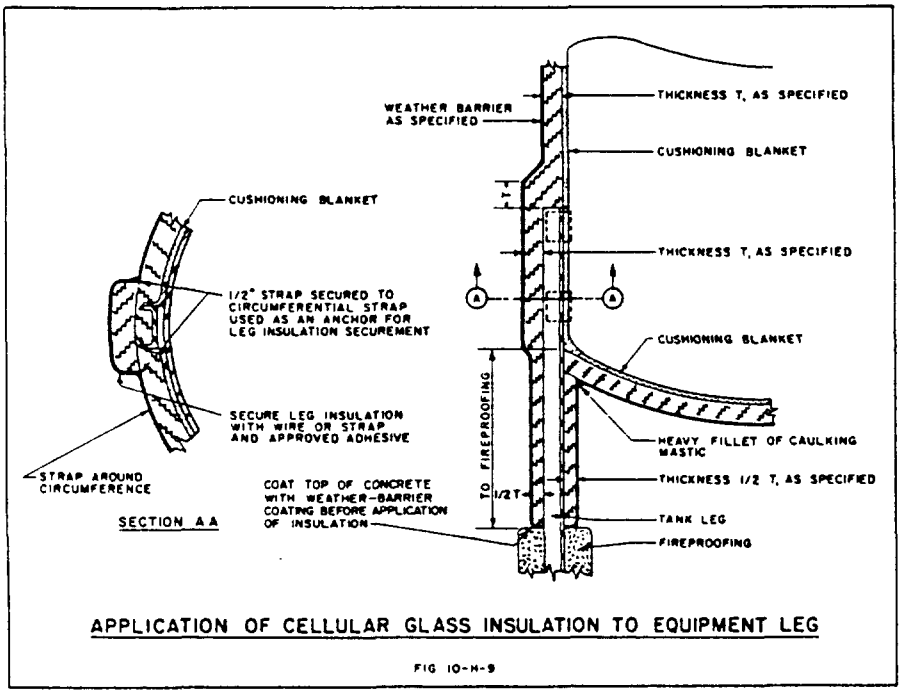
FIG 10-H-8

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

i. Vessel Legs

(1) 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 1/2 that specified for body of vessel. Body insulation shall be brought up to and butted firmly against tank leg flange.

(2) Re-entrant space between channel flanges and over channel flanges between body insulation shall be filled with block cemented in place with the specified adhesive cement. Surface of fireproofing material abutting tank leg insulation shall be coated with the specified weather-barrier coating. Installation shall be as shown in Figure 10-H-9.

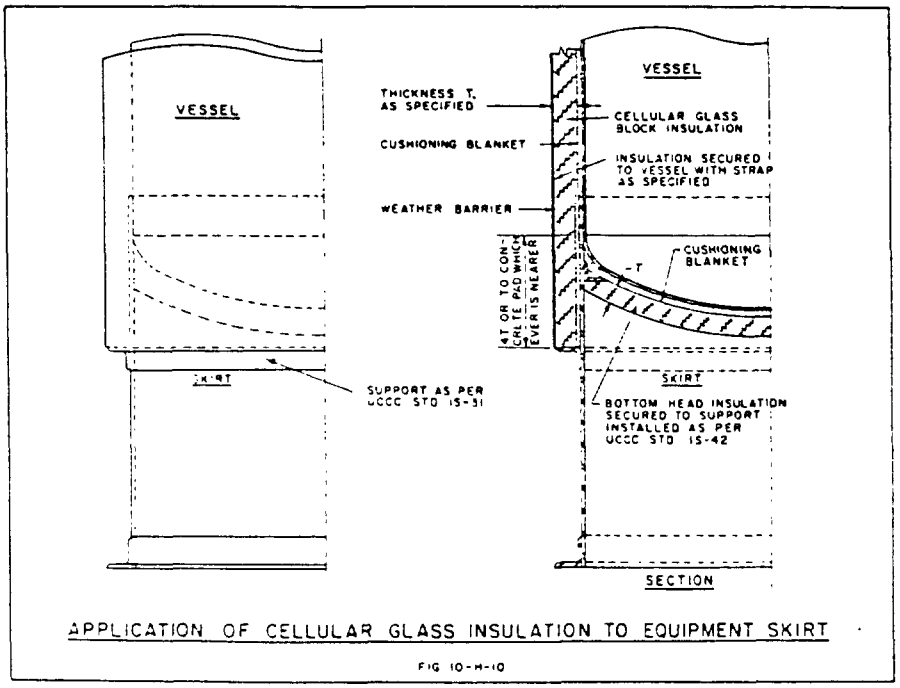


APPLICATION OF CELLULAR GLASS INSULATION TO EQUIPMENT LEG

FIG 10-H-9

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 shall be provided for securement of bottom head insulation in accordance with UCCC Standard IS-42. Installation shall be as shown in Figure 10-H-10.



APPLICATION OF CELLULAR GLASS INSULATION TO EQUIPMENT SKIRT

FIG 10-H-10

II. B. 1. contd

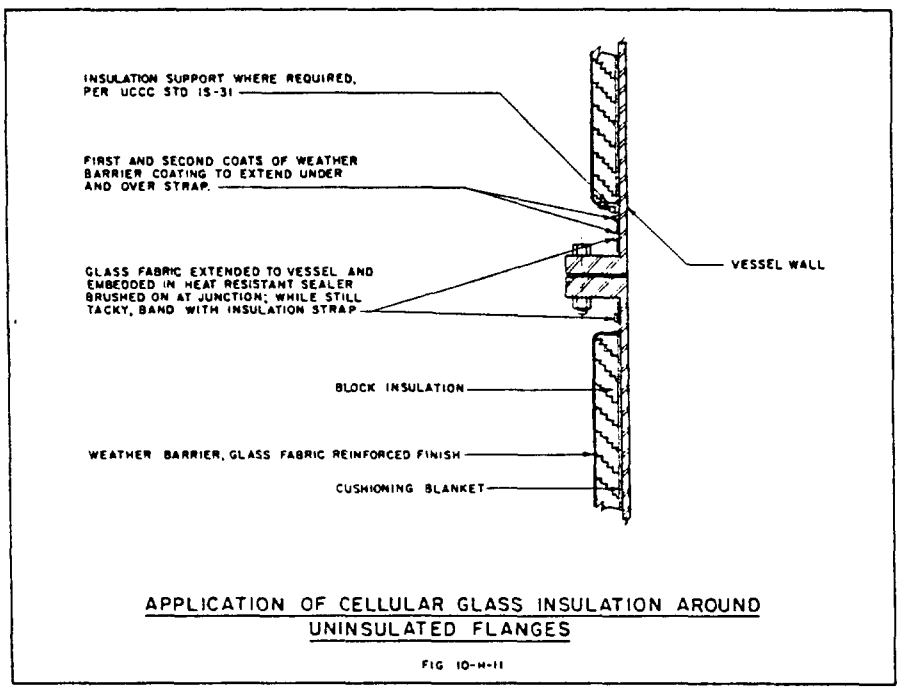
k. Weather-Barrier

(1) Weather-barrier coating shall be applied in accordance with the GENERAL SPECIFICATIONS, Parts I. B. 9 and 17.

(2) Weather-barrier consisting of sta[illegible]s steel jacketing, if required, shall be applied in accordance with the GENERAL SPECIFICATIONS, Part I. B. 18. Thi[illegible]equirement is indicated by the addition of the letter M to the specification designations, thus: 10-HM, 10-HSSM.

(3) Weather-barrier coating shall be completed and allowed to cure before the system is put in hot service.

(4) Weather-barrier membrane shall be carried out 3 inches onto any metal, beyond termination of insulation. Where operating temperatures are above 300 F, the portion of the weather-barrier in contact with metal shall consist of reinforcing cloth embedded in heat-resistant sealer instead of the weather-barrier coating. A second application of the heat-resistant sealer shall then be applied over the reinforcing cloth and, while still tacky, the weather-barrier membrane shall be secured with strap where practicable. Securement shall then be coated with heat-resistant sealer. Typical installation is shown in Figure 10-H-11.



APPLICATION OF CELLULAR GLASS INSULATION AROUND UNINSULATED FLANGES

FIG 10-H-11

2. Piping

a. Pipe Insulation

(1) Pipe insulation shall be supported as specified in the GENERAL SPECIFICATIONS, Part I. B. 5.

(2) Insulation in excess of 2-1/2 inches total thickness shall be applied in multiple layers, as specified in the GENERAL SPECIFICATIONS, Part I. B. 2.

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

(4) Piping operating at temperatures of 350 F and below, except stainless steel, shall have 1/2-inch thick preformed cushioning material applied before application of cellular glass insulation and secured with a minimum of four staples per 3-foot section. Piping, operating at temperatures above 350 F (except stainless steel), or where preformed cushioning material is not available, shall have 1-inch thick cushioning blanket secured with stainless steel wire and compressed to approximately 1/2-inch thickness, applied before application of cellular glass insulation. Cushioning material shall not be considered as part of the specified insulation thickness.

(5) All stainless steel piping shall have 1-inch thick white glass wool cushioning blanket, as specified for stainless steel, secured with stainless steel wire and compressed to approximately 1/2-inch thickness, applied before application of cellular glass insulation.

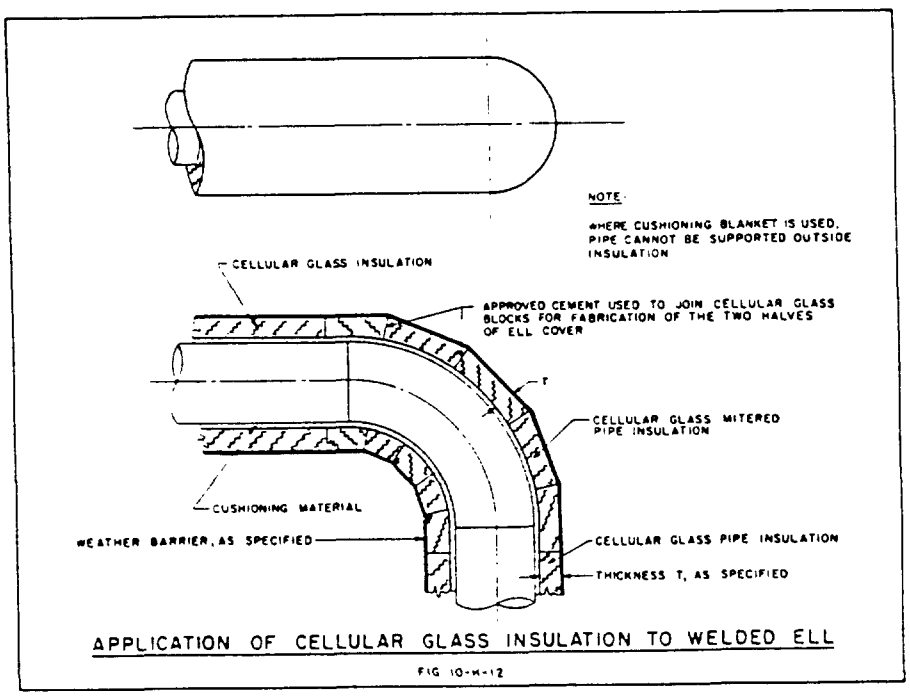
(6) Insulation shall be applied with all joints tightly butted and fitted, to eliminate voids. Large voids shall not be filled with weather-barrier coating, but eliminated by either refitting or replacing insulation. Any rounded corners on the insulation surfaces to be butted shall be trued before application.

(7) Butt edges and ends of all inner layers shall be given a smooth brush or spray coat of the specified anti-abrasion coating and allowed to dry for a minimum of 4 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.

b. Fitting, Flange, and Valve Covers

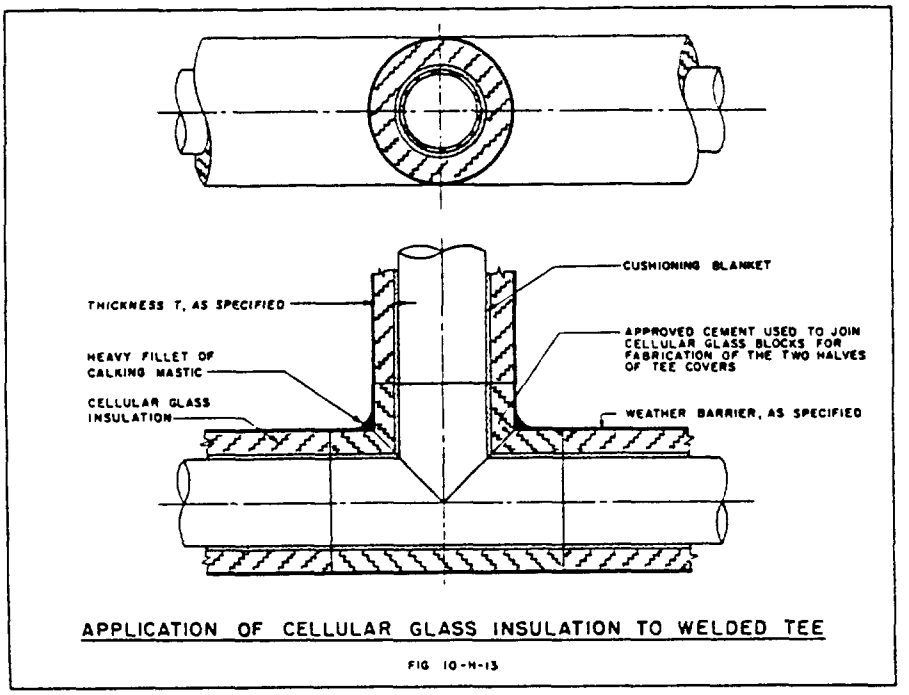
(1) Welded fitting covers shall be fabricated to an inside diameter 1 inch greater than the outside diameter of the welded fitting to allow for cushioning material.

(2) Fitting, flange, and valve covers shall be shop fabricated in accordance with the UCCC Dimensional Standards Fabrication Manual or ASTM Recommended Practice C 450, latest revision. Installations of typical fittings and valves are shown in Figures 10-H-12, 10-H-13, 10-H-14, 10-H-15, and 10-H-16.



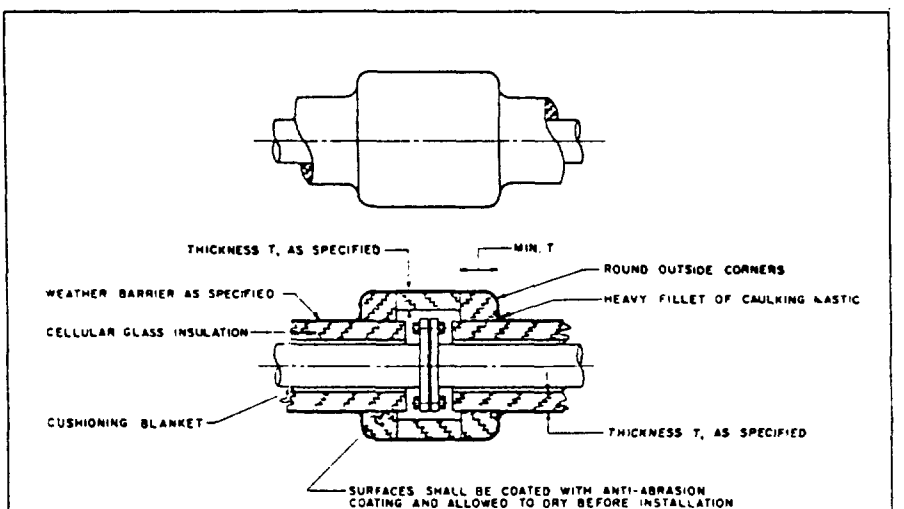
APPLICATION OF CELLULAR GLASS INSULATION TO WELDED ELL

FIG 10-H-12



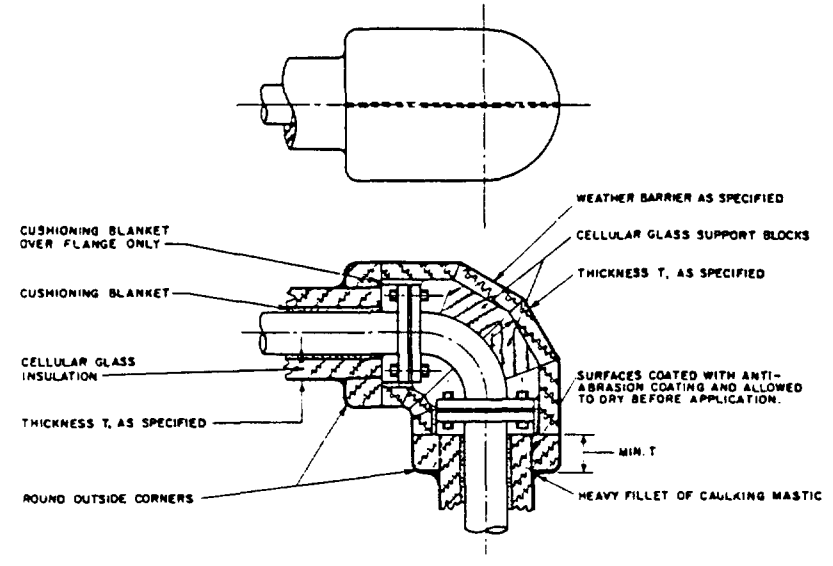
APPLICATION OF CELLULAR GLASS INSULATION TO WELDED TEE

FIG 10-H-13



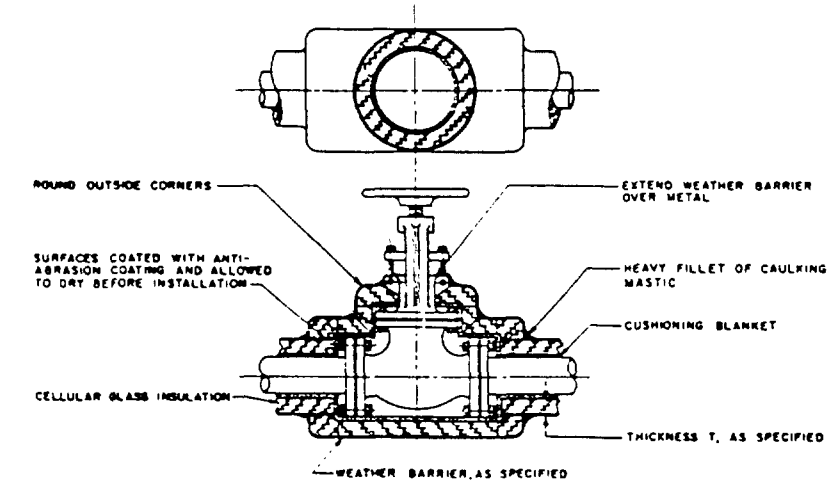
APPLICATION OF CELLULAR GLASS INSULATION TO LINE FLANGE

FIG. 10-H-14



APPLICATION OF CELLULAR GLASS INSULATION TO FLANGED ELL

FIG. 10-H-15



APPLICATION OF CELLULAR GLASS INSULATION TO FLANGED VALVE

FIG 10-H-16

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

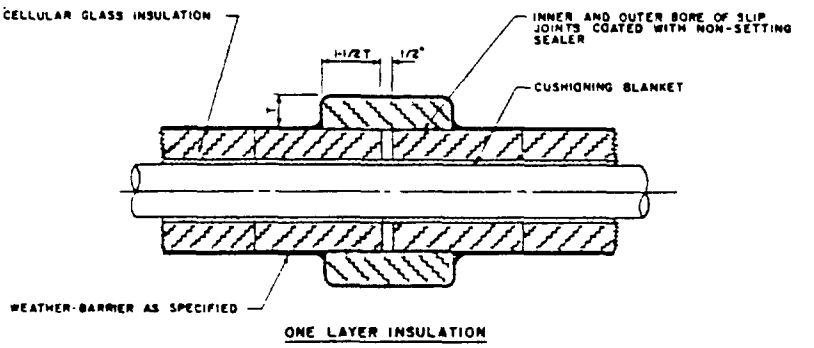
(4) Cementing of shop assemblies shall be done with specified fabricating cement. In all cases the joints shall be as thin as possible with just sufficient cement to obtain good adhesion and complete closure. In no case will wide cement joints, or voids and holes plugged with cement be permitted.

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:

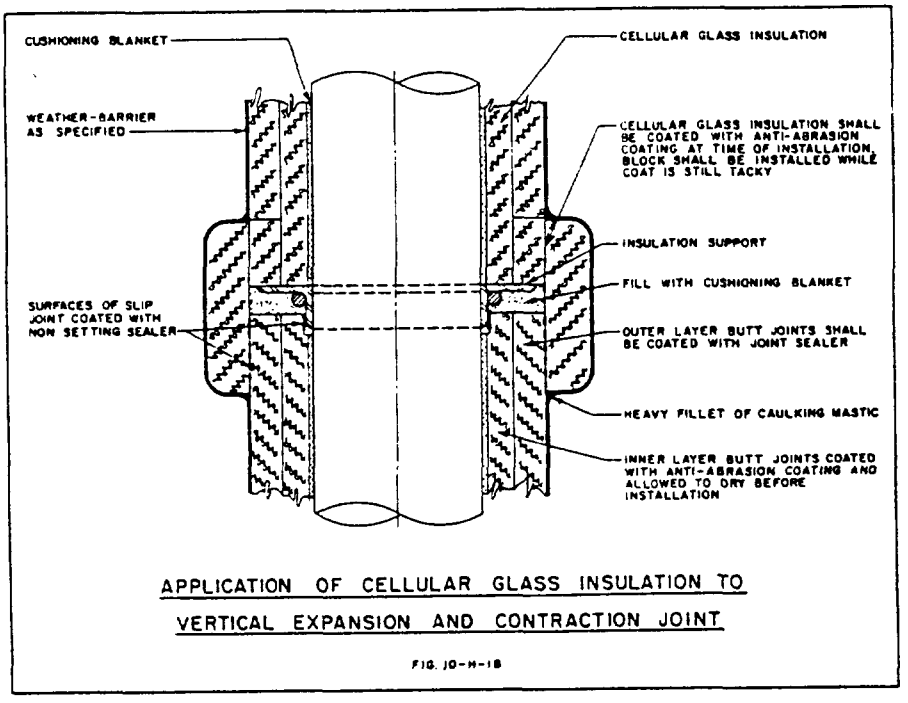
Up to 2-1/2-inch thick insulation - one for each 60 feet
3-inch to 5-inch thick insulation - one for each 45 feet
5-1/2-inch to 7-1/2 inch thick insulation - one for each 30 feet

(2) Where flanged fittings or valves occur within these units, expansion 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 & CONTRACTION JOINT IN HORIZONTAL PIPING

FIG 10-H-17



APPLICATION OF CELLULAR GLASS INSULATION TO VERTICAL EXPANSION AND CONTRACTION JOINT

FIG. 10-H-18

d. Securement

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

(2) Outer layers 4-1/2 inches and less in outside diameter shall be secured with strapping tape.

(3) Location of strap and tape shall be as described in the GENERAL SPECIFICATIONS, Part I. B. 6.

e. Weather-Barrier

(1) Weather-barrier coating shall be applied in accordance with the GENERAL SPECIFICATIONS, Part I. B. 17.

(2) Weather-barrier consisting of stainless steel jacketing, if required, shall be applied in accordance with the GENERAL SPECIFICATIONS, Part I. B. 18. This requirement is indicated by the addition of the letter M to the specification designations, thus: 10-HM, 10-HSSM.

(3) Weather-barrier coating shall be completed and allowed to cure before the system is put in hot service.

UNION CARBIDE CHEMICALS COMPANY
DEPARTMENT OF DESIGN AND CONSTRUCTION

THERMAL INSULATION SPECIFICATIONS

II. SPECIFICATION 10-J — Cellular Glass
10-JSS (For Stainless Steel)

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

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

A. MATERIAL

1. Composition

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

2. Properties

Cellular glass insulation shall have the following properties:

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

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

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

Combustibility . . . . . Shall be incombustible.

Compressive Strength . . . Shall be not less than 100 psi when tested in accordance with ASTM C 240, latest revision.

Density . . . . . Shall be not less than 8 lb per cu ft, nor more than 11 lb per cu ft, when tested in accordance with ASTM C 303, latest revision.

Flexural Strength . . . . . Shall be not less than 75 psi when tested in accordance with ASTM C 203, latest revision.

Hygroscopicity . . . . . Two-inch cubes dried at 220 F to constant weight, then exposed to air at 70 F and 90% relative humidity for 14 days, shall not gain any weight.

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

Shear Strength . . . . . Shall be not less than 65 psi.

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

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

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

Thermal Conductivity . . . When tested in accordance with ASTM C 177, latest revision, or ASTM C 335, latest revision, the thermal conductivity at the given mean temperatures shall not exceed the following values:

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

Thermal Diffusivity . . . . Shall average 0.42 sq ft per day.

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

Vapor Transmission . . . . When tested in accordance with ASTM C 355, latest revision, shall have a WVT of zero grains per sq ft per hour.

3. Accessory Materials

a. Stainless Steel Wire - 0.0475-inch diameter, Type 304, cold drawn, bright annealed, 18-gage.

b. Stainless Steel Insulation Strap - 1/2-inch by 0.020-inch, Type 304, or approved equal.

c. Stainless Steel Clips - Double-pronged, Type 304, A. J. Gerrard, Techalloy double-pronged seal, or approved equal.

d. Strapping Tape - Glass filament, vinyl-backed, Dutch Brand No. 400 or approved equal.

e. Strap Anchor Clip - A. J. Gerrard's strap hanger.

f. Pipe Insulation Support - Techalloy insulation support strap or approved equal.

g. Anti-Abrasion Coating - Dampney No. 70 Black.

h. Weather-Barrier Coating - (color as specified) - Vimasco WC-1, Pittsburgh-Corning Pittcote 500C, or approved equal.

i. Reinforcing Cloth - Glass fabric, 10 by 10 thread count, Perma-Glas Mesh, Glass Mesh 10s, Benjamin Foster Open Weave No. 10, or approved equal.

j. Adhesive Cement - Miracle Adhesive Type H or approved equal.

k. Fabricating Cement - Miracle Adhesive RT-1000P or approved equal.

l. Heat-Resistant Sealer - Benjamin Foster No. 30-43 or approved equal.

m. Glass Wool Meatl Mesh Blanket - White glass wool, expanded metal lath on one side - Fiberglas Metal Mesh Blanket TWL Style 1, or approved equal.

n. Insulating Cement - Hydraulic setting - Baldwin-Ehret-Hill Powerhouse, Eagle-Picher One Coat, Detrick Utility, or approved equal.

B. APPLICATION

1. Equipment

a. Insulation Supports

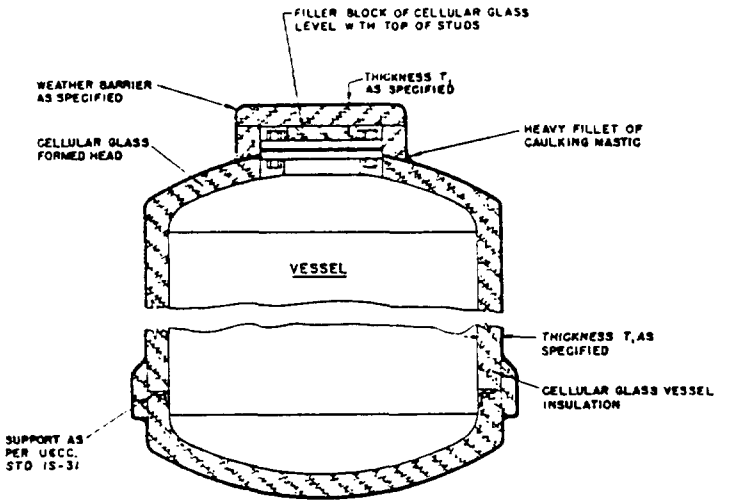
Equipment shall be provided with insulation supports as called for in the GENERAL SPECIFICATIONS, Part I. B. 5.

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 the GENERAL SPECIFICATIONS, Part I. B. 2.

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.



APPLICATION OF CELLULAR GLASS INSULATION TO VESSEL HEAD & NOZZLE

FIG. 10-J-1

(2) Inner surface of vessel insulation shall be coated with the specified anti-abrasion coating, of just sufficient thickness to fill half cells, and allowed to dry before installation.

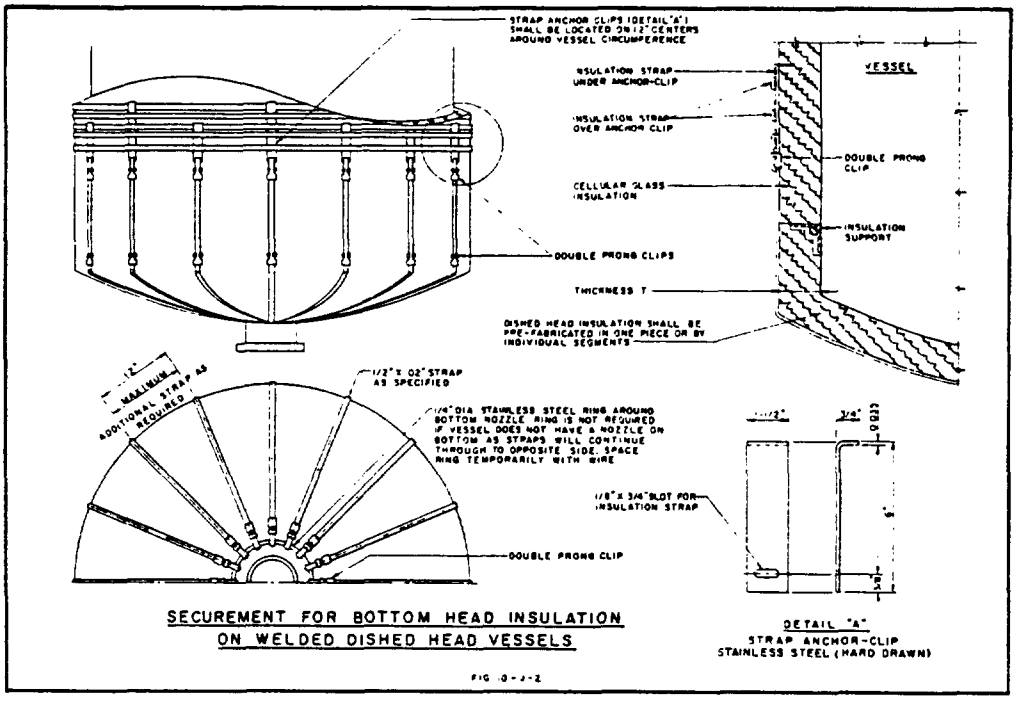
d. Flat Surfaces

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

e. Securement

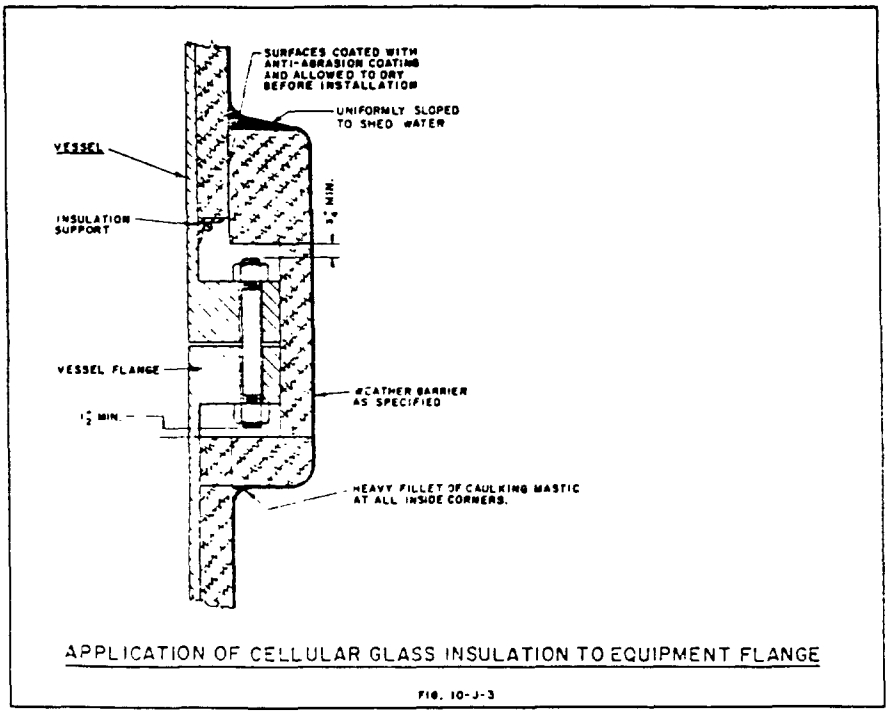
(1) Where contour of vessel permits firm and effective attachment, all layers of cellular glass insulation shall be secured in place with stainless steel insulation strap. Insulation applied to irregular surfaces, where use of insulation strap is impracticable, shall be secured with stainless steel wire.

(2) Inner layer or layers of cellular glass insulation on bottom heads of vertical equipment, or heads of horizontal equipment, shall be held in place with stainless steel wire secured to support as shown in UCCC Standards IS-31, IS-36, and IS-42. 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-J-2.

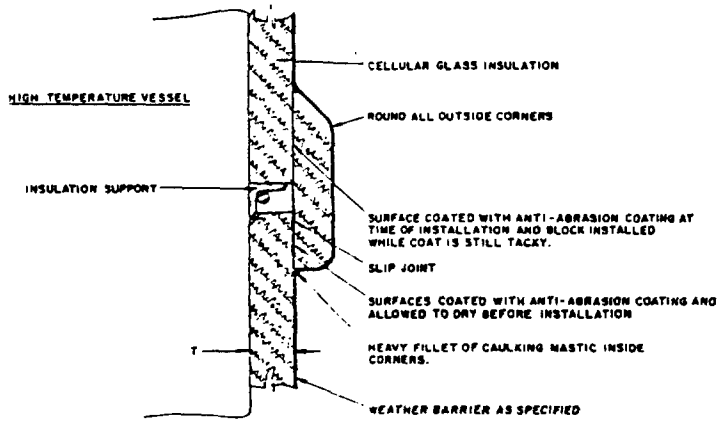


f. Expansion Joints

(1) Cellular glass applications shall be provided with expansion joints at vessel flanges, constructed as shown in Figure 10-J-3.



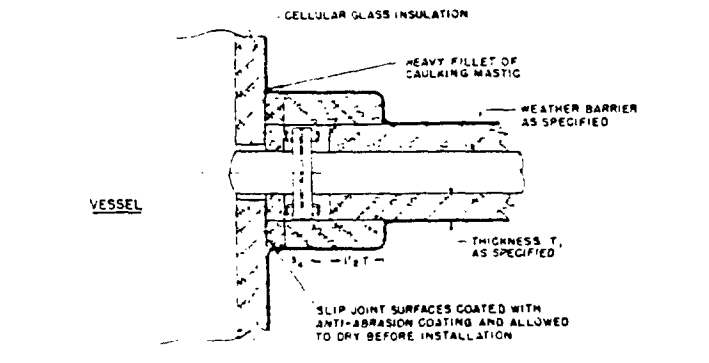
(2) Longitudinal expansion of vessels shall be provided for by installing expansion joints at the insulation supports as shown in Figure 10-J-4. When more than one thickness is specified for a vessel, an insulation support shall be provided at the junction of two different thicknesses and insulated in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



APPLICATION OF CELLULAR GLASS INSULATION TO EXPANSION JOINT

FIG 10-J-4

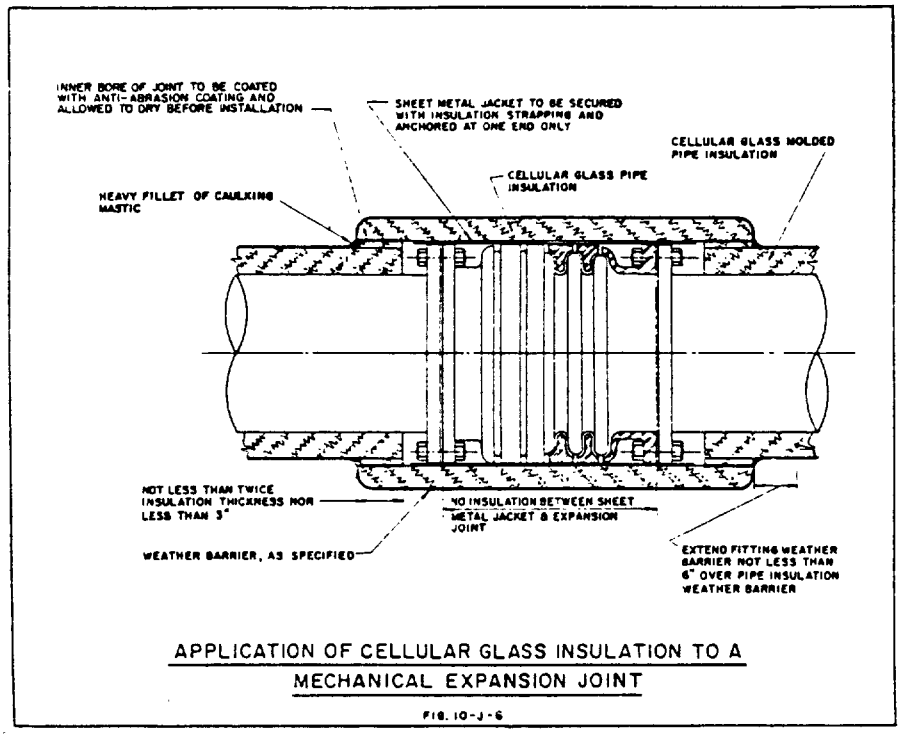
(3) Where nozzles and projections extend through the insulation, they shall be insulated as shown in Figure 10-J-5.



APPLICATION OF CELLULAR GLASS INSULATION TO NOZZLE

FIG 10-J-5

(4) Corrugated mechanical expansion joints on piping (usually listed as equipment item) where cellular glass products are specified shall be insulated as shown in Figure 10-J-6.

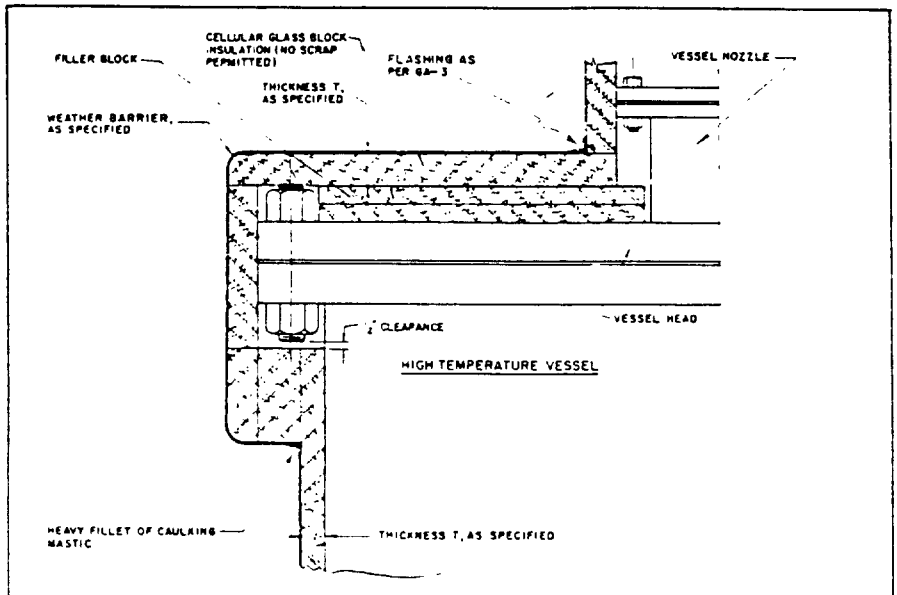


APPLICATION OF CELLULAR GLASS INSULATION TO A MECHANICAL EXPANSION JOINT

FIG. 10-J-6

g. 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-J-7.



APPLICATION OF CELLULAR GLASS INSULATION TO FLAT EQUIPMENT HEAD

FIG 10-J-7

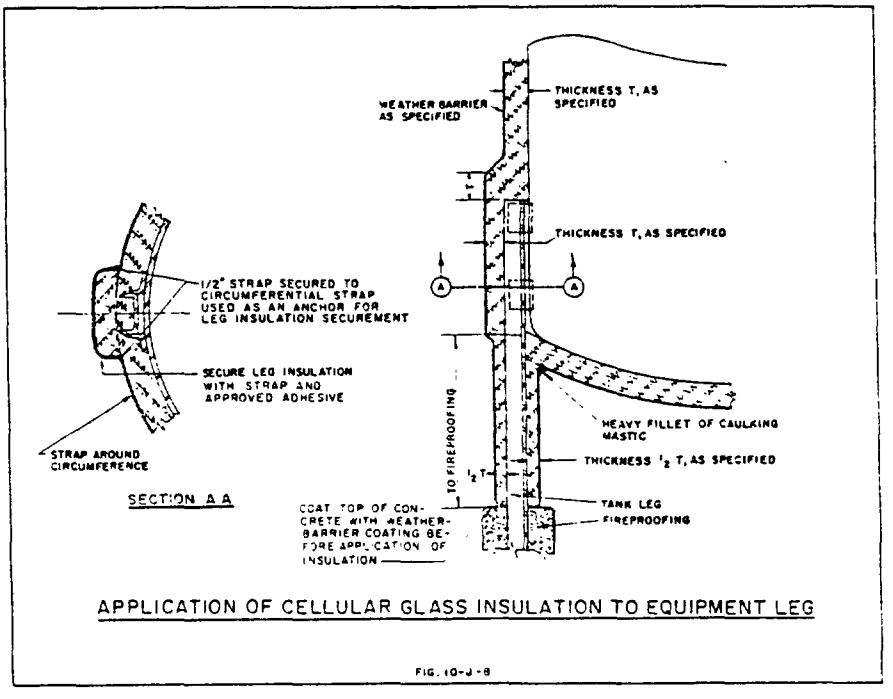
II. B. 1. g. contd

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

h. Vessel Legs

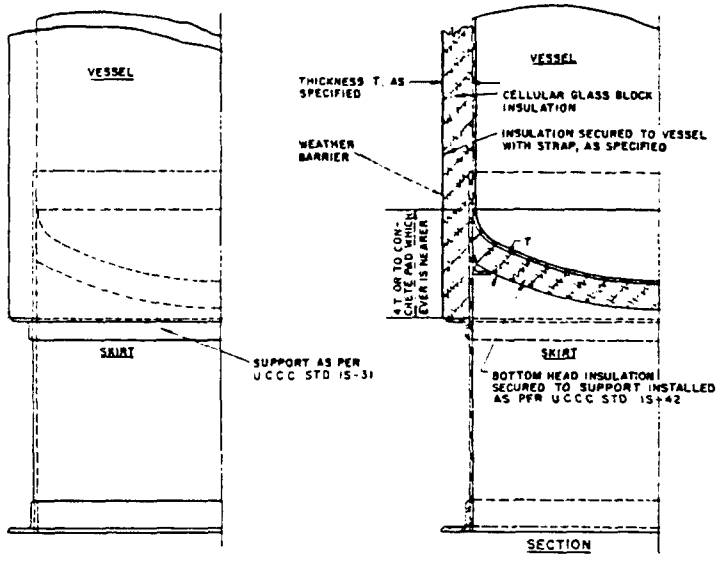
(1) Vessel legs shall be insulated with block which shall extend over channel flanges and down channel legs to junction with any fire resistant material. Thickness shall be 1/2 that specified for body of vessel. Body insulation shall be brought up to and butted firmly against tank leg flange.

(2) Re-entrant space between channel flanges and over channel flanges between body insulation shall be filled with block cemented in place with the specified 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.



i. Vessel Skirts

Skirts supporting vertical equipment shall be insulated outside. Insulation shall extend downward, fr junction of skirt with bottom head, a distance of not less than four times the specified thickness or to co crete pad, whichever is nearer. Where specified, entire surface of skirt shall be insulated. Thickne shall be as specified for body of vessel. An insulation support shall be provided for securement of botto head insulation in accordance with UCCC Standard IS-42. Installation shall be as shown in Figure 10-J-



APPLICATION OF CELLULAR GLASS INSULATION TO EQUIPMENT SKIRT

FIG. 10-J-9

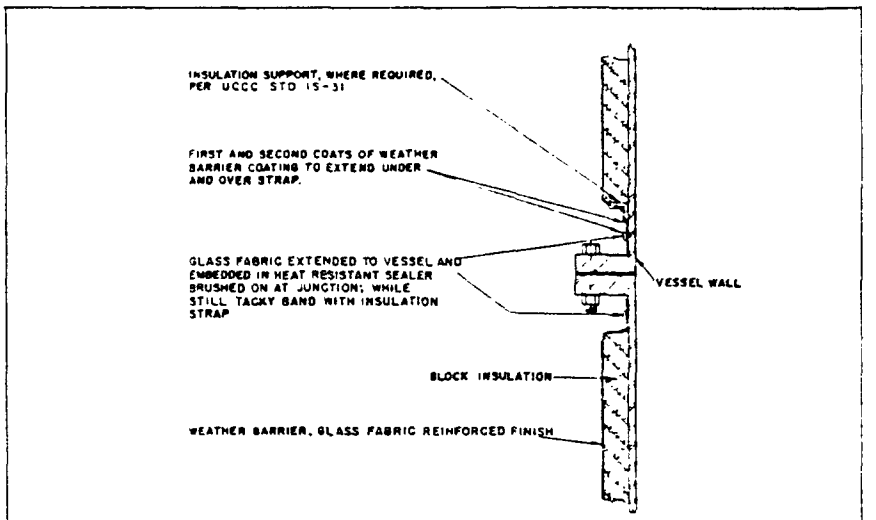
j. Weather-Barrier

(1) Weather-barrier coating shall be applied as specified in the GENERAL SPECIFICATIONS, Parts I. B. 9. and 17.

(2) Weather-barrier consisting of stainless steel jacketing, if required, shall be applied as specified in the GENERAL SPECIFICATIONS, Part I. B. 18. This requirement is indicated by the addition of the letter M to the specification designations, thus: 10-JM, 10-JSSM.

(3) Weather-barrier coating shall be completed and allowed to cure before the system is put in hot service.

(4) Weather-barrier membrane shall be carried out 3 inches onto any metal, beyond termination of insulation. Where operating temperatures are above 300 F, the portion of the weather-barrier in contact with metal shall consist of reinforcing cloth embedded in heat-resistant sealer instead of the weather-coating. A second application of the heat-resistant sealer shall then be applied over the reinforcing cloth and, while still tacky, the weather-barrier membrane shall be secured with strap where practicable. Securement shall then be coated with heat-resistant sealer. Typical installation is shown in Figure 10-J-10.



APPLICATION OF CELLULAR GLASS INSULATION AROUND UNINSULATED FLANGES

FIG 10-J-10

2. Piping

a. Pipe Insulation

(1) Pipe insulation shall be supported as specified in the GENERAL SPECIFICATIONS, Part I. B. 5.

(2) Insulation thicknesses in excess of 2-1/2 inches shall be applied in multiple layers as specified in the GENERAL SPECIFICATIONS, Part I. B. 2.

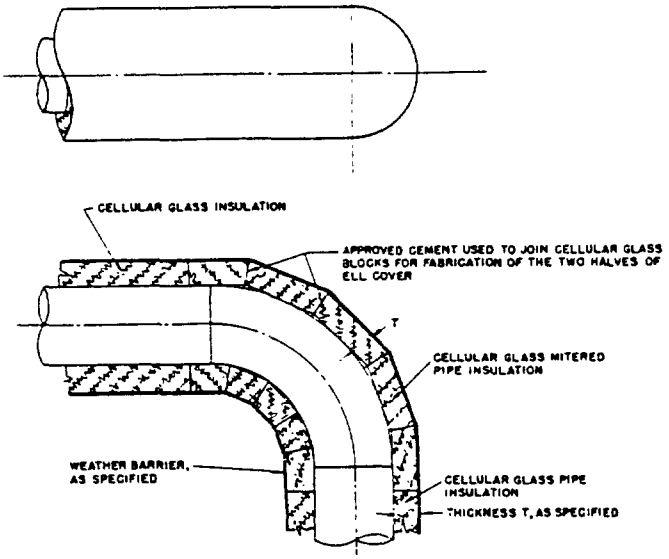
(3) Pipe insulation shall be applied to piping in a staggered position in accordance with Figures GA-1 and GA-2 of the GENERAL SPECIFICATIONS.

(4) Insulation shall be applied with all joints tightly butted and fitted, to eliminate voids. Large voids shall not be filled with weather-barrier coating, but eliminated either by refitting 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 the specified anti-abrasion coating and allowed to dry for a minimum of 4 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.

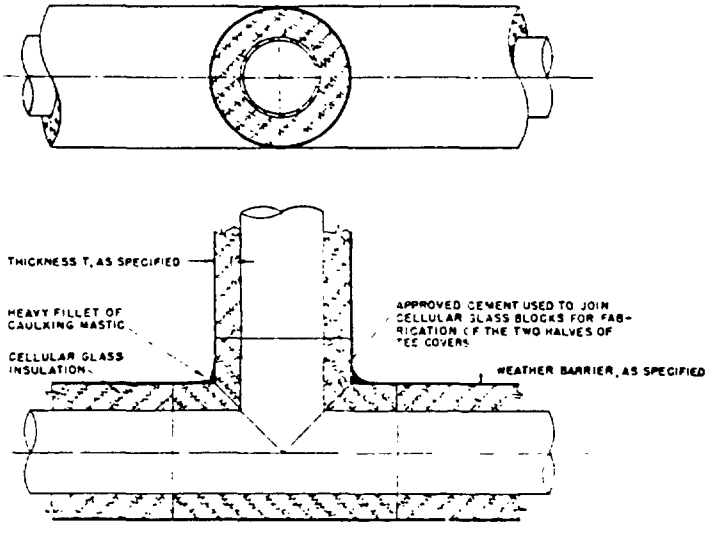
b. Fitting, Flange, and Valve Covers

(1) Fitting, flange, and valve covers shall be shop fabricated in accordance with the UCCC Dimensional Standards Fabrication Manual or ASTM Recommended Practice C 450, latest revision. Installation of typical fittings and valves is shown in Figures 10-J-11, 10-J-12, 10-J-13, 10-J-14, and 10-J-15.



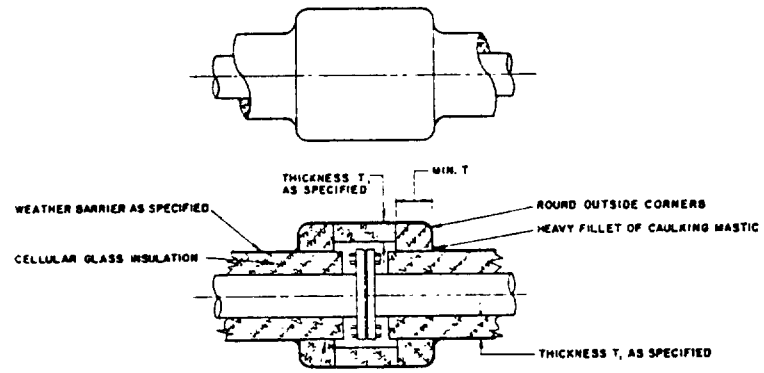
APPLICATION OF CELLULAR GLASS INSULATION TO WELDED ELL

FIG. 10-J-11



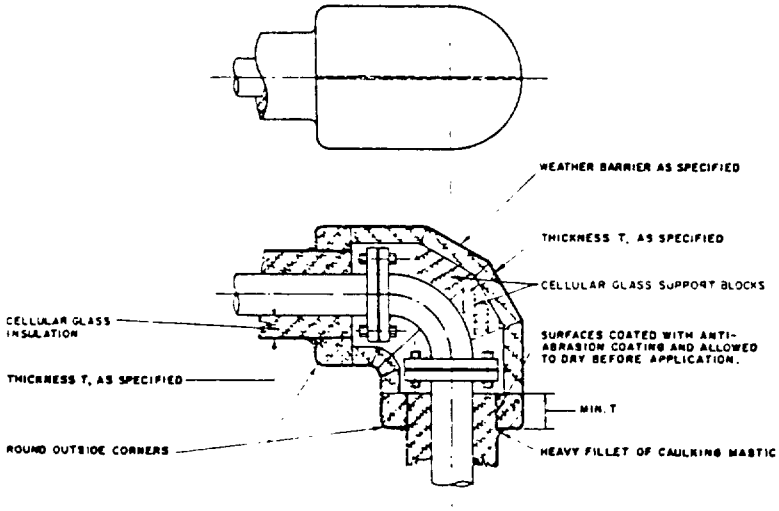
APPLICATION OF CELLULAR GLASS INSULATION TO WELDED TEE

FIG 10-J-12



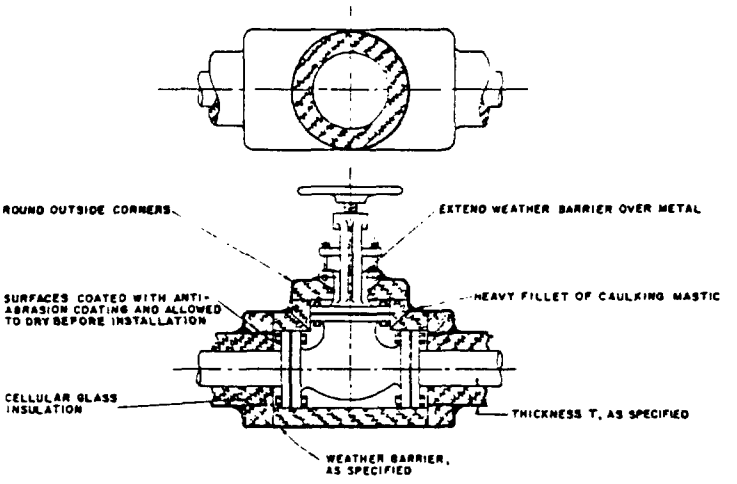
APPLICATION OF CELLULAR GLASS INSULATION TO LINE FLANGE

FIG. 10-J-13



APPLICATION OF CELLULAR GLASS INSULATION TO FLANGED ELL

FIG. 10-J-14



APPLICATION OF CELLULAR GLASS INSULATION TO FLANGED VALVE

FIG. 10-J-15

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

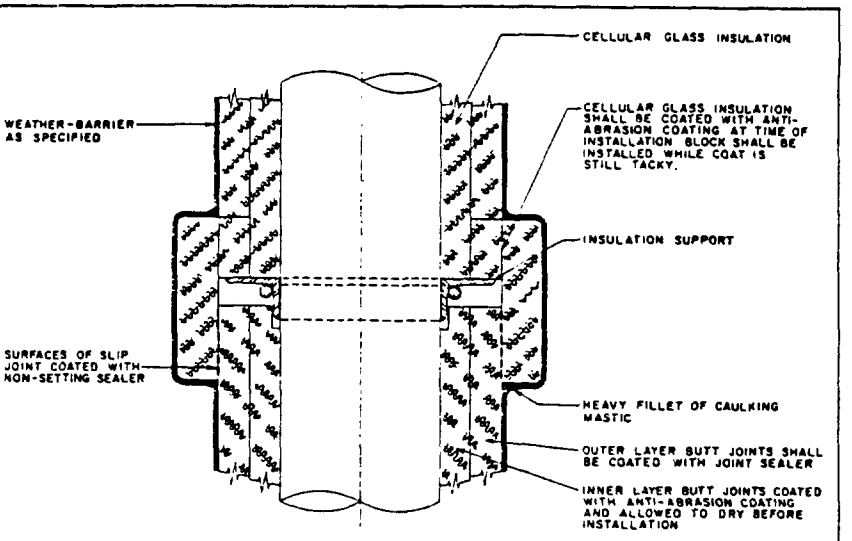
(3) Cementing of shop assemblies shall be done with specified fabricating cement. In all cases the joints shall be as thin as possible with just sufficient cement to obtain good adhesion and complete closure. In no case will wide cement joints, or voids and holes plugged with cement, be permitted.

c. Expansion and Contraction Joints

(1) Expansion and contraction joints shall be installed as shown in Figure 10-J-16 or 17, in both horizontal and vertical straight run piping, at intervals as follows:

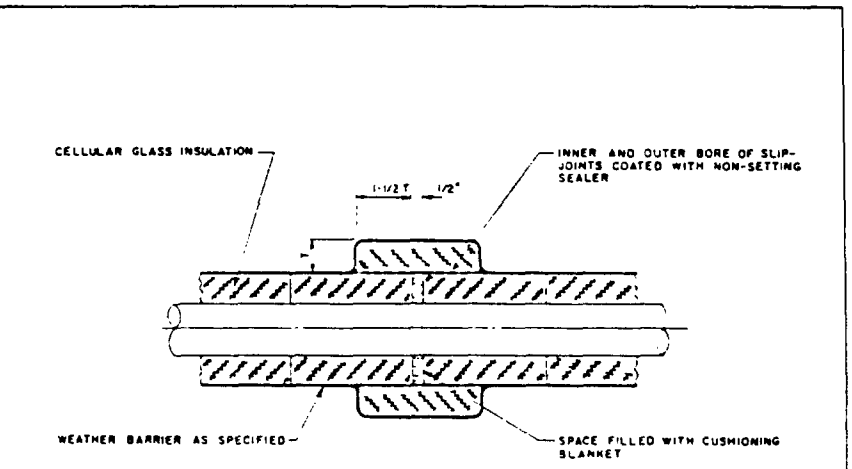
Up to 2 1/2-inch thick insulation-one for each 60 feet
3-inch to 5-inch thick insulation - one for each 45 feet
5-1/2 inch to 7-1/2 inch thick insulation - one for each 30 feet

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



APPLICATION OF CELLULAR GLASS INSULATION
TO VERTICAL EXPANSION AND CONTRACTION JOINT

FIG. 10-J-17



APPLICATION OF CELLULAR GLASS INSULATION TO EXPANSION
AND CONTRACTION JOINT IN HORIZONTAL PIPING

FIG 10-J-16

II. B. 2. contd

d. Securement

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

(2) Outer layers 4-1/2 inches and less in outside diameter shall be secured with strapping tape.

(3) Location of strap and tape shall be as described in the GENERAL SPECIFICATIONS, Part I. B. 6.

II. SPECIFICATION 10-L — Cellular Glass
10-LSS (For Stainless Steel)

Scope

This Specification describes the essential requirements for the purchase and application of preformed cellular glass thermal insulation, for use on equipment and piping normally operating at temperatures below 70 F, and including cycle operating and thawout service up to 400 F. It is applicable to both indoor and outdoor service.

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

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

A. MATERIAL

1. Composition

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

2. Properties

Cellular glass insulation shall have the following properties:

Alkalinity	pH shall be between 6.9 and 7.5.
Capillarity	After 7 days on wet surface, gain in weight shall be 0%.
Coefficient of Expansion	Shall average 4.6×10^{-6} per degree F.
Combustibility	Shall be incombustible.
Compressive Strength	Shall be not less than 100 psi when tested in accordance with ASTM C 240, latest revision.
Density	Shall be not less than 8 lb per cu ft, nor more than 11 lb per cu ft, when tested in accordance with ASTM C 303, latest revision.
Flexural Strength	Shall be not less than 75 psi when tested in accordance with ASTM C 203, latest revision.
Hygroscopicity	Two-inch cubes dried at 220 F to constant weight, then exposed to air at 70 F and 90% relative humidity for 14 days, shall not gain any weight.
Resistance to Acids	Shall be impervious to common acids and fumes except hydrofluoric and hot phosphoric.
Shear Strength	Shall be not less than 65 psi.
Specific Heat	Shall average 0.20 Btu per lb per degree F.
Temperature Limit	Maximum temperature without mechanical, thermal, or chemical failure shall be not less than 800F.
Tensile Strength	Shall be not less than 75 psi.
Thermal Conductivity	When tested in accordance with ASTM C 177, latest revision, or ASTM C 335, latest revision, the thermal conductivity at the given mean temperatures shall not exceed the following values.

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

Thermal Diffusivity	Shall average 0.42 sq ft per day.

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

Vapor Transmission . . . When tested in accordance with ASTM C 355, latest revision shall have a WVT of zero grains per sq ft per hour.

3. Accessory Materials - Specification 10-L

a. Cushioning Blanket - 3-lb density, Fine Fyber Felt, Ultralite, Superfine, or approved equal, 1/2 inch thick.

b. Glass Wool Blanket - TWL Fiberglas glass wool blanket 1 inch thick.

c. Stainless Steel Wire - 0.0475-inch diameter, Type 304, cold drawn, bright annealed, 18 gage, steel wire.

d. Stainless Steel Insulation Strap - 1/2-inch by 0.020-inch, Type 304, or approved equal.

e. Stainless Steel Clips - Double-pronged, Type 304, A. J. Gerrard, Techalloy double-pronged seal, or approved equal.

f. Strapping Tape - Glass filament, vinyl-backed, Dutch Brand No. 400 or approved equal.

g. Strap Anchor Clip - A. J. Gerrard's strap hanger.

h. Pipe Insulation Support - Techalloy insulation support strap or approved equal.

i. Anti-Abrasion Coating - Dampney No. 70 Black.

j. Vinyl Asphalt Joint Sealer - Vimasco 49 or approved equal.

k. Weather-Barrier Coating (Color as specified) - PVA - Vimasco No. WC-1, Pittsburgh-Corning Pittcote 500 C, or approved equal.

l. Reinforcing Cloth - Glass fabric, 10 by 10 thread count, Perma-Glas Mesh, Glass Mesh 10S, Benjamin Foster Open Weave No. 10, or approved equal.

m. Adhesive Cement - Miracle Adhesive Type H or approved equal.

n. Caulking Mastic - Vimasco Caulking Compound or approved equal.

o. Fabricating Cement - Hot (180 F) Asphalt or approved equal.

p. Prefabricated Vegetable Cork - 16 to 20 lb per cu ft - National Cork, Mundet, or approved equal.

q. Non-setting Sealer - Benjamin Foster 30-94 or approved equal.

4. Accessory Materials - Specification 10L-SS

Accessory materials for Specification 10L-SS shall be the same as those listed in Part II. A. 3, with the following exceptions:

Cushioning Blanket and Glass Wool Blanket - 2-1/2 lb per cu ft density TWL Fiberglas or approved equal white glass wool blanket 1 inch thick.

Joint Sealer - Dampney No. 70 Black.

B. APPLICATION - SPECIFICATIONS 10-L and 10-LSS

1. Equipment

a. Insulation Supports

Equipment shall be provided with insulation supports as specified in the GENERAL SPECIFICATIONS, Part I. B. 5.

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 the GENERAL SPECIFICATIONS, Part I. B. 2.

c. Cushioning Blanket

(1) On all equipment operating below 350 F, except stainless steel, a 1/2-inch thick cushioning blanket shall be applied over the entire surface as a cushioning material before application of the cellular glass insulation. Blanket shall be held in place with a minimum amount of stainless steel wire. Cellular glass insulation shall then be applied over the blanket in the manner described in this Specification. Cushioning material shall not be considered as part of the specified insulation thickness.

(2) On all equipment which has a top operating temperature above 350 F, except stainless steel, a 1-inch thick glass wool cushioning blanket shall be applied over the entire surface, compressed to 1/2-inch thickness, and secured in the same manner as that called for in Part II. B. 1. c. (1).

(3) On all stainless steel equipment, a 1-inch thick white glass wool cushioning blanket, as specified for stainless steel, shall be applied over the entire surface, compressed to 1/2-inch thickness, and secured in the same manner as that called for in Part II. B. 1. c. (1).

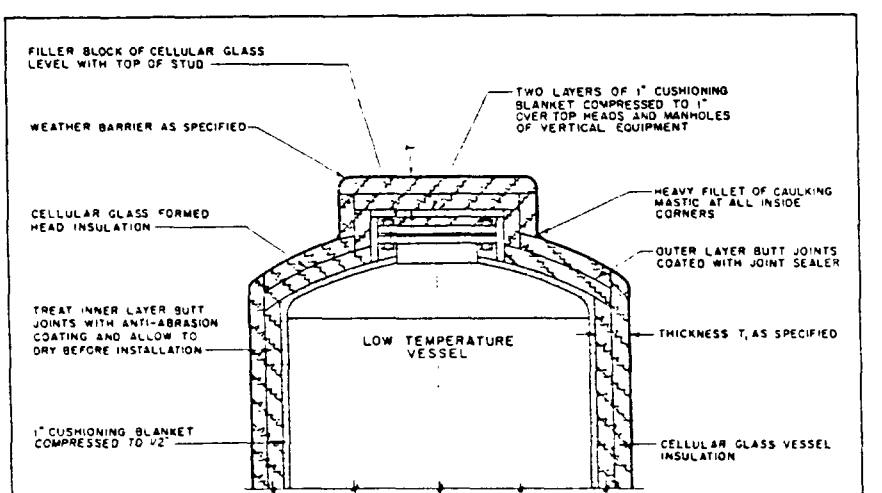
d. Curved Surfaces

(1) Cellular glass block insulation shall be shop fabricated and fitted to allow a 1/2-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 layer.

(2) All butt edges and ends of insulation fabricated for inner layer or layers shall be given a smooth brush or spray coat of the specified anti-abrasion coating and allowed to dry for a minimum of 4 hours before application of insulation to equipment.

(3) On stainless steel equipment, all butt edges and ends of insulation fabricated for inner layer or layers shall be given a smooth coat of anti-abrasion coating in the same manner as that called for in Part II. B. 1. d. (2).

(4) 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-L-1.



APPLICATION OF CELLULAR GLASS INSULATION TO VESSEL HEAD AND NOZZLE

FIG 10-L-1

e. Flat Surfaces

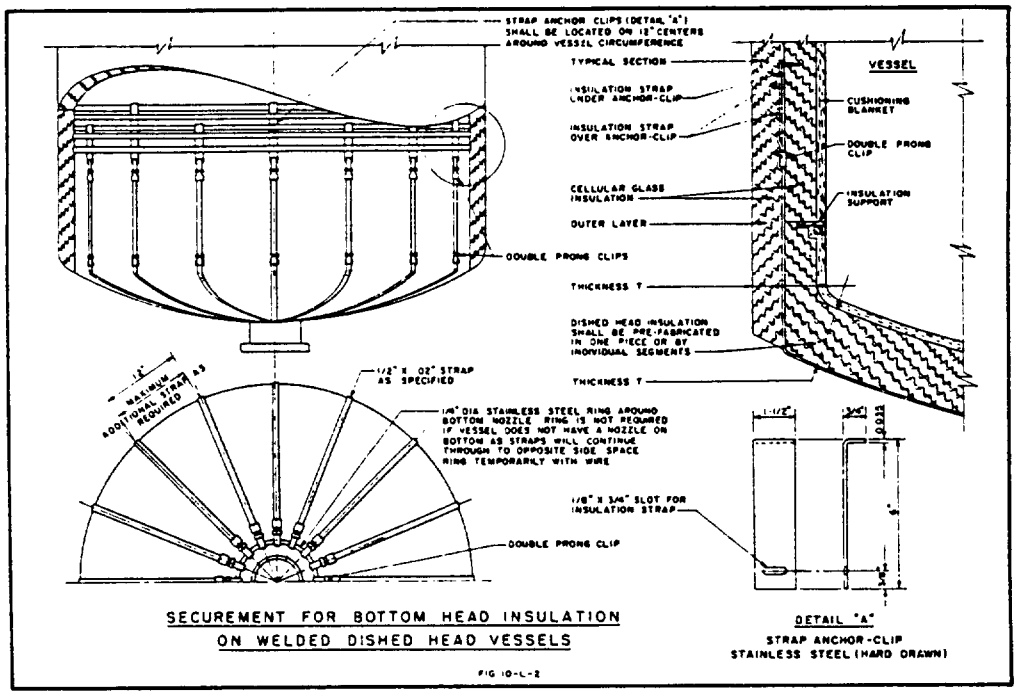
Block shall be applied to flat surfaces in the same manner as specified for curved surfaces, except where it is specified to be applied directly to metal surfaces with adhesive or other approved securement.

f. 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. Insulation applied to irregular surfaces, where use of insulation strap is impracticable, shall be secured with stainless steel wire.

(2) Inner layer or layers of cellular glass insulation on bottom heads of vertical equipment, or heads of horizontal equipment, shall be held in place with specified stainless steel strap secured to insulation supports, as shown in UCCC Standards IS-31, IS-36, and IS-42. Outer layer of cellular glass insula-

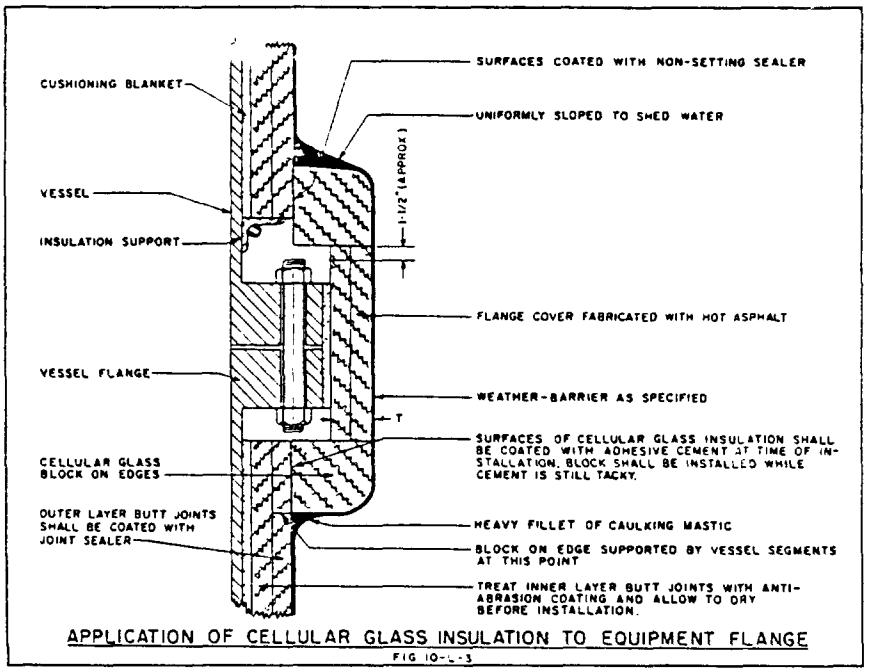
tion on bottom heads of vertical equipment, or heads of horizontal equipment, shall be secured with insulation strap, as shown in Figure 10-L-2.



(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.

g. Expansion Joints

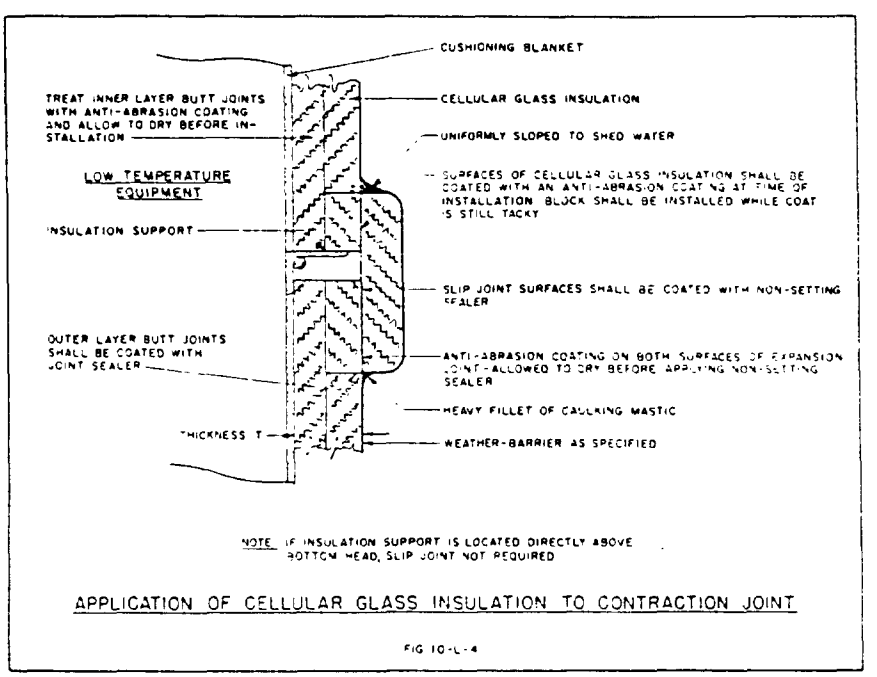
(1) Cellular glass applications shall be provided with expansion-contraction joints at vessel flanges, constructed as shown in Figure 10-L-3. Where movement is likely to occur, non-setting sealer shall be applied to surfaces of insulation, as shown, to provide proper slip joint.



APPLICATION OF CELLULAR GLASS INSULATION TO EQUIPMENT FLANGE

FIG 10-L-3

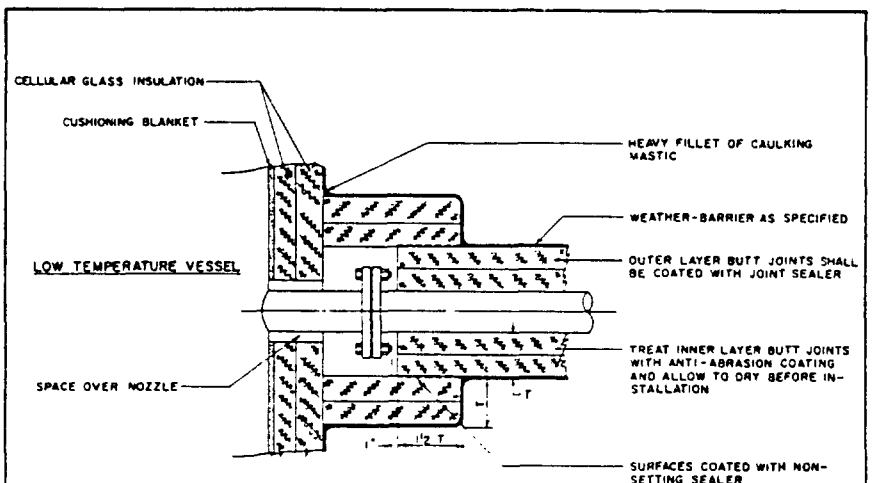
(2) Longitudinal contraction of vessels shall be provided for by installing expansion-contraction joints at the insulation supports, as shown in Figure 10-L-4. Where more than one thickness of insulation is specified for a vessel, an insulation support shall be provided at the junction of two different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



APPLICATION OF CELLULAR GLASS INSULATION TO CONTRACTION JOINT

FIG 10-L-4

(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.

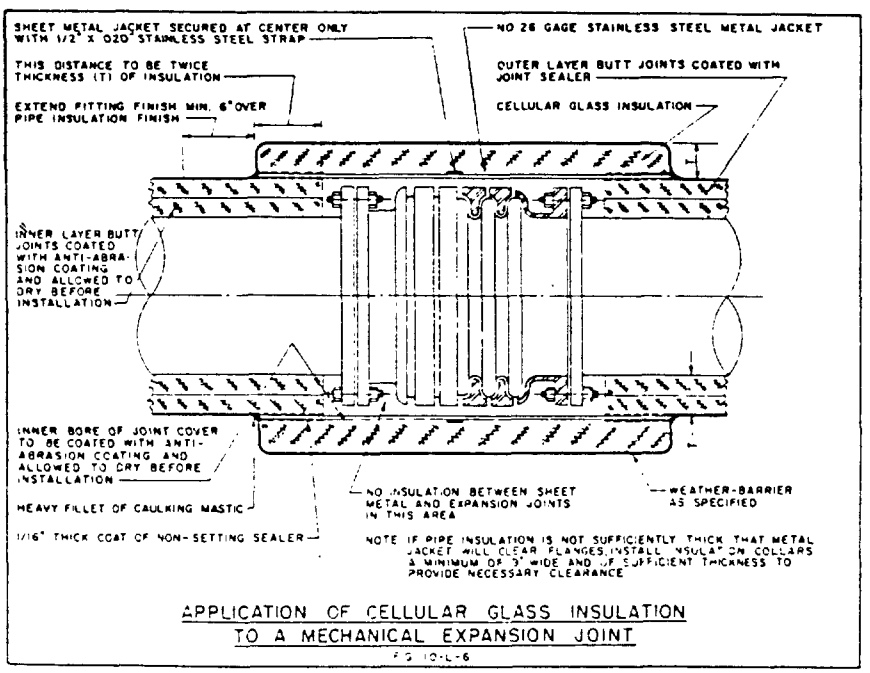


APPLICATION OF CELLULAR GLASS INSULATION TO NOZZLE

FIG. 10-L-5

h. Mechanical Expansion Joints

Corrugated mechanical expansion joints in piping (usually listed as equipment items) shall be insulated as shown in Figure 10-L-6. Where movement is likely to occur, non-setting sealer shall be applied to surfaces of insulation to provide proper slip joint.



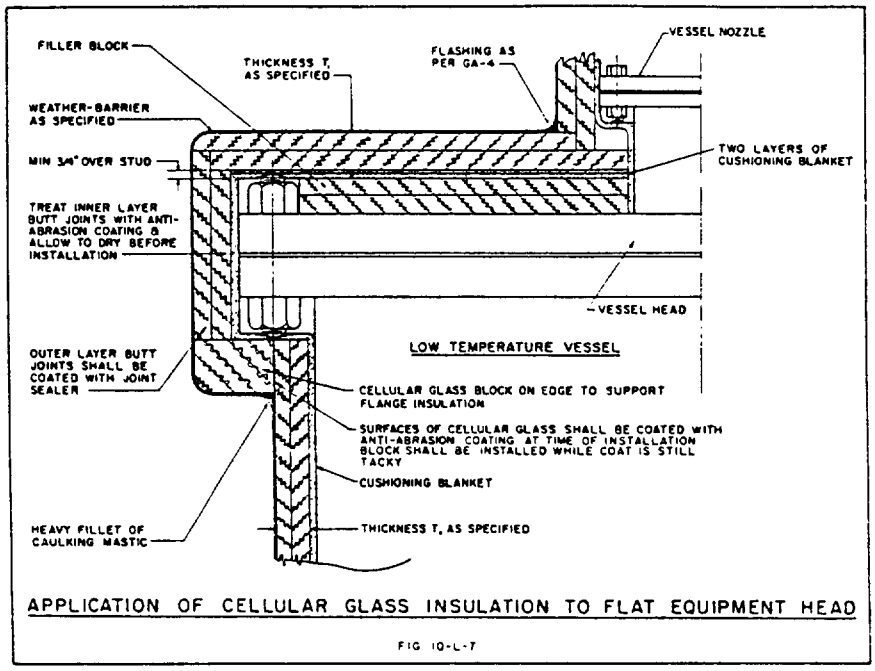
APPLICATION OF CELLULAR GLASS INSULATION TO A MECHANICAL EXPANSION JOINT

FIG. 10-L-6

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-L-7.

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



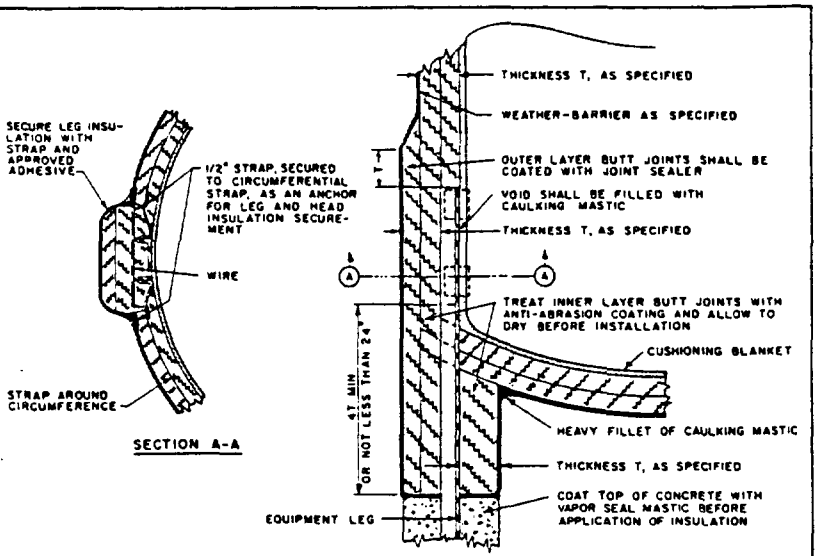
APPLICATION OF CELLULAR GLASS INSULATION TO FLAT EQUIPMENT HEAD

FIG 10-L-7

j. Vessel Legs

(1) Vessel legs shall be insulated with block which shall extend over channel flanges and down channe to the junction with any fire-resistant material, or a distance of four times insulation thickness not less than 24 inches. Thickness shall be as specified for body of vessel but not less than 2 : Body insulation shall be butted firmly against tank leg flange.

(2) Re-entrant space between channel flanges shall be filled with block cemented in place with the sa adhesive cement. Surface of fire-resistant material abutting tank leg insulation shall be coated weather-barrier coating. Installation shall be as shown in Figure 10-L-8.

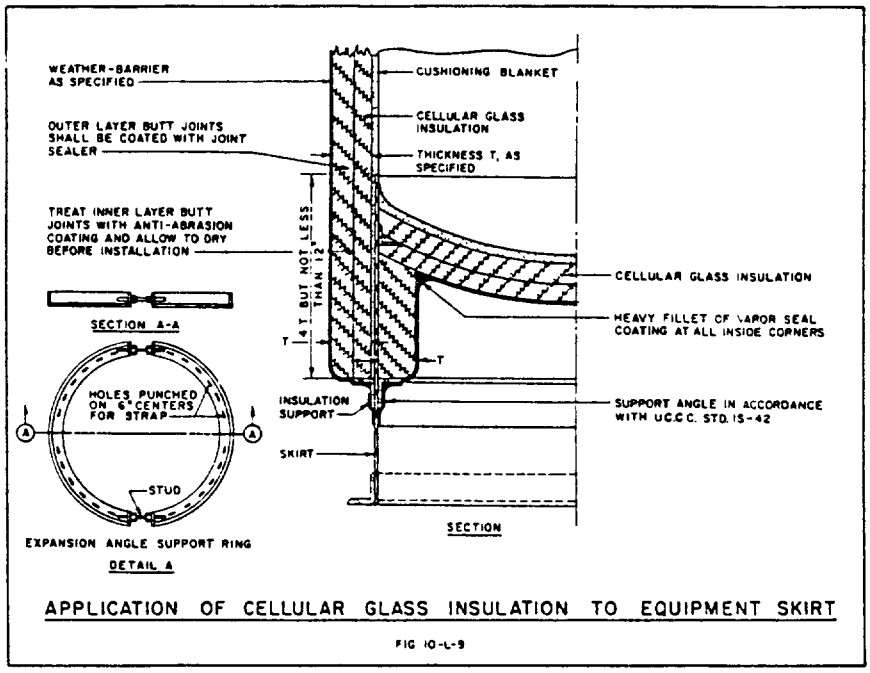


APPLICATION OF CELLULAR GLASS INSULATION TO EQUIPMENT LEG

FIG. 10-L-8

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. Insulating material shall be secured to inside of skirt with adhesive cement. Support for inside skirt insulation and bottom head insulation shall be in accordance with UCCC Standard IS-42. Installation shall be as shown in Figure 10-L-9.

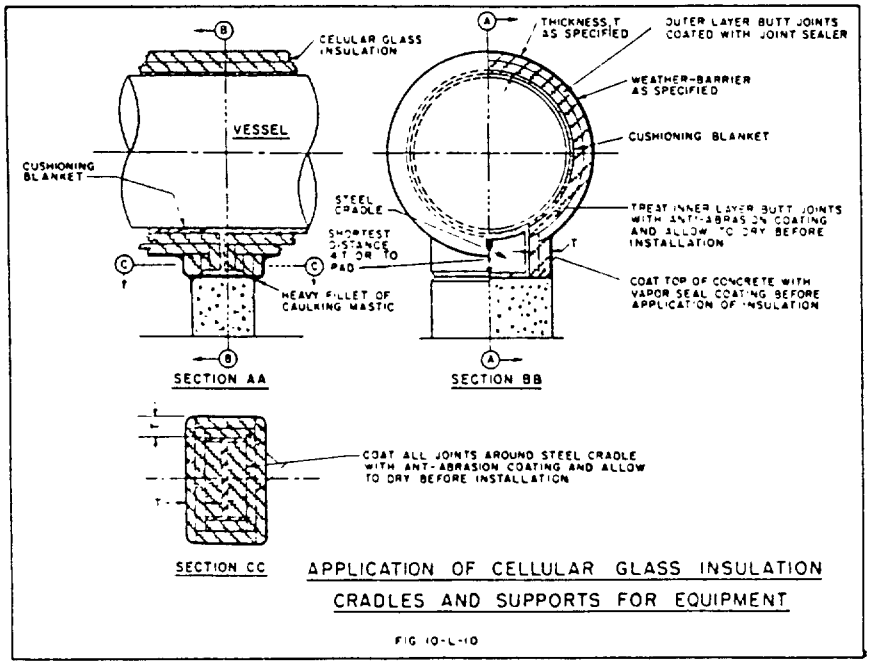


APPLICATION OF CELLULAR GLASS INSULATION TO EQUIPMENT SKIRT

FIG 10-L-9

1. Equipment Supports

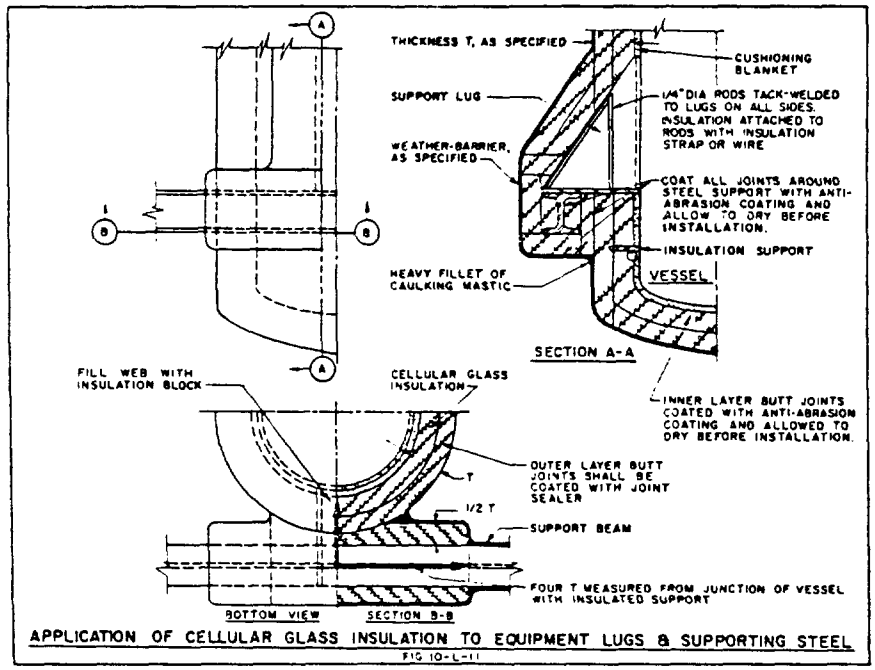
(1) Where equipment is supported on cradles, vessel insulation shall extend over cradles as shown in Figure 10-L-10.



APPLICATION OF CELLULAR GLASS INSULATION CRADLES AND SUPPORTS FOR EQUIPMENT

FIG 10-L-10

(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-11.



APPLICATION OF CELLULAR GLASS INSULATION TO EQUIPMENT LUGS & SUPPORTING STEEL

FIG 10-L-11

m. Weather-Barrier

(1) Weather-barrier coating shall be applied in accordance with the GENERAL SPECIFICATIONS, Parts I. B. 9. and 17.

(2) Weather-barrier consisting of stainless steel jacketing, if required, shall be applied in accordance with the GENERAL SPECIFICATIONS, Part I. B. 18. This requirement is indicated by the addition of the letter M to the specification designations, thus: 10-LM, 10-LSSM.

2. Piping

a. Pipe Insulation

(1) Pipe Insulation shall be supported as specified in the GENERAL SPECIFICATIONS, Part I. B. 5.

(2) Insulation thickness in excess of 2-1/2 inches shall be applied in multiple layers as specified in the GENERAL SPECIFICATIONS, Part I. B. 2.

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

(4) All butt edges and ends of single layer 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.

(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) Butt edges and ends of all inner layers of insulation shall be given a smooth brush or spray coat of anti-abrasion coating and allowed to dry for a minimum of 4 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.

II. B. 2. a. contd

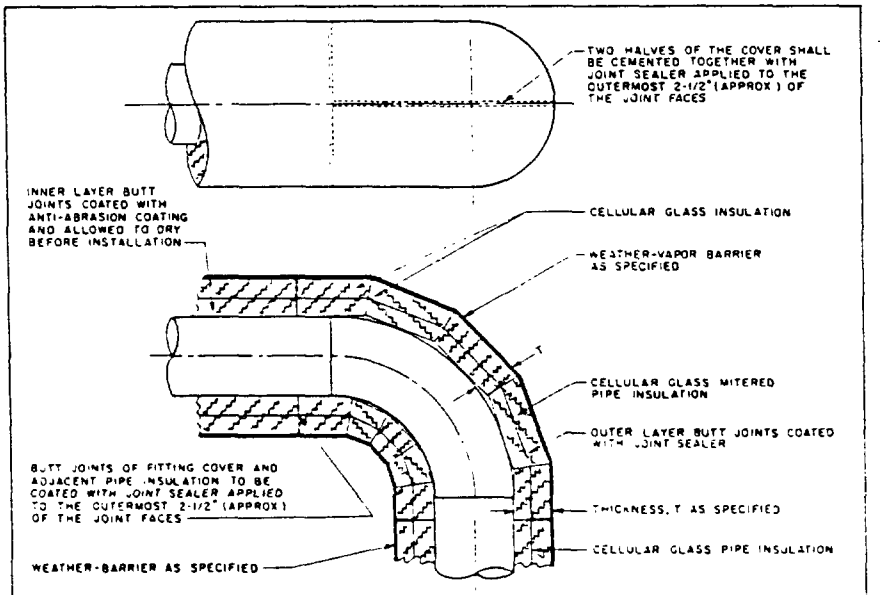
(7) When scheduled for installations where severe vibration is expected, entire surface area shall be coated with anti-abrasion coating as called for in Part II. B. 2. a. (6) or (7).

(8) 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.

b. Fitting, Flange, and Valve Covers

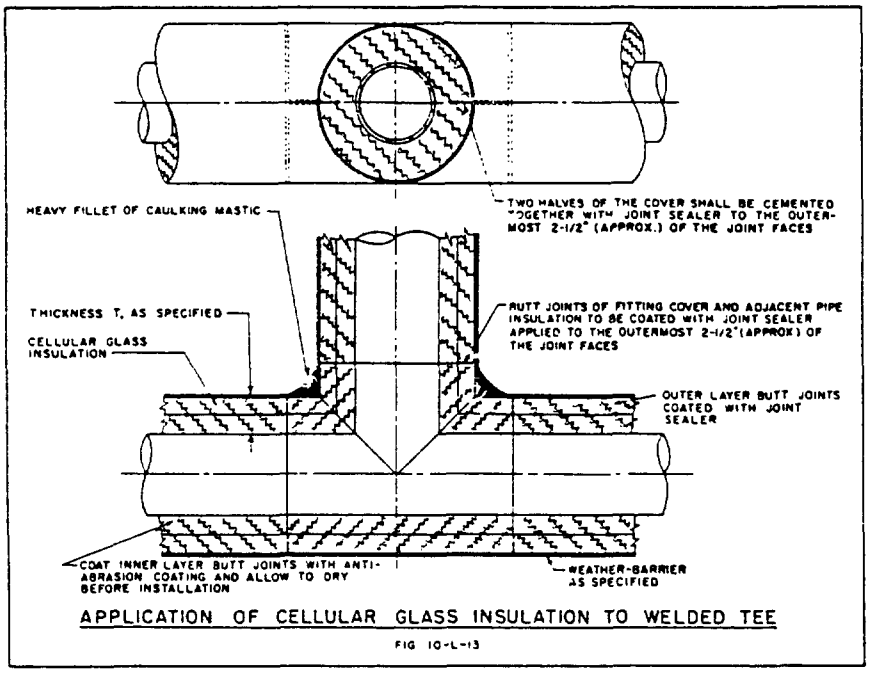
(1) Fitting, flange, and valve covers shall be shop fabricated in accordance with the UCCC Dimensional Standards Fabrication Manual, or ASTM Recommended Practice C 450, latest revision, using hot (180 F) asphalt as a fabricating cement.

(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 applied to the outermost 2-1/2 inches (approx) of the faces of the joint. 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-12 and 10-L-13.



APPLICATION OF CELLULAR GLASS INSULATION TO WELDED ELL

FIG 10-L-12



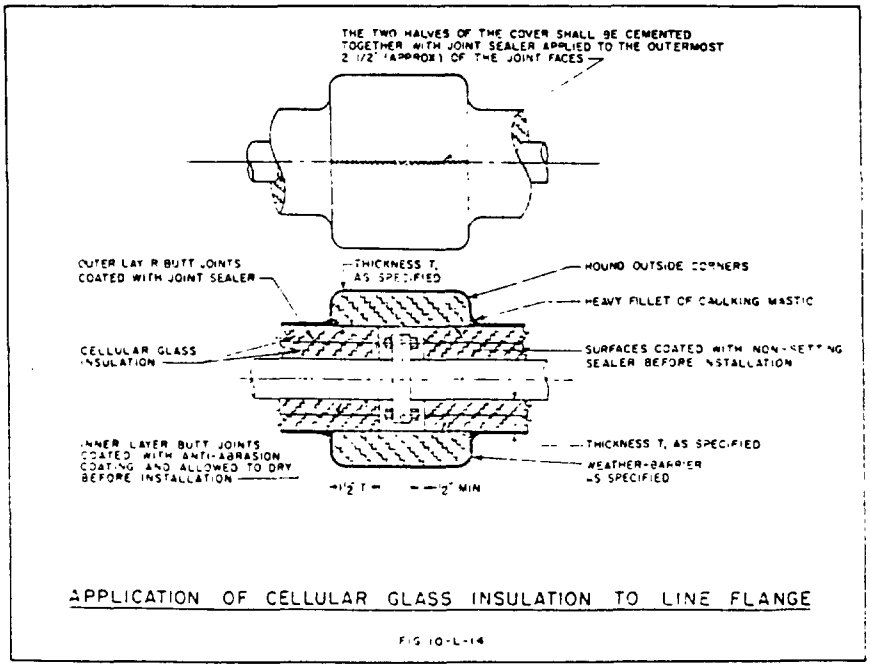
APPLICATION OF CELLULAR GLASS INSULATION TO WELDED TEE

FIG 10-L-13

(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 applied to the outermost 2-1/2 inches (approx) of the faces of the joint.

(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 fittings and valves are shown in Figures 10-L-14, 10-L-15, and 10-L-16.



APPLICATION OF CELLULAR GLASS INSULATION TO LINE FLANGE

FIG 10-L-14

TABLE II
RESISTANCE TO ACIDS, ALKALIES, AND SALTS

	SAMPLE CONDITION AFTER 96 HOURS				SAMPLE CONDITION AFTER TEST				GENERAL ATMOSPHERIC CONDITIONS
	COMPLETE IMMERSION		FREQUENT SPILLAGE		COMPLETE IMMERSION		VAPOR EFFECT		
	H.	C.	H.	C.	H.	C.	H.	C.	
ACIDS									
ACETIC 5%	G	F	E	G	G	E	E	E	E
ACETIC 50%	P	P	P	F	P	P	G	F	G
CHROMIC 5%	G-D	F-SS	E	G	P	F-D	G	G	G
CHROMIC 50%	P	P	P	P	P-D	F-D	F	G	G VSD
CITRIC 25%	G	G	E	E	E	E	E	E	E
HYDROCHLORIC 5%	G	F-SS	E	G	E	E	E	E	E
HYDROCHLORIC 35%	P-SS	G	F	E	P	G	G	E	E
LACTIC 5%	F	G	G	E	F	G	E	E	E
LACTIC 85%	P-SS	P-SS	F	F	P	P	G	G	G
NITRIC 5%	F-SS	G	G	E	P	G	F	G-D	G VSD
NITRIC 40%	P	P	P	P	P	P	P	F	F
PHOSPHORIC 5%	G	E	E	E	F	E	G	E	E
PHOSPHORIC 85%	P	P-SS	P	P	P	P	G	G	G
SULFURIC 5%	G	G	E	E	G	E	E	E	E
SULFURIC 50%	P	P	P	F	P	P	G	G	G
TARTARIC 10%	F	G	G	E	E	E	E	E	E
ALKALIES									
SODIUM HYDROXIDE 25%	P	P-SS	F	F	P-D	P	G	G	G
CALCIUM HYDROXIDE 10%	E	G	E	E	E	E	E	E	E
AMMONIUM HYDROXIDE 10%	E	E	E	E	E	G	E	E	E
SALTS									
AMMONIUM TARTRATE (sat.)	E	E	E	E	G	G	E	E	E
POTASSIUM SULFATE (sat.)	E	E	E	E	E	E	E	E	E
SODIUM SULFATE (sat.)	E	E	E	E	E	E	E	E	E
AMMONIUM SULFATE (sat.)	G	E	E	E	E	E	E	E	E
SODIUM CARBONATE (sat.)	E	G	E	E	E	E	E	E	E

Key

H = Hot + 125 F.
C = Cold + 75 F.
E = Excellent, No Attack
G = Good
F = Fair, Usable Sometimes
P = Poor, Not Recommended
SS = Slight Swelling
VSS = Very Slight Swelling
D = Discoloration

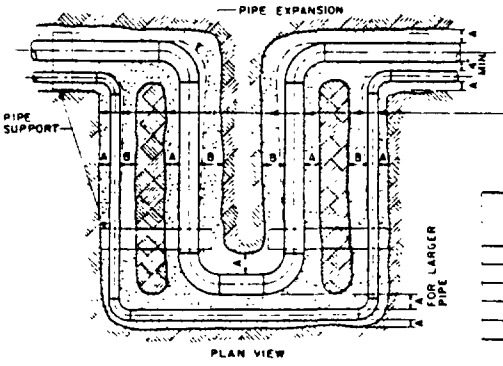
TABLE I
RESISTANCE TO ORGANIC CHEMICALS

	SAMPLE CONDITION AFTER 96 HOURS		SAMPLE CONDITION AFTER TEST		GENERAL ATMOSPHERIC CONDITIONS
	COMPLETE IMMERSION	FREQUENT SPILLAGE	COMPLETE IMMERSION	VAPOR EFFECT	
KETONES					
ACETONE	P-SS	G	P	G	G
METHYL ETHYL	P-SS	F	P	F	F
METHYL ISOBUTYL	P-SS	F	P	F	F
ALCOHOLS					
METHYL	P	F	P	G	G
ETHYL	P	F	P	G	G
ISOPROPYL	F	G	F	G	G
GLYCOLS					
ETHYLENE	E	E	E	E	E
PROPYLENE	E	E	E	E	E
CHLORINATED HYDCBNS.					
CARBON TETRACHLORIDE	P-SS	G	G	E	E
TRICHLORETHYLENE	P-SS	F	G	E	E
ARO. HYDROCARBONS					
TOLUOL	P-SS	F	F	F	F
XYOL	P-VSS	G	F	F	G
ALPH. HYDROCARBONS					
GASOLINE	F-VSS	E	G	E	E
MINERAL SPIRITS	E	E	G	E	E
STODDARD SOLVENT	F	G	F	G	G
KEROSENE	E	E	E	E	E
LUBRICATING OILS	E	E	E	E	E

Key
E = Excellent, No Attack
G = Good
F = Fair, Usable Sometimes
P = Poor, Not Recommended
SS = Slight Swelling
VSS = Very Slight Swelling

b. Where lines insulated with bituminous fill enter a manhole or building wall, an asbestos rope or lead packing shall be applied between the pipes and the sleeves.

c. Before installation, the outer surface of the galvanized steel jacket shall be cleaned of all dirt, mud, oil, grease, and other foreign matter, and coated with two coats of the specified corrosion-resistant coating, applied by brush or spray. Coating shall be allowed to dry thoroughly before the jacket is installed.



RECOMMENDED ENVELOPS

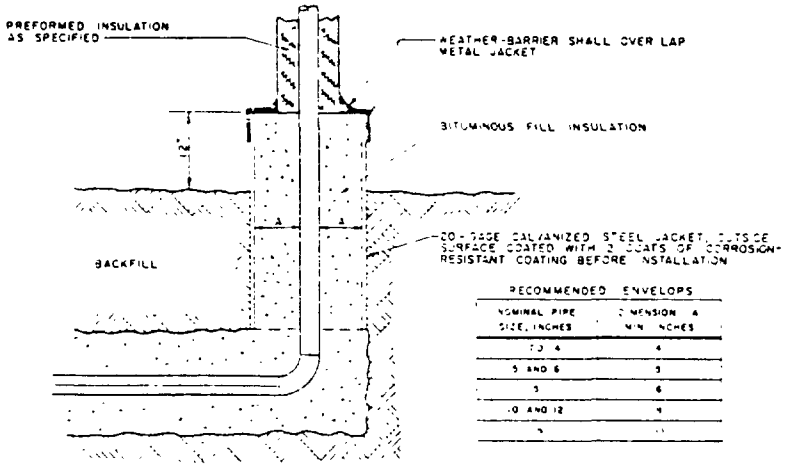
NOMINAL PIPE SIZE INCHES	DIMENSION "A" MIN INCHES	DIMENSION "B" MIN INCHES
1 TO 4	4	9
5 AND 6	5	10
8	6	11
10 AND 12	8	13
16	11	18

APPLICATION OF BITIMINOUS FILL INSULATION TO UNDERGROUND EXPANSION LOOPS

FIG 39-H-2

3. Transition and Termination

a. Where the bituminous insulation system emerges above the surface, a transition consisting of a 20-gage galvanized steel jacket shall be provided to the type of insulation specified for portion above surface. The junction of the bituminous fill insulation and the above-ground insulation shall be sealed with the specified weather-barrier coating. Installation shall be as shown in Figure 39-H-3.



RECOMMENDED ENVELOPS

NOMINAL PIPE SIZE, INCHES	DIMENSION A MIN INCHES
TO 4	4
5 AND 6	5
8	6
10 AND 12	8
16	11

TRANSITION AND TERMINATION OF BITUMINOUS FILL INSULATION

FIG 39-H-3

II. SPECIFICATION 40-J — Cork-Filled Polyvinyl Acetate Mastic

Scope

This Specification dsecribes the essential requirements for the purchase and application of cork-filled polyvinyl acetate insulating mastic for use on equipment and piping normally operating at temperatures from 34 F up to and including 180 F.

A. MATERIAL

1. 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.

2. Properties

Cork-filled polyvinyl acetate insulating mastic shall have the following 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 20% 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.
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.
Temperature Limits	Shall be suitable for use from 34 F to 180 F without mechanical, thermal, or chemical failure.
Tensile Strength	Shall be not less than 1000 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

B. APPLICATION

1. Preparation of Surface

The surface to be insulated shall be dry, and cleaned by thorough wire brushing to remove all rust, grease paint, loose mill scale, or other foreign matter. Surface shall then be wiped down with a volatile solvent, such as coal tar naphtha, to remove any oil or grease remaining.

2. Priming

a. Primer shall be Amercoat 86, Porter Paint Company No. 3078B Heavy Duty Chromate Primer, or approved equal.

b. All steel surfaces to be insulated shall be coated with the specified corrosion-inhibitive, moisture-resistant primer before insulation is applied.

3. Methods of Application

Insulation may be applied in one coat by palming, troweling, or spraying. The following apparatus is required for application by spraying:

a. Grayco Mogul Type Pump, 8 to 1 ratio, equipped with follow-plate and Evenflo regulators, or approved equal.

b. 1-inch material hose; 1/2-inch air hose.

c. Grayco or approved equal mastic gun equipped with 1/4-inch minimum tip.

Spraying is recommended only for equipment or pipe not less than 24 inches in diameter. Required thickness of insulation shall be obtained by multiple passes.

4. Surface Temperature

The temperature of the surface to be insulated shall not exceed 180 F. If insulation is to be applied to operating equipment or piping, application should be done, when possible, while equipment, or piping, or both, is shut down, or during the high-temperature portion of a cycle period. Insulation should never be applied to a surface at a temperature below the dew point, or when the surface temperature is expected to be below the dew point before the insulation is dried and cured.

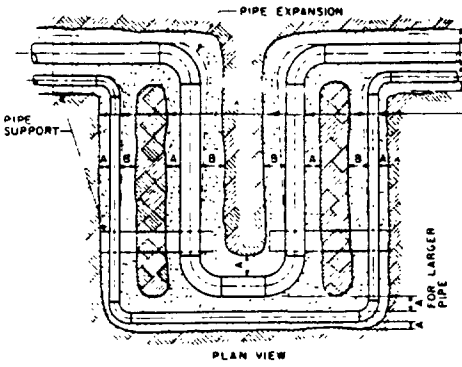
5. Drying

A minimum drying period of 24 hours shall be allowed for each 1/8-inch thickness of insulation, and an additional 24-hour curing period before equipment, or piping, or both, is put in operation.

6. Thickness and Coverage

a. Thickness of insulation shall be as specified in the Insulation Schedule.

b. Coverage shall be as follows:
1/8-inch thickness: 8-1/2 to 10 Gal per 100 sq ft.
1/4-inch thickness: 17 to 20 gal per 100 sq ft.



RECOMMENDED ENVELOPS

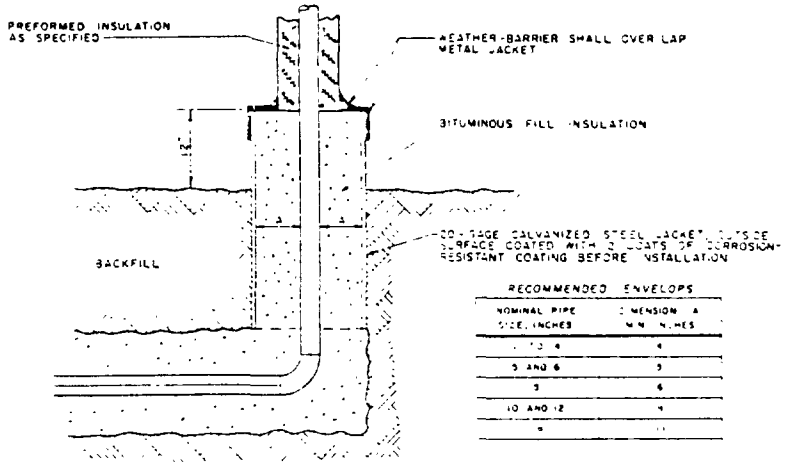
NOMINAL PIPE SIZE INCHES	DIMENSION "A" MIN INCHES	DIMENSION "B" MIN INCHES
1 TO 4	4	9
5 AND 6	5	10
8	6	11
10 AND 12	8	13
16	11	16

APPLICATION OF BITIMINOUS FILL INSULATION TO UNDERGROUND EXPANSION LOOPS

FIG 39-H-2

3. Transition and Termination

a. Where the bituminous insulation system emerges above the surface, a transition consisting of a 20-gage galvanized steel jacket shall be provided to the type of insulation specified for portion above surface. The junction of the bituminous fill insulation and the above-ground insulation shall be sealed with the specified weather-barrier coating. Installation shall be as shown in Figure 39-H-3.



RECOMMENDED ENVELOPS

NOMINAL PIPE SIZE, INCHES	DIMENSION A MIN INCHES
1 TO 4	4
5 AND 6	5
8	6
10 AND 12	8
16	11

TRANSITION AND TERMINATION OF BITUMINOUS FILL INSULATION

FIG 39-H-3

b. Where lines insulated with bituminous fill enter a manhole or building wall, an asbestos rope or lead packing shall be applied between the pipes and the sleeves.

c. Before installation, the outer surface of the galvanized steel jacket shall be cleaned of all dirt, mud, oil, grease, and other foreign matter, and coated with two coats of the specified corrosion-resistant coating, applied by brush or spray. Coating shall be allowed to dry thoroughly before the jacket is installed.

II. SPECIFICATION 39-H — Underground Bituminous Fill

Scope

This Specification describes the purchase and application of a bituminous insulation for use on underground piping normally operating at temperatures from 220 F up to and including 520 F.

A. MATERIAL

1. 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.

2. Properties

Bituminous fill insulation shall have the following properties.

Capillarity . . . . . Water resistant.

Composition . . . . . Pure bitumen, bitumen with volcanic rock, or approved equal.

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

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.

Temperature Limits . . . . 220 F to 520 F

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

Mean Temp, °F	Conductivity Btu/hr/sq ft
300	0.54

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

Grade . . . . . As required by temperatures.

3. Accessory Materials

a. Corrosion-Resistant Coating (For ambient temperatures from 40 F to 120 F) - Roskote 612XM or approved equal.

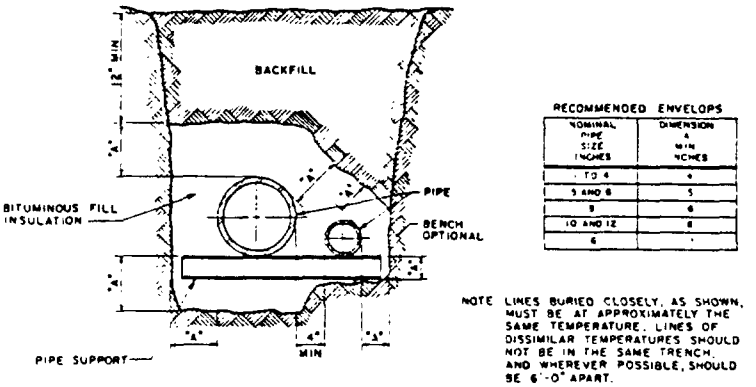
b. Corrosion-Resistant Coating (For ambient temperatures below 40 F) - Roskote 612XP or approved equal.

c. Weather-Barrier Coating (Color as specified) - Vimasco WC-1, Pittsburgh-Corning Pittcote 300 C, or approved equal.

B. APPLICATION

1. Piping

a. Unless otherwise specified, insulation thickness shall be not less than that shown in Figure 39-H-1. Where the piping passes under areas supporting heavy loads, thickness of insulation on top side of pipe shall be increased 3 inches.



RECOMMENDED ENVELOPS

NOMINAL PIPE SIZE INCHES	DIMENSION A MIN INCHES
1 TO 4	4
5 AND 8	5
9	6
10 AND 12	8
6	-

NOTE LINES BURIED CLOSELY, AS SHOWN, MUST BE AT APPROXIMATELY THE SAME TEMPERATURE. LINES OF DISSIMILAR TEMPERATURES SHOULD NOT BE IN THE SAME TRENCH, AND WHEREVER POSSIBLE, SHOULD BE 6'-0" APART.

APPLICATION OF BITUMINOUS FILL INSULATION TO UNDERGROUND PIPING

FIG 39-H-1

b. The trench shall be dewatered, and shall be kept free from water, until the installation is completed and the insulating material has cured.

c. Process lines shall be supported, welded and tested, and loose paint, dirt, rust, scale, wax, and other extraneous materials removed before the insulating material is applied.

d. The bituminous insulation fill shall be poured into the trench and then tamped around the lines with one 10-inch stroke of an 8-inch by 8-inch by 1/4-inch steel plate per 8-inch by 8-inch area. The fill shall then be covered with the bags in which the insulation was shipped.

e. Insulating material shall be kept free of soil or other foreign matter before and during the pouring procedure.

f. Where the width of the trench is greater than required, a leapfrog form shall be used for the side walls. The insulation material shall be applied and sides backfilled before forms are moved to the next position.

g. The curing of the bituminous insulation shall be not less than the time and temperature specified by the manufacturer for the material supplied.

h. Trench shall be backfilled only after curing is completed, unless the installation is being made in dry soil.

i. A minimum of 12 inches of backfill shall be placed over the top of the bituminous insulation, as shown in Figure 39-H-1.

2. Expansion Loops

a. The insulation material shall be applied to expansion loops as shown in Figure 39-H-2.

d. The asphalt shall be poured into the joint, at a temperature between 400 F and 450 F, in the following stages:

1. Fill to top of insulation and let cool for one hour.
2. Fill to within 1/2" of the top and let cool for one hour.
3. Fill until asphalt is level with top of metal jacket.

4. Conduit Terminals

a. When the insulation conduit terminates at a building, manhole, or pit, it shall extend through the concrete to the inner face. A weather seal shall be applied between the conduit and the concrete.

b. A water seal shall be applied to the conduit end, and the remainder of the line insulated as specified in the Insulation Line and Equipment List.

5. Backfill

a. Boulders and concrete debris shall not be used as a portion of the backfilling materials.

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

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

II. SPECIFICATION 37-H — Insulated Conduit

Scope

This Specification describes the essential insulation requirements for the installation of insulated conduit used on underground systems normally operating at temperatures up to and including 750 F.

A. MATERIAL

1. Composition

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

   b. Insulation material for use in conduit will be specified in Insulation Line and Equipment List.

2. Accessory Materials

   a. Insulated Conduit-Ric-wil Hel-cor, Durant Pre-Sealed, Kaiser Ebko, or approved equal.

   b. 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.

B. APPLICATION

1. Trench Preparation

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

   b. The bottom of the trench shall be made smooth and uniform before the installation of conduit.

2. Process Pipe

   a. After process line has been welded and tested, insulation shall be applied to uninsulated joints.

   b. All loose paint, dirt, grease, rust, scale, wax, and other extraneous materials shall be removed from the exposed ends of the pipe before the conduit connections are made.

   c. Insulation of the type specified for conduit shall be applied to the area of the pipe left bare for field welding, and joints and cracks filled with insulating cement.

3. Field Connections

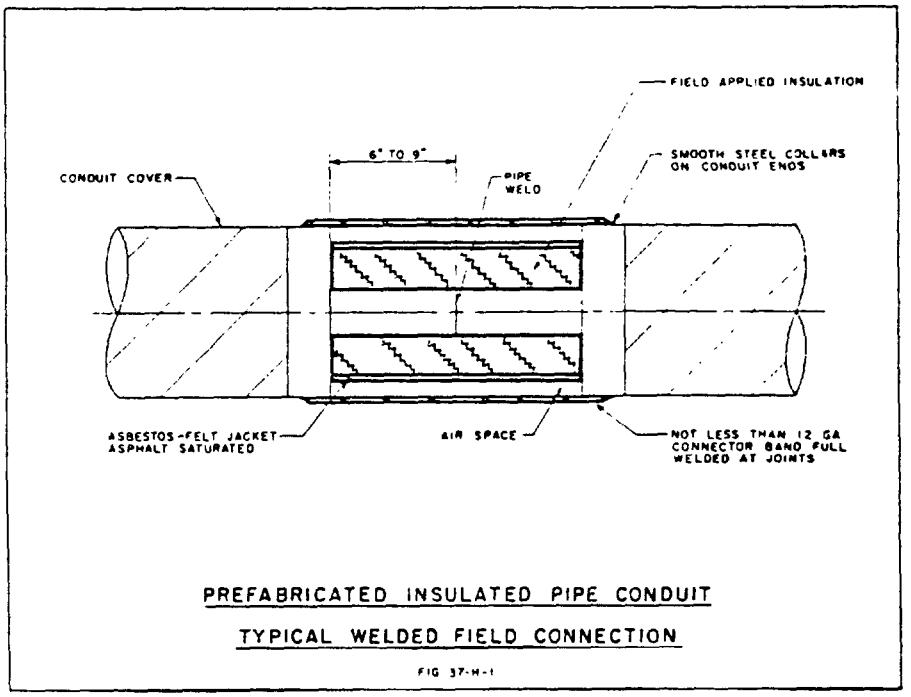
   (1) Field Welded Conduit Connections (Fig. 37-H-1)

      a. An asbestos felt jacket shall be applied over the insulation and secured with wire.

      b. The cylindrical conduit closure supplied by the manufacturer shall be installed at the joint, and the circumferential and longitudinal joints welded.

      c. The system shall be required to withstand air test at 15 psig without leaks.

      d. The welds shall be smoothed and cleaned, and an industrial tape applied around each circumferential weld. Entire connection shall then be wrapped continuously with tape.



PREFABRICATED INSULATED PIPE CONDUIT

TYPICAL WELDED FIELD CONNECTION

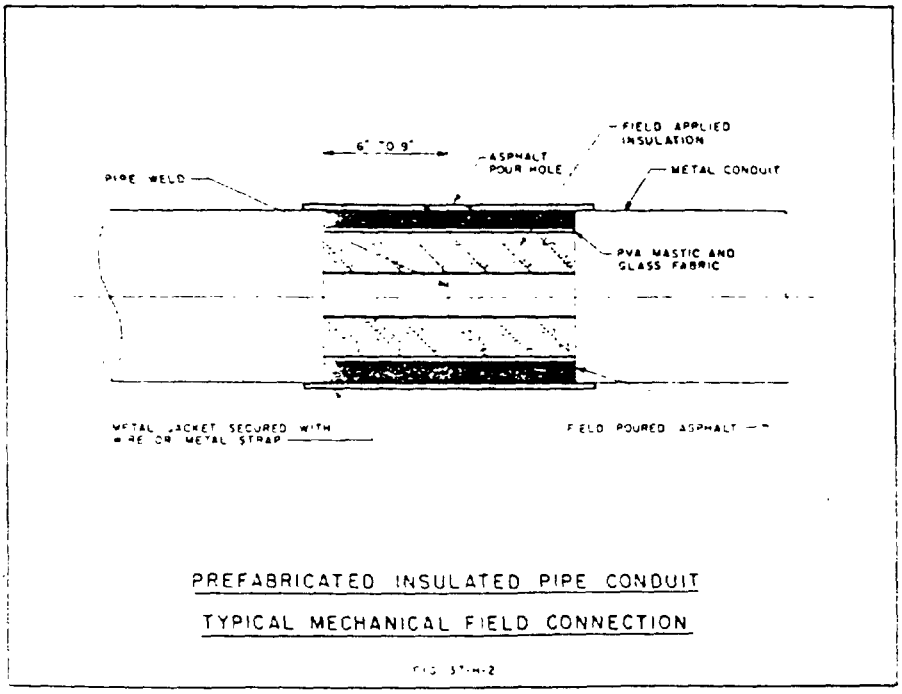
FIG 37-H-1

(2) Mechanical Conduit Connections (Fig. 37-H-2)

a. Entire area of exposed insulation shall be thoroughly covered with PVA mastic and glass fabric.

b. The outer metal jacket, furnished by manufacturer, shall be installed over-lapping the conduit jacket at both ends, and sealed with insulating cement before securing with stainless steel insulation strap.

c. A 2-inch by 3-inch pour hole shall be cut in the top center of the connection jacket if the pipe is level. The pour hole shall be located at the highest point.



PREFABRICATED INSULATED PIPE CONDUIT

TYPICAL MECHANICAL FIELD CONNECTION

FIG 37-H-2

f. Weather-Barrier

(1) Weather-barrier coating shall be applied in accordance with the GENERAL SPECIFICATIONS, Part I. B. 17.

(2) Weather-barrier consisting of stainless steel jacketing, if required, shall be applied in accordance with the GENERAL SPECIFICATIONS, Part I. B. 18. This requirement is indicated by the addition of the letter *M* to the specification designations, thus: 32-*LM*, 32-*LSSM*.

g. Traced Installations

Traced lines, where specified, shall be installed and insulated in accordance with the GENERAL SPECIFICATIONS, Part I. B. 16.

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 shell.

(2) Where any field cutting or fitting around supports or nozzles is required, care shall be exercised to insure good workmanship, and to seal the 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 caulked or flashed to form a watershed. Where caulking mastic is impractical to use for sealing joints or openings, as in the case of removable units, aluminum tape as specified, shall be used.

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

(5) Traced lines, where specified, shall be installed and insulated in accordance with the GENERAL SPECIFICATIONS, Part I. B. 16.

II. SPECIFICATION 32-H — Hydrous Calcium Silicate

Scope

This Specification describes the essential requirements for the purchase and application of preformed hydrous calcium silicate insulation for use on equipment and piping, operating above 70 F, specified to be protected from fire exposure.

Procedures outlined in the GENERAL SPECIFICATIONS are applicable to and constitute an integral part of this Specification, with exceptions as noted herein.

A. MATERIAL

1. Composition

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

2. Properties

Hydrous calcium silicate insulation shall have the following properties:

Alkalinity	pH shall be not below 10 and not above 13.
Coefficient of Expansion	3×10^{-6} on reheat to 1200 F.
Combustibility	Shall be incombustible.
Compressive Strength	When tested in accordance with ASTM C 165, latest revision, the percentage of deformation produced by loading shall not exceed the following:

Deformation, %	Load, psi
2	50
5	130

Density	Shall be not less than 11.5 lb per cu ft, or more than 13.5 lb per cu ft, when tested in accordance with ASTM C 303, latest revision.
Flexural Strength	Shall be not less than 55 psi when tested in accordance with ASTM C 203, latest revision.
Hardness	A 1/8-inch ball point under a 1-kg load shall produce a maximum penetration of 0.85 mm.
Hygroscopicity	When oven-dried to constant weight, then exposed to air at 70 F and 90% relative humidity for 14 days, shall gain a maximum of 10% of the original weight.
Resistance to Abrasion	When subjected to the Navy Tumbling Test, shall lose not more than 7% of original weight after first 10-minute run, and not more than 15% after second 10-minute run.
Resistance to Acids and Caustics	Shall be resistant to most common caustics (not considered an acid-resisting material).
Shrinkage	When tested in accordance with ASTM C 356, latest revision, the shrinkage at the given temperatures shall not exceed the following percentages:

Temp, F	Shrinkage, %
1200	0.4
1500	1.4
1600	1.9

Specific Heat	0.20 to 0.26 Btu per lb per degree F at 400 F.
Temperature Limit	Maximum temperature without mechanical, thermal, or chemical failure shall be not less than 1600 F.

Thermal Conductivity . . . When tested in accordance with ASTM C 177, latest revision, or ASTM C 335, latest revision, 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 . . . 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 1800 F and then quenched with water.

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

Make . . . . . Kaylo No. 20 or approved equal.

3. Accessory Materials

a. Stainless Steel Wire - 0.0475-inch diameter, Type 304, cold drawn, bright annealed, 18 gage.

b. Insulation Strap - Stainless steel, 1/2-inch by 0.020-inch, Type 304, or approved equal.

c. Clips - Stainless steel, 1/2-inch double-pronged, Type 304, A. J. Gerrard or approved equal.

d. Weather-Barrier Coating (Color as specified)- PVA-Vimasco No. WC-1, Pittsburgh-Corning Pittcote 500 C, or approved equal.

e. Reinforcing Cloth - Glass fabric, 10 by 10 thread count, Perma Glas Mesh, Glasfab, Benjamin Foster Open Weave No. 10, or approved equal.

f. Fabricating Cement - Philip Carey Careytemp, Refractory and Insulation Block Stick, or approved equal.

g. Wire Netting - One-inch hexagonal mesh, 20-gage, stainless steel or monel.

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

i. Mineral Wool Blanket - Black, spun rock wool, hexagonal netting on one side, expnaded metal lath on the other side.

B. APPLICATION

1. Equipment

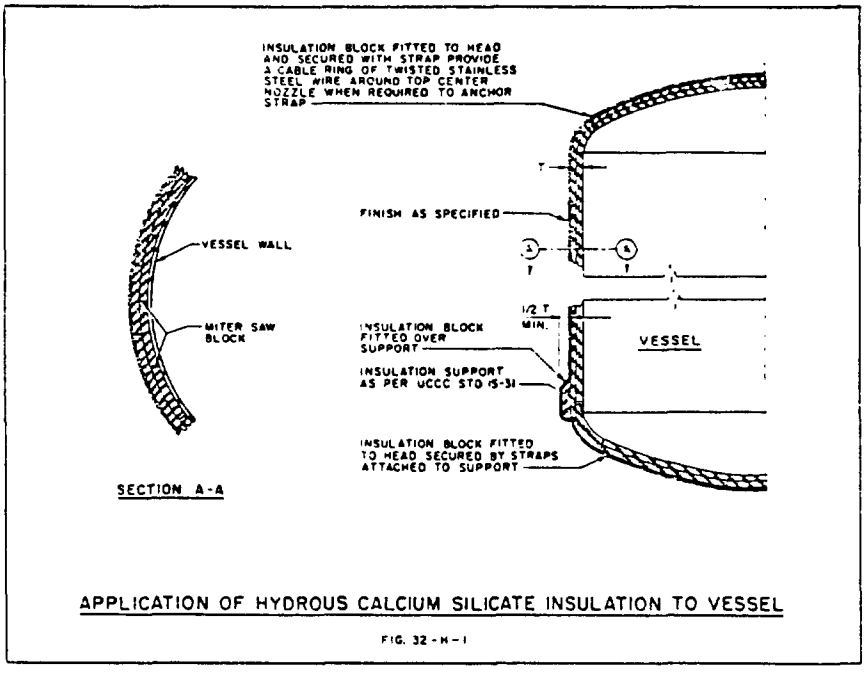
a. Equipment shall be provided with insulation supports as called for in the GENERAL SPECIFICATIONS, Part I. B. 5.

b. Thickness Schedule

Unless otherwise specified, insulation in excess of 1-1/2-inch total thickness shall be applied in two layers in accordance with thickness schedule shown in Part II. B. 2. a. (1) of this Specification, except that outer layer shall be calcium silicate insulation per Specification 20-H.

c. Curved Surfaces

On all equipment, insulation block shall be cut into curved segments to fit vessel surface, and applied to vessel sides and heads in staggered position with all joints tightly butted. Block shall be applied to vessel sides with linear dimension parallel to axis of vessel. Typical installation is shown in Figure 32-H-1.

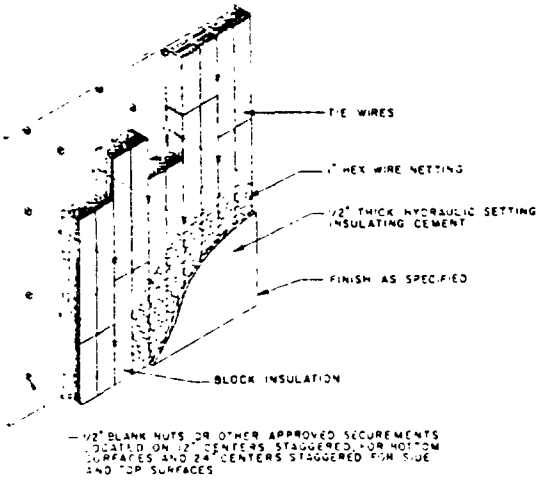


APPLICATION OF HYDROUS CALCIUM SILICATE INSULATION TO VESSEL

FIG. 32-H-1

d. Flat Surfaces

Block insulation shall be applied to flat surfaces in staggered position with all joints tightly butted. It shall be secured with wire attached to blank nuts, or other approved securement. On rectangular equipment, the blank nuts or other approved securements shall be placed on 12-inch centers, staggered, for bottom surfaces and on 24-inch centers, staggered, for side and top surfaces. Typical installation is shown in Figure 32-H-2.



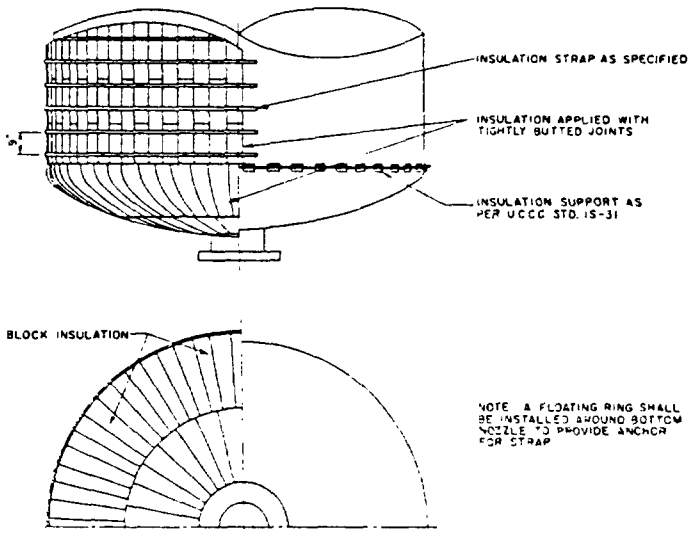
APPLICATION OF HYDROUS CALCIUM SILICATE INSULATION TO FLAT SURFACE

FIG 32-H-2

e. Securement

(1) All layers of insulation shall be secured with insulation strap where contour of vessel permits firm and effective attachment. Insulation applied to irregular surfaces, where strap is impracticable, shall be secured with wire, drawn taut, ends twisted and embedded in insulation.

(2) All layers of insulation on bottom heads of vertical equipment 12 ft and less in diameter, and heads of horizontal equipment shall be secured in place with insulation strap attached to insulation support as specified in UCCC Standard IS-31 and Figure 32-H-3.

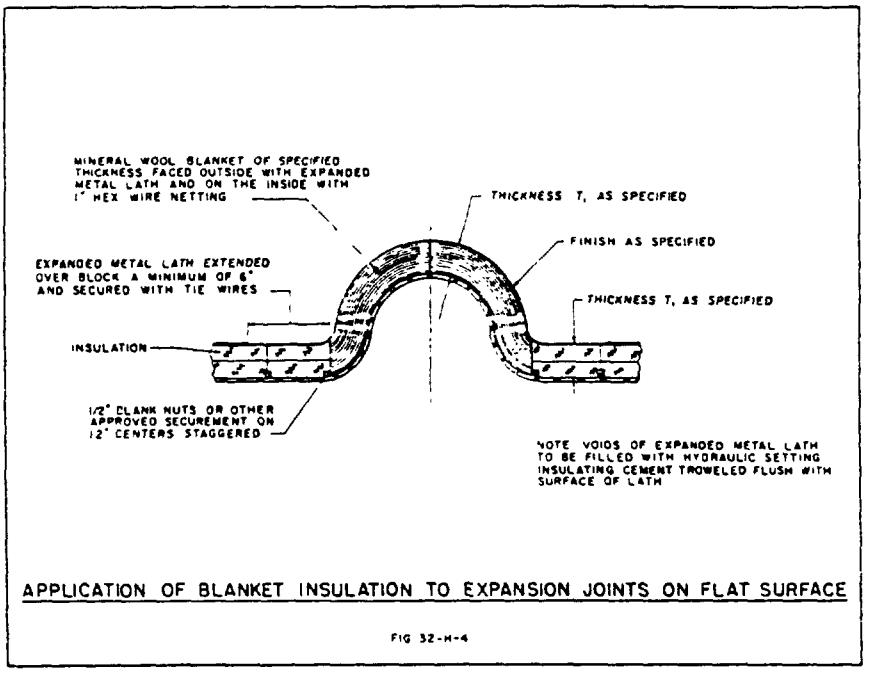


SECUREMENT OF HYDROUS CALCIUM SILICATE INSULATION ON VESSEL HEAD

FIG. 32-H-3

f. Expansion Joints

Expansion joints in flat surfaces or cylindrical vessels shall be insulated with flexible blanket insulation. Typical installation is shown in Figure 32-H-4.

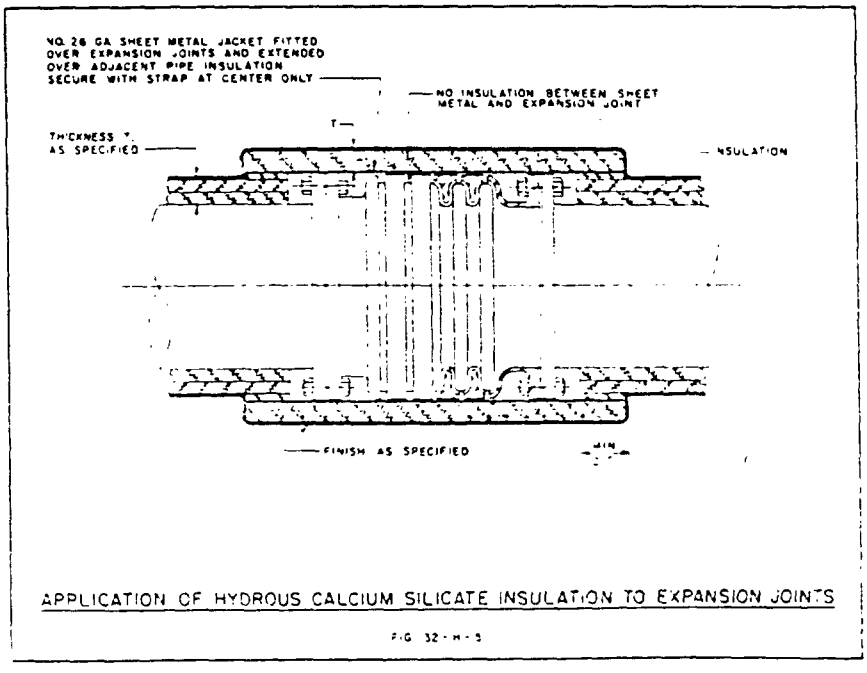


APPLICATION OF BLANKET INSULATION TO EXPANSION JOINTS ON FLAT SURFACE

FIG 32-H-4

g. Mechanical Expansion Joints

Corrugated mechanical expansion joints in piping (usually listed as equipment items) shall be insulated as shown in Figure 32-H-5. Where movement is likely to occur in the insulation, non-setting sealer shall be applied to surfaces of insulation to provide proper slip joint.



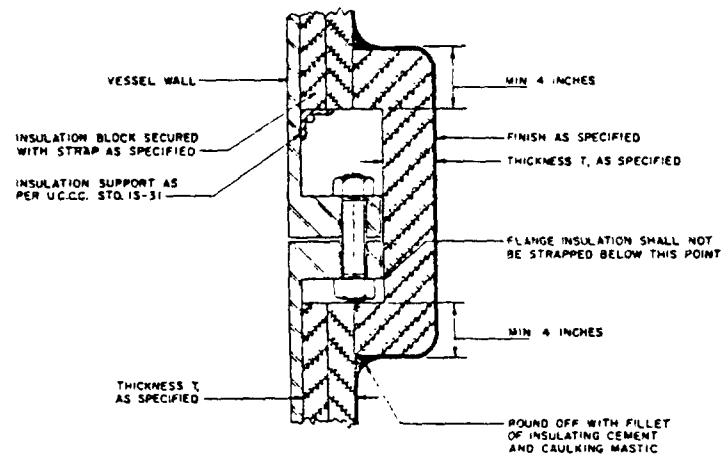
APPLICATION OF HYDROUS CALCIUM SILICATE INSULATION TO EXPANSION JOINTS

FIG 32-H-5

II. B. 1. contd

h. Insulated Vessel Flanges

Vessel flanges shall be insulated with block in the same manner as specified for body of vessel. An insulation support shall be provided immediately above vessel flange. The top of projecting flange insulation shall be sloped to shed water. Typical installation is shown in Figure 32-H-6.

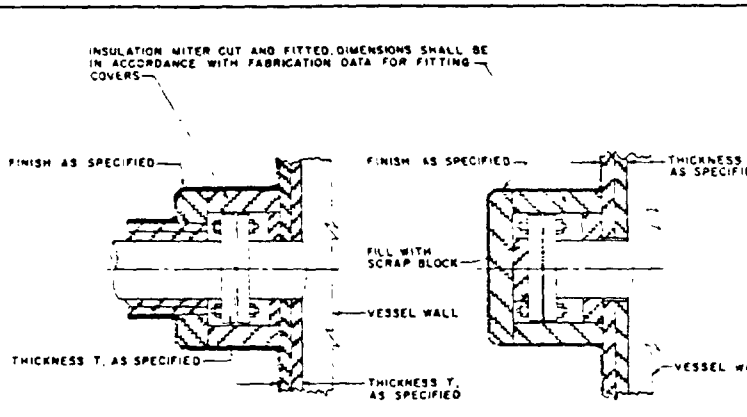


APPLICATION OF HYDROUS CALCIUM SILICATE INSULATION TO VESSEL FLANGE

FIG 32-H-6

i. Vessel Nozzles

Vessel nozzles shall be insulated as shown in Figure 32-H-7.



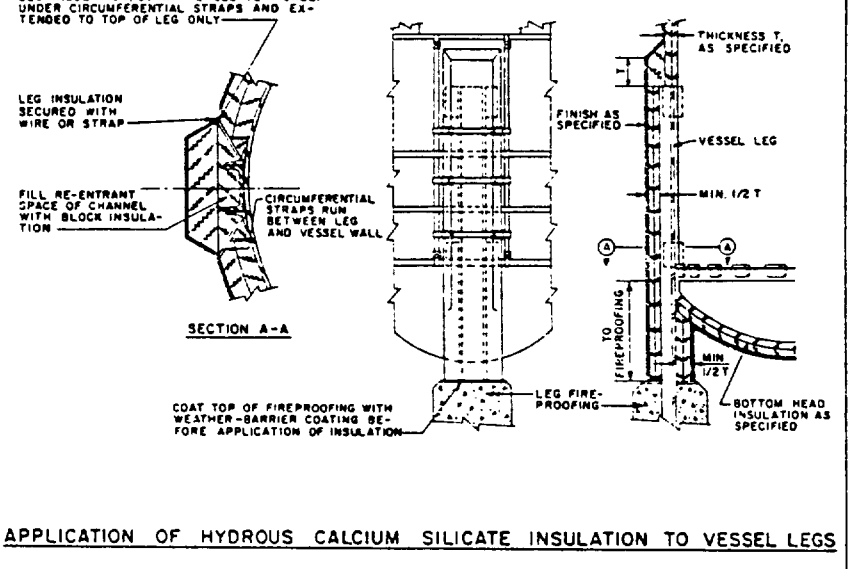
APPLICATION OF HYDROUS CALCIUM SILICATE TO VESSEL NOZZLES

FIG 32-H-7

j. Vessel Legs

(1) Vessel 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.

(2) 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 32-H-8.



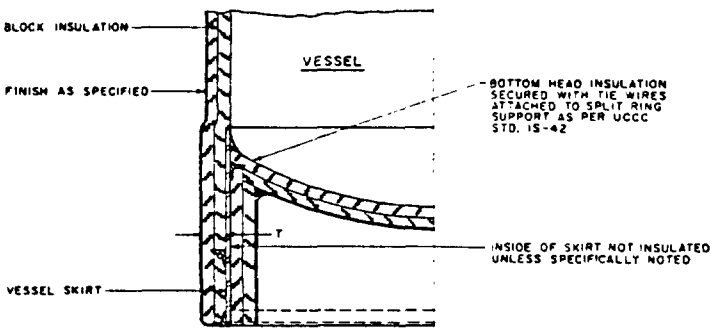
APPLICATION OF HYDROUS CALCIUM SILICATE INSULATION TO VESSEL LEGS

FIG 32-H-8

k. 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-9.

Thickness shall be as specified for body of vessel.



APPLICATION OF HYDROUS CALCIUM SILICATE INSULATION TO VESSEL SKIRT

FIG 32-H-9

1. Surface Finish

When specified thickness of insulation has been applied, any small cracks or depressions shall be pointed up with insulation cement troweled flush with surface of insulation.

m. Weather-Barrier

(1) Weather-barrier coating shall be applied in accordance with the GENERAL SPECIFICATIONS, Parts I. B. 9 and 17.

(2) Weather-barrier consisting of stainless steel jacketing, if required, shall be applied in accordance with the GENERAL SPECIFICATIONS, Part I. B. 18. This requirement is indicated by the addition of the letter M to the specification designation, thus: 32-HM.

2. Piping

a. Pipe Insulation

(1) Thickness Schedule

Unless otherwise specified, pipe insulation in excess of 1-1/2-inch total thickness shall be applied in accordance with the following table:

Total Scheduled Thickness, inches	Inner Layer, inches	Outer Layer, inches
2	1	1
2-1/2	1	1-1/2
3	1-1/2	1-1/2
3-1/2	1-1/2	2
4	2	2

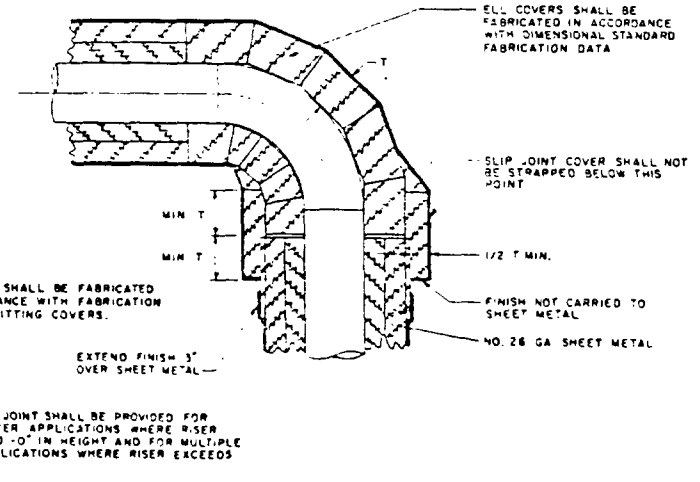
(2) Securement

All layers of insulation shall be secured with stainless steel insulation strap spaced in accordanc with the GENERAL SPECIFICATIONS, Parts I. B. 5. c. and d.

b. Fittings, Flanges, and Valves

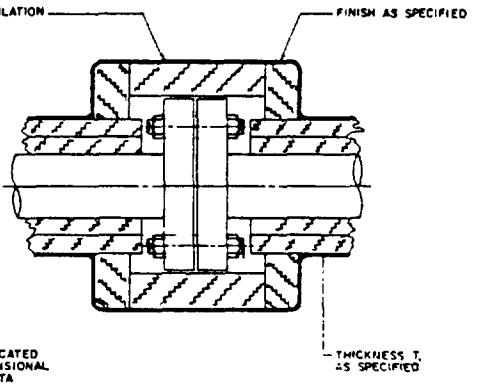
(1) All sizes of fittings, flanges, and valves shall be insulated with prefabricated fitting covers in ac cordance with the Dimensional Standard Fabrication Data. Where impractical to shop fabricate, an with the approval of the representative of the Department of Design and Construction, fitting cover may be field fabricated provided work is in accordance with the Dimensional Standard Fabricatior Data. Segments shall be carefully fitted to insure tight joints.

(2) Cement of shop fabricated assemblies shall be done with specified fabricating cement. In all case the joints shall be as thin as possible, with just sufficient cement to obtain good adhesion and comple closure. In no case will wide cement joints, or voids and holes filled with fabrication cement, b permitted. Typical installations are shown in Figure 32-H-10, 32-H-11, 32-H-12 and 32-H-13.



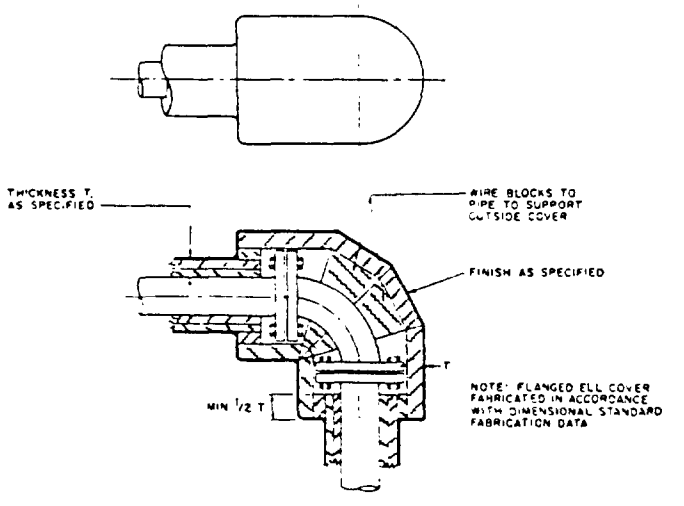
APPLICATION OF HYDROUS CALCIUM SILICATE INSULATION TO WELDING ELL

FIG-32-H-10



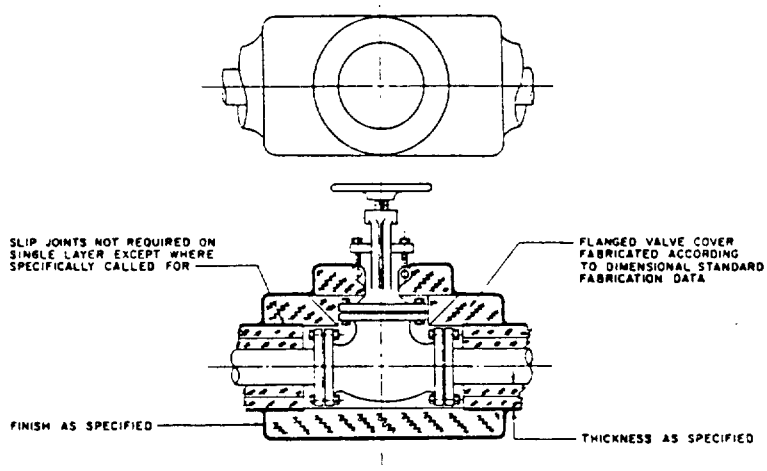
APPLICATION OF HYDROUS CALCIUM SILICATE INSULATION TO LINE FLANGE

FIG 32-H-11



APPLICATION OF HYDROUS CALCIUM SILICATE INSULATION TO FLANGED ELL

FIG 32-H-12



APPLICATION OF HYDROUS CALCIUM SILICATE INSULATION TO FLANGED VALVE

FIG 32-H-13

(3) Surface Finish

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

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

c. Polyethylene Conduit, Junction Boxes and Copper Tubing

(1) Where specified on Insulation Design Schedule and/or Line List, polyethylene tubing (placed in metal conduit) and copper tubing (for a minimum distance of 6'-0") from the junction boxes shall be insulated for fire protection.

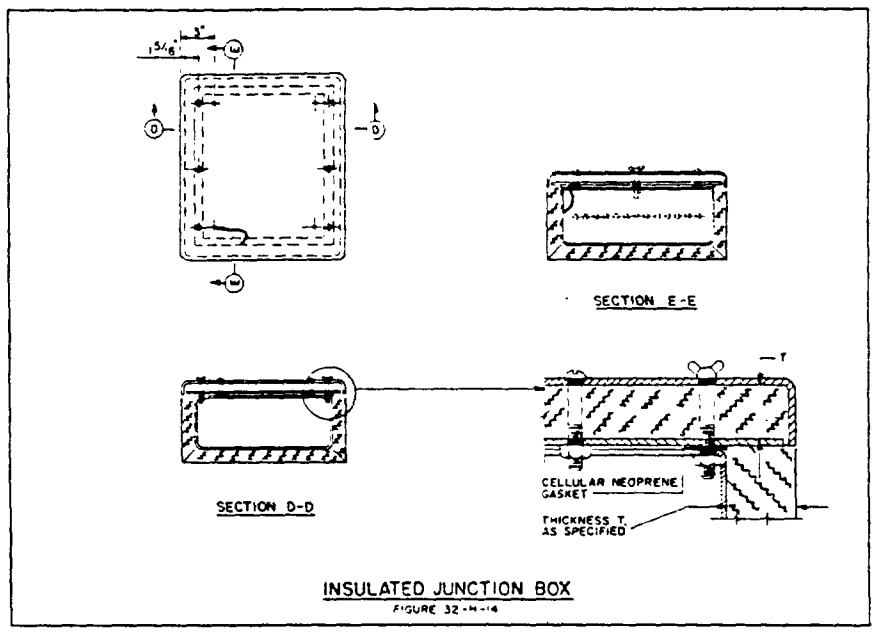
(2) Unless otherwise specified, insulation shall be a minimum of one inch thickness.

(3) Insulation shall be applied to conduit and junction boxes 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 strap.

(5) Insulation on junction boxes shall be secured with stainless steel wire and blank nuts. If welding on junction boxes and covers is prohibited, stick clip fasteners shall be used.

(6) The body of the junction boxes shall be insulated separately from the removable covers. Typical installation is shown in Figure 32-H-14.



INSULATED JUNCTION BOX
FIGURE 32-H-14

d. Weather-Barrier

(1) Weather-barrier coating shall be applied in accordance with the GENERAL SPECIFICATIONS, Part I. B. 17.

(2) Weather-barrier consisting of stainless steel jacketing, if required, shall be applied in accordance with the GENERAL SPECIFICATIONS, Part I. B. 18. This requirement is indicated by the addition of the letter M to the specification designation, thus: 32-HM.

II. SPECIFICATION 32-L
32-LSS (For Stainless Steel)

Hydrous Calcium Silicate
and Cellular Glass

Scope

This Specification describes the essential requirements for the purchase and application of hydrous calcium silicate and cellular glass insulation to low temperature equipment and piping, normally operating below 70 F, to be protected from fire exposure.

The second designation, 32-LSS, indicates that this Specification shall be used for stainless steel equipment and piping. However, this Specification shall be subject to the use of accessory materials specified for stainless steel.

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

A. MATERIAL

1. Hydrous Calcium Silicate

a. Composition

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

b. Properties

Hydrous calcium silicate insulation shall have the following properties:

Alkalinity . . . . . pH shall be not more than 10.0.

Capillarity . . . . . When placed on wet surface, absorption after 1/2 hour shall be less than 100%, and after 7 days less than 300% of its original weight.

Coefficient of Expansion . After being heated to 1800 F, then cooled, expansion upon reheating shall not exceed 4×10^{-6} per degree F.

Coefficient of Shrinkage . When heated from 70 F to 1800 F (not reheated), linear shrinkage shall be less than 2%.

Combustibility . . . . . Shall be incombustible.

Compressive Strength . The percentage of deformation produced by loading shall be less than the following:

Deformation, %	Load, psi
2	20
6	60
10	100

Density . . . . . 10 to 14 lb per cu ft.

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

Hygroscopicity . . . . . When oven-dried at 200 F to 230 F, then exposed to air at 70 F and 90% relative humidity for 14 days, shall gain a maximum of 10% of the original weight.

Modulus of Elasticity . . Shall be not less than 35,000 psi.

Modulus of Rupture . . . Shall be above 50 psi.

Resistance to Abrasion . When placed in Rotap on 20-mesh, a 3-inch by 3-inch by 1-1/2-inch sample shall lose not more than 25% of original weight after 10-minute run, nor more than 40% after 20-minute run.

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

Specific Gravity . . . . 0.15 to 0.28

Specific Heat . . . . . 0.20 to 0.30 Btu per lb per degree F.

Temperature Limits . . Shall be suitable for use at temperatures from 0 F to 1800 F without mechanical, thermal, or chemical failure.

Thermal Conductivity . Shall not exceed the following values at the given mean temperatures:

Mean Temp, °F	Btu/inch, hr, sq ft, °F
100	0.43
400	0.58
800	0.78
1200	1.09

Thermal Diffusivity . . Shall not exceed 0.325 sq ft per day.

Thermal Shock Resistance . . . . Shall not spall, chip, crack, or otherwise fail when heated to 1800 F and then quenched with water.

Water Absorption . . . After 24-hour submersion, shall gain not more than 93% of volume.

Make . . . . . Kaylo No. 20 or approved equal.

2. Cellular glass insulation shall have the following properties:

Alkalinity . . . . . pH shall be 7.5.

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

Coefficient of Expansion . 4×10^{-6} per degree F.

Combustibility . . . . . Shall be incombustible.

Composition . . . . . A true glass; completely inorganic.

Compressive Strength . . 100 psi

Density . . . . . 9 lb per cu ft.

Flexural Strength . . . . 100 psi

Hygroscopicity . . . . . No increase in weight in 246 days in air at 90% relative humidity.

Modulus of Elasticity . . . 200,000 psi

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

Shear Strength . . . . . 64 psi

Specific Gravity 0.16

Specific Heat . . . . . 0.20 Btu per lb.

Temperature Limits . . . Shall be suitable for use at temperatures from minus 350 F to plus 600 F without mechanical, thermal, or chemical failure.

Tensile Strength . . . . . 84 psi

Thermal Conductivity . . . Shall not exceed the following values at the given mean temperatures:

Mean Temp, °F	Btu/inch, hr, sq ft, °F
50	0.40
300	0.55

Thermal Diffusivity . . . 0.40 sq ft per day

Water Absorption . . . . 0.2% by volume on a 2-inch by 12-inch by 18-inch block (all on surface only).

Make . . . . . Foamglas or approved equal.

II. A. contd

3. Accessory Materials - Specification 32-L

a. Stainless Steel Insulation Strap - 1/2-inch by 0.020-inch, Type 304, or approved equal.

b. Stainless Steel Wire - 0.0475-inch diameter, Type 304, cold drawn, bright annealed, 18 gage, or approved equal.

c. Stainless Steel Clips - Double-pronged, Type 304, A. J. Gerrard, Techalloy double-pronged seal, or approved equal

d. Strapping Tape - Glass filament, vinyl-backed, Dutch Brand No. 400 or approved equal.

e. Fabricating Cement (for use with calcium silicate) - Philip Carey Careytemp, Refractory and Insulation Block Stick, or approved equal.

f. Fabricating Cement (for use with cellular glass) - Miracle RT-1000. or approved equal.

g. Cushioning Blanket - 3-lb density, 1/2-inch thick glass fiber insulation, or approved equal.

h. Weather-Barrier Coating (Color as specified) - PVA-Vimasco No. WC-1, Pittsburgh-Corning Pittcote 500C, or approved equal.

i. Reinforcing cloth - Glass fabric, 10 by 10 thread count, with starch binder, Glass Mesh, Inc, Benjamin Foster Open Weave No. 10, or approved equal.

j. Anti-Abrasion Coating - Dampney No. 70 Black.

k. Vinyl Asphalt Joint Sealer - Vimasco 49, or approved equal.

l. Non-setting Sealer - Benjamin Foster 30-73, or approved equal.

m. Adhesive Cement - Miracle Adhesive Type H or approved equal.

4. Accessory Materials - Specification 32-LSS

Accessory materials for Specification 32-LSS shall be the same as those listed in Part II. A. 3. with the following exceptions:

Cushioning Blanket - 2-1/2 lb per cu ft density TWL Fiberglas or approved equal white glass wool blanket 1 inch thick.

Joint Sealer - Dampney No. 70 Black.

B. APPLICATION - SPECIFICATIONS 32-L and 32-LSS

1. Equipment

a. Equipment shall be provided with insulation supports as called for in the GENERAL SPECIFICATIONS, Part I. B. 5.

b. Thickness Schedule

Second layer, or inner layers, as specified in the GENERAL SPECIFICATIONS, Part I. B. 2, shall be required thickness of cellular glass, but not less than 1-1/2 inch thick. Outer layer shall be 1-1/2-inch thick hydrous calcium silicate insulation.

c. Cushioning Blanket

(1) On all equipment except stainless steel, a 1/2-inch thick cushioning blanket shall be applied over the entire surface before the application of the cellular glass insulation. Blanket shall be held in place with a minimum amount of stainless steel wire. Cellular glass insulation shall then be applied over the blanket in the following manner. Cushioning blanket shall not be considered as part of the specified insulation thickness.

(2) On all stainless steel equipment, a 1-inch thick white glass wool cushioning blanket, as specified for stainless steel, shall be applied over the entire surface, compressed to 1/2-inch thickness, and secured in the same manner as that specified in part II. B. 1. c. (1).

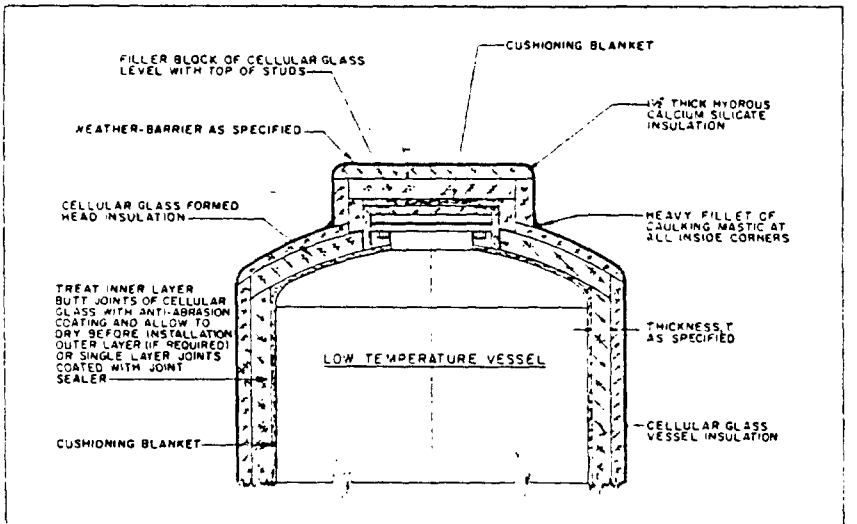
d. Curved Surfaces

(1) Cellular glass block insulation shall be shop fabricated and fitted to allow a 1/2-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 layer.

(2) All butt edges and ends of insulation fabricated for inner layer, or layers, shall be given a smooth brush or spray coat of the specified anti-abrasion coating and allowed to dry for a minimum of 4 hours before application of insulation to equipment.

II. A. 1. d. contd

(3) All butt edges and ends of outermost layer (or single layer) of cellular glass formed insulation shall be sealed with a buttered coat of the specified joint sealer. This coating shall be only of sufficient thickness to provide proper adhesion, seal, and cushion between the individual pieces of insulation. Typical installation is shown in Figure 32-L-1.



HYDROUS CALCIUM SILICATE-CELLULAR GLASS INSULATION
ON LOW TEMPERATURE VESSEL HEAD & NOZZLE

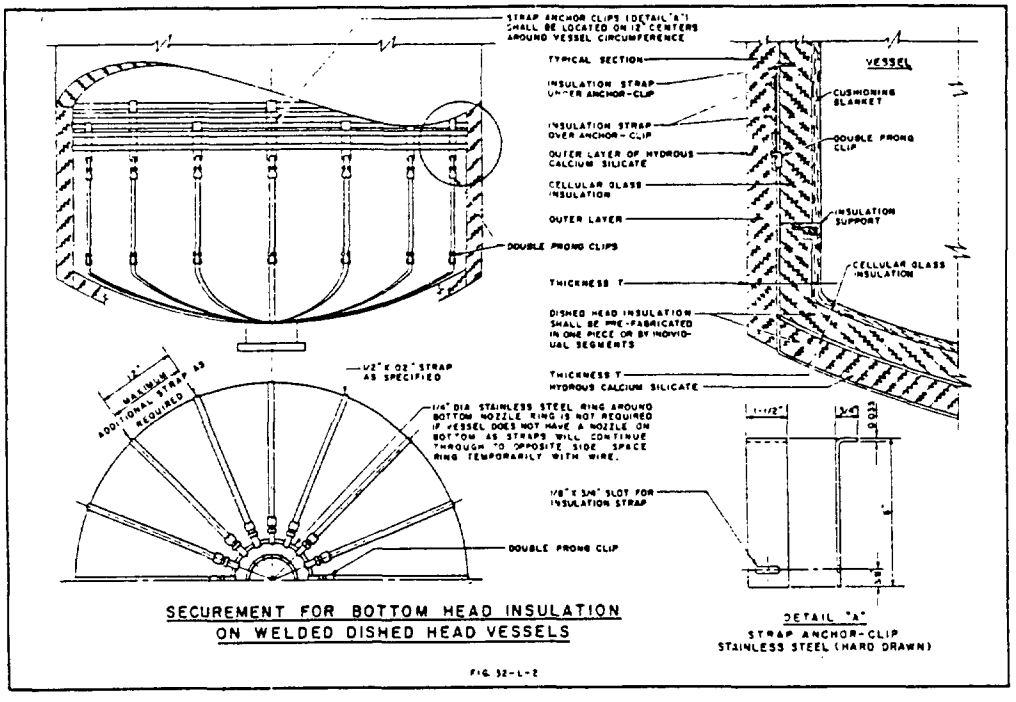
FIG 32-L-1

(4) Calcium silicate block shall be properly cut into curved segments to fit the outside surface of the cellular glass insulation, and applied to insulated sides and heads of vessel in staggered position, with all joints tightly butted. Block shall be applied to vessel sides with linear dimension paralleling axis of vessel.

e. Securement

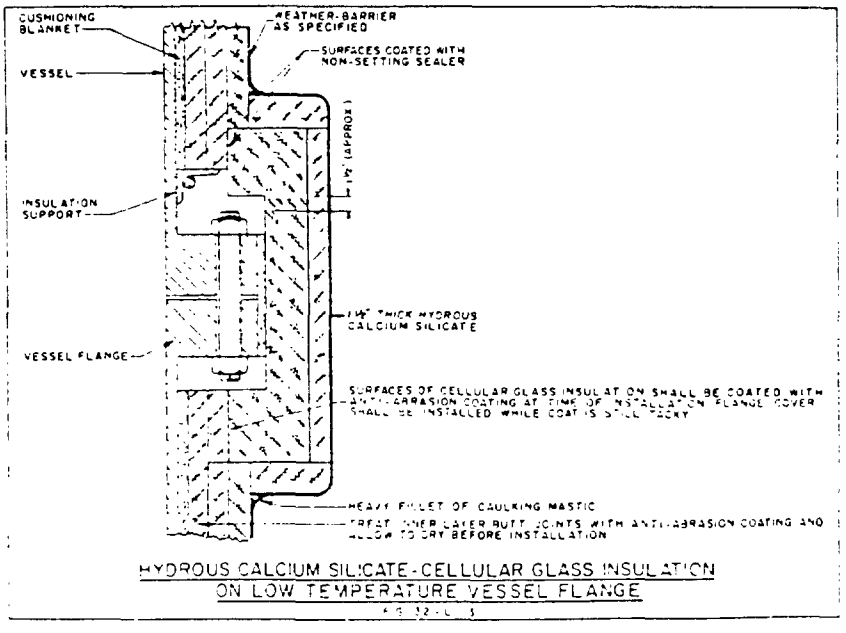
(1) All layers of cellular glass and calcium silicate insulation shall be secured in place with stainless steel insulation strap where contour of vessel permits firm and effective attachment. Insulation shall be secured to irregular surfaces with stainless steel wire.

(2) Inner layer or layers of cellular glass insulation on bottom heads of vertical equipment, or heads of horizontal equipment, shall be held in place with specified stainless steel insulation strap secured to insulation supports as shown in UCCC Standards IS-31, IS-36, and IS-42. 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 32-L-2.

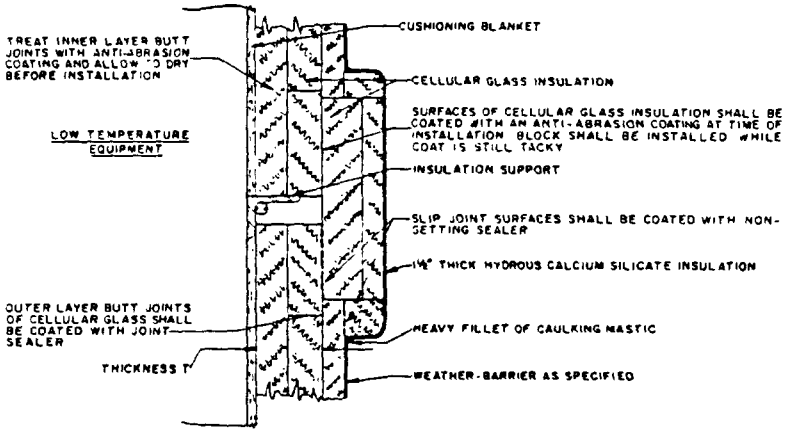


f. Expansion Joints

(1) Cellular glass-calcium silicate applications shall be provided with expansion-contraction joints at vessel flanges, constructed as shown in Figure 32-L-3. Where movement is likely to occur, the specified non-setting sealer shall be applied to surfaces of insulation, as shown, to provide proper slip joint.



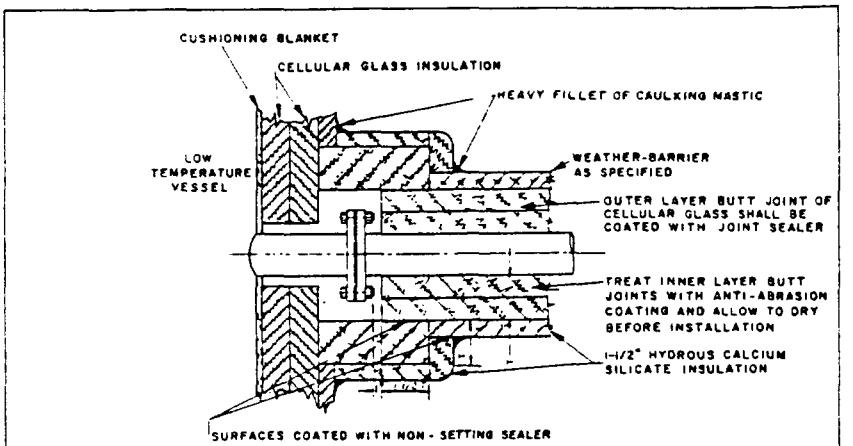
(2) Longitudinal contraction of vessels shall be provided for by installing expansion-contraction joints at the insulation supports, as shown in Figure 32-L-4. Where more than one total thickness is specified for a vessel, an insulation support shall be provided at the junction of two different thicknesses, and insulated in a manner similar to that shown in Figure 32-L-4. Where movement is likely to occur, non-setting sealer shall be applied to surfaces of insulation to provide proper slip joint.



HYDROUS CALCIUM SILICATE - CELLULAR GLASS INSULATION
CONTRACTION JOINT ON LOW TEMPERATURE VESSEL

FIG 32-L-4

(3) A 1-inch space shall be left around nozzles and projections where they extend through the insulation, as shown in Figure 32-L-5. Where movement is likely to occur, non-setting sealer shall be applied to surfaces of insulation to provide proper slip joint.

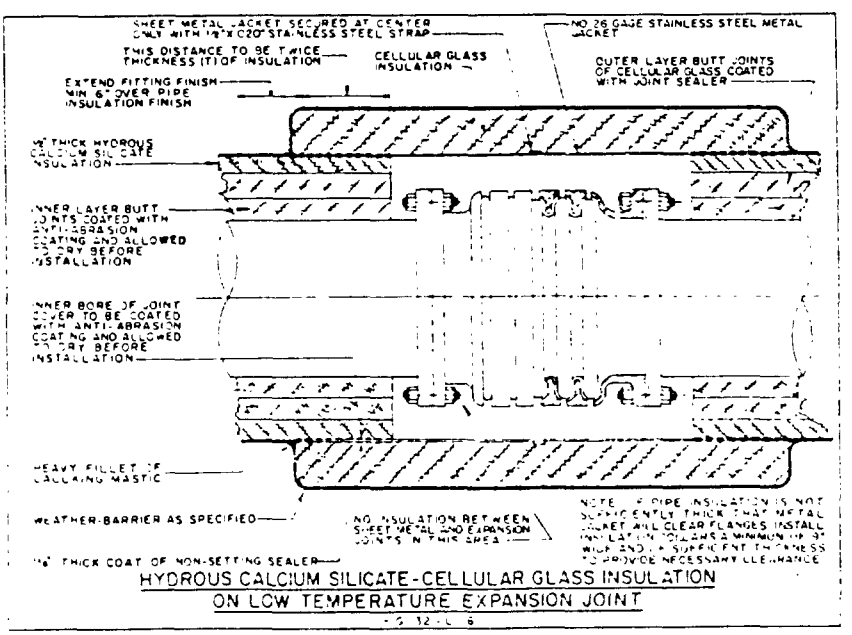


HYDROUS CALCIUM SILICATE - CELLULAR GLASS INSULATION
OF NOZZLE ON LOW TEMPERATURE VESSEL

FIG 32-L-5

g. Mechanical Expansion Joints

Corrugated mechanical expansion joints in piping (usually listed as equipment items) shall be insulated as shown in Figure 32-L-6. Where movement is likely to occur, non-setting sealer shall be applied to surfaces of insulation to provide proper slip joint.



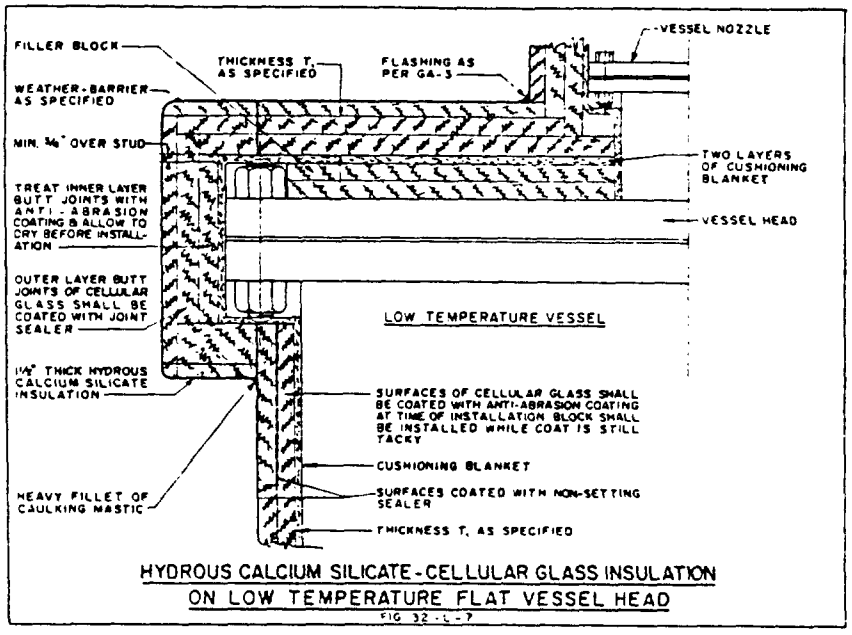
HYDROUS CALCIUM SILICATE-CELLULAR GLASS INSULATION
ON LOW TEMPERATURE EXPANSION JOINT

FIG 32-L-6

II. B. 1. 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. Water pockets shall be eliminated and proper drainage provided as shown in Figure 32-L-7.



HYDROUS CALCIUM SILICATE-CELLULAR GLASS INSULATION
ON LOW TEMPERATURE FLAT VESSEL HEAD

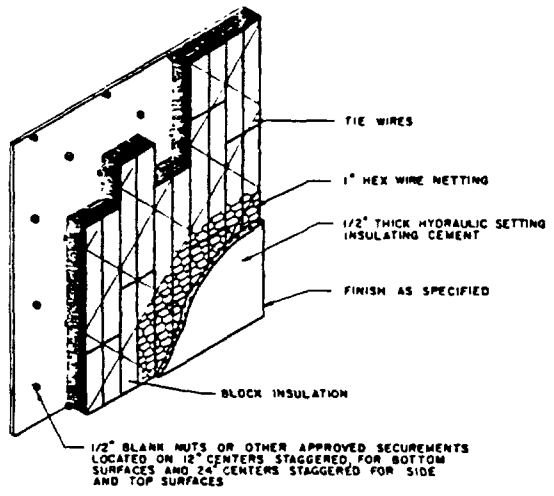
FIG 32-L-7

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

i. Vessel Legs

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

(2) Re-entrant space between channel flanges shall be filled with block cemented in place with the specified adhesive cement. Surface of fire-resistant material abutting tank leg insulation shall be coated with weather-barrier coating. Installation shall be as shown in Figure 32-L-8.



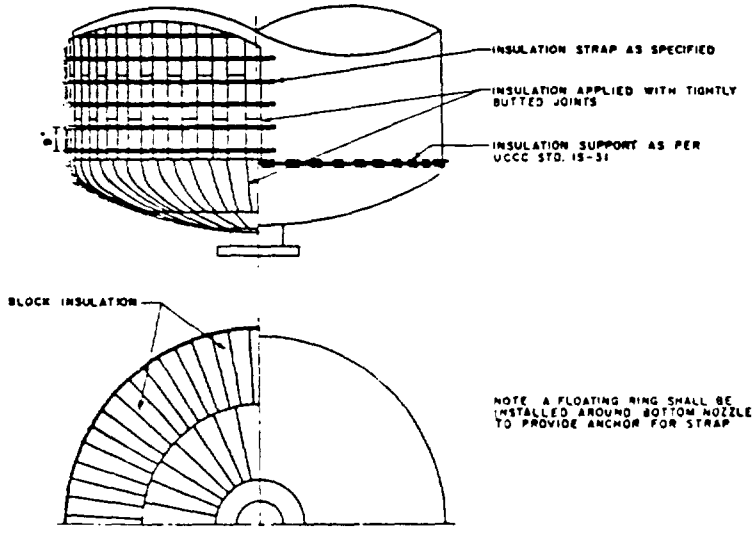
APPLICATION OF CALCIUM SILICATE INSULATION TO FLAT SURFACE

FIG. 20-H-2

e. Securement

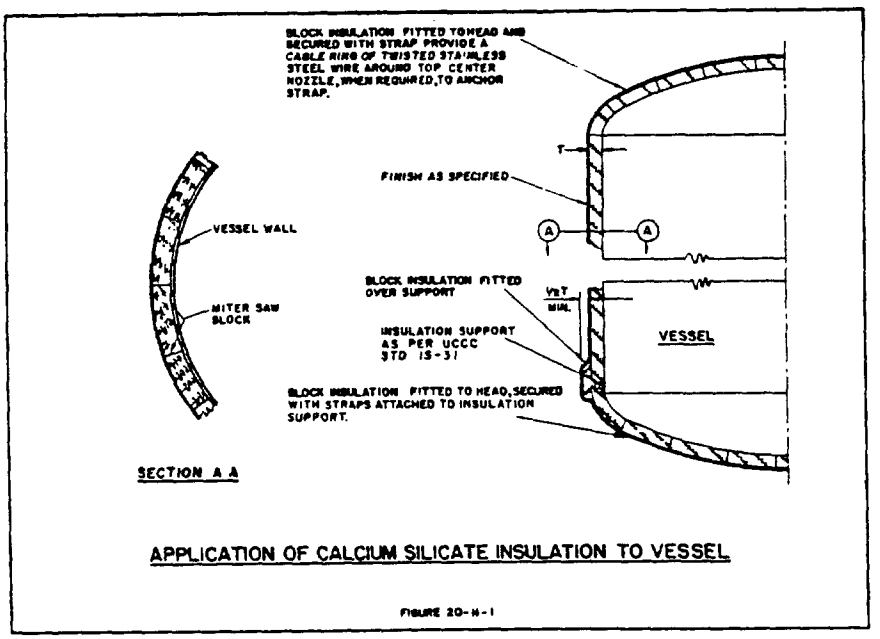
(1) All layers of insulation shall be secured with insulation strap where contour of vessel permits firm and effective attachment. Insulation applied to irregular surfaces, where strap is impracticable, shall be secured with wire, drawn taut, ends twisted and embedded in insulation.

(2) All layers of insulation on bottom heads of vertical equipment and heads of horizontal equipment shall be secured in place with wire attached to blank nuts, or with insulation strap attached to insulation support, as specified in UCCC Standard IS-31 and Figure 20-H-3.



SECUREMENT OF CALCIUM SILICATE INSULATION ON VESSEL HEAD

FIG. 20-H-3



APPLICATION OF CALCIUM SILICATE INSULATION TO VESSEL

FIGURE 20-H-1

d. Flat Surfaces

(1) Block insulation shall be applied to flat surfaces in staggered position with all joints tightly butted. It shall be secured with wire attached to blank nuts or other approved securement. On rectangular equipment, the blank nuts, or other approved securements, shall be placed on 12-inch centers, staggered, for bottom surfaces, and on 24-inch centers, staggered, for side and top surfaces. Where specified in the Insulation Design Schedule, block may be applied to flat surfaces with an approved adhesive.

(2) When specified thickness of insulation has been applied, reinforcing netting shall be stretched tightly over block and secured with tie wires or other approved securement. Entire surface shall be given a 1/2-inch thick, smooth and uniformly applied trowel coat of hydraulic setting insulating cement. Typical installation is shown in Figure 20-H-2.

II. A. 2. contd

Thermal Conductivity . . . When tested in accordance with ASTM C 177, latest revision, or ASTM C 335, latest revision, the thermal conductivity at the given mean temperatures shall not exceed the following values:

Mean Temp, °F	Btu/inch, hr, sq ft, °F
100	0.36
200	0.40
300	0.45
400	0.51
600	0.63

Thermal Diffusivity . . . Shall average 0.11 to 0.25 sq ft per day.

Thermal Shock Resistance . Shall not spall, chip, crack, or otherwise fail when heated to 1200 F and then quenched with water.

Water Absorption . . . After 24-hour submersion, shall gain not more than 400% of the original weight.

3. Accessory Materials

a. Stainless Steel Wire - 0.0475-inch diameter, Type 304, cold drawn, bright annealed, 18 gage.

b. Insulation Strap - Stainless steel, 1/2-inch by 0.020-inch, Type 304, or approved equal.

c. Clips - Stainless steel, 1/2-inch double-pronged, Type 304, A. J. Gerrard, Techalloy double-pronged seal, or approved equal.

d. Insulating Cement - Hydraulic setting, Baldwin - Ehret-Hill Powerhouse, Eagle - Picher One Coat Detrick Utility, or approved equal.

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

f. Mineral Wool Blanket - Black, spun rock wool, hexagonal wire netting on both sides.

g. Mineral Wool Blanket - Black,spun rock wool, hexagonal wire netting on one side, expanded metal lath on the other side.

h. Heat Resistant Sealer - Benjamin Foster No. 30-43 or approved equal.

i. Weather-Barrier Coating (Color as specified)-PVA - Vimasco No. WC-1, Pittsburgh-Corning Pittcote 500C, or approved equal.

j. Reinforcing Cloth - Glass fabric, 10 by 10 thread count, Perma-Glas Mesh, Glasfab, Benjamin Foster Open Weave No. 10, or approved equal.

k. Fabricating Cement - A. P. Green Insulation Adhesive, Philip Carey Careytemp, Refractory and Insulation Block Stick, or approved equal.

l. Wire Netting - One-inch, hexagonal mesh, 20-gage, stainless steel, Type 304, or approved equal.

B. APPLICATION

1. Equipment

a. Insulation Supports

Equipment shall be provided with insulation supports as called for in the GENERAL SPECIFICATIONS, Part I. B. 5.

b. Thickness Schedule

Unless otherwise specified, insulation in excess of 2-1/2 inches total thickness shall be applied in multi-layer construction, as specified in the GENERAL SPECIFICATIONS, Part I. B. 2.

c. Curved Surfaces

On all equipment, insulation block shall be properly miter cut to fit vessel surface and applied to vessel sides and heads in staggered position, with all joints tightly butted. Block shall be applied to vessel sides with linear dimension paralleling axis of vessel. Typical installation is shown in Figure 20-H-1.

II. SPECIFICATION 20-H — Calcium Silic

This Specification describes the essential requirements for the purchase and application of preformed calcium silic insulation for use on equipment and piping normally oper ting at temperatures from 70 F up to and including 750 F.

Procedures outlined in the GENERAL SPECIFICATIONS are applicable to and constitute an integral part of this Spe fication.

A. MATERIAL

1. Composition

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

2. Properties

Calcium Silicate Insulation shall have the following properties:

Alkalinity . . . . . pH shall be not below 8 and not above 13.

Breaking Strength . . . . . Not less than 20 psi when testing a specimen 6 inches wide by 1 inch thick o a 10-inch span.

Coefficient of Expansion . . 2×10^{-6} average on reheat to 1200 F.

Combustibility . . . . . Shall be incombustible.

Compressive Strength . . . When tested in accordance with ASTM C 165, latest revision, the percentag deformation produced by loading shall not exceed the following:

Deformation, %	Load, Psi
2	45
5	105
10	130

Density . . . . . Shall be not less than 10 lb per cu ft, or more than 15 lb per cu ft, when tes in accordance with ASTM C 303, latest revision.

Flexural Strength . . . . . Shall be not less than 45 psi when tested in accordance with ASTM C 203, la revision.

Hardness . . . . . A 1/8-inch ball point under a 1-kg load shall produce a maximum penetratio 0.85 mm.

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

Resistance to Abrasion . . . When subjected to the Navy Tumbling Test, shall lose not more than 30% of o inal weight after first 10-minute run, and not more than 55% after second minute run.

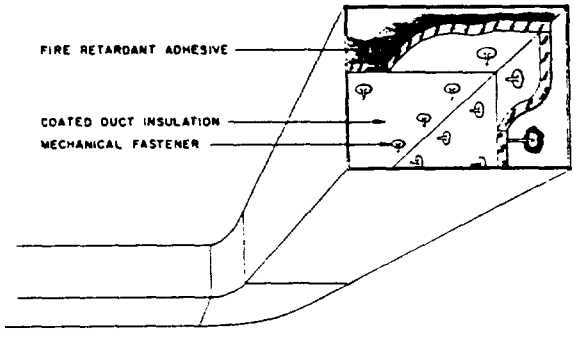
Resistance to Acids and Caustics . . . . . Shall be resistant to most common caustics (not considered an acid-resist material).

Shrinkage . . . . . Shall be not more than 2% at 1200 F when tested in accordance with ASTM C latest revision.

Specific Heat . . . . . 0.21 to 0.30 Btu per lb per degree F at 400 F.

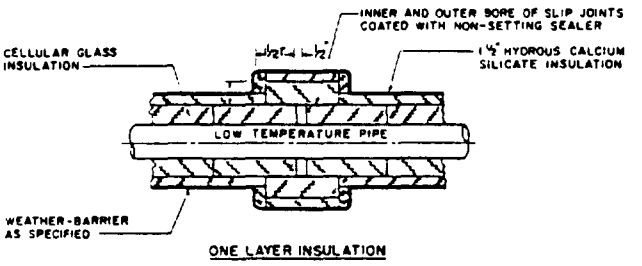
Temperature Limit . . . . Maximum temperature without mechanical, thermal, or chemical failure sh be not less than 1200 F.

Tensile Strength . . . . . Shall be not less than 10 psi.



APPLICATION OF PREFORMED FIBROUS GLASS COATED RIGID INSULATION TO INTERIOR OF DUCT

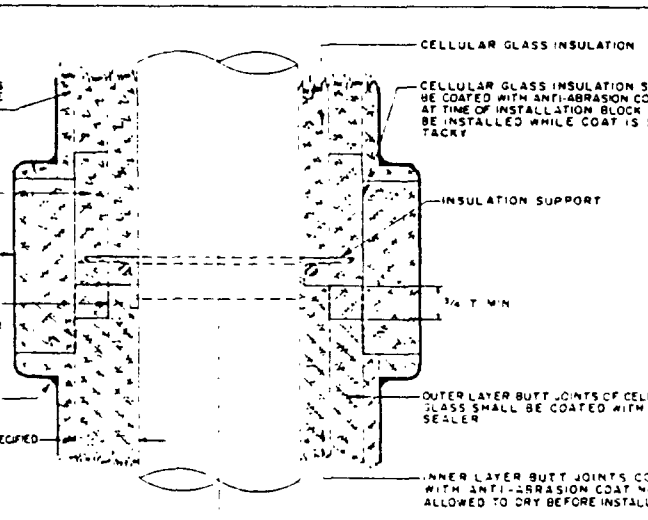
FIG 17-RY-1



HYDROUS CALCIUM SILICATE-CELLULAR GLASS INSULATION
EXPANSION & CONTRACTION JOINT FOR HORIZONTAL PIPING

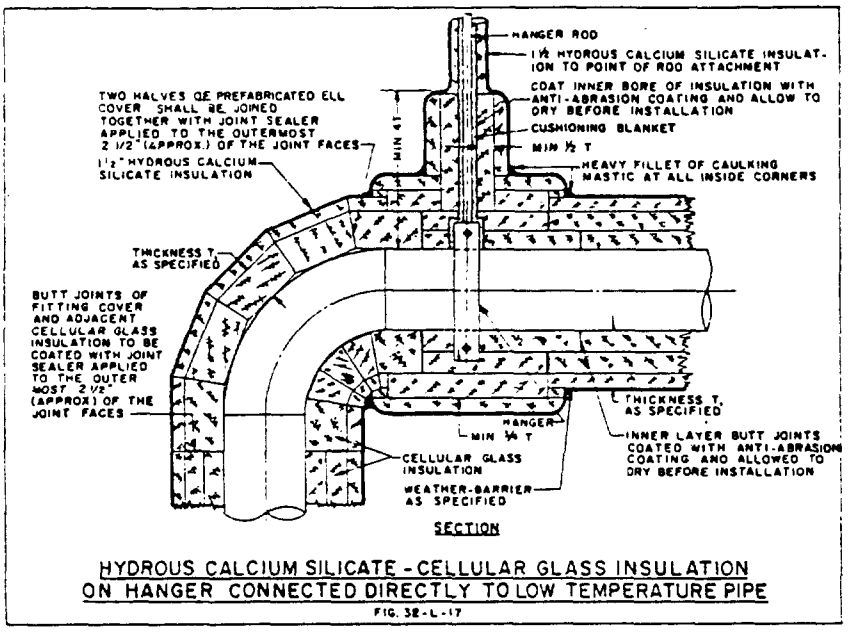
FIG 32-L-18

(4) Where it is necessary to install expansion-contraction joints in insulation on vertical piping, an insulation support shall be provided. Installation shall be as shown in Figure 32-L-19.



HYDROUS CALCIUM SILICATE-CELLULAR GLASS INSULATION VERTICAL
EXPANSION AND CONTRACTION JOINT ON LOW TEMPERATURE PIPING

FIG 32-L-19



HYDROUS CALCIUM SILICATE - CELLULAR GLASS INSULATION
ON HANGER CONNECTED DIRECTLY TO LOW TEMPERATURE PIPE

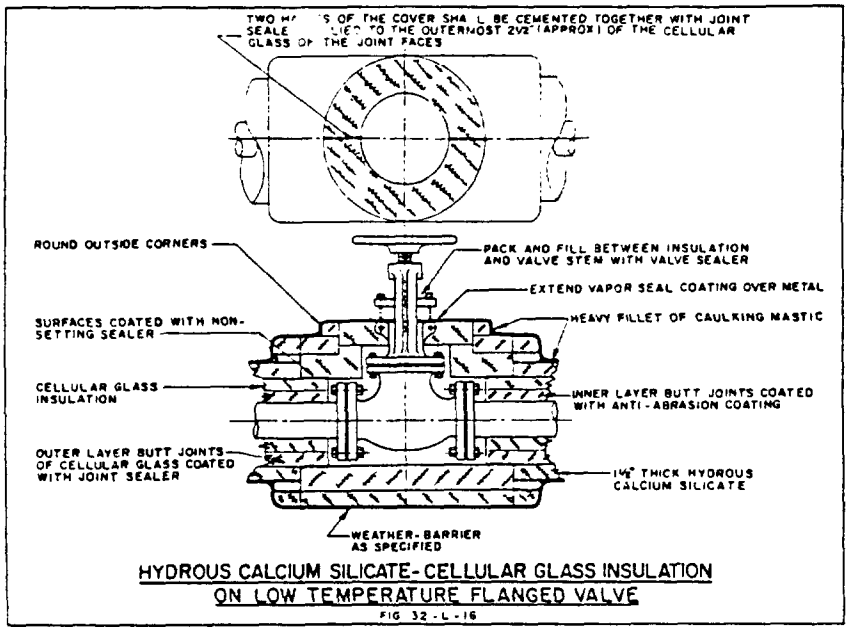
FIG. 32-L-17

e. *Expansion-Contraction Joints*

(1) Expansion and contraction joints shall be installed, as per Figure 32-L-18, in both horizontal and vertical straight run piping, at intervals as follows.

Up to 2-1/2 inches thick insulation - one for each 45 feet
3 inches to 5 inches thick insulation - one for each 33 feet
5-1/2 inches to 7-1/2 inches thick insulation - one for each 21 feet

(2) Where flanged joints occur within these limits, expansion and contraction shall be provided for in the flange cover, and expansion-contraction joints in insulation will not be required.



HYDROUS CALCIUM SILICATE-CELLULAR GLASS INSULATION
ON LOW TEMPERATURE FLANGED VALVE

FIG 32-L-16

(6) All fittings shall be fitted and assembled with very thin, tight joints. Cellular glass fittings shall be cemented with the specified fabricating cement. In all cases the joints shall be thin, with just sufficient cement to obtain good adhesion and complete closure. Wide cement joints, voids, or holes plugged with fabricating cement, will not be permitted.

c. Securement

All layers of cellular glass and calcium silicate pipe insulation shall be secured in place with stainless steel insulation strap, as specified in the GENERAL SPECIFICATIONS, Parts I. B. 6. c and d.

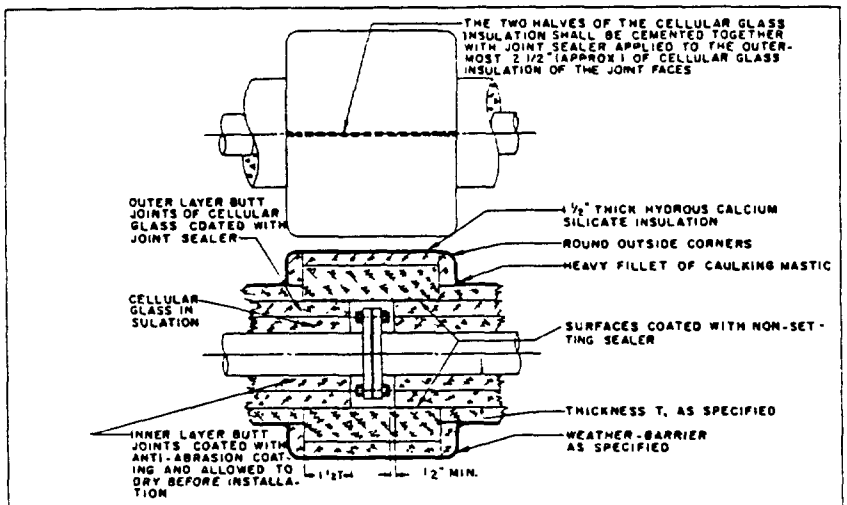
d. Supports and Hangers

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

(2) Hangers attached directly to piping shall be insulated as shown in Figure 32-L-17.

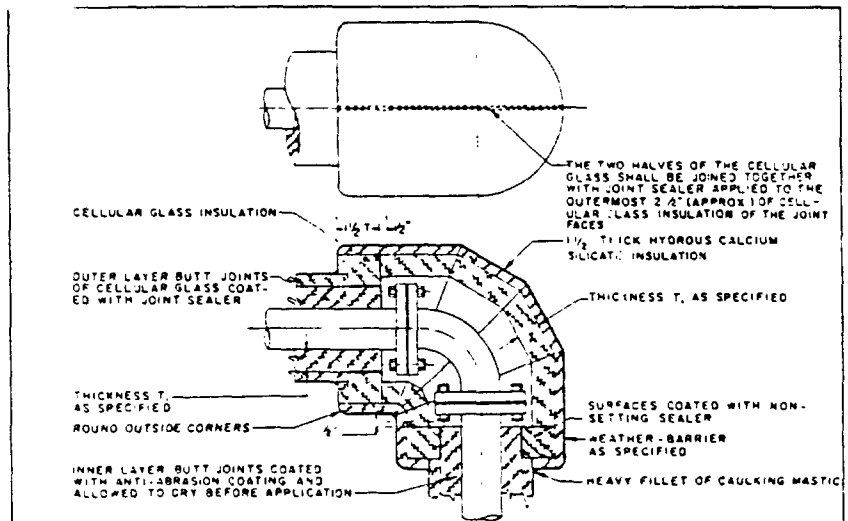
(4) All valves shall be packed and filled around valve stem and packing gland assembly with joint sealer, to avoid water pockets.

(5) Installations of typical fittings and valves are shown in Figures 32-L-14, 32-L-15, and 32-L-16.



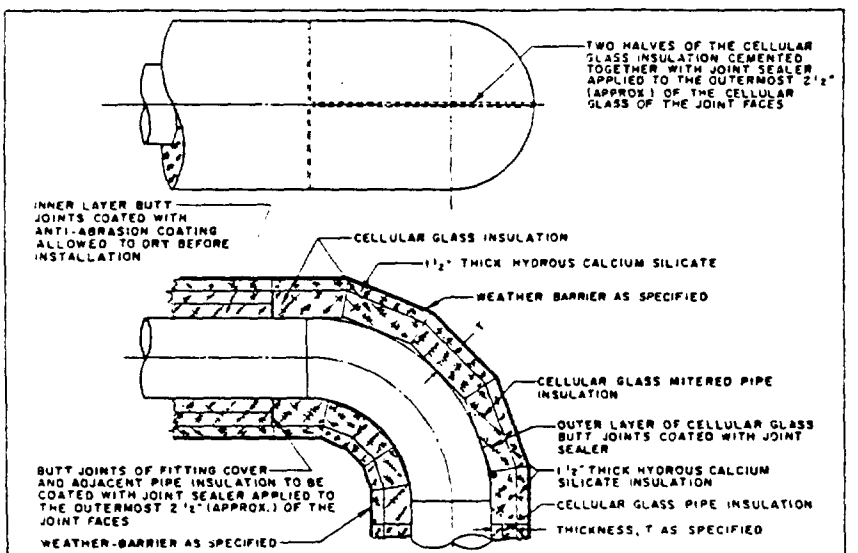
HYDROUS CALCIUM SILICATE-CELLULAR GLASS INSULATION ON LOW TEMPERATURE LINE FLANGE

FIG 32-L-14



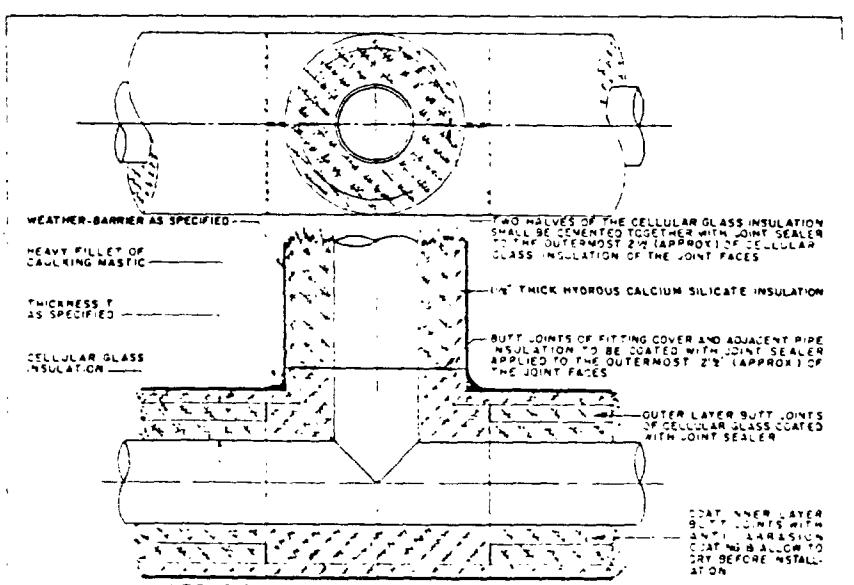
HYDROUS CALCIUM SILICATE-CELLULAR GLASS INSULATION ON LOW TEMPERATURE FLANGED ELL

FIG 32-L-15



HYDROUS CALCIUM SILICATE CELLULAR GLASS INSULATION
ON LOW TEMPERATURE WELDED ELL

FIG 32-L-12



HYDROUS CALCIUM SILICATE-CELLULAR GLASS INSULATION
ON LOW TEMPERATURE WELDED TEE

FIG 32-L-13

1. Weather-Barrier

(1) Weather-barrier coating shall be applied in accordance with the GENERAL SPECIFICATIONS, Parts I. B. 9 and 17.

(2) Weather-barrier consisting of stainless steel jacketing, if required, shall be applied in accordance with the GENERAL SPECIFICATIONS, Part I. B. 18. This requirement is indicated by the addition of the letter M to the specification designations, thus: 32-LM, 32-LSSM.

2. Piping

a. Pipe Insulation

(1) Unless otherwise specified, insulation shall be applied in multiple layers. Inner layer, or layers, shall be the required thickness of cellular glass insulation. The outer layer shall be hydrous calcium silicate insulation a minimum of 1-1/2 inch thick.

(2) Cellular glass insulation thicknesses in excess of 2-1/2 inches shall be applied in multiple layers as specified in the GENERAL SPECIFICATIONS, Part I. B. 2.

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

(4) All butt edges and ends of single layer cellular glass insulation, and outer layer of multiple layer cellular glass applications shall be buttered with the specified joint sealer before application. 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) Butt edges and ends of all inner layers of cellular glass shall be given a smooth brush or spray coat of anti-abrasion coating and allowed to dry for a minimum of 4 hours before application. Care shall be exercised to obtain a thin, even coat of only sufficient thickness to cover and fill the cut cells of the insulation.

(7) When scheduled for installations where thermal shock is expected, a cushioning blanket, as specified, shall be applied to bare pipe before application of cellular glass insulation.

b. Fitting, Flange, and Valve Covers

(1) Fitting, flange, and valve covers shall be shop fabricated in accordance with the UCCC Dimensional Standards Fabrication Manual or ASTM Recommended Practice C 450, latest revision.

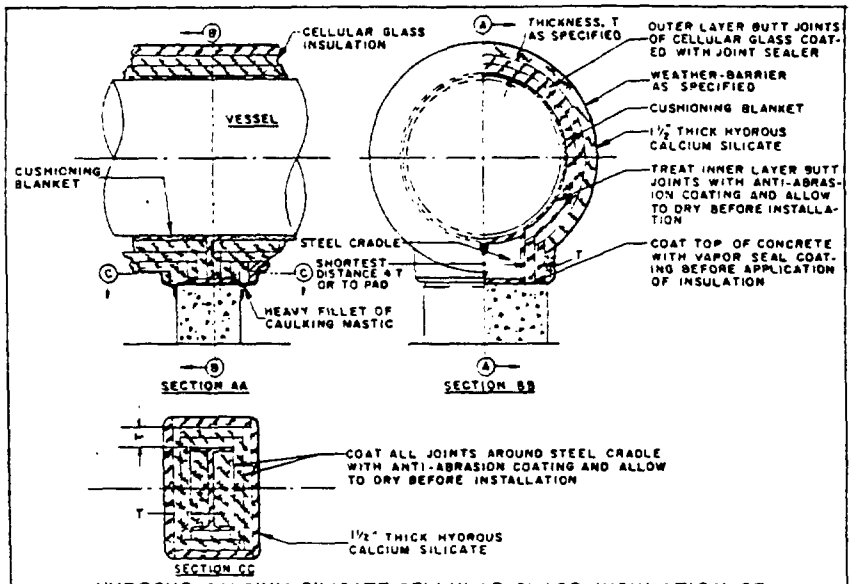
(2) Fitting, flange, and valve covers shall be fabricated in two layers. Inside layer shall be the specified thickness of cellular glass insulation. Outside layer shall be 1-1/2-inch thick hydrous calcium silicate insulation.

(3) 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 applied to the outermost 2-1/2 inches (approx) of the inner layers of cellular glass. 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 32-L-12 and 32-L-13.

II. B. 1. contd

k. Equipment Supports

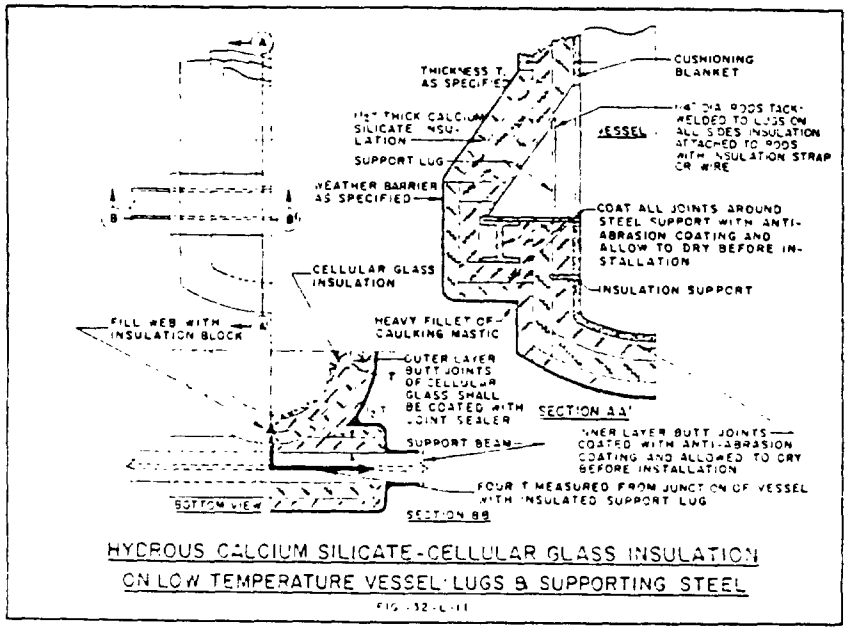
(1) Where equipment is supported on cradles, vessel insulation shall extend over cradles as shown in Figure 32-L-10.



HYDROUS CALCIUM SILICATE-CELLULAR GLASS INSULATION OF CRADLES & SUPPORTS ON LOW TEMPERATURE VESSEL

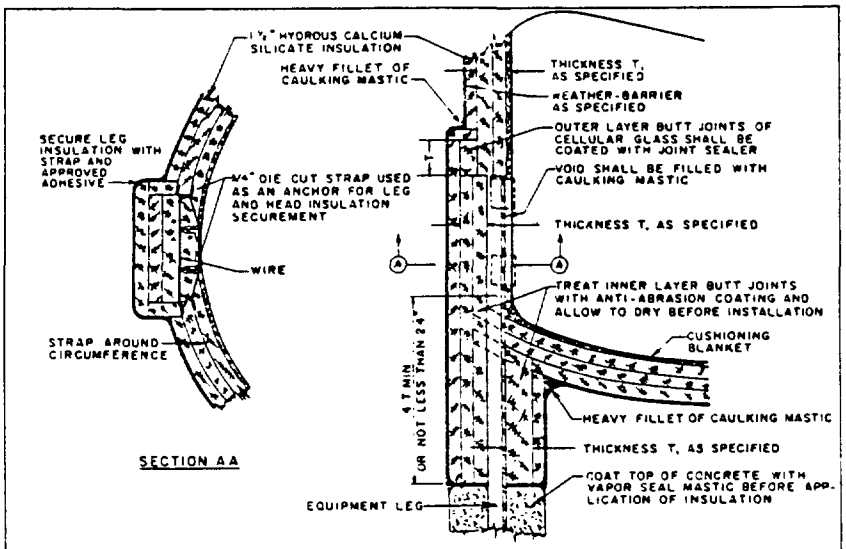
FIG 32-L-10

(2) Where equipment is supported by structural steel members, insulation shall be extended not less than four times the specified insulation thickness in each direction, measured from junction of vessel with insulated support 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 body insulation. Installation shall be as shown in Figure 32-L-11.



HYDROUS CALCIUM SILICATE-CELLULAR GLASS INSULATION ON LOW TEMPERATURE VESSEL LUGS & SUPPORTING STEEL

FIG 32-L-11



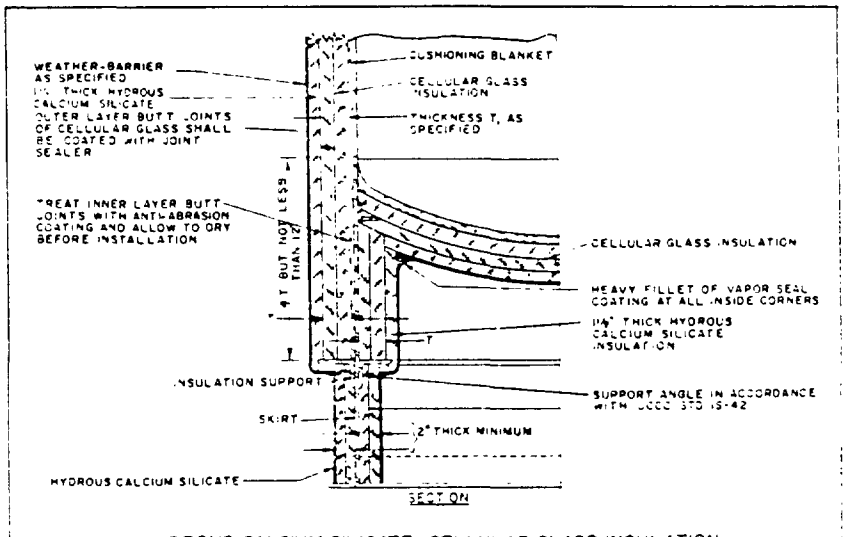
HYDROUS CALCIUM SILICATE - CELLULAR GLASS INSULATION FOR LOW TEMPERATURE VESSEL LEG

FIG 32-L-8

j. **Vessel Skirts**

(1) Both interior and exterior surfaces of skirts supporting vertical equipment shall be insulated. Insulation shall extend downward, from junction of skirt with bottom head, to junction with fire-resistant material or to concrete pad. Thickness of insulation over skirt shall be as specified for body of vessel. Insulating material shall be secured to inside of skirt with adhesive cement.

(2) Support for insulation inside skirts and support for securement of bottom head insulation shall be in accordance with UCCC Standard IS-42. Installation shall be as shown in Figure 32-L-9.



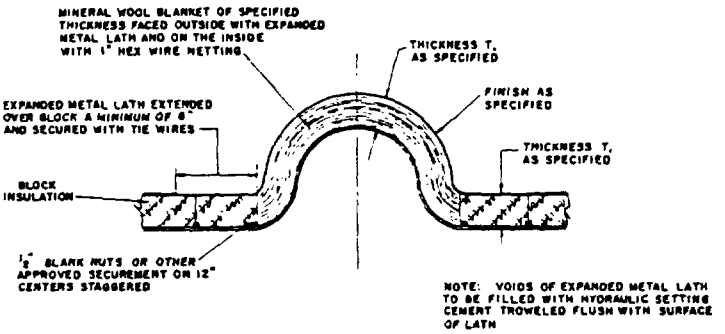
HYDROUS CALCIUM SILICATE CELLULAR GLASS INSULATION ON LOW TEMPERATURE VESSEL SKIRT

FIG 32-L-9

II. B. 1. contd

f. Expansion Joints

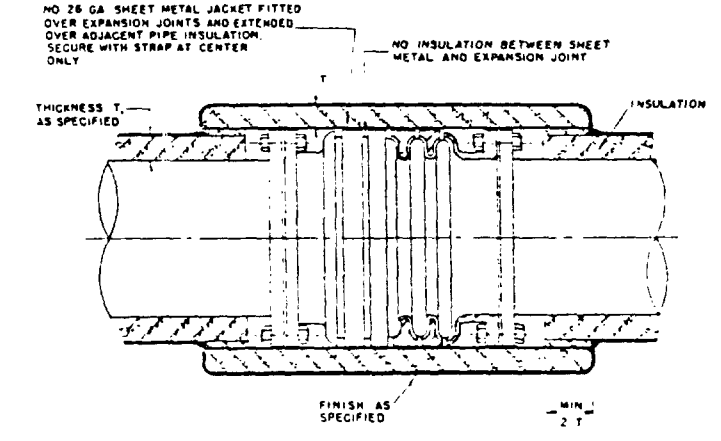
Expansion joints in flat surfaces or cylindrical vessels shall be insulated with flexible blanket insulation Typical installation is shown in Figure 20-H-4.



APPLICATION OF BLANKET INSULATION TO EXPANSION JOINTS ON FLAT SURFACE

FIG. 20-H-4

g. Corrugated mechanical expansion joints on piping (usually listed as equipment items) shall be insulated as shown in Figure 20-H-5.

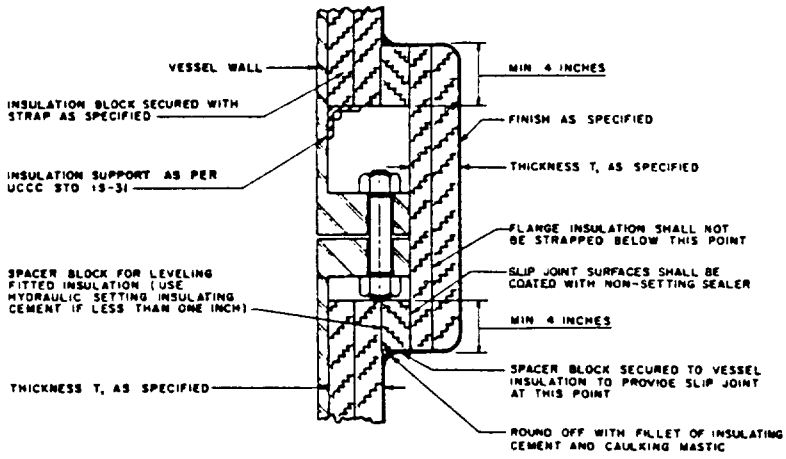


APPLICATION OF CALCIUM SILICATE INSULATION TO EXPANSION JOINTS

FIG. 20-H-5

h. Insulated Vessel Flanges

Vessel flanges shall be insulated with block in the same manner as specified for body of vessel. An insulation support shall be provided immediately above vessel flange. The top of projecting flange insulation shall be sloped to shed water. Typical installation is shown in Figure 20-H-6.

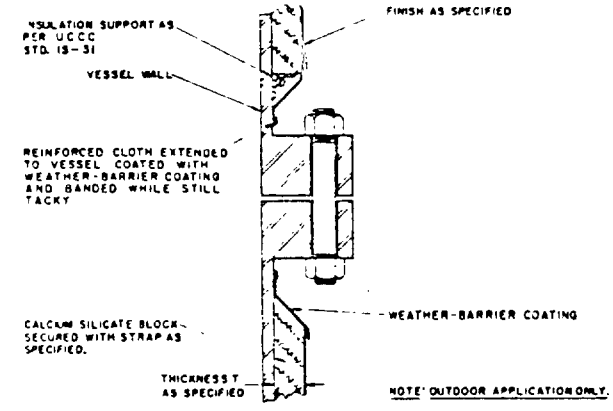


APPLICATION OF CALCIUM SILICATE INSULATION TO VESSEL FLANGE

FIG. 20-H-6

i. Uninsulated Vessel Flanges

Where vessel flanges are located outdoors and specified 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 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 20-H-7.



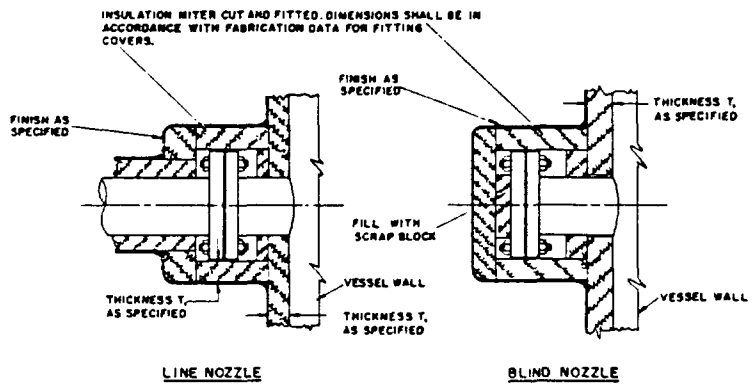
WEATHER SEALING OF CALCIUM SILICATE VESSEL INSULATION AT UNINSULATED FLANGES

FIGURE 20-H-7

II. B. 1. contd

j. Vessel Nozzles

Vessel nozzles shall be insulated as shown in Figure 20-H-8.



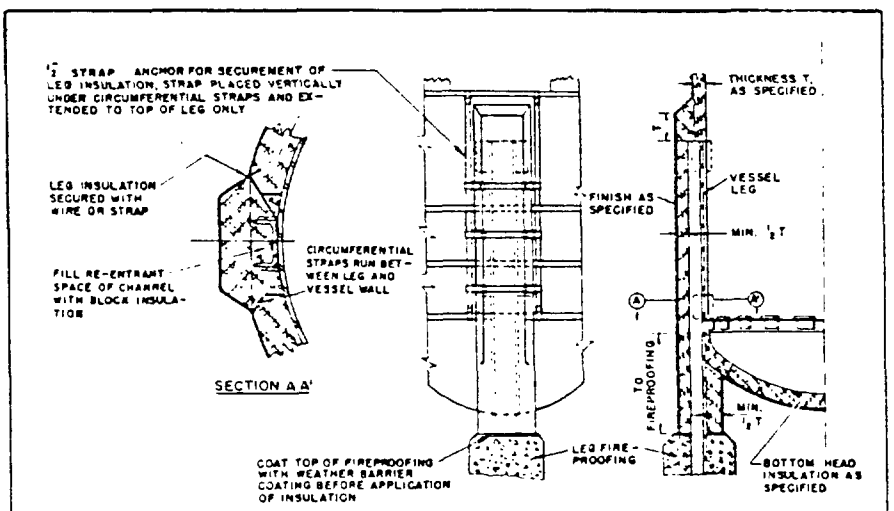
APPLICATION OF CALCIUM SILICATE INSULATION TO VESSEL NOZZLES

FIGURE 20-H-8

k. Vessel Legs

(1) Vessel 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.

(2) 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 20-H-9.



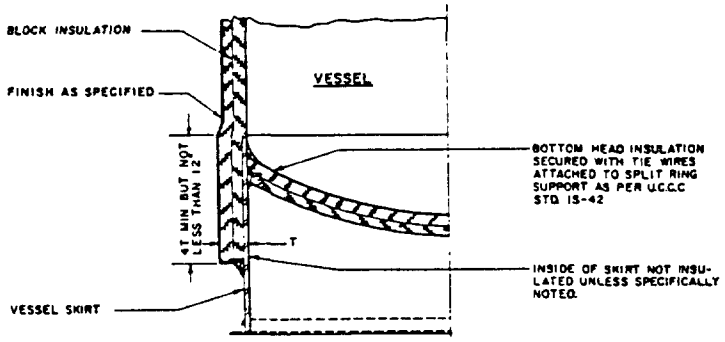
APPLICATION OF CALCIUM SILICATE INSULATION TO VESSEL LEGS

FIG. 20-H-9

II. B. 1. contd

1. 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 UCCC Standard IS-42. Installation shall be as shown in Figure 20-H-10.



APPLICATION OF CALCIUM SILICATE INSULATION TO VESSEL SKIRT

FIG 20-H-10

m. Surface Finish

When specified thickness of insulation has been applied, any small cracks or depressions shall be pointed up with insulation cement trowelled flush with surface of insulation.

n. Weather-Barrier

(1) Weather-barrier coating shall be applied in accordance with the GENERAL SPECIFICATIONS, Parts I. B. 9. and 17.

(2) Weather-barrier consisting of stainless steel jacketing, if required, shall be applied in accordance with the GENERAL SPECIFICATIONS, Part I. B. 18. This requirement is indicated by the addition of the letter M to the specification designation, thus: 20-HM.

2. Piping

a. Pipe Insulation

(1) Thickness Schedule

Unless otherwise specified, insulation in excess of 2-1/2 inches total thickness shall be applied in multi-layer construction as specified in : GENERAL SPECIFICATIONS, Part I. B. 2.

(2) Securement

(a) Insulation shall be applied to piping in accordance with the GENERAL SPECIFICATIONS, Parts I. B. 5, 6, 7, and 8.

(b) All inner layers of sectional pipe insulation shall be secured with stainless steel wire.

(c) All sectional pipe insulation 6-5/8 inches and less in outside diameter shall be secured with stainless steel wire.

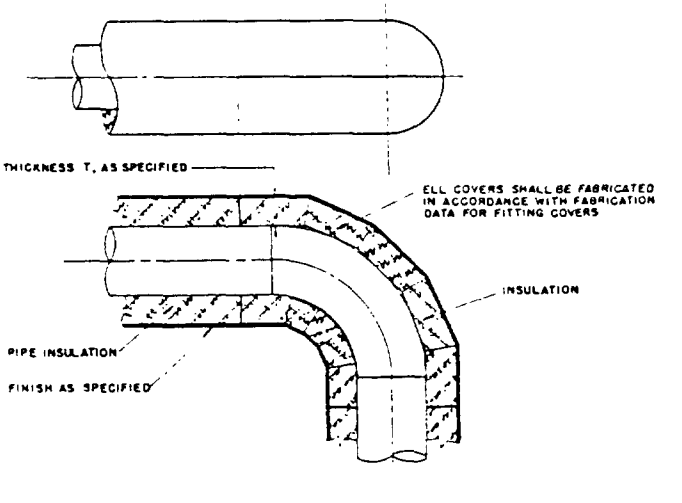
(d) All pipe insulation larger than 6-5/8 inches in outside diameter shall be secured with stainless steel insulation strap.

(e) Location of strap and wire shall be as described in the GENERAL SPECIFICATIONS, Part I. B. 6.

b. Fitting, Flange, and Valve Covers

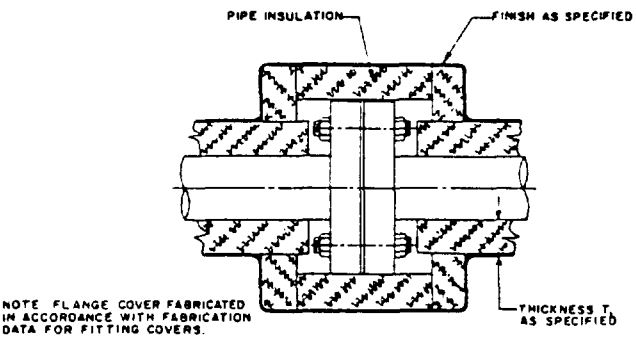
(1) Fitting insulation shall be secured with specified wire or strap as required.

(2) Insulation for all fittings shall be fitted and assembled with tight joints. Cementing of shop fabricated assemblies shall be done with specified 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 filled with fabricating cement, be permitted. Typical installations are shown in Figures 20-H-11, 20-H-12, and 20-H-13.



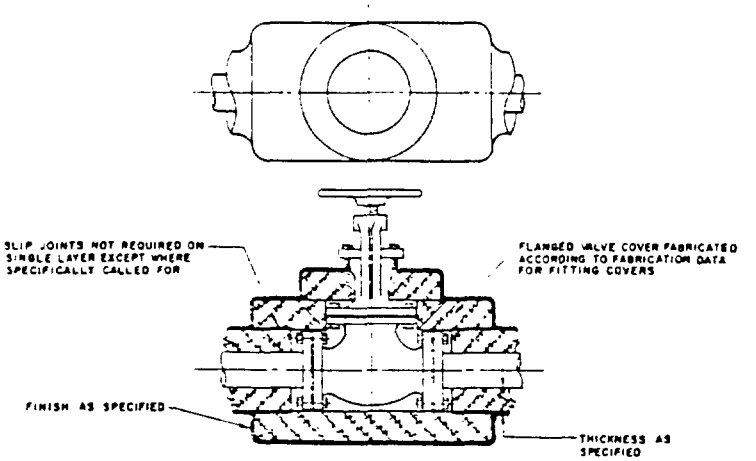
APPLICATION OF CALCIUM SILICATE INSULATION TO WELDING ELL

FIG 20-H-11



APPLICATION OF CALCIUM SILICATE INSULATION TO LINE FLANGE

FIG. 20 - H - 12



APPLICATION OF CALCIUM SILICATE INSULATION TO FLANGED VALVE

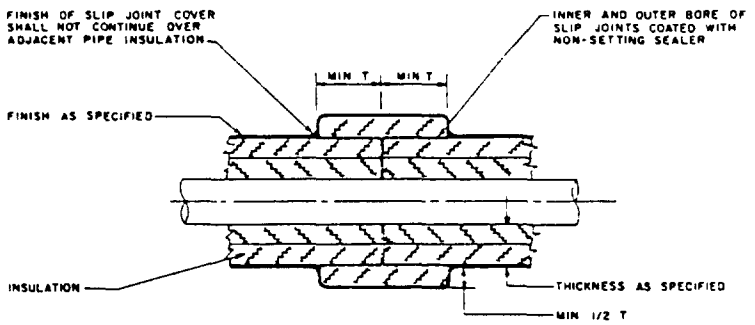
FIG 20-H-13

(3) Fittings, flanges and valves shall be insulated with prefabricated fitting covers (preferred method) in accordance with the UCCC Dimensional Standards Fabrication Manual.

(4) Fitting, flange and valve covers may be field fabricated provided work is in accordance with the UCCC Dimensional Standards Fabrication Manual, and approved by the Field Representative of the Department of Design and Construction. Segments shall be carefully fitted to insure tight joints.

c. Expansion Joints

(1) Expansion slip joints shall be provided in the insulation for multiple layer applications. An expansion joint shall be installed in each 21 ft of straight piping not interrupted by flanges, valves, or fittings. Typical installation is shown in Figure 20-H-14.

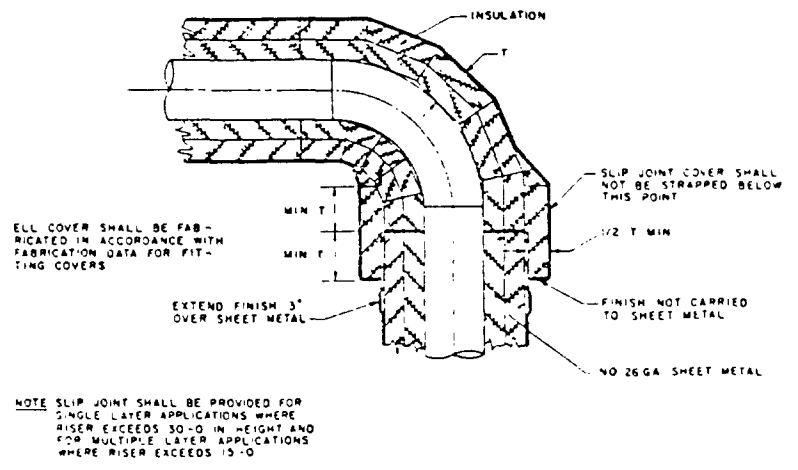


EXPANSION JOINT FOR SINGLE LAYER APPLICATION OF CALCIUM SILICATE INSULATION

FIG 20-H-14

(2) The expansion slip joints shall be installed at the insulation support in vertical piping. Care shall be exercised to place the slip joint so that movement occurs at the bottom in order to shed water.

(3) Expansion slip joints shall be provided at junction of fitting covers and pipe insulation located at the tops of risers, where riser exceeds 30 ft in height for single layer applications, and where riser exceeds 15 ft in height for multiple layer applications. Typical installation is shown in Figure 20-H-15.



APPLICATION OF CALCIUM SILICATE INSULATION TO WELDING ELL

FIG 20-H-15

(4) Insulation supports shall be installed at the bottoms of all risers.

d. Traced Installations

Traced lines, where specified, shall be installed and insulated in accordance with the GENERAL SPECIFICATIONS, Part I. B. 16.

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

(1) Weather-barrier coating shall be applied in accordance with the GENERAL SPECIFICATIONS, Part I. B. 17.

(2) Weather-barrier consisting of stainless steel jacketing, if required, shall be applied in accordance with the GENERAL SPECIFICATIONS, Part I. B. 18. This requirement is indicated by the addition of the letter M to the specification designation, thus: 20-HM.

II. SPECIFICATION 21-H — Asbestos Fiber

Scope

This Specification covers the application of preformed asbestos fiber insulation for use on piping normally operating at temperatures from 70 F up to and including 750 F.

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

A. MATERIAL

1. Composition

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

2. Properties

Asbestos Fiber Insulation shall have the following properties:

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

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

Density	Shall be not less than 14 nor more than 18 lb per cu ft.
Flexural Strength	Shall be not less than 100 psi when tested in accordance with ASTM C 203, latest revision.
Hardness	A 1/8-inch ball point under a 1-kg load shall produce a maximum penetration of 0.40 mm.
Hygroscopicity	Two-inch cubes oven-dried to constant weight, then exposed to air at 70 F, and 90% relative humidity for 14 days, shall gain a maximum of 12.1% of the original weight.
Resistance to Acids and Caustics	Solutions or vapors of those commonly used in industry have negligible effect on physical characteristics.
Shrinkage	Shall be not more than 0.25% when tested at 1200 F in accordance with ASTM C 356, latest revision.
Specific Heat	Shall be not less than 0.22, nor more than 0.24, Btu per lb per degree F.
Temperature Limit	Maximum temperature without mechanical, thermal, or chemical failure shall be not less than 1200 F.

Thermal Conductivity . . . When tested in accordance with ASTM C 177, latest revision, or ASTM C 355, latest revision, the thermal conductivity at the given mean temperatures shall not exceed the following values:

Mean Temp °F	Btu/inch, hr, sq ft, °F
100	0.32
200	0.37
300	0.42
400	0.47
600	0.57

Thermal Diffusivity . . . Shall be approximately 0.197 sq ft per day.

Thermal Shock Resistance. Material shall not spall, chip, crack, or otherwise fail when heated to 750 F and then quenched with water.

Make . . . . . Unibestos, or approved equal.

3. Accessory Materials

a. Stainless Steel Wire - 0.0475-inch diameter, Type 304, cold drawn, bright annealed, 18 gage.

b. Insulation Strap - Stainless steel, 1/2-inch by 0.020-inch, Type 304 or approved equal.

c. Clips - Stainless steel, 1/2-inch double-pronged, Type 304, A. J. Gerrard or approved equal.

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

e. Finishing Cement - Hard surface, Eagle Picher No. 106, Johns Manville 678, or approved equal.

f. Heat Resistant Sealer - Benjamin Foster No. 30-43 or approved equal.

g. Weather Barrier Coating (Color as specified) - PVA-Vimasco No. WC-1, Pittsburgh-Corning Pittcote 500 C, or approved equal.

h. Reinforcing Cloth - Glass fabric, 10 by 10 thread count, Perma-Glas Mesh, Benjamin Foster Open Weave No. 10, Glasfab, or approved equal.

i. Fabricating Cement - A. P. Green Insulation Adhesive, Philip Carey Careytemp, Refractory and Insulation Block Stick, or approved equal.

B. APPLICATION

1. Piping

a. Pipe Insulation

(1) Unless otherwise specified, insulation in excess of 2-1/2 inches total thickness shall be applied in multiple layers as specified in the GENERAL SPECIFICATIONS, Part I. B. 2.

(2) Insulation shall be applied to piping in staggered position in accordance with the GENERAL SPECIFICATIONS, Parts I. B. 5, 6, 7, and 8, with all joints tightly butted and factory attached sheeting jacket, where furnished, removed.

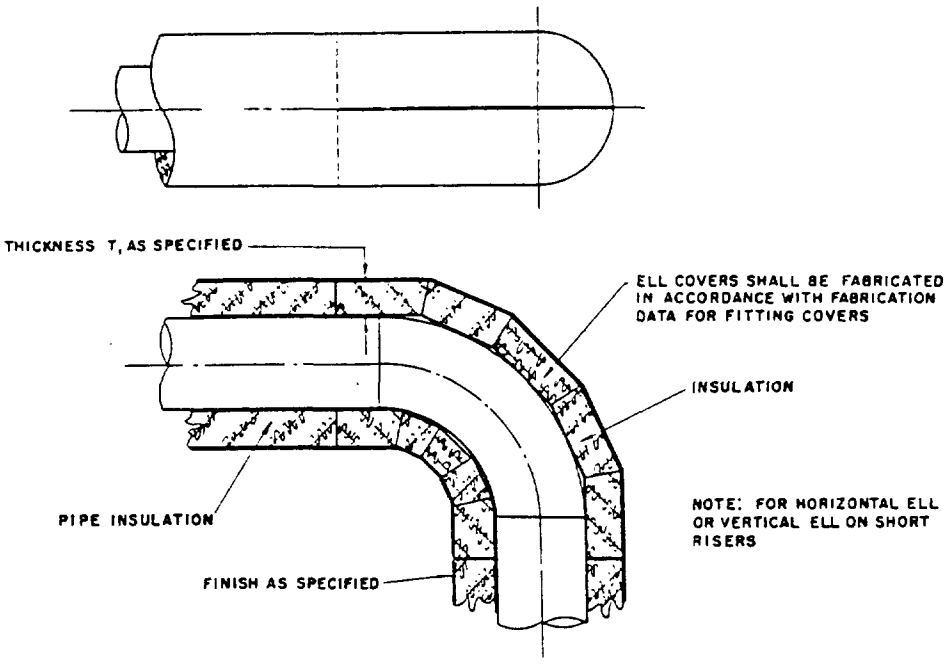
(3) Small cracks and depressions, where present, shall be pointed up with insulating cement troweled smooth with insulation surface.

b. Fittings, Flanges and Valves

(1) Fittings, flanges and valves shall be insulated with prefabricated insulation covers fabricated in accordance with the UCCC Dimensional Standard Fabrication Manual.

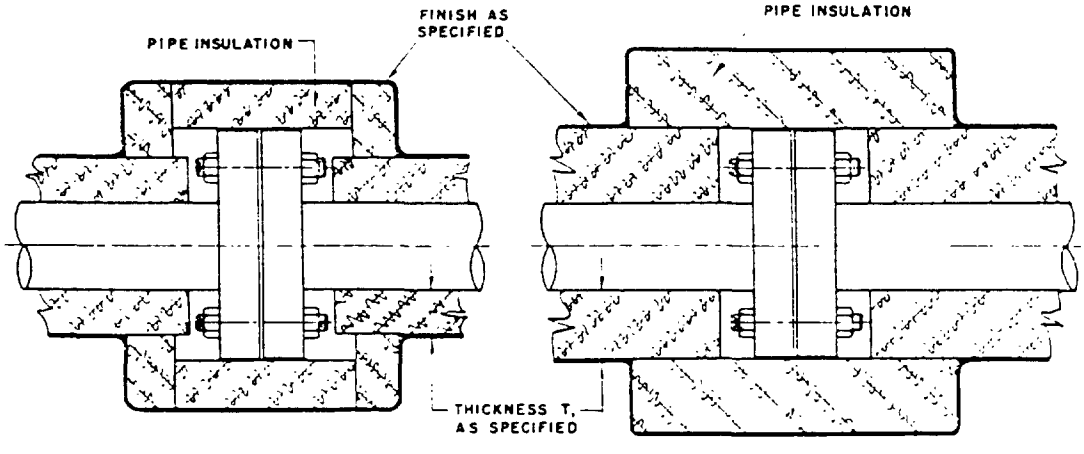
(2) Subject to the approval of the representative of the Department of Design and Construction, fitting covers may be field fabricated, provided work is in accordance with the UCCC Dimensional Standard Fabrication Manual. Segments shall be carefully fitted to insure tight joints.

(3) Fabricated assemblies shall be cemented with specified 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 fabricating cement joints, or voids and holes filled with fabricating cement, be permitted. Typical installations are shown in Figures 21-H-1, 21-H-2, 21-H-3, and 21-H-4.



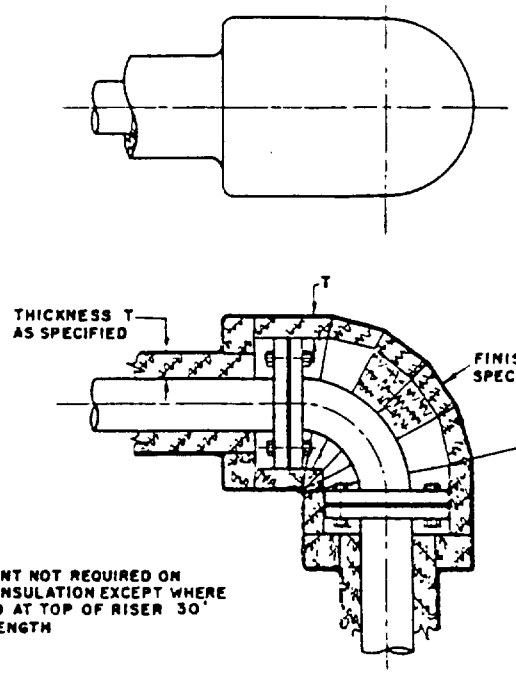
APPLICATION OF ASBESTOS FIBER INSULATION TO WELDING ELL

FIG. 21-H-1



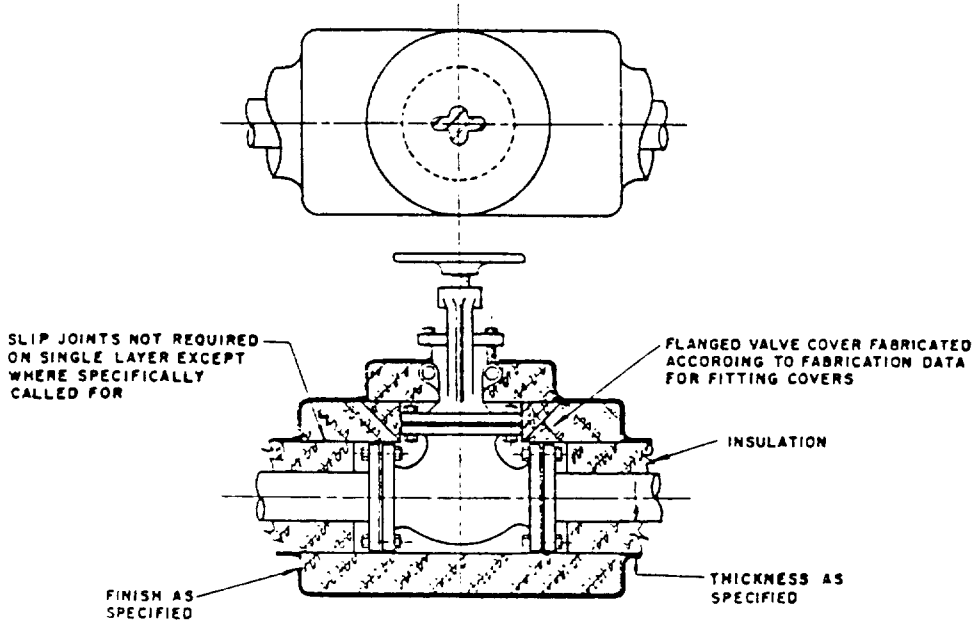
APPLICATION OF ASBESTOS FIBER INSULATION TO LINE FLANGE

FIG. 21-H-2



APPLICATION OF ASBESTOS FIBER INSULATION TO FLANGED ELL

FIG. 21-H-3



APPLICATION OF ASBESTOS FIBER INSULATION TO FLANGED VALVE

FIG. 21-H-4

I. B. 1. contd

c. Securement

(1) Application and securement of pipe insulation shall be as shown in Figures GA-1 and GA-2 of the GENERAL SPECIFICATIONS.

(2) All inner layers, and outer layers of sectional pipe insulation 6-5/8 inches and less in outside diameter, shall be secured with stainless steel wire.

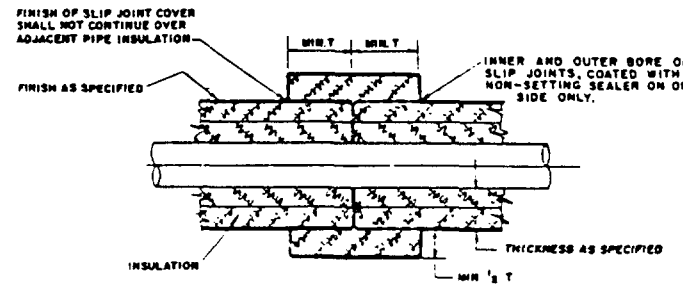
(3) All pipe insulation larger than 6 5/8 inches in outside diameter shall be secured with stainless steel insulation strap.

(4) Fitting, flange and valve covers shall be secured with specified insulation strap as required.

(5) Location of strap and wire shall be as described in the GENERAL SPECIFICATIONS, Part I. B. 6.

d. Expansion Joints

(1) Expansion slip joints shall be provided in the insulation for multiple layer applications. An expansion joint shall be installed in each 21 ft of straight piping not interrupted by flanges, valves, or fittings. Typical installation is shown in Figure 21-H-5.

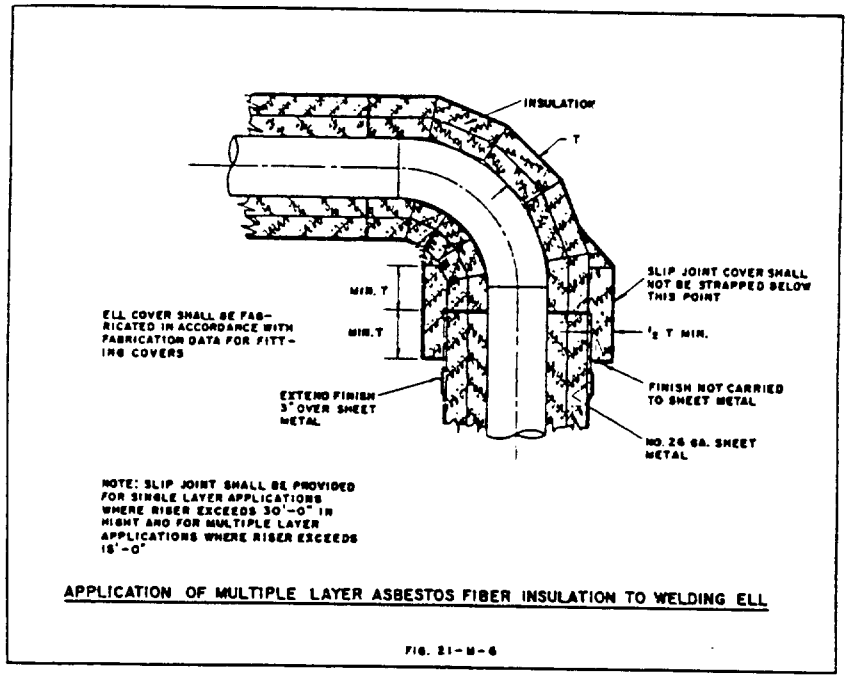


EXPANSION JOINT FOR MULTIPLE LAYER APPLICATION OF ASBESTOS FIBER INSULATION

FIG. 21-H-6

(2) The expansion slip joints shall be installed at the insulation support in vertical piping. Care shall be exercised to place slip joint so that movement occurs at the bottom in order to shed water.

(3) Expansion slip joints shall be provided at junction of fitting covers and pipe insulation located at the top of risers, where riser exceeds 30 ft in height for single layer applications and where riser exceeds 15 ft in height for multiple layer applications. Typical installation is shown in Figure 21-H-6.

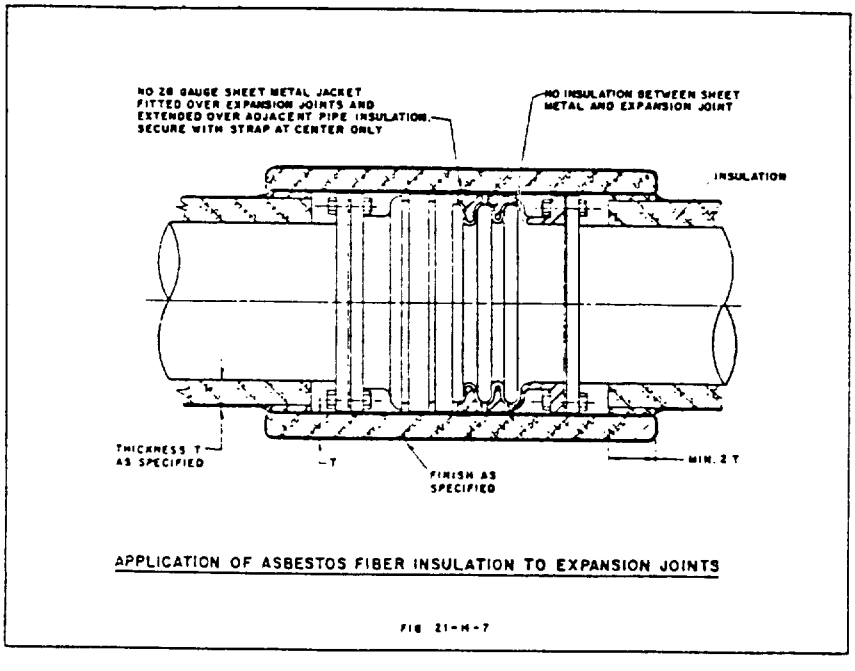


APPLICATION OF MULTIPLE LAYER ASBESTOS FIBER INSULATION TO WELDING ELL

FIG. 21-H-6

(4) Insulation supports shall be installed at the bottoms of all risers.

(5) Corrugated mechanical expansion joints in piping (usually listed as equipment items) shall be insulated as shown in Figure 21-H-7.



APPLICATION OF ASBESTOS FIBER INSULATION TO EXPANSION JOINTS

FIG 21-H-7

II. B. 1. contd

e. Traced Installations

Traced lines, where specified, shall be installed and insulated in accordance with the GENERAL SPECIFICATIONS, Part I. B. 16.

f. Weather-Barrier

(1) Weather-barrier coating shall be applied in accordance with the GENERAL SPECIFICATIONS, Part I. B. 17.

(2) Weather-barrier consisting of stainless steel jacketing shall be applied in accordance with the GENERAL SPECIFICATIONS, Part I. B. 18. This requirement is indicated by the addition of the letter M to the specification designation, thus: 21-HM.

II. SPECIFICATION 22-H — Bonded Expanded Silica

Scope

This Specification describes the essential requirements for the purchase and application of preformed bonded and reinforced expanded silica (perlite) insulation for use on equipment and piping normally operating at temperatures from 70 F up to and including 1600 F.

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

A. MATERIAL

1. Composition

Material shall be composed of expanded silica (perlite), reinforced with asbestos and glass fibers in suitable proportion, and with other binding fillers added to provide proper structural strength.

2. Properties

Bonded expanded silica insulation shall have the following properties:

Alkalinity . . . . . pH shall be not below 8.0 and not above 8.6.

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

Combustibility . . . . . Shall be incombustible.

Compressive Strength . . . The percentage of deformation produced by loading shall be less than the following:

Deformation, %	Load, psi
2	70
5	70

Density . . . . . Shall be not less than 9.5 lb per cu ft, nor more than 11.5 lb per cu ft, when tested in accordance with ASTM C 303, latest revision.

Flexural Strength . . . . . Shall be not less than 70 psi when tested in accordance with ASTM C 203, latest revision.

Hygroscopicity . . . . . Two-inch cubes, oven-dried to constant weight, then exposed to air at 70 F and 90% relative humidity, shall gain a maximum of 6% of the original weight.

Resistance to Abrasion . . When subjected to the Navy Tumbling Test, shall lose not more than 40% of original weight after first 10-minute run, and not more than 70% after second 10-minute run.

Resistance to Acids . . . . Excellent; when immersed in sulfuric acid, hydrochloric acid, or aqua regia, no damage in 100 hours.

Resistance to Caustics . . Good for most common caustics.

Shrinkage . . . . . When tested in accordance with ASTM C 356, latest revision, shall be not more than 0.80% at 1200 F, and not more than 1.85% at 1500 F.

Temperature Limit . . . . Maximum temperature without mechanical, thermal, or chemical failure shall be not less than 1600 F.

Thermal Conductivity . . . Shall not exceed the following values at the given mean temperatures:

Mean Temp, °F	Btu/inch, hr, sq ft, °F
100	0.34
200	0.39
300	0.44
400	0.50
600	0.60
1000	0.81

Thermal Diffusivity . . . Shall not exceed 0.33 sq ft per day.

Water Absorption . . . After 24-hour submersion, shall gain not more than 25% of the original weight.

Make . . . . . Philip Carey Manufacturing Company "Careytemp"

II. A. contd

3. Accessory Materials

a. Stainless Steel Wire - 0.0475-inch diameter, Type 304, cold drawn, bright annealed, 18 gage.

b. Insulation Strap - Stainless Steel, 1/2-inch by 0.020-inch, Type 304, or approved equal.

c. Clips - Stainless steel, 1/2-inch double-pronged, Type 304, A. J. Gerrard, Techalloy double-pronged seal, or approved equal.

d. Insulating Cement - Careytemp Asbestos Cement.

e. Mineral Wool Blanket - Black, spun rock wool, hexagonal wire netting on both sides.

f. Mineral Wool Blanket - Black, spun rock wool, hexagonal wire netting on one side, expanded metal lath on the other side.

g. Heat-Resistant Sealer - Benjamin Foster No. 30-43 or approved equal.

h. Weather-Barrier Coating (Color as specified) - PVA-Vimasco No. WC-1, Pittsburgh-Corning Pittcote 500 C, or approved equal.

i. Reinforcing Cloth - Glass fabric, 10 by 10 thread count, Perma-Glas Mesh, Glasfab, Benjamin Foster Open Weave No. 10, or approved equal.

j. Fabricating Cement - Careytemp Adhesive or approved equal.

k. Wire Netting - One-inch Hexagonal Mesh, 20 gage, Type 304 stainless steel, or approved equal.

II. B. APPLICATION

1. Equipment

a. Insulation Supports

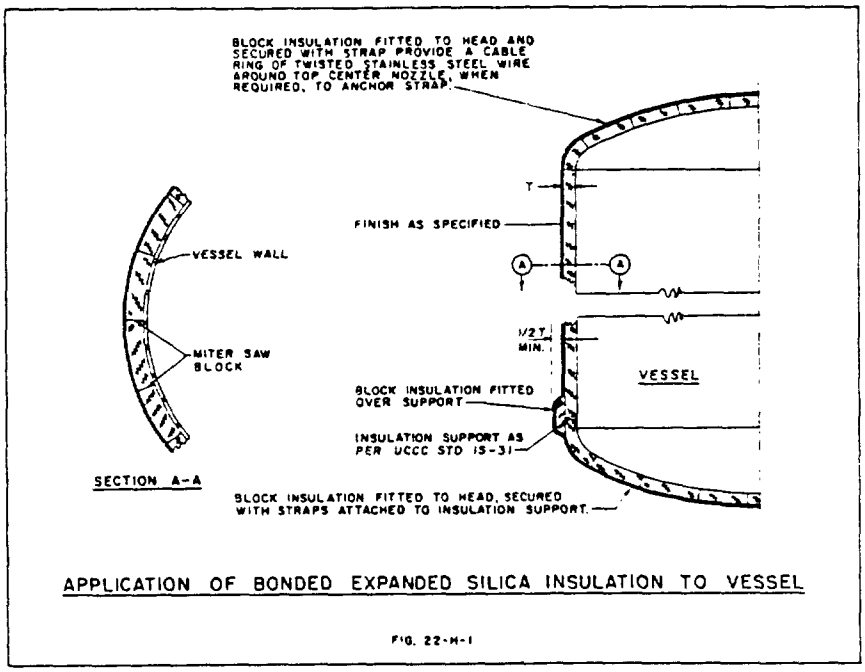
Equipment shall be provided with insulation supports as called for in the GENERAL SPECIFICATIONS, Part I. B. 5.

b. Thickness Schedule

Unless otherwise specified, insulation in excess of 2-1/2 inches total thickness shall be applied in multi-layer construction, as specified in the GENERAL SPECIFICATIONS, Part I. B. 2.

c. Curved Surfaces

On all equipment, insulation block shall be properly miter cut to fit vessel surface and applied to vessel sides and heads in staggered position, with all joints tightly butted. Block shall be applied to vessel sides with linear dimension paralleling axis of vessel. Typical installation is shown in Figure 22-H-1.



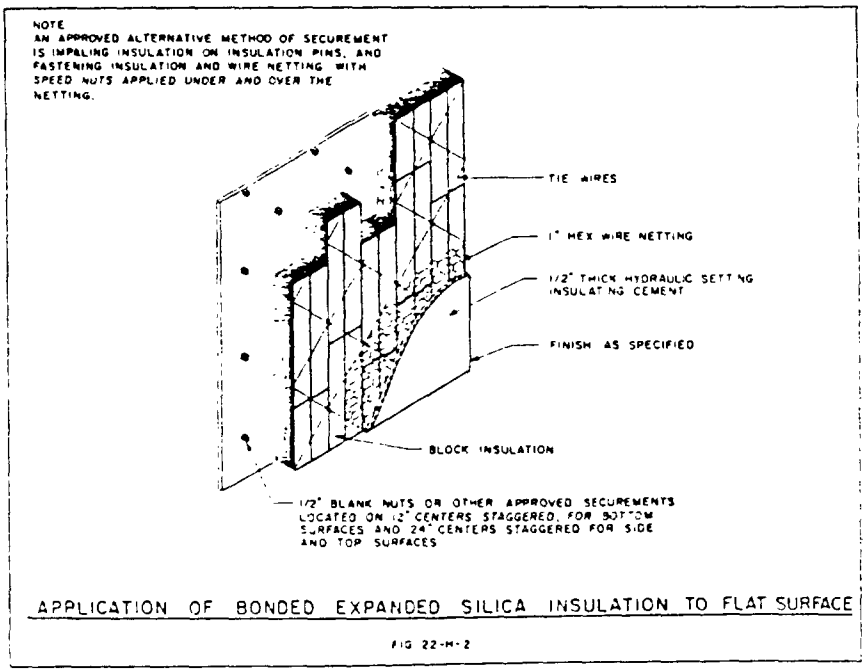
APPLICATION OF BONDED EXPANDED SILICA INSULATION TO VESSEL

FIG. 22-H-1

d. Flat Surfaces

(1) Block insulation shall be applied to flat surfaces in staggered position with all joints tightly butted. It shall be secured with wire attached to blank nuts or other approved securement. On rectangular equipment, the blank nuts, or other approved securements, shall be placed on 12-inch centers, staggered, for bottom surfaces, and on 24-inch centers, staggered, for side and top surfaces. Where specified in the Insulation Design Schedule, block may be applied to flat surfaces with an approved adhesive.

(2) When specified thickness of insulation has been applied, reinforcing netting shall be stretched tightly over block and secured with tie wires or other approved securement. Entire surface shall be given a 1/2-inch thick, smooth and uniformly applied trowel coat of hydraulic setting insulating cement Typical installation is shown in Figure 22-H-2.



APPLICATION OF BONDED EXPANDED SILICA INSULATION TO FLAT SURFACE

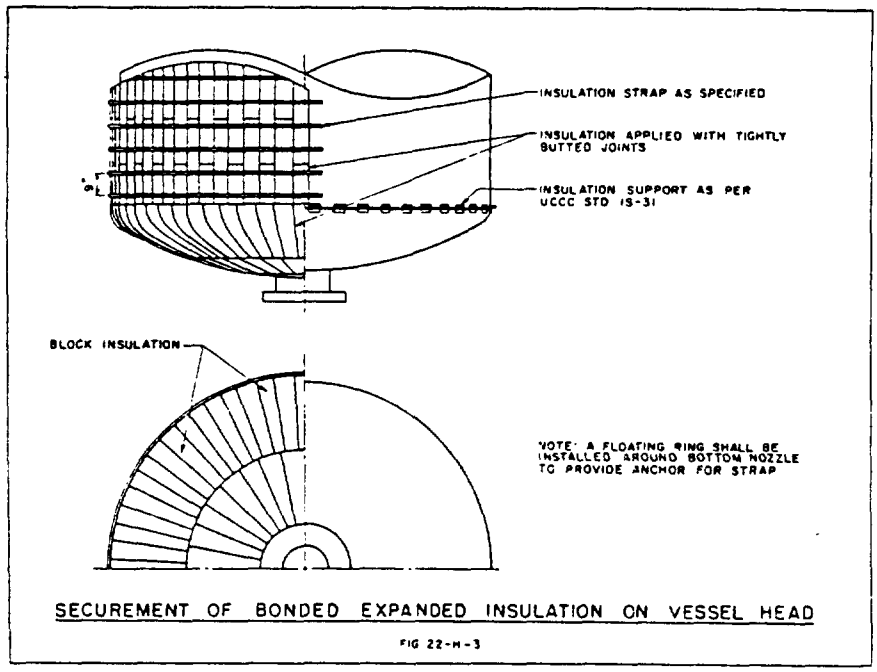
FIG 22-H-2

II. B. 1. contd

e. Securement

(1) All layers of insulation shall be secured with insulation strap where contour of vessel permits firm and effective attachment. Insulation applied to irregular surfaces, where strap is impracticable, shall be secured with wire, drawn taut, ends twisted and embedded in insulation.

(2) All layers of insulation on bottom heads of vertical equipment and heads of horizontal equipment sh. be secured in place with wire attached to blank nuts, or with insulation strap attached to insulation support, as specified in UCCC Standard IS-31 and Figure 22-H-3.

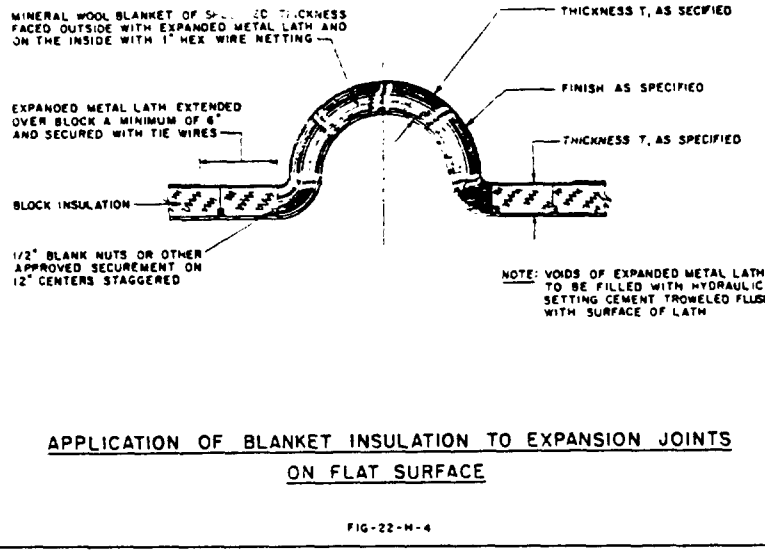


SECUREMENT OF BONDED EXPANDED INSULATION ON VESSEL HEAD

FIG 22-H-3

f. Expansion Joints

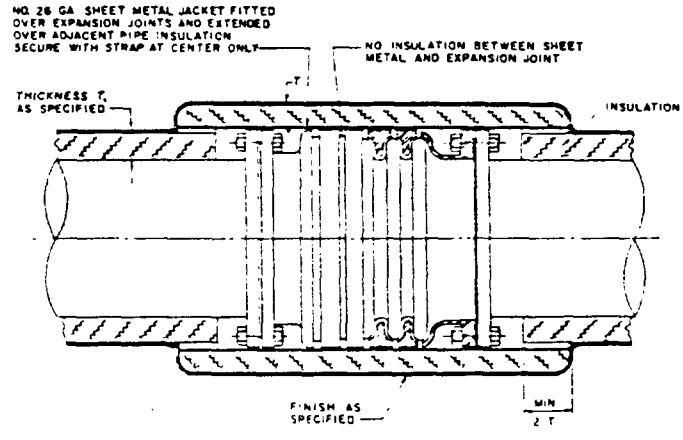
Expansion joints in flat surfaces or cylindrical vessels shall be insulated with flexible blanket insulation. Typical installation is shown in Figure 22-H-4.



APPLICATION OF BLANKET INSULATION TO EXPANSION JOINTS ON FLAT SURFACE

FIG-22-H-4

g. Corrugated mechanical expansion joints on piping (usually listed as equipment items) shall be insulated as shown in Figure 22-H-5.

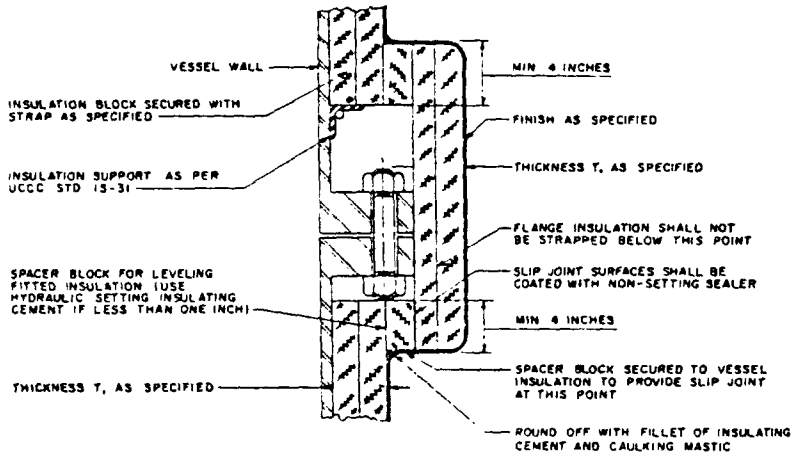


APPLICATION OF BONDED EXPANDED SILICA INSULATION TO EXPANSION JOINTS

FIG 22-H-5

h. Insulated Vessel Flanges

Vessel flanges shall be insulated with block in the same manner as specified for body of vessel. An insulation support shall be provided immediately above vessel flange. The top of projecting flange insulation shall be sloped to shed water. Typical installation is shown in Figure 22-H-6.

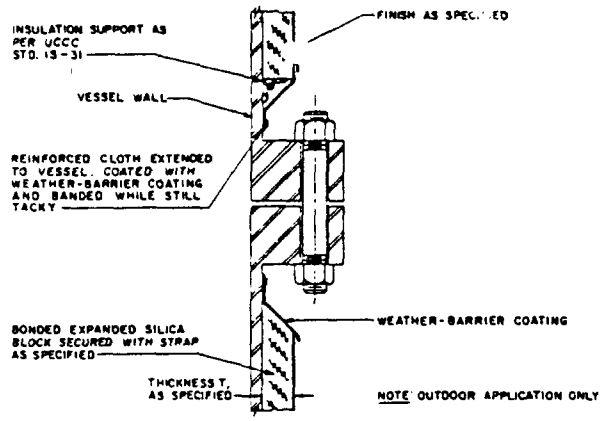


APPLICATION OF BONDED EXPANDED SILICA INSULATION TO VESSEL FLANGE

FIG 22-H-6

i. Uninsulated Vessel Flanges

Where vessel flanges are located outdoors and specified 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 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.

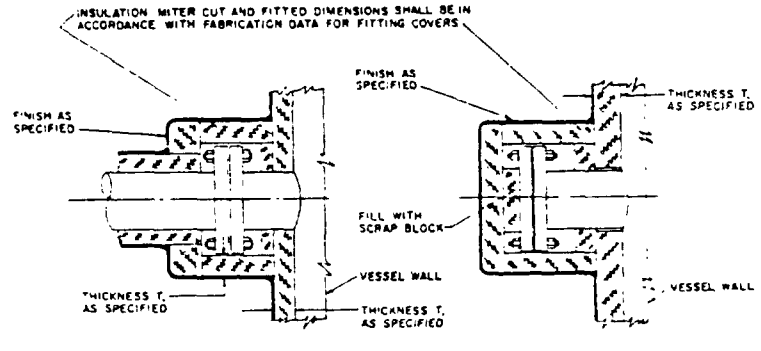


WEATHER SEALING OF BONDED EXPANDED SILICA VESSEL INSULATION AT UNINSULATED FLANGES

FIG. 22-H-7

j. Vessel Nozzles

Vessel nozzles shall be insulated as shown in Figure 22-H-8.



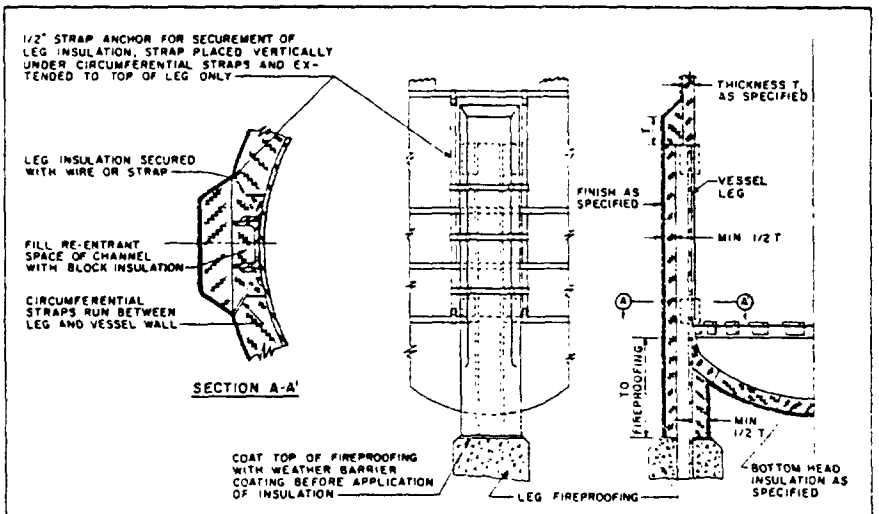
APPLICATION OF BONDED EXPANDED SILICA INSULATION TO VESSEL NOZZLES

FIGURE 22-H-8

k. Vessel Legs

(1) Vessel 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.

(2) 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-9.

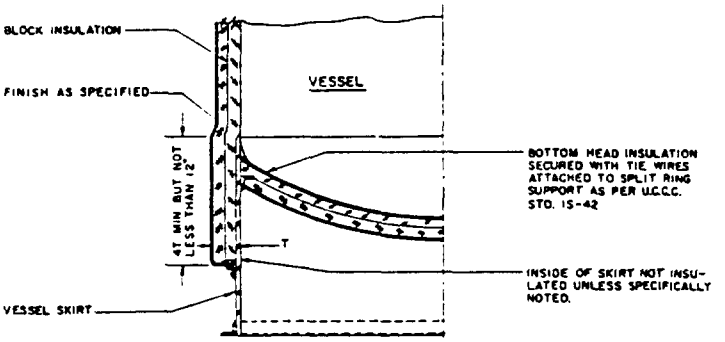


APPLICATION OF BONDED EXPANDED SILICA INSULATION TO VESSEL LEGS

FIG 22-H-9

l. 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 UCCC Standard IS-42. Installation shall be as shown in Figure 22-H-10.



APPLICATION OF BONDED EXPANDED SILICA INSULATION TO VESSEL SKIRT

FIG 22-H-10

m. Surface Finish

When specified thickness of insulation has been applied, any small cracks or depressions shall be pointed up with insulation cement trowelled flush with surface of insulation.

n. Weather-Barrier

(1) Weather-barrier coating shall be applied in accordance with the GENERAL SPECIFICATIONS, Parts I. B. 9 and 17.

(2) Weather-barrier consisting of stainless steel jacketing, if required, shall be applied in accordance with the GENERAL SPECIFICATIONS, Part I. B. 18. This requirement is indicated by the addition of the letter M to the specification designation, thus: 22-HM.

2. Piping

a. Pipe Insulation

(1) Thickness Schedule

Unless otherwise specified, insulation in excess of 2-1/2 inches total thickness shall be applied in multi-layer construction as specified in the GENERAL SPECIFICATIONS, Part I. B. 2.

(2) Securement

(a) Insulation shall be applied to piping in accordance with the GENERAL SPECIFICATIONS, Parts I. B. 5, 6, 7, and 8.

(b) All inner layers of sectional pipe insulation shall be secured with stainless steel wire.

(c) All sectional pipe insulation 6-5/8 inches and less in outside diameter shall be secured with stainless steel wire.

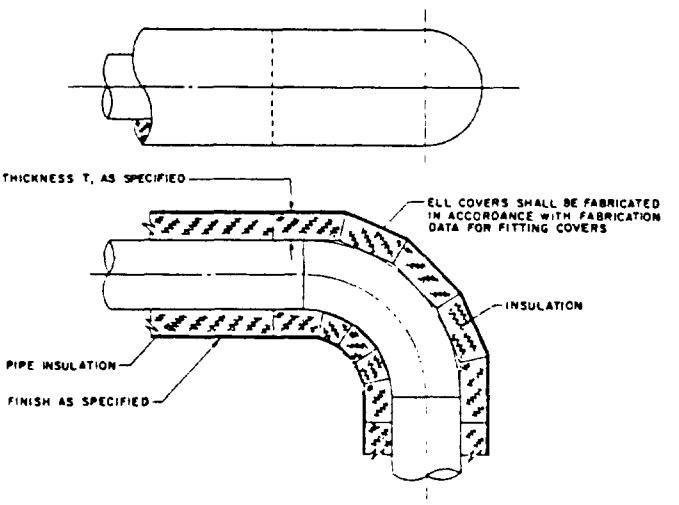
(d) All pipe insulation larger than 6-5/8 inches in outside diameter shall be secured with stainless steel insulation strap.

II. B. 3. contd

b. Fitting, Flange, and Valve Covers

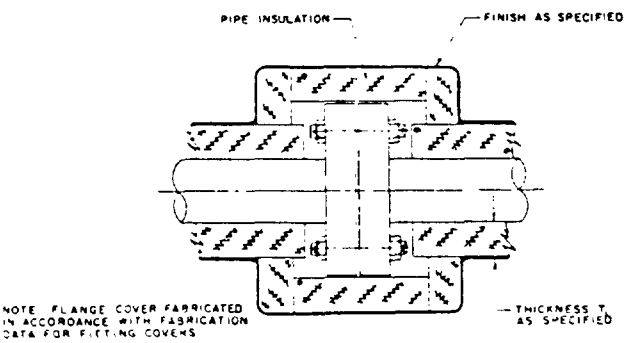
(1) Fitting insulation shall be secured with specified wire or strap as required.

(2) Insulation for all fittings shall be fitted and assembled with tight joints. Cementing of shop fabricated assemblies shall be done with specified 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 filled with fabricating cement, be permitted. Typical installations are shown in Figures 22-H-11, 22-H-12, and 22-H-13.



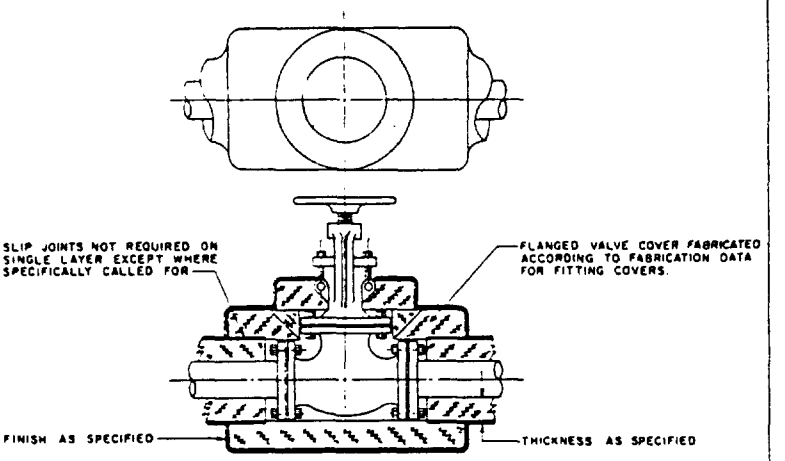
APPLICATION OF BONDED EXPANDED SILICA INSULATION TO WELDING ELL

FIG 22-H-11



APPLICATION OF BONDED EXPANDED SILICA INSULATION TO LINE FLANGE

FIG 22-H-12



APPLICATION OF BONDED EXPANDED SILICA INSULATION TO FLANGED VALVE

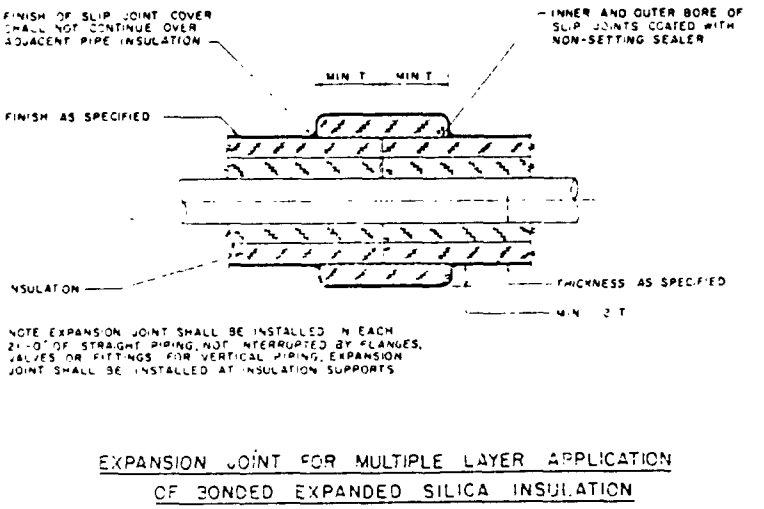
FIG 22-H-13

(3) Fittings, flanges, and valves shall be insulated with prefabricated fitting covers (preferred method) in accordance with the UCCC Dimensional Standards Fabrication Manual.

(4) Fitting, flange, and valve covers may be field fabricated provided work is in accordance with the UCCC Dimensional Standards Fabrication Manual, and approved by the Field Representative of the Department of Design and Construction. Segments shall be carefully fitted to insure tight joints.

c. Expansion Joints

(1) Expansion slip joints shall be provided in the insulation for multiple layer applications. An expansion joint shall be installed in each 21 ft of straight piping not interrupted by flanges, valves, or fittings. Typical installation is shown in Figure 22-H-14.



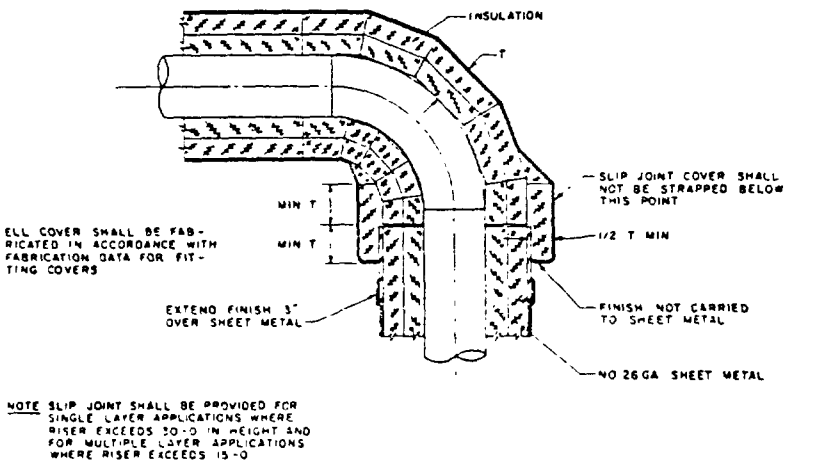
EXPANSION JOINT FOR MULTIPLE LAYER APPLICATION OF BONDED EXPANDED SILICA INSULATION

FIG 22-H-14

II. B. 2. c. contd

(2) The expansion slip joints shall be installed at the insulation support in vertical piping. Care shall be exercised to place the slip joint so that movement occurs at the bottom in order to shed water.

(3) Expansion slip joints shall be provided at junction of fitting covers and pipe insulation located at the tops of risers, where riser exceeds 30 ft in height for single layer applications, and where riser exceeds 15 ft in height for multiple layer applications. Typical installation is shown in Figure 22-H-15.



APPLICATION OF BONDED EXPANDED SILICA INSULATION TO WELDING ELL

FIG 22-H-15

(4) Insulation supports shall be installed at the bottoms of all risers.

d. Traced Installations

Traced lines, where specified, shall be installed and insulated in accordance with the GENERAL SPECIFICATIONS, Part I. B. 16.

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

(1) Weather-barrier coating shall be applied in accordance with the GENERAL SPECIFICATIONS, Part I. B. 17.

(2) Weather-barrier consisting of stainless steel jacketing, if required, shall be applied in accordance with the GENERAL SPECIFICATIONS, Part I. B. 18. This requirement is indicated by the addition of the letter M to the specification designation, thus: 22-HM.

II. SPECIFICATION 25-H — Hydrous Calcium Silicate

Scope

This Specification describes the essential requirements for the purchase and application of preformed calcium silicate insulation for use on equipment and piping normally operating at temperatures from 750 F up to and including 1200 F.

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

A. MATERIAL

1. Composition

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

2. Properties

Calcium Silicate Insulation shall have the following properties:

Alkalinity . . . . . pH shall be not below 10 and not above 13.

Coefficient of Expansion . . 3×10^{-6} average on reheat to 1200 F.

Combustibility . . . . . Shall be incombustible.

Compressive Strength . . . When tested in accordance with ASTM C 165, latest revision, the percentage of deformation produced by loading shall not exceed the following:

Deformation, %	Load, psi
2	50
5	130

Density . . . . . Shall be not less than 11.5 lb per cu ft, or more than 13.5 lb per cu ft, when tested in accordance with ASTM C 303, latest revision.

Flexural Strength . . . . . Shall be not less than 55 psi when tested in accordance with ASTM C 203, latest revision.

Hardness . . . . . A 1/8-inch ball point under a 1-kg load shall produce a maximum penetration of 0.85 mm.

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

Resistance to Abrasion . . . When subjected to the Navy Tumbling Test, shall lose not more than 7% of original weight after first 10-minute run, and not more than 15% after second 10-minute run.

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

Shrinkage . . . . . When tested in accordance with ASTM C 356, latest revision, the shrinkage at the given temperatures shall not exceed the following percentages:

Temp °F	Shrinkage, %
1200	0.4
1500	1.4
1800	1.9

Specific Heat. . . . . 0.20 to 0.25 Btu per lb per degree F at 400 F.

Temperature Limit. . . . Maximum temperature without mechanical, thermal, or chemical failure shall be not less than 1800 F.

II. A. 2. contd

Thermal Conductivity. . . When tested in accordance with ASTM C 177, latest revision, or ASTM C 335, latest revision, 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 . . . 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 1800 F and then quenched with water.

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

Make . . . . . Kaylo No. 20 or approved equal.

3. Accessory Materials

a. Calcium Silicate Insulation - per Specification 20-H.

b. Stainless Steel Wire - 0.0475-inch diameter, Type 304, cold drawn, bright annealed, 18 gage.

c. Insulation Strap - Stainless steel, 1/2-inch by 0.020-inch, Type 304, or approved equal.

d. Clips - Stainless Steel, 1/2-inch double-pronged, Type 304, A. J. Gerrard or approved equal.

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

f. Mineral Wool Blanket - Black, spun rock wool, hexagonal wire netting on both sides.

g. Mineral Wool Blanket - Black, spun rock wool, hexagonal wire netting on one side, expanded metal lath on the other side.

h. Heat Resistant Sealer - Benjamin Foster No. 30-43 or approved equal.

i. Weather-Barrier Coating (Color as specified) - PVA-Vimasco No. WC-1, Pittsburgh-Corning Pittcote 500 C, or approved equal.

j. Reinforcing Cloth - Glass fabric, 10 by 10 thread count, Perma-Glas Mesh, Glasfab, or approved equal.

k. Fabricating Cement - A. P. Green Insulation Adhesive, Philip Carey Careytemp, Refractory and Insulation Block Stick, or approved equal.

l. Wire Netting - One-inch, hexagonal mesh, 20-gage, stainless steel, Type 304, or approved equal.

m. Curly Cushion Blanket - Mineral wool blanket with 1-inch wire mesh on both sides, Baldwin-Ehret-Hill, M. H. Detrick, or approved equal.

B. APPLICATION

1. Equipment

a. Insulation Supports

Equipment shall be provided with insulation supports as called for in the GENERAL SPECIFICATIONS, Part I. B. 5.

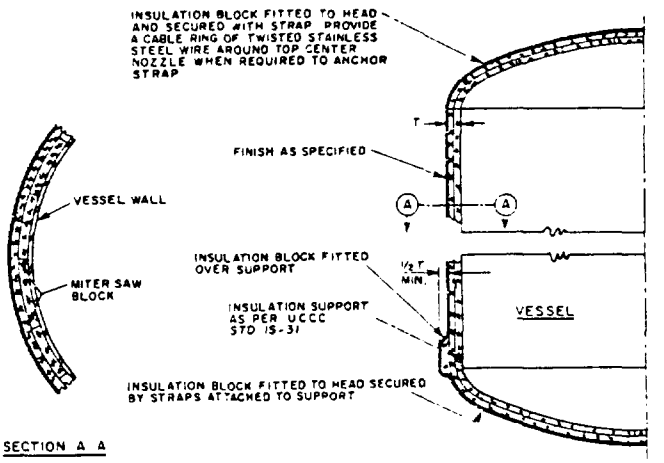
b. Thickness Schedule

Unless otherwise specified, insulation in excess of 2-1/2 inches total thickness shall be applied in multi-layer construction as specified in the GENERAL SPECIFICATIONS, Part I. B. 2, except that outer layer shall be calcium silicate insulation per Specification 20-H.

II. B. 1. contd

c. Curved Surfaces

(1) On all equipment, insulation block shall be properly miter cut to fit vessel surface and applied to vessel sides and heads in staggered position, with all joints tightly butted. Block shall be applied to vessel sides with linear dimension paralleling axis of vessel, and using broken joint construction. Typical installation is shown in Figure 25-H-1.



APPLICATION OF HYDROUS CALCIUM SILICATE INSULATION TO VESSEL

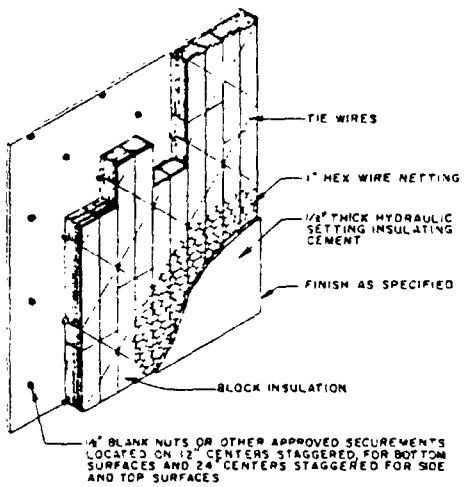
FIG 25-H-1

(2) A curly cushion blanket shall be installed on all cylindrical vessels operating above 600 F, before the application of the hydrous calcium silicate insulation.

d. Flat Surfaces

(1) Block insulation shall be applied to flat surfaces in staggered position with all joints tightly butted. It shall be secured with wire attached to blank nuts or other approved securement. On rectangular equipment, the blank nuts, or other approved securements, shall be placed on 12-inch centers, staggered, for bottom surfaces and on 24-inch centers, staggered for side and top surfaces.

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



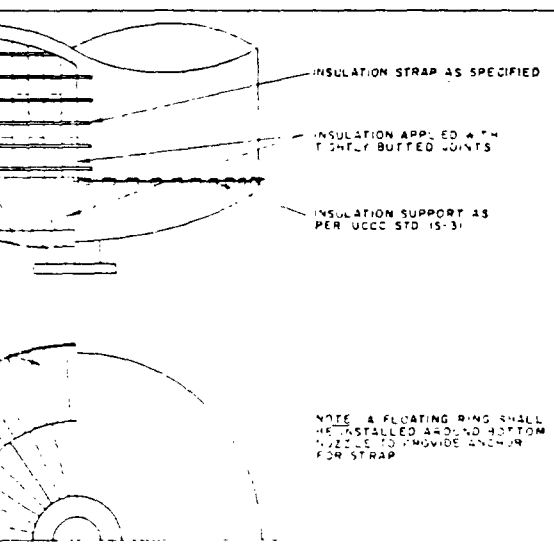
APPLICATION OF HYDROUS CALCIUM SILICATE INSULATION TO FLAT SURFACE

FIG 25-H-2

e. Securement

(1) All layers of insulation shall be secured with insulation strap where contour of vessel permits firm and effective attachment. Insulation applied to irregular surfaces, where strap is impracticable, shall be secured with wire, drawn taut, ends twisted and embedded in insulation.

(2) All layers of insulation on bottom heads of vertical equipment and heads of horizontal equipment shall be secured in place with wire attached to blank nuts, or with insulation strap attached to insulation support, as specified in UCCC Standard IS-31 and Figure 25-H-3.



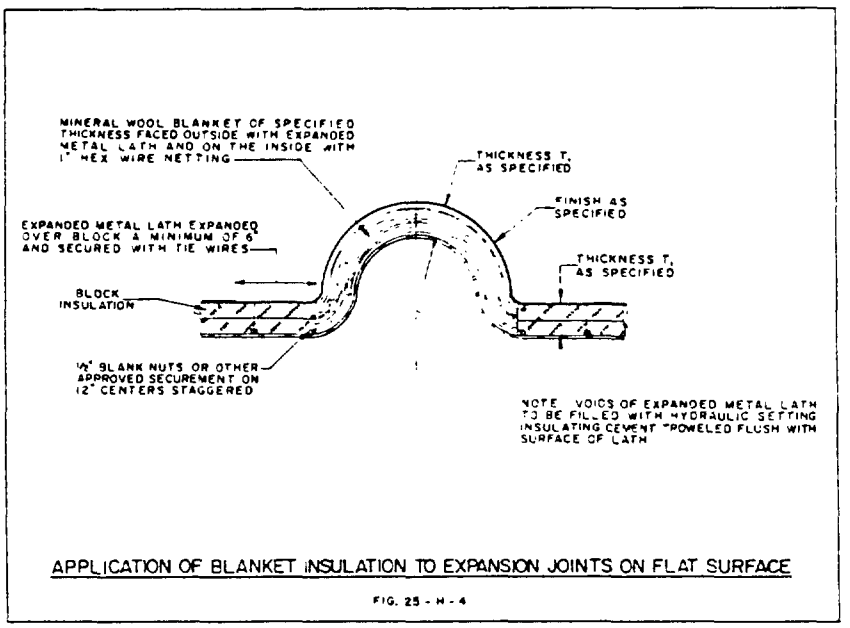
SECUREMENT OF HYDROUS CALCIUM SILICATE INSULATION ON VESSEL HEAD

FIG 25-H-3

II. B. 1. contd

f. Expansion Joints

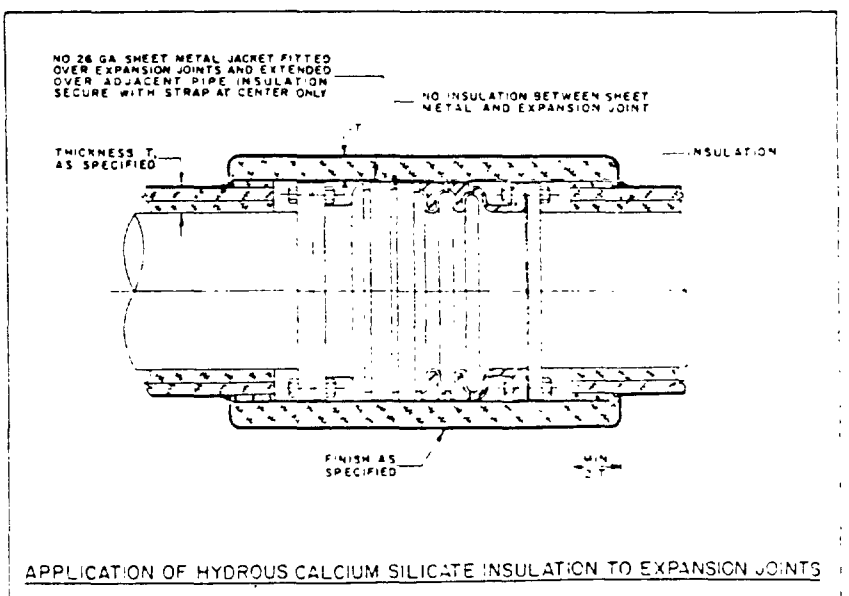
(1) Expansion joints in flat surfaces or cylindrical vessels shall be insulated with flexible blanket insulation. Typical installation is shown in Figure 25-H-4.



APPLICATION OF BLANKET INSULATION TO EXPANSION JOINTS ON FLAT SURFACE

FIG. 25 - H - 4

(2) Corrugated mechanical expansion joints on piping (usually listed as equipment items) shall be insulated as shown in Figure 25-H-5.

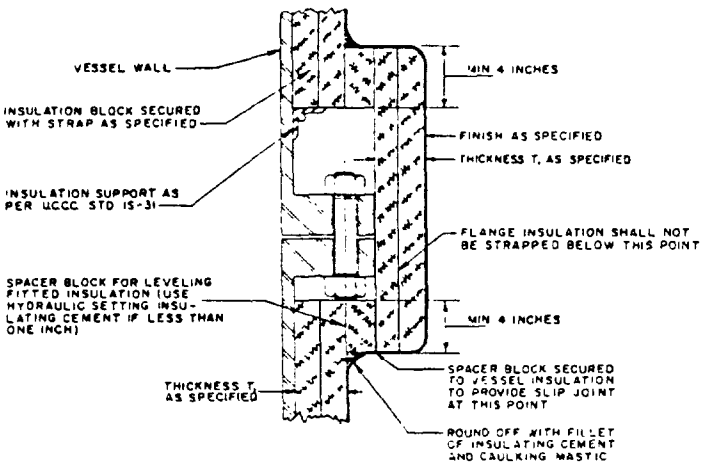


APPLICATION OF HYDROUS CALCIUM SILICATE INSULATION TO EXPANSION JOINTS

FIG 25 - H - 5

g. Insulated Vessel Flanges

Vessel flanges shall be insulated with block in the same manner as specified for body of vessel. An insulation support shall be provided immediately above vessel flange. The top of projecting flange insulation shall be sloped to shed water. Typical installation is shown in Figure 25-H-6.

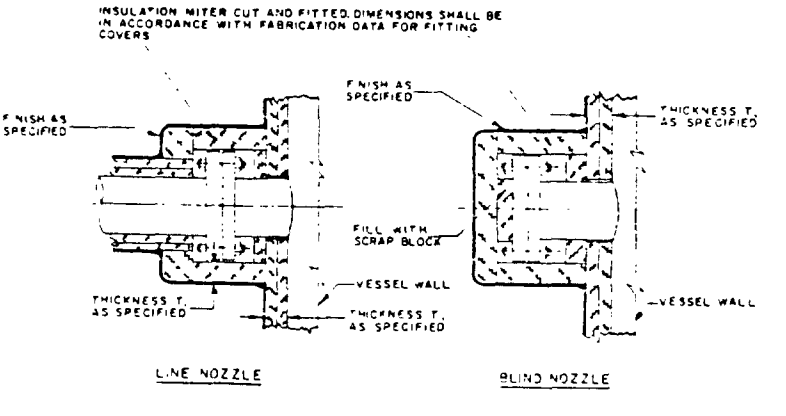


APPLICATION OF HYDROUS CALCIUM SILICATE TO VESSEL FLANGE

FIG 25 - H - 6

h. Vessel Nozzles

Vessel nozzles shall be insulated as shown in Figure 25-H-7.



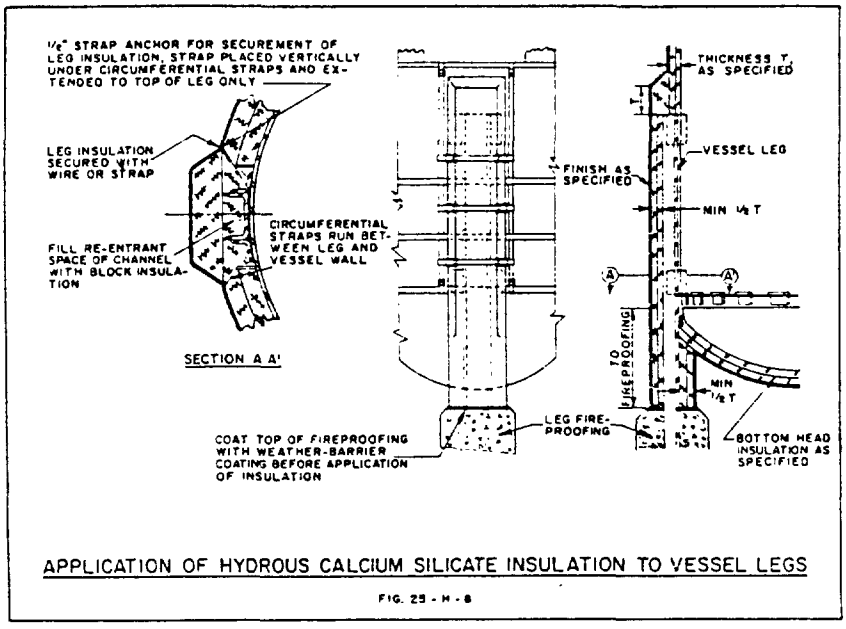
APPLICATION OF HYDROUS CALCIUM SILICATE TO VESSEL NOZZLES

FIG 25 - H - 7

i. Vessel Legs

(1) Vessel 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.

(2) 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 25-H-8.

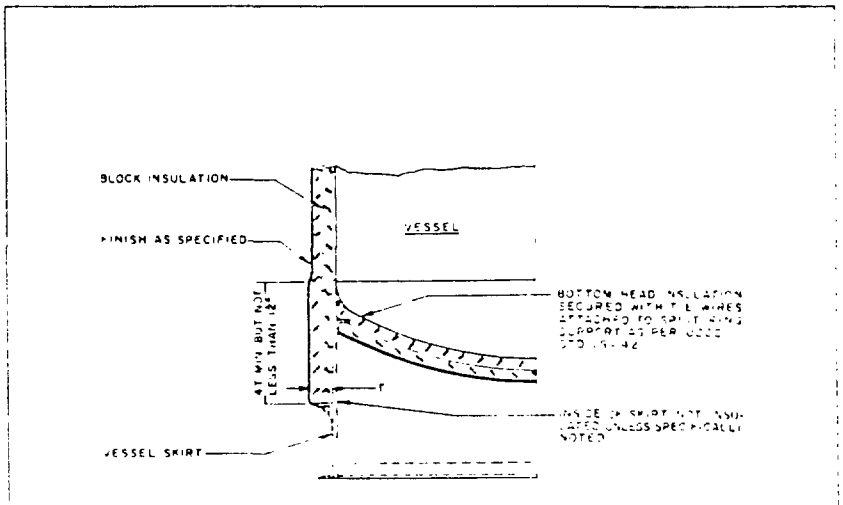


APPLICATION OF HYDROUS CALCIUM SILICATE INSULATION TO VESSEL LEGS

FIG. 25-H-8

j. 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 UCCC Standard IS-42. Installation shall be as shown in Figure 25-H-9.



APPLICATION OF HYDROUS CALCIUM SILICATE INSULATION TO VESSEL SKIRT

FIG. 25-H-9

II. B. 1. contd

k. Surface Finish

When specified thickness of insulation has been applied, any small cracks or depressions shall be pointed up with insulating cement, troweled flush with surface of insulation.

l. Weather-Barrier

(1) Weather-barrier coating shall be applied in accordance with the GENERAL SPECIFICATIONS, Parts I. B. 9. and 17.

(2) Weather-barrier consisting of stainless steel jacketing, if required, shall be applied in accordance with the GENERAL SPECIFICATIONS, Part I. B. 18. This requirement is indicated by the addition of the letter M to the specification designation, thus: 25-HM.

2. Piping

a. Pipe Insulation

(1) Insulation shall be applied to piping in accordance with the GENERAL SPECIFICATIONS, Parts I. B. 5, 6, 7, and 8.

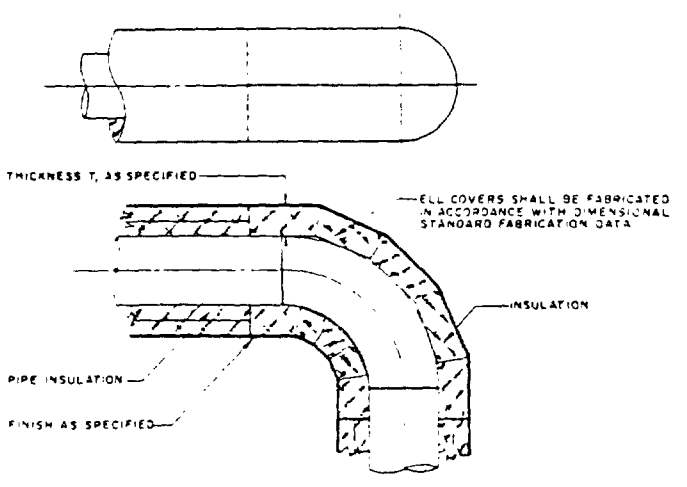
(2) Unless otherwise specified, insulation in excess of 2-1/2 inches total thickness shall be applied in multi-layer construction as specified in the GENERAL SPECIFICATIONS, Part I. B 2.

b. Fittings, Flanges, and Valves

(1) Fittings, flanges, and valves shall be insulated with prefabricated fitting covers (preferred method) in accordance with the UCCC Dimensional Standards Fabrication Manual.

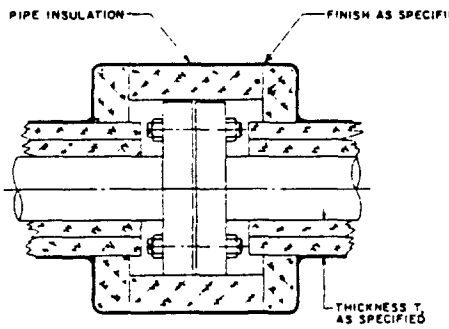
(2) Fitting, flange and valve covers may be field fabricated provided work is in accordance with the UCCC Dimensional Standards Fabrication Manual, and approved by the Field Representative of the Department of Design and Construction. Segments shall be carefully fitted to insure tight joints.

(3) Insulation for all fittings shall be fitted and assembled with tight joints. Cementing of shop fabricated assemblies shall be done with specified 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 filled with fabricating cement, be permitted. Typical installations are shown in Figures 25-H-10, 25-H-11, 25-H-12, and 25-H-13.



APPLICATION OF HYDROUS CALCIUM SILICATE INSULATION TO WELDING ELL

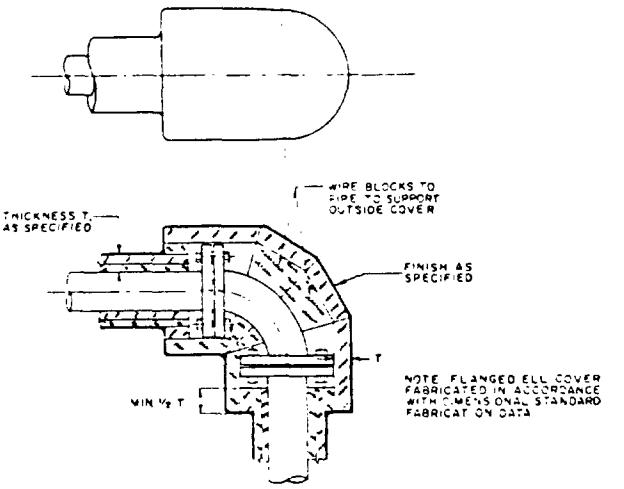
FIG 25 - H - 10



NOTE: FLANGE COVER FABRICATED IN ACCORDANCE WITH DIMENSIONAL STANDARD FABRICATION DATA.

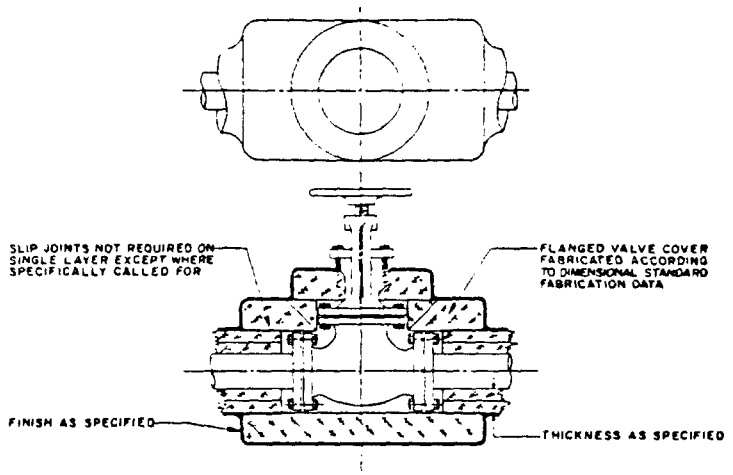
APPLICATION OF HYDROUS CALCIUM SILICATE INSULATION TO LINE FLANGE

FIG 25-M-11



APPLICATION OF HYDROUS CALCIUM SILICATE INSULATION TO FLANGED ELL

FIG 25-M-12



APPLICATION OF HYDROUS CALCIUM SILICATE INSULATION TO FLANGED VALVE

FIG. 25-H-13

(4) Fitting insulation shall be secured with specified 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.

c. Traced Installations

Traced lines, where specified, shall be installed and insulated in accordance with the GENERAL SPECIFICATIONS, Part I. B. 16.

d. Surface Finish

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

e. Weather-Barrier

(1) Weather-barrier coating shall be applied in accordance with the GENERAL SPECIFICATIONS, Part I. B. 17.

(2) Weather-barrier consisting of stainless steel jacketing, if required, shall be applied in accordance with the GENERAL SPECIFICATIONS, Part I. B. 18. This requirement is indicated by the addition of the letter M to the specification designation, thus: 25-HM.

II. SPECIFICATION 31-H — Prefabricated Stainless-Cased Aluminum

Scope

This Specification describes the essential requirements for the purchase and application of prefabricated stainless-cased aluminum reflective insulation for use on piping and equipment normally operating at temperatures from 33 F up to and including 1000 F.

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

A. MATERIAL

1. 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 equipped with means of securement.

2. Properties

a. Properties shall be as listed in the following table:

Emissivity	Shall be approximately 0.03.
Reflectivity	Shall be approximately 95%.
Temperature Limits . .	Shall be suitable for use from 33 F to 1000 F without deterioration or cracking of parts.
Make	Mirror Insulation Company "SC-MIRROR" insulation, or approved equal.

b. Forms

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

(1) Sectional Pipe Insulation

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

Sheet Location	Material	Minimum Thickness of Sheet, in.
Outer shell:		
Over 17-inch diameter	Type 302 SS	0.012 (Rigidized)
17-inch diameter and under	Type 302 SS	0.010 (Rigidized)
Inner Sheets	Aluminum Alloy	0.006

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

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

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

(2) Fitting covers shall be prefabricated, and of the same general composition and construction as sectional pipe insulation, except that the outer shell shall be Type 302 stainless steel 0.015 inch thick (minimum), the intermediate sheets shall be of light gage aluminum alloy suitable for forming, and the inner shell 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	0.012 (Rigidized)
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 designed 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 drawings.

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

3. Accessory Materials

a. Stainless Steel Insulation Strap - 3/8-inch by 0.015-inch, Type 304, or approved equa

b. Stainless Steel Sheet Metal Screws (minimum Size No. 12)

c. Caulking Mastic - Suitable for temperature to which it will be subjected.

d. Aluminum Pressure Sensitive Sealing Tape - Suitable for temperature to which it will be subjected.

B. APPLICATION

1. Equipment

a. Supports

Equipment shall be provided with insulation supports as specified in 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. Panels shall be secured to each other with sheet metal screws through the casing laps, or trim strips, over joints to form a continuous envelope over the surface to be insulated, except at expansion joints, flanges, etc. Where required, panels shall be secured with insulation strap or special fasteners.

d. Flat Surfaces

Panels fabricated for flat surfaces shall be applied in the same manner as specified for curved surfaces. Where the span of surface to be insulated exceeds 30 inches, panels shall be secured to the surface by a method approved by the Owner.

2. Piping

a. Pipe Insulation

(1) Insulation supports, where required, shall be provided by the Contractor.

(2) Unless otherwise specified, insulation shall be applied in one layer.

(3) Insulation shall be applied to piping with the flush separator end of each section inserted into overlapping end of abutting sections. The extended longitudinal edges 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, or screws, furnished by the manufacturer, as specified in the Accessory Materials Section of this Specification.

II. SPECIFICATION 15-H

Preformed Fibrous Glass
High Density
(Over 6.5 lb per cu ft)

Scope

This Specification describes the essential requirements for the purchase and application of preformed fibrous glass thermal insulation for use on equipment and piping normally operating at temperatures not more than 375 F nor less than 70 F. It is applicable to both indoor and outdoor service.

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

A. MATERIAL

1. Composition

Material shall be composed of fibrous glass formed into molded pipe and block insulation with a modified phenolic type binder. Insulation for pipe shall have factory-applied fire-retardant jackets.

2. Properties

Preformed fibrous glass insulation shall have the following properties:

Alkalinity	pH shall be between 7 and 10.
Capillarity	After 7 days on wet surface, gain in weight shall be 0%.
Density:	
Pipe	Shall be not less than 6.5 nor more than 8.0 lb per cu ft, except that pipe smaller than 1-1/2 by 1 may be up to 9 lb per cu ft.
Board	Shall be not less than 8 nor more than 10 lb per cu ft.
Hygroscopicity	When exposed to air at 120 F and 95% relative humidity for 96 hours, shall be not less than 0.2% by volume.
Loss on Ignition	Shall be not less than 6 nor more than 10% by weight.
Resistance to Acids	Fairly good, except to hydrofluoric.
Resistance to Alkalies	Poor.
Specific Gravity	Shall average 2.6 true, 0.11 to 0.16 apparent.
Specific Heat	Shall average 0.20 Btu per lb per degree F.
Temperature Limits	Shall be suitable for use from minus 120 F to plus 375 F without mechanical, thermal, or chemical failure.
Thermal Conductivity	When tested in accordance with ASTM C 177, latest revision, or ASTM C 335, latest revision, the thermal conductivity at the given mean temperatures shall not exceed the following values:

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

Thermal Diffusivity at 75 F	0.4 sq ft per day
Water Absorption (by immersion)	Percentage of volume is very high, due to open fibrous structure, but does not retain if water can run out.

3. Accessory Materials

a. Butt Joint Strips - White Fire-Retardant Jacket material (designated White FRJ), same as factory-applied jacket.

b. Welding Pins - 12 gage steel, KSM, Omark, or approved equal. Length shall be equal to insulation thickness plus 1/4 inch minimum.

c. Stainless Steel Wire - 0.0475-inch diameter, Type 304, cold drawn, bright annealed, 18 gage.

d. Stainless Steel Insulation Strap - 1/2-inch by 0.020-inch, Type 304, A. J. Gerrard, Techalloy, or approved equal.

e. Strapping Tape - Glass filament, vinyl-backed, Dutch Brand 400, or approved equal.

f. Pipe Insulation Support - Techalloy insulation support strap or approved equal.

g. Vapor Seal Lap Cement - Benjamin Foster 81-99, Vimasco Viny-Lag, or approved equal.

h. Weather-Barrier Coating (Color as specified) - PVA - Vimasco No. WC-1, Pittsburgh-Corning Pittcote 500 C, or approved equal.

i. Reinforcing Cloth - Glass fabric, 10 by 10 thread count. Perma-Glas, Twinsburg-Miller, Benjamin Foster Open Weave No. 10, or approved equal.

j. Vapor Seal Adhesive Cement - Benjamin Foster 81-42W, Vimasco Viny-Lag W, Arabol 60-89-05, or approved equal.

k. Wire Netting - 1-inch hexagonal mesh, 20-gage, Monel or Type 304 stainless steel.

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

m. Insulating Cement - Hydraulic setting - Baldwin-Ehret-Hill Powerhouse, Eagle-Picher One Coat, Detrick Utility, or approved equal.

n. Fabrication Cement - Vimasco "J" seal "S" or approved equal.

B. APPLICATION

1. Equipment

a. Insulation Supports

Equipment shall be provided with insulation supports as specified in the GENERAL SPECIFICATIONS, Part I. B. 5.

b. Thickness Schedule

Unless otherwise specified, insulation over 3 inches in total thickness shall be applied in multiple layers.

c. Curved Surfaces

(1) Insulation for equipment less than 3 feet in diameter shall be preformed pipe insulation. Insulation for larger equipment shall be bent, and kerfed where necessary, so as to fit vessel contour, and shall be held in place with stainless steel insulation strap on 9-inch centers.

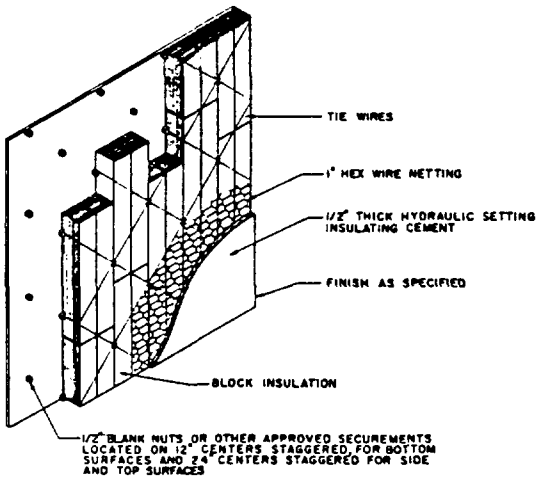
(2) Insulation on bottom heads of vertical equipment shall be secured in place with stainless steel insulation strap attached to insulation supports, in accordance with UCCC Standard IS-31.

(3) On multiple layers of insulation, joints of outer layer shall be staggered a minimum of 2 inches from joints immediately below.

(4) Insulation shall be installed with all joints tightly butted, and circumferential butt joints staggered.

d. Flat Surfaces

(1) Block insulation shall be applied to flat surfaces in staggered position with all joints tightly butted. It shall be secured with wire attached to welded studs with speed nuts; welded blank nuts; welded eye bolt studs; or other approved securement. On rectangular equipment, the studs or nuts, or other approved securements, shall be spaced on 12-inch centers, staggered, on bottom surfaces, and on 24-inch centers, staggered, on side and top surfaces. Typical installation is shown in Figure 15-H-1.



APPLICATION OF PREFORMED FIBROUS GLASS INSULATION TO FLAT SURFACE

FIG. 15-H-1

(2) When specified thickness has been applied, the specified wire netting shall be stretched over block and secured in place with tie wires or other approved securement.

(3) Entire surface shall be given a smooth and uniformly applied coat of the specified hydraulic setting insulating cement 1/2 inch thick.

(4) Where stiffeners or other projections make insulation of flat surfaces impracticable, welded steel wire fabric shall be placed over the projections, and secured by spot welding or wire, as specified. Block shall then be secured to the welded wire fabric with wire, as specified in Part II. B. 1. d. (1).

e. Weather-Barrier

If specified, weather-barrier shall be installed in accordance with the GENERAL SPECIFICATIONS, Part I. B. 17.

2. Piping

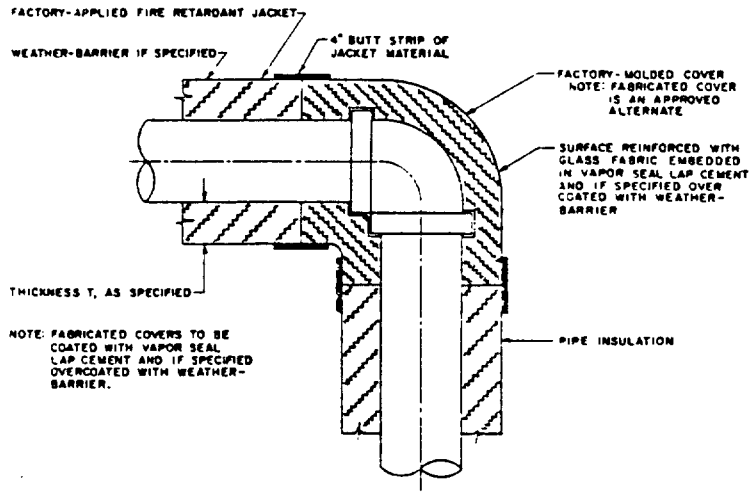
a. Pipe Insulation

(1) Unless otherwise specified, insulation in excess of 2-1/2-inch total thickness shall be applied in multiple layers, as specified in the GENERAL SPECIFICATIONS, Part I. B. 1. Where possible, joints of outer layer shall be staggered a minimum of 2 inches from joints immediately below.

(2) Insulation shall be applied to pipe in accordance with the GENERAL SPECIFICATIONS, Parts I. B. 5, 6, 7, and 8. Laps of factory-applied fire-retardant jackets shall be sealed with the specified vapor seal lap cement. All joints shall be tightly butted, and covered with the specified butt joint strips 4 inches wide, lapped the same as the jackets. The strips shall be attached to the jackets with the specified vapor seal adhesive cement, and strip laps sealed with vapor seal lap cement.

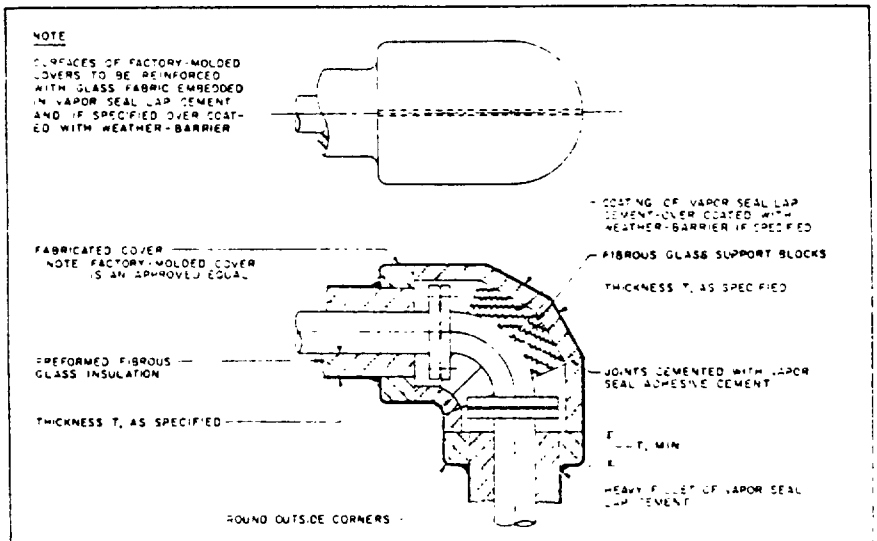
b. Fitting, Flange, and Valve Covers

(1) Fitting, flange, and valve covers may be factory-molded, or shop-fabricated in accordance with the UCCC Dimensional Standards Fabrication Manual, or ASTM Recommended Practice C 450, latest revision. Typical fitting covers are shown in Figures 15-H-2 and 15-H-3. Covers for flanges, and other screwed or flanged fittings and valves, shall be similar to those shown.



APPLICATION OF FIBROUS GLASS INSULATION TO SCREWED ELL

FIG 15-H-2



APPLICATION OF PREFORMED FIBROUS GLASS INSULATION TO FLANGED ELL

FIG 15-H-3

(2) Fitting, flange, and valve covers may be field-fabricated, provided work is in accordance with the UCCC Dimensional Standards Fabrication Manual, or ASTM C 450, latest revision, and approved by the Field Representative of the Department of Design and Construction.

(3) The two halves of factory-molded covers shall be strapped together with stainless steel insulation strap for outside diameters larger than 8-5/8 inches and with the specified strapping tape for outside diameters 8-5/8 inches and less.

(4) The two halves of fabricated covers shall be cemented together with vapor seal adhesive 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 filled with cement, be permitted.

(5) 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 for piping.

(6) The surfaces of factory-molded covers shall be coated with vapor seal lap cement, and reinforced with the specified glass fabric embedded in the cement.

(7) The surfaces of fabricated covers shall be coated with vapor seal lap cement.

c. Weather-Barrier

If specified, weather-barrier shall be installed in accordance with the GENERAL SPECIFICATIONS, Part I. B. 17.

II. SPECIFICATION 15-L

Preformed Fibrous Glass
High Density
(Over 6.5 lb per cu ft)

Scope

This Specification describes the essential requirements for the purchase and application of preformed fibrous glass thermal insulation for use on equipment and piping normally operating at temperatures not more than 100 F nor less than 20 F. It is applicable to both indoor and outdoor service.

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

A. MATERIAL

1. Composition

Material shall be composed of fibrous glass formed into molded pipe and block insulation with a modified phenolic type binder. Insulation shall have factory-applied fire-retardant vapor barrier jackets.

2. Properties

Preformed fibrous glass insulation shall have the following properties:

Alkalinity	pH shall be between 7 and 10.
Capillarity	After 7 days on wet surface, gain in weight shall be 0%.
Density:	
Pipe	Shall be not less than 6.5 nor more than 9.0 lb per cu ft.
Block	Shall be not less than 8 nor more than 10 lb per cu ft.
Hygroscopicity	When exposed to air at 120 F and 95% relative humidity for 96 hours, shall be less than 0.2% by volume.
Loss on Ignition	Shall be not less than 6 nor more than 10% by weight.
Resistance to Acids	Fairly good, except to hydrofluoric.
Resistance to Alkalies	Poor
Specific Gravity	Shall average 2.6 true, 0.11 to 0.16 apparent.
Specific Heat	Shall average 0.20 Btu per lb per degree F.
Temperature Limits	Shall be suitable for use from minus 120 F to plus 375 F without mechanical, thermal, or chemical failure.
Thermal Conductivity	When tested in accordance with ASTM C 177, latest revision, or ASTM C 335, latest revision, the thermal conducitivty at the given mean temperatures shall not exceed the following values:

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

Thermal Diffusivity at 75 F	0.23 to 0.40 sq ft per day
Water Absorption (by immersion)	Percentage of volume is very high, due to open fibrous structure, but does not retain if water can run out.

II. A. contd

3. Accessory Materials

a. Butt Joint Strips and Vapor-Barrier - White Fire-Retardant Jacket material (designated White FRJ), same as factory-applied jacket.

b. Welding Pins - 12 gage steel, KSM, Omark, or approved equal. Length shall be equal to insulation thickness plus 1/4 inch minimum.

c. Stainless Steel Wire - 0.0475-inch diameter, Type 304, cold drawn, bright annealed, 18 gage.

d. Stainless Steel Insulation Strap - 1/2-inch by 0.020-inch, Type 304, A. J. Gerrard, Techalloy, or approved equal.

e. Strapping Tape - Glass filament, vinyl-backed, Dutch Brand No. 400, or approved equal.

f. Pipe Insulation Support - Techalloy insulation support strap or approved equal.

g. Vapor Seal Lap Cement - Benjamin Foster 81-99, Vimasco Viny-Lag, or approved equal.

h. Fire-Resistant Mastic - Benjamin Foster 60-30N or approved equal.

i. Weather-Barrier Coating (Color as specified) - PVA - Vimasco No. WC-1, Pittsburgh-Corning Pittcote 500 C, or approved equal.

j. Reinforcing Cloth - Glass fabric, 10 by 10 thread count, Perma-Glas, Twinsburg-Miller, Benjamin Foster Open Weave No. 10, or approved equal.

k. Vapor Seal Adhesive Cement - Benjamin Foster 81-42W, Vimasco Viny-Lag W, Arabol 60-89-05, or approved equal.

l. Wire Netting - 1-inch hexagonal mesh, 20-gage, Monel or Type 304 stainless steel.

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

n. Fabrication Cement - Vimasco "J" seal "S", or approved equal.

B. APPLICATION

1. Equipment

a. Insulation Supports

Equipment shall be provided with insulation supports as specified in the GENERAL SPECIFICATIONS, Part I. B. 5.

b. Thickness Schedule

Unless otherwise specified, insulation over 3 inches in total thickness shall be applied in multiple layers.

c. Curved Surfaces

(1) Insulation for equipment less than 3 feet in diameter shall be preformed pipe insulation. Insulation for larger equipment shall be bent, and kerfed where necessary so as to fit vessel contour, and shall be held in place with stainless steel insulation strap on 9-inch centers.

(2) Insulation shall be installed with all joints tightly butted, and circumferential butt joints staggered.

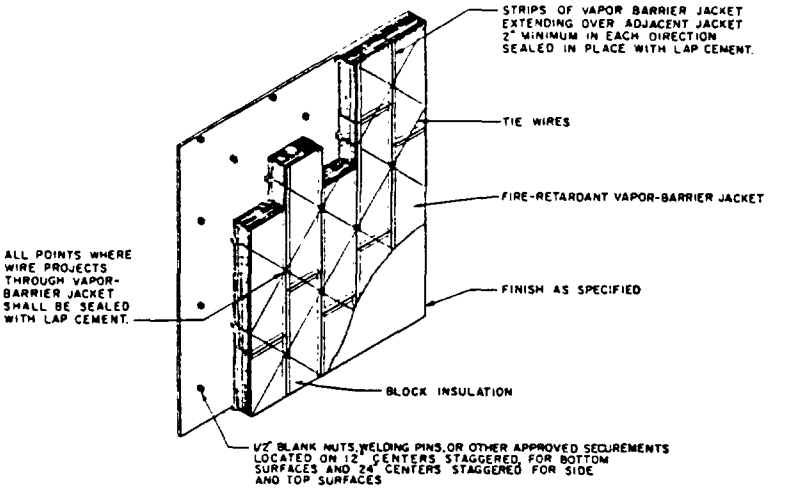
(3) Each layer of insulation shall be vapor sealed as called for in Part II. B. 1. e.

(4) On multiple layers of insulation, joints of outer layer shall be staggered a minimum of 2 inches from joints immediately below.

(5) Insulation on bottom heads of vertical equipment shall be secured in place with stainless steel insulation strap attached to insulation supports, in accordance with UCCC Standard IS-31.

d. Flat Surfaces

(1) Block insulation shall be applied to flat surfaces in staggered position with all joints tightly butted. It shall be secured with wire attached to welded studs with speed nuts; welded blank nuts; welded eye bolt studs; or other approved securement. On rectangular equipment, the studs or nuts, or other approved securements, shall be spaced on 12-inch centers, staggered, on bottom surfaces, and on 24-inch centers, staggered, on side and top surfaces. Typical installation is shown in Figure 15-L-1.



APPLICATION OF PREFORMED FIBROUS GLASS INSULATION TO FLAT SURFACE

FIG 15-L-1

(2) Where stiffeners or other projections make insulation of flat surfaces impracticable, welded steel wire fabric shall be placed over the projections, and secured by spot welding or wire, as specified. Block insulation shall then be secured to the welded wire fabric with wire, as specified in Part II. B. 1. d. (1) and vapor sealed as specified in Part II. B. 1. e.

e. Vapor-Barrier

Where equipment operating below 70 F is insulated with multiple layers of insulation, which does not have a factory-applied vapor-barrier jacket, a vapor-barrier consisting of the specified jacket material shall be installed between each layer, using the specified vapor seal adhesive cement. All edges shall be lapped a minimum of 2 inches, and all laps sealed with the specified vapor seal lap cement. Vapor-barrier over the outer layer, and over single layer insulation not having the vapor-barrier jacket, shall consist of the specified jacket material applied in the same manner, except that laps shall be sealed with the specified fire-resistant mastic.

f. Projections Through Insulation

All metal projections through the insulation shall be insulated with 1/2 the specified thickness of the insulation for a minimum distance of four times the specified thickness. Vapor-barrier shall be installed as called for in Part II. B. 1. e.

g. Weather-Barrier

If specified, weather-barrier shall be installed in accordance with the GENERAL SPECIFICATIONS, Part I. B. 17.

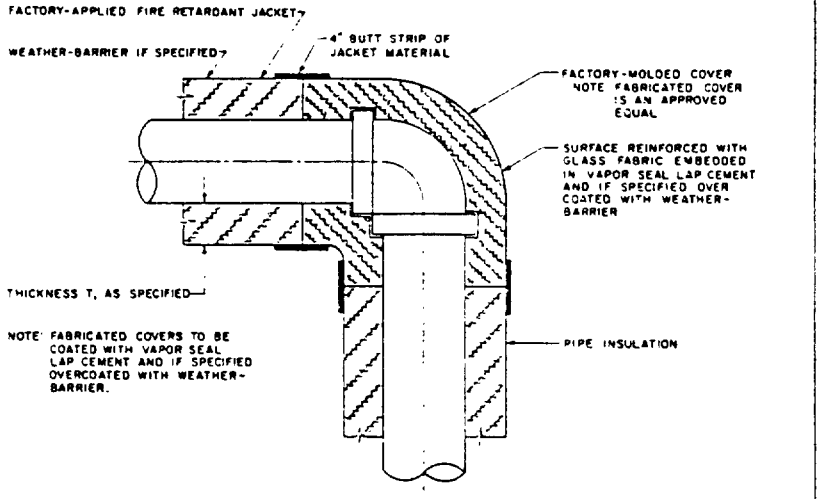
2. Piping

a. Pipe Insulation

(1) Unless otherwise specified, insulation in excess of 2-1/2-inch total thickness shall be applied in multiple layers, as specified in the GENERAL SPECIFICATIONS, Part I. B. 1. Where possible, joints of outer layer shall be staggered a minimum of 2 inches from joints immediately below.

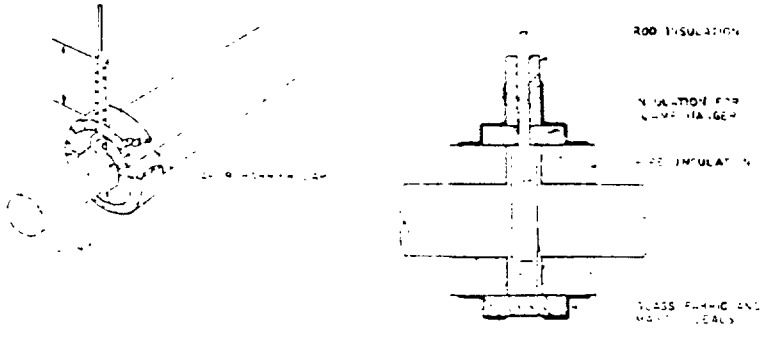
b. Fitting, Flange, and Valve Covers

(1) Fitting, flange, and valve covers may be factory-molded, or shop-fabricated in accordance with the UCCC Dimensional Standards Fabrication Manual, or ASTM Recommended Practice C 450, latest revision. Typical fitting covers are shown in Figures 15-L-2 and 15-L-3. Covers for flanges, and other screwed or flanged fittings and valves, shall be similar to those shown.



APPLICATION OF FIBROUS GLASS INSULATION TO SCREWED ELL

FIG 15-L-2



DETAILS OF INSULATED PIPE CLAMP AND INSULATED ROD HANGER

(2) Fitting, flange, and valve covers may be field fabricated, provided work is in accordance with the UCCC Dimensional Standards Fabrication Manual, or ASTM C 450, latest revision, and approved by the Field Representative of the Department of Design and Construction.

(3) The two halves of factory-molded covers shall be strapped together with stainless steel insulation strap for outside diameters larger than 8-5/8 inches, and with the specified strapping tape for outside diameters 8-5/8 inches and less.

(4) The two halves of fabricated covers shall be cemented together with vapor seal adhesive 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 filled with cement, be permitted.

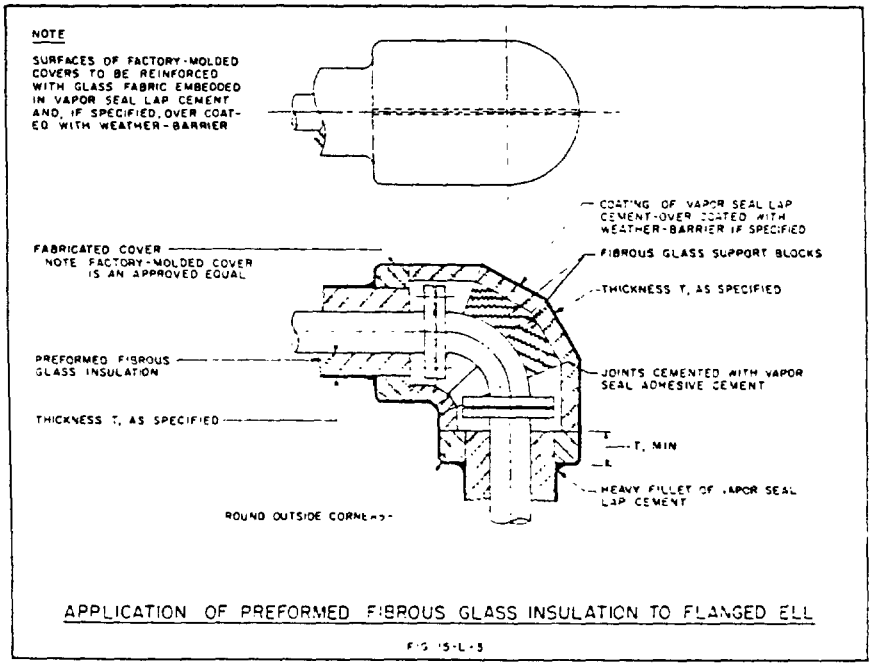
(5) The pipe insulation adjacent to ocvers for screwed fittings and valves shall be fitted tightly to the butt ends of the cover, and the joints sealed as specified for piping.

(6) The surfaces of factory-molded covers shall be coated with vapor seal lap cement, and reinforced with the specified glass fabric embedded in the cement.

(7) The surfaces of fabricated covers shall be coated with vapor seal lap cement.

c. Pipe Hangers

Pipe hangers and hanger rods shall be insulated as shown in Figure 15-L-4.



APPLICATION OF PREFORMED FIBROUS GLASS INSULATION TO FLANGED ELL

FIG 15-L-5

d. Weather-Barrier

If specified, weather-barrier shall be installed in accordance with the GENERAL SPECIFICATIONS, Part I. B. 17.

II. SPECIFICATION 16-H

**Preformed Fibrous Glass
Low Density
(More than 3 lb/cu ft)**

Scope

This Specification describes the essential requirements for the purchase and application of preformed glass fiber thermal insulation for use on piping normally operating at temperatures above 70 F and up to and including 350 F. It is applicable to both indoor and outdoor service.

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

A. MATERIAL

1. Composition

Material shall be composed of fibrous glass molded into pipe insulation with a modified phenolic type binder, and a factory-applied fire-resistant jacket.

2. Properties

Preformed fibrous glass insulation shall have the following properties:

Alkalinity	pH shall be between 7 and 10.
Capillarity	After 7 days on wet surface, gain in weight shall be 0%.
Density	Shall be greater than 3 and less than 5 lb per cu ft.
Hygroscopicity.	When exposed to air at 120 F and 95% relative humidity for 96 hours, shall be less than 0.2% by volume.
Loss on Ignition	Shall be between 8 and 19% by weight.
Resistance to Acids. . . .	Fairly good, except to hydrofluoric.
Resistance to Alkalies . .	Poor.
Specific Gravity	Shall average 2.6 true, 0.047 to 0.071 apparent.
Specific Heat	Shall average 0.20 Btu per lb per degree F.
Temperature Limits . . .	Shall be suitable for use from minus 120 F to plus 375 F without mechanical, thermal, or chemical failure.
Thermal Conductivity. . .	When tested in accordance with ASTM C 177, latest revision, or ASTM C 335, latest revision, the thermal conductivity at the given mean temperatures shall not exceed the following values:

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

Thermal Diffusivity at 75 F	0.46 sq ft per day (5 lb) 0.77 sq ft per day (3 lb)
Water Absorption (by immersion)	Percentage of volume is very high, due to open fibrous structure, but does not retain if water can run out.

II. A. contd

3. Accessory Materials

a. Butt Joint Strips - White Fire-Retardant Jacket material (designated White FRJ), same as factory-applied jacket.

b. Stainless Steel Wire - 0.0475-inch diameter, Type 304, cold drawn, bright annealed, 18 gage.

c. Stainless Steel Insulation Strap - A. J. Gerrard, Techalloy, 1/2-inch by 0.20-inch, Type 304, or approved equal.

d. Strapping Tape - Glass filament, vinyl-backed, Dutch Brand No. 400, or approved equal.

e. Pipe Insulation Support - Techalloy insulation support strap or approved equal.

f. Vapor Seal Lap Cement - Benjamin Foster 81-99 Sealfas, Vimasco Viny-Lag, or approved equal.

g. Weather-Barrier Coating (Color as specified) - PVA - Vimasco No. WC-1, Pittsburgh-Corning Pittcote 500 C, or approved equal.

h. Reinforcing Cloth - Glass fabric, 10 by 10 thread count, Perma-Glas, Twinsburg-Miller, Benjamin Foster Open Weave No. 10, or approved equal.

i. Vapor Seal Adhesive Cement - Benjamin Foster 81-42W, Vimasco Viny-Lag W, Arabol 60-89-05, or approved equal.

j. Fabrication Cement - Vimasco "J" seal "S" or approved equal.

B. APPLICATION

1. Piping

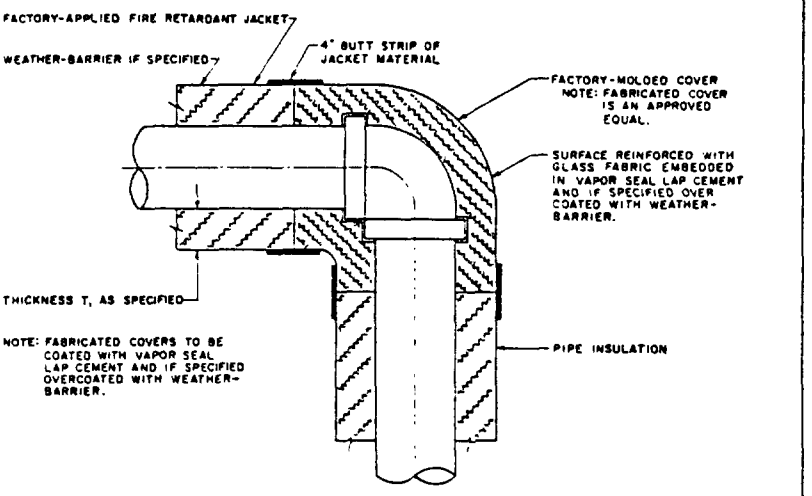
a. Pipe Insulation

(1) Unless otherwise specified, insulation in excess of 2-1/2-inch total thickness shall be applied in multiple layers, as specified in the GENERAL SPECIFICATIONS, Part I. B. 1. Where possible, joints of outer layer shall be staggered a minimum of 2 inches from joints immediately below.

(2) Insulation shall be applied to pipe in accordance with the GENERAL SPECIFICATIONS, Parts I. B. 5, 6, 7, and 8. Laps of factory-applied fire-retardant jackets shall be sealed with the specified vapor seal lap cement. All joints shall be tightly butted, and covered with the specified butt joint strips 4 inches wide, lapped the same as the jackets. The strips shall be attached to the jackets with the specified vapor seal adhesive cement, and strip laps sealed with vapor seal lap cement.

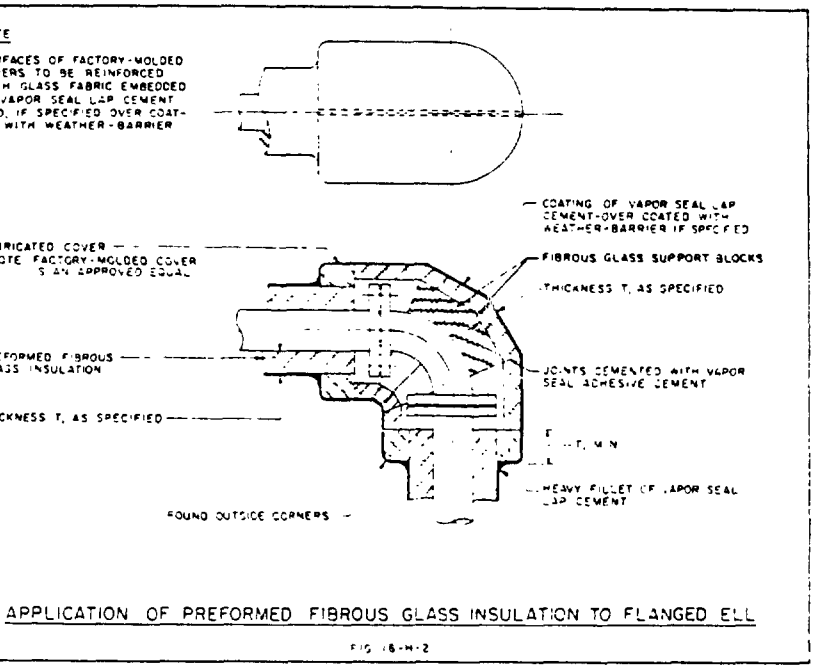
b. Fitting, Flange, and Valve Covers

(1) Fitting, flange, and valve covers shall be factory-molded, or shop-fabricated in accordance with the UCCC Dimensional Standards Fabrication Manual, or ASTM Recommended Practice C 450, latest revision. Typical fitting covers are shown in Figures 16-H-1 and 16-H-2. Covers for flanges, and other screwed or flanged fittings and valves, shall be similar to those shown.



APPLICATION OF FIBROUS GLASS INSULATION TO SCREWED ELL

FIG 16-H-1



APPLICATION OF PREFORMED FIBROUS GLASS INSULATION TO FLANGED ELL

FIG 16-H-2

II. B. 1. b. contd

(2) Fitting, flange, and valve covers may be field-fabricated, provided work is in accordance with the UCGC Dimensional Standards Fabrication Manual, or ASTM C 450, latest revision, and approved by the Field Representative of the Department of Design and Construction.

(3) The two halves of factory-molded covers shall be strapped together with stainless steel insulation strap for outside diameters larger than 4-1/2 inches, and with the specified strapping tape for outside diameters 4-1/2 inches and less.

(4) The two halves of fabricated covers shall be cemented together with vapor seal adhesive 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 filled with cement, be permitted.

(5) 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 for piping.

(6) The surfaces of factory-molded covers shall be coated with vapor seal lap cement, and reinforced with the specified glass fabric embedded in the cement.

(7) The surfaces of fabricated covers shall be coated with vapor seal lap cement.

c. Weather-Barrier

If specified, weather-barrier shall be installed in accordance with the GENERAL SPECIFICATIONS, Part I. B. 17.

(2) Fitting, flange, and valve covers may be field fabricated, provided work is in accordance with the UCCC Dimensional Standards Fabrication Manual, or ASTM C 450, latest revision, and approved by the Field Representative of the Department of Design and Construction.

(3) The two halves of factory-molded covers shall be strapped together with stainless steel insulation strap for outside diameters larger than 4-1/2 inches, and with the specified strapping tape for outside diameters 4-1/2 inches and less.

(4) The two halves of fabricated covers shall be cemented together with vapor seal adhesive 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 filled with cement, be permitted.

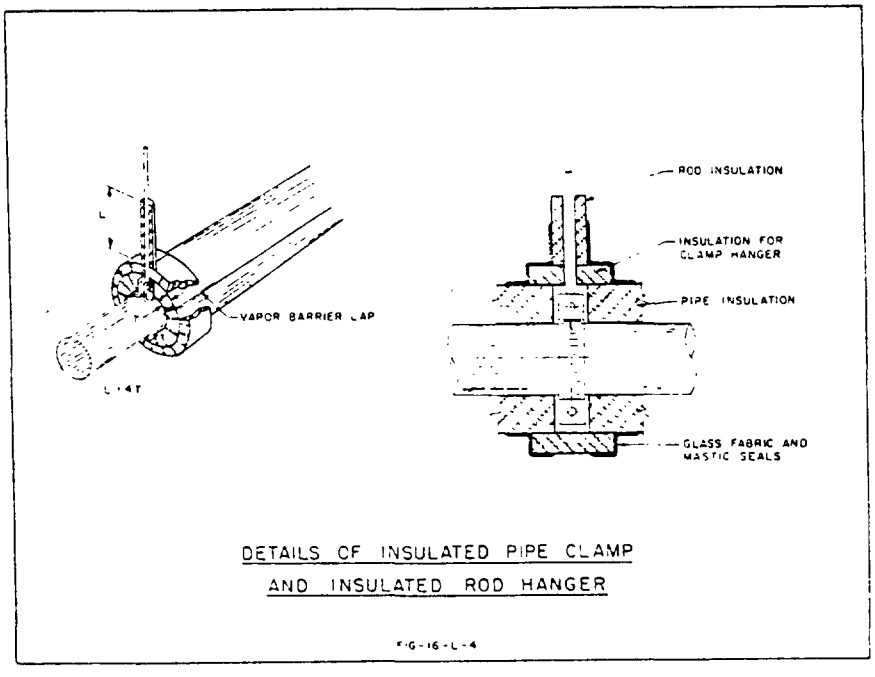
(5) The pipe insulation adjacent to covers for screwed fittings and valves shall be fitted tightly to the butt ends of the cover, and the joints sealed as specified for piping.

(6) The surfaces of factory-molded covers shall be coated with vapor seal lap cement, and reinforced with the specified glass fabric embedded in the cement.

(7) The surfaces of fabricated covers shall be coated with vapor seal lap cement.

c. Pipe Hangers

Pipe hangers and hanger rods shall be insulated as shown in Figure 16-L-4.



DETAILS OF INSULATED PIPE CLAMP AND INSULATED ROD HANGER

FIG-16-L-4

d. Weather-Barrier

If specified, weather-barrier shall be installed in accordance with the GENERAL SPECIFICATIONS, Part I. B. 17.

UNION CARBIDE CHEMICALS COMPANY
DEPARTMENT OF DESIGN AND CONSTRUCTION

THERMAL INSULATION SPECIFICATIONS

II. SPECIFICATION 16-L

Preformed Fibrous Glass
Pipe Insulation - from 3.0 to 5.0 lb/cu ft
Board - from 3.0 to 10.0 lb/cu ft

Scope

This Specification describes the essential requirements for the purchase and application of preformed fibrous glass thermal insulation for use on equipment and piping normally operating at temperatures not more than 100 F nor less than 20 F. It is applicable to both indoor and outdoor service.

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

A. MATERIAL

1. Composition

Material shall be composed of fibrous glass molded into pipe and board insulation with a modified phenolic type binder. Insulation shall have a factory-applied fire-retardant vapor barrier jacket.

2. Properties

Preformed fibrous glass insulation shall have the following properties:

Alkalinity	pH shall be between 7 and 10.
Capillarity	After 7 days on wet surface shall show no evidence of capillarity.
Density:	
Pipe	Shall be not less than 3.0 nor more than 5 lb per cu ft.
Board	Shall be not less than 3.0 nor more than 10.0 lb per cu ft.
Hygroscopicity.	When exposed to air at 120 F and 95% relative humidity for 96 hours, shall be less than 0.2% by volume.
Loss on Ignition	Shall be not less than 6 nor more than 19% by weight.
Resistance to Acids . . .	Fairly good, except to hydrofluoric.
Resistance to Alkalies . .	Poor.
Specific Gravity	Shall average 2.6 true, 0.047 to 0.16 apparent.
Specific Heat	Shall average 0.20 BTU per lb per degree F.
Temperature Limits . . .	Shall be suitable for use from minus 120 F to plus 375 F without mechanical, thermal, or chemical failure.
Thermal Conductivity. . .	When tested in accordance with ASTM C 177, latest revision, or ASTM C 335, latest revision, the thermal conductivity at the given mean temperatures shall not exceed the following values:

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

Thermal Diffusivity at 75 F.	0.77 sq ft per day (5-lb) 0.23 sq ft per day (10-lb)
Water Absorption (by immersion) . . .	Percentage of volume is very high, due to open fibrous structure, but does not retain if water can run out.

II. A. contd

3. Accessory Materials

a. Butt Joint Strips - White Fire-Retardant Vapor Barrier Jacket material (designated White FRJ), same as factory-applied jacket.

b. Welding Pins - 12-gage steel, KSM, Omark, or approved equal. Length shall be equal to insulation thickness plus 1/4 inch minimum.

c. Stainless Steel Wire - 0.0475-inch diameter, Type 304, cold drawn, bright annealed, 18 gage.

d. Stainless Steel Insulation Strap - 1/2-inch by 0.020-inch, Type 304, A. J. Gerrard, Techalloy, or approved equal.

e. Strapping Tape - Glass filament, vinyl-backed, Dutch Brand No. 400, or approved alternate.

f. Pipe Insulation Support - Techalloy insulation support strap or approved equal.

g. Vapor Seal Lap Cement - Benjamin Foster 81-99, Vimasco Viny-Lag, or approved equal.

h. Fire-Resistant Mastic - Benjamin Foster 60-30N or approved equal.

i. Weather-Barrier Coating (Color as specified) - PVA - Vimasco No. WC-1, Pittsburgh-Corning Pittcote 500 C, or approved equal.

j. Reinforcing Cloth - Glass fabric, 10 by 10 thread count, Perma-Glas, Twinsburg-Miller, Benjamin Foster Open Weave No. 10, or approved equal.

k. Vapor Seal Adhesive Cement - Benjamin Foster 31-42W, Arabol 60-89-05, Vimasco Viny-lag W, or approved equal.

l. Wire Netting - 1-inch hexagonal mesh, 20-gage, Monel or Type 034 stainless steel.

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

n. Fabrication Cement - Vimasco "J" seal "S" or approved equal.

B. APPLICATION

1. Equipment

a. Insulation Supports

Equipment shall be provided with insulation supports as specified in the GENERAL SPECIFICATIONS, Part I. B. 5.

b. Thickness Schedule

Unless otherwise specified, insulation over 3 inches in total thickness shall be applied in multiple layers.

c. Curved Surfaces

(1) Insulation for equipment less than 3 feet in diameter shall be preformed pipe insulation. Insulation for larger equipment shall be bent, and kerfed where necessary, so as to fit vessel contour, and shall be held in place with stainless steel insulation strap on 9-inch centers.

(2) Insulation shall be installed with all joints tightly butted, and circumferential butt joints staggered.

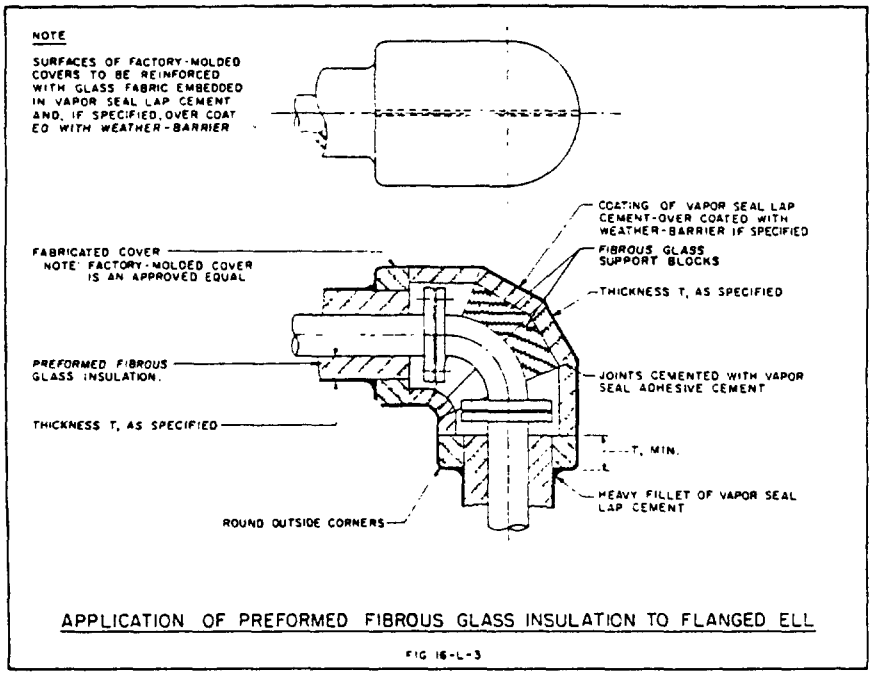
(3) Each layer of insulation shall be vapor sealed as called for in Part II. B. 1. e.

(4) On multiple layers of insulation, joints of outer layers shall be staggered a minimum of 2 inches from joints immediately below.

(5) Insulation on bottom heads of vertical equipment shall be secured in place with stainless steel insulation strap or stainless steel wire attached to insulation supports in accordance with UCCC Standard IS-31.

d. Flat Surfaces

(1) Board insulation shall be applied to flat surfaces in staggered position with all joints tightly butted. It shall be secured with stainless steel wire attached to welded studs with speed nuts; welded blank nuts; welded eye bolt studs; or other approved securement. On rectangular equipment, the studs or nuts, or other approved securements, shall be spaced on 12-inch centers, staggered, on bottom surfaces, and on 24-inch centers, staggered, on side and top surfaces. Typical installation is shown in Figure 16-L-1.



APPLICATION OF PREFORMED FIBROUS GLASS INSULATION TO FLANGED ELL

FIG 16-L-3

(2) Where stiffeners or other projections make insulation of flat surfaces impracticable, welded steel wire fabric shall be placed over the projections and secured by spot welding or wire, as specified. Board insulation shall then be secured to the welded wire fabric with wire, as specified in Part II. B. 1. d. (1), and vapor sealed as specified in Part II. B. 1. e.

e. Vapor-Barrier

Where equipment operating below 70 F is insulated with multiple layers of insulation which does not have a factory-applied vapor-barrier jacket, a vapor-barrier consisting of the specified jacket material shall be applied to each layer before the next layer of insulation is installed, using the specified vapor seal adhesive cement. All edges shall be lapped a minimum of 2 inches, and all laps sealed with the specified vapor seal lap cement. Vapor-barrier over the outer layer, and over single layer insulation not having the vapor-barrier jacket, shall consist of jacket material applied in the same manner, except that laps shall be sealed with the specified fire-resistant mastic.

f. Projections Through Insulation

All metal projections through the insulation shall be insulated with 1/2 the specified thickness of insulation for a minimum distance of four times the specified thickness. Vapor-barrier shall be installed as called for in Part II. B. 1. e.

g. Weather-Barrier

If specified, weather-barrier shall be installed in accordance with the GENERAL SPECIFICATIONS, Part I. B. 17.

2. Piping

a. Pipe Insulation

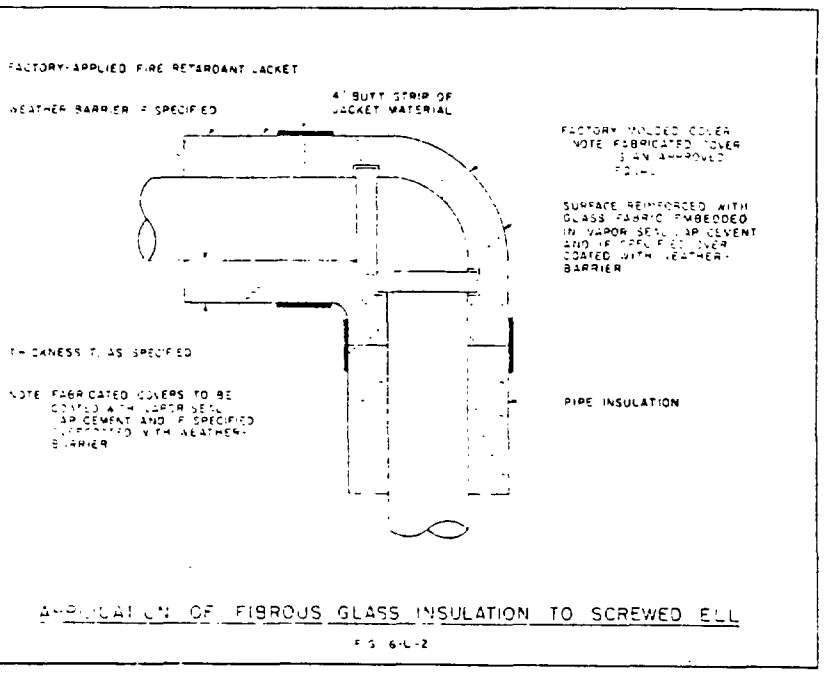
(1) Unless otherwise specified, insulation in excess of 3 inches total thickness shall be applied in multiple layers, as specified in the GENERAL SPECIFICATIONS, Part I. B. 1. Where possible, joints of outer layer shall be staggered a minimum of 2 inches from joints immediately below.

(2) Insulation shall be applied to pipe in accordance with the GENERAL SPECIFICATIONS, Parts I. B. 5, 6, 7, and 8. Laps of factory-applied fire-retardant jackets shall be sealed with vapor seal lap cement. All joints shall be tightly butted, and covered with the specified butt joint strips 4 inches wide, lapped the same as the jackets. The strips shall be adhered to the jackets with vapor seal adhesive cement, and strip laps sealed with vapor seal lap cement.

II. B. contd

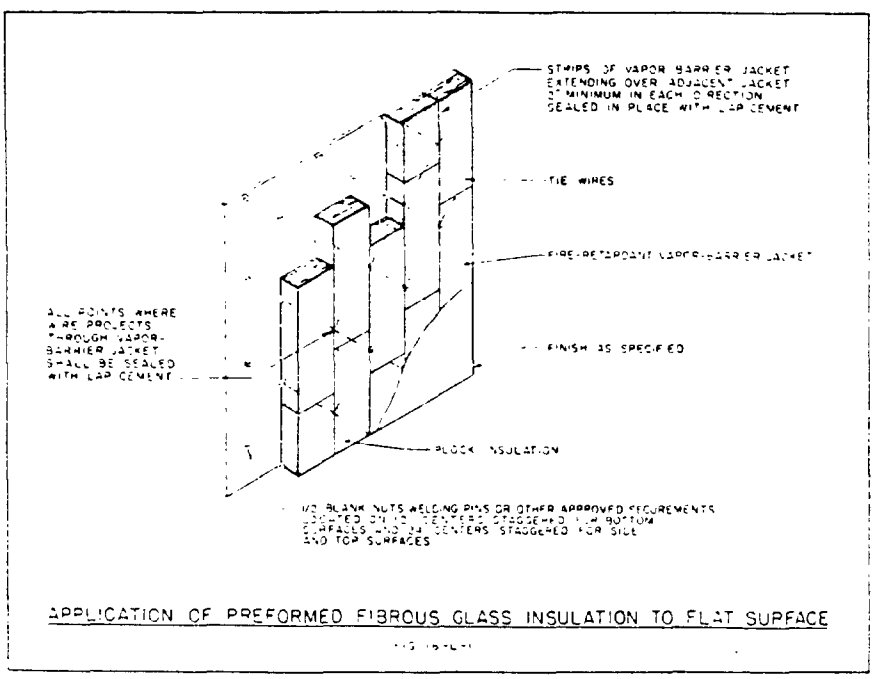
b. Fitting, Flange, and Valve Covers

(1) Fitting, flange, and valve covers may be factory-molded, or shop-fabricated in accordance with the UCCC Dimensional Standards Fabrication Manual, or ASTM Recommended Practice C 450, latest revision. Typical fitting covers are shown in Figures 16-L-2 and 16-L-3. Covers for flanges, and other screwed or flanged fittings and valves, shall be similar to those shown.



APPLICATION OF FIBROUS GLASS INSULATION TO SCREWED ELL

FIG 6-L-2



APPLICATION OF PREFORMED FIBROUS GLASS INSULATION TO FLAT SURFACE

UNION CARBIDE CHEMICALS COMPANY
DEPARTMENT OF DESIGN AND CONSTRUCTION

THERMAL INSULATION SPECIFICATIONS

II. SPECIFICATION 17-FX — Fibrous Glass Flexible Duct Insulation

Scope

This Specification describes the essential requirements for the purchase and application of glass fiber blanket insulation for use on the exterior surfaces of heating, ventilating, and air conditioning ducts.

A. MATERIAL

1. Composition

Material shall be composed of fibrous glass with a modified phenolic resin binder, formed into a flexible blanket, and faced with a factory-applied fire-retardant vapor barrier of kraft paper reinforced with 0.002-inch aluminum foil.

2. Properties

Flexible fibrous glass insulation shall have the following properties:

Alkalinity	pH shall be between 7 and 10.
Capillarity	After 7 days on wet surface, gain in weight shall be 0%.
Density, average of 10 samples	Shall not be less than 0.9 lb per cu ft.
Hygroscopicity	When oven-dried to constant weight, then exposed to air at 70 F and 90% relative humidity for 14 days, gain in weight shall be not more than 2%.
Resistance to Acids	Fairly good, except to hydrofluoric.
Resistance to Alkalies	Poor.
Specific Heat	Shall average 0.20 Btu per lb per cu ft.
Temperature Limits (Glass Core)	Shall be suitable for use from minus 120 F to plus 375 F without mechanical, thermal, or chemical failure.
Tensile Strength (Parting Strength, average)	Shall be greater than 1.2 lb per gram of weight.
Thermal Conductivity	When tested in accordance with ASTM C 177, latest revision, the thermal conductivity at the given mean temperatures shall not exceed the following values:

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

Thermal Diffusivity at 75 F	2.5 sq ft per day.
Water Absorption (by immersion)	Percentage of volume is very high, due to open fibrous structure, but does not retain if water can run out.

3. Accessory Materials

a. Strapping Tape - Glass filament, vinyl backed, Dutch Brand No. 400 or approved equal.

b. Fire-Resistant Adhesive - Benjamin Foster 81-99, Minnesota Mining and Manufacturing Company EC-890, Vimasco Viny-Lag, or approved equal.

c. Reinforcing Cloth - Glass fabric, 10 by 10 thread count, Perma-Glas, Twinsburg-Miller, Benjamin Foster Open Weave No. 10, or approved equal.

d. Exterior Paper Wrapping - Resin-sized or asbestos paper.

e. Weather-Barrier Coating (Color as specified) - PVA - Vimasco No. WC-1, Pittsburgh-Corning Pittcote 500 C, or approved equal.

f. Lagging Coating (Color as specified) - Resin base, Benjamin Foster Lagtone, Armstrong Insulcolor, Vimasco Viny-Lag, or approved equal.

g. Outer Covering - 8-oz canvas.

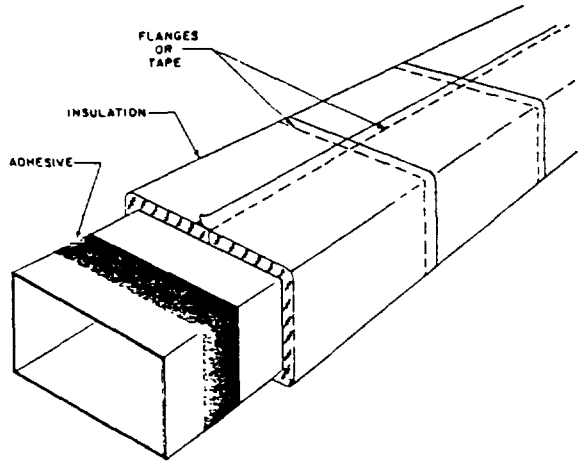
B. APPLICATION

1. Thickness of Insulation

Thickness of insulation shall be as scheduled.

2. Concealed Indoor Ducts

Insulation shall be adhered to ducts with the specified fire-resistant adhesive. All joints shall be tightly butted and sealed with the specified strapping tape adhered to the insulation with fire-resistant adhesive. Typical installation is shown in Figure 17-FX-1.



APPLICATION OF FIBROUS GLASS FLEXIBLE DUCT INSULATION TO EXTERIOR OF DUCT

FIG 17-FX-1

Exposed Indoor Ducts

Insulation shall be applied as specified in Part II. B. 1. The specified exterior paper wrapping shall be installed over the insulation in such a manner that the wrapping is smooth and free from wrinkles. The paper wrapping shall be secured, and all joints sealed, with the specified strapping tape. Canvas outer covering shall be adhered to the paper wrapping with the specified lagging coating. After drying, the canvas shall be given a second application of lagging coating in sufficient thickness to provide a smooth, evenly textured, and evenly colored surface.

4. Outdoor Ducts

Insulation and exterior paper wrapping shall be applied as specified in Parts II. B. 1 and II. B. 2, respectively. Weather-barrier of the specified reinforcing cloth and weather-barrier coating shall be installed in accordance with the GENERAL SPECIFICATIONS, Part I. B. 17.

UNION CARBIDE CHEMICALS COMPANY
DEPARTMENT OF DESIGN AND CONSTRUCTION

ACOUSTICAL AND/OR THERMAL DUCT LINER SPECIFICATIONS

SPECIFICATION 17-FY

Fibrous Glass Flexible Duct Insulation (More than 2 lb per cu ft)

Scope

This Specification describes the essential requirements for the purchase and application of fibrous glass flexible duct liner acoustical and thermal insulation for use on supply and return air ducts, carrying both conditioned and warm air.

A. MATERIAL

1. Composition

Material shall be composed exclusively of long textile-type glass fibers bonded into an acoustical and thermal blanket with a modified phenolic type binder. Surface spray coating one side shall meet NBFU 90A and 90B bulletins and shall be clearly imprinted on surface face with density and thickness.

2. Properties

Alkalinity . . . . . pH shall be between 7 and 10.

Capillarity . . . . . After 7 days on wet surface there shall be no capillary action.

Density . . . . . Shall be not less than 2 lb per cu ft.

Erosion Resistance . . . . Shall handle air velocities up to 7500 ft per minute with no air erosion.

Friction Coefficient . . . . Shall not exceed 0.030.

Hygroscopicity . . . . . When exposed to air at 120 F and 95% relative humidity for 96 hours, shall be less than 0.2% by volume.

Loss on Ignition . . . . . Shall not be less than 12 nor more than 20% by weight.

Resistance to Alkalies . . . Poor

Noise Reduction Coefficient. NRC shall be 0.75 or above.

Specific Gravity . . . . . Shall average 2.5 true, 0.03 apparent.

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

Temperature Limits . . . . Shall be suitable for use from minus 120 F to plus 250 F without mechanical, thermal, or chemical failure.

Thermal Conductivity . . . When tested in accordance with ASTM C177, latest revision, or ASTM C335, latest revision, the thermal conductivity at the given mean temperatures shall not exceed the following values:

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

Thermal Diffusivity . . . At 75F 1.2 sq ft per day.

Water Absorption . . . . Percentage of volume is very high due to open fibrous structure, but does not retain if water can run out.

3. Accessory Materials

a. Adhesive - Quick-tacking rubber based, Benjamin Foster 81-71, or approved equal.

b. Sheet Metal screws and washers.

c. Welding Pins - 12 gage steel, KSM, Omark, or approved equal. Length shall be equal to insulation thickness plus 1/4 inch minimum.

d. Fasteners - Pin clips to fit pins.

B. APPLICATION

1. Thickness of Insulation

Thickness of insulation shall be as scheduled.

2. Forming

a. Forming Duct Liner with the Metal

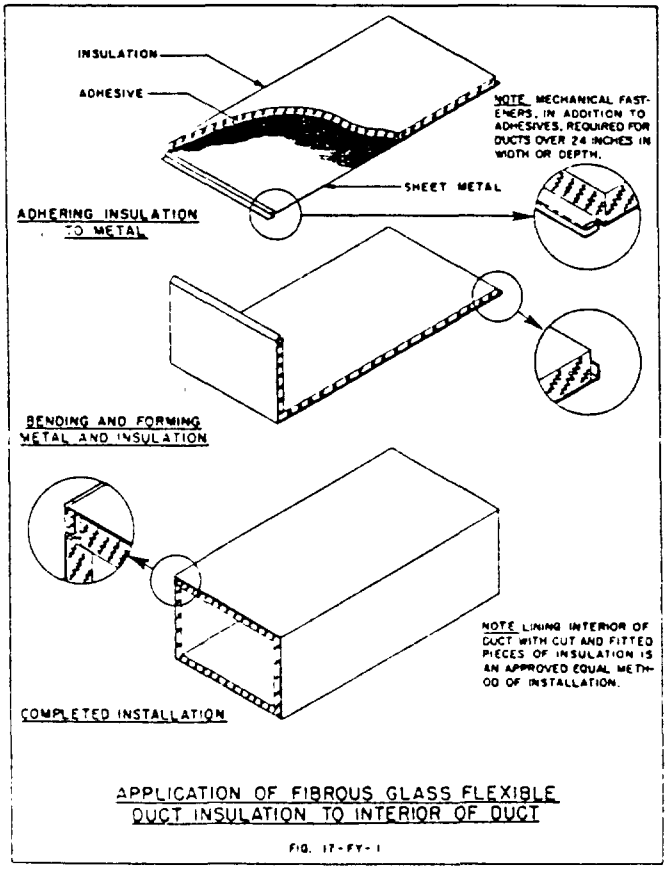
All ducts requiring insulation liner shall be lined by carefully adhering the liner in a continuous piece to clean flat metal sheets with the specified adhesive and forming the liner with the metal through the brake. Coated side of the duct liner shall face the air stream. All exposed edges shall be coated with adhesive. In ducts over 24 inches in width or depth, the liner shall be additionally secured with sheet metal screws and washers, or stud welded pins and clips placed on not less than 18-inch centers.

b. Cutting and Fitting Individual Pieces

All ducts requiring insulation liner shall be lined by cutting pieces to fit snugly the interior of the duct surfaces. The liner shall be fastened to the duct with a heavy coat of adhesive spread over the entire duct surface. The top and bottom pieces shall lap the side pieces, and all exposed edges of the insulation at the duct ends shall be coated with adhesive. The coated surface shall face the air stream. In ducts over 24 inches in width or breadth, the liner shall be additionally secured with sheet metal screws and washers, or stud welded pins and clips placed on not less than 18-inch centers.

3. Typical Installation

Typical installation of formed insulation is shown in Figure 17-FY-1.



APPLICATION OF FIBROUS GLASS FLEXIBLE DUCT INSULATION TO INTERIOR OF DUCT

FIG. 17-FY-1

SPECIFICATION 17-RX

Preformed Fibrous Glass Vapor Seal Rigid-Faced Insulation

Scope

This Specification describes the essential requirements for the purchase and application of preformed fibrous glass vapor seal rigid-faced insulation for use on the exterior surfaces of heating, ventilating, and air conditioning ducts.

A. MATERIAL

1. Composition

Material shall be composed of fibrous glass with a modified phenolic resin binder, formed into a rigid board and faced with a factory-applied vapor barrier of 0.0025-inch aluminum foil.

2. Properties

Rigid preformed fibrous glass duct insulation shall have the following properties:

Alkalinity	pH shall be between 7 and 10.
Capillarity	After 7 days on wet surface, gain in weight shall be 0%.
Density, average of 10 samples	Shall be not less than 3.0 nor more than 6.5 lb per cu ft.
Hygroscopicity	When oven-dried to constant weight, then exposed to air at 70 F and 90% relative humidity for 14 days, the gain in weight shall be less than 2%.
Resistance to Abrasion	When tested in accordance with ASTM C 421, latest revision, weight loss shall be less than the following: After first 10-minute run: 35% After second 10-minute run: 55%
Resistance to Acids	Fairly good, except hydrofluoric.
Resistance to Alkalies	Poor.
Specific Heat	Shall average 0.20 Btu per lb per degree F.
Temperature Limits, glass core	Shall be suitable for use from minus 120 F to plus 375 F without mechanical, thermal, or chemical failure.
Thermal Conductivity	When tested in accordance with ASTM C 177, latest revision, the thermal conductivity at the given mean temperatures shall not exceed the following values:

Mean Temp, °F	Btu/inch, hr, sq ft, °F
75	0.26
100	0.27
200	0.28

Thermal Diffusivity	Shall average not more than 0.77 sq ft per day.
Water Absorption (by immersion)	Percentage of volume is very high, due to open fibrous structure, but does not retain if water can run out.

3. Accessory Materials

a. Welding Pins - 12 gage steel, KSM, Omark, or approved equal. Length shall be equal to insulation thickness plus 1/4 inch minimum.

b. Adhesive Type Pins - Stic-Klip Type N or approved equal; used with adhesive recommended by manufacturer.

c. Fasteners - For welding pins: pin clips to fit pins. For adhesive type pins: speed washers furnished with pins.

II. A. 3. contd

d. Reinforcing Cloth - Glass fabric, 10 by 10 thread count, Perma-Glas, Twinsburg-Miller, Benjamin Foster Open Weave No. 10, or approved equal.

e. Fire-Resistant Adhesive - Benjamin Foster 81-99, Minnesota Mining and Manufacturing Company EC-890, Vimasco Viny-Lag, or approved equal.

f. Fire-Resistant Caulking Mastic - Benjamin Foster 60-30N, or approved equal.

g. Weather-Barrier Coating (Color as specified) - PVA-Vimasco No. WC-1, Pittsburgh-Corning Pittcote 500 C, or approved equal.

h. Lagging Coating (Color as specified) - Resin base, Benjamin Foster Lagtone, Armstrong Insulcolor, Vimasco Viny-Lag, or approved equal.

i. Outer Covering - 8-oz canvas.

B. APPLICATION

1. Thickness of Insulation

Thickness of insulation shall be as scheduled.

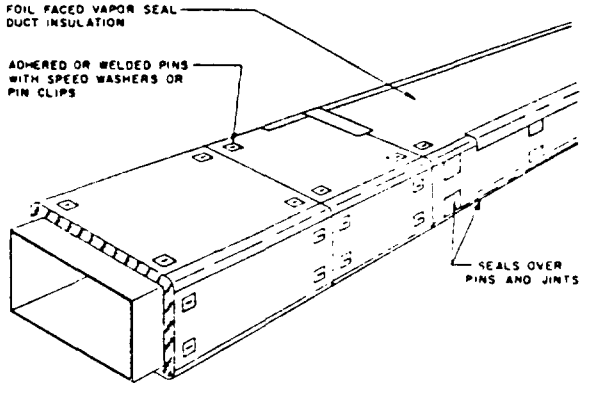
2. Concealed Indoor Ducts

a. Joints

Insulation shall be applied with all joints tightly butted.

b. Securement

Where welding is possible, insulation shall be attached to ducts with the specified welding pins and pin clips. Where welding is impossible, attachment shall be made with the specified adhesive type pins and speed washers. Longitudinal spacing of pins shall be from 12 to 18 inches. On sides 8 inches and less in width, one row of fasteners is required. On sides more than 8 inches wide, one additional row is required for each multiple of 8 inches or fraction thereof. Pins shall be cut off 1/16 inch from outside of clips or washer. Typical installation is shown in Figure 17-RX-1.



APPLICATION OF PREFORMED FIBROUS GLASS VAPOR SEAL RIGID-FACED INSULATION TO EXTERIOR OF DUCT

FIG 17-RX-1

c. Vapor Barrier

(1) All joints, cracks, punctures, and breaks shall be sealed with the specified vapor barrier strips, so as to form a continuous vapor-tight envelope. The strips shall be adhered to the factory-applied vapor barrier with the specified fire-resistant adhesive. Where pins project through insulation, holes shall be sealed with this adhesive.

(2) An alternative method of sealing joints, cracks, punctures, or breaks in insulation on concealed indoor ducts is to apply 4-inch wide strips of fire-resistant caulking mastic.

3. Exposed Indoor Ducts

a. Insulation shall be applied to exposed indoor ducts in the manner specified for concealed indoor ducts, in Parts II. B. 2. a and b.

b. Before application of lagging coating, cracks and depressions in the surface of the insulation shall be filled with the specified weather-barrier coating and troweled smooth. Canvas outer covering shall be adhered to the surface with the specified lagging coating. After drying, the canvas shall be given a second application of lagging coating in sufficient thickness to provide a smooth, evenly textured, evenly colored surface.

4. Outdoor Ducts

a. Insulation shall be applied to outdoor ducts in the manner specified for concealed indoor ducts, in Parts II. B. 2. a and b.

b. Before application of weather-barrier, cracks and depressions in the surface of the insulation shall be filled with the specified weather-barrier coating and troweled smooth. Weather-barrier of the specified reinforcing cloth and weather-barrier coating shall be installed in accordance with the GENERAL SPECIFICATIONS, Part I. B. 17.

II. SPECIFICATION 17-RY

Preformed Fibrous Glass Coated Rigid Insulation

Scope

This Specification describes the essential requirements for the purchase and application of glass fiber rigid insulation for use on the interior surfaces of heating, ventilating, and air conditioning ducts.

A. MATERIAL

1. Composition

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

2. Properties

Rigid fibrous glass insulation shall have the following properties:

Alkalinity	pH shall be between 7 and 10.
Capillarity	After 7 days on wet surface, gain in weight shall be 0%.
Density, average of 10 samples	Shall be not less than 3.0 nor more than 6.5 lb per cu ft.
Hygroscopicity	When oven-dried to constant weight, then exposed to air at 70 F and 90% relative humidity for 14 days, gain in weight shall be less than 2%.
Resistance to Acids	Fairly good, except to hydrofluoric.
Resistance to Alkalies	Poor.
Specific Heat	Shall average 0.20 Btu per lb per cu ft.
Temperature Limits	Shall be suitable for use from minus 120 F to plus 250 F without mechanical, thermal, or chemical failure.
Tensile Strength (Parting Strength, average)	Shall be greater than 1.2 lb per gram of weight.
Thermal Conductivity	When tested in accordance with ASTM C 177, latest revision, the thermal conductivity at the given mean temperatures shall not exceed the following values:

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

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

3. Accessory Materials

a. Welding Pins - 12 gage steel, KSM, Omark, or approved equal. Length shall be equal to insulation thickness plus 1/4 inch minimum.

b. Adhesive Type Pins - Stic-Klip Type N or approved equal; used with adhesive recommended by manufacturer.

c. Fasteners - For welding pins: pin clips to fit pins. For adhesive type pins: speed washers furnished with pins.

d. Fire-Resistant Adhesive - Benjamin Foster 81-99, Minnesota Mining and Manufacturing Company EC-890, Vimasco Viny-Lag or approved equal.

e. Fire-Resistant Caulking Mastic - Benjamin Foster 60-30N, Insul-Coustic Fire Resistive Caulking, or approved equal.

f. Weather-Barrier Coating (Color as specified) - PVA-Vimasco No. WC-1, Pittsburgh-Corning Pittcote 500 C, or approved equal.

g. Lagging Coating (Color as specified) - Resin base, Benjamin Foster Lagtone, Armstrong Insulcolor, or approved equal.

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, pins and fasteners of one of the specified types shall be installed on the interior top and side surfaces of the duct where the width and height of the duct exceed 12 inches and 24 inches, respectively. The maximum spacing of the pins shall be 16 inches on centers.

b. Insulation shall be applied with all joints tightly butted, and shall be adhered to the interior surfaces of the duct with the specified fire-resistant adhesive, applied at a minimum coverage of 50 per cent, and with the specified pins and fasteners, if required.

c. All joints shall be caulked with the specified fire-resistant caulking mastic.

3. Ducts Handling Air between 3000 and 4500 fpm

Before insulation is applied, all edges shall be coated with a heavy coat (1/8 inch thick) of the specified fire-resistant caulking mastic. The purpose of the mastic is to prevent air from getting behind the insulation or weakening the bond of the insulation to the metal surface. After coating has been completed, the insulation shall be applied as specified in Parts II. B. 2. a, b, and c, with the following additions:

a. Mechanical fasteners shall be installed on all four sides of the duct.

b. Metal corners shall be installed on leading edges of insulation to protect them from damage.

c. Caps of mechanical fasteners shall be coated with a brush coat of the specified weather-barrier coating.

4. Ducts Handling Air between 4500 and 6000 fpm

Insulation shall be applied as specified in Parts II. B. 2. a, b, and c. In addition, a light brush coat (100 sq ft per gal) of the specified lagging coating shall be applied to all interior surfaces of the insulation, to reduce friction loss and improve absorption of low-frequency fan noise.

5. Typical Installation

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

DESIGN AND CONSTRUCTION
UNION CARBIDE CHEMICALS COMPANY
Division of
UNION CARBIDE CORPORATION

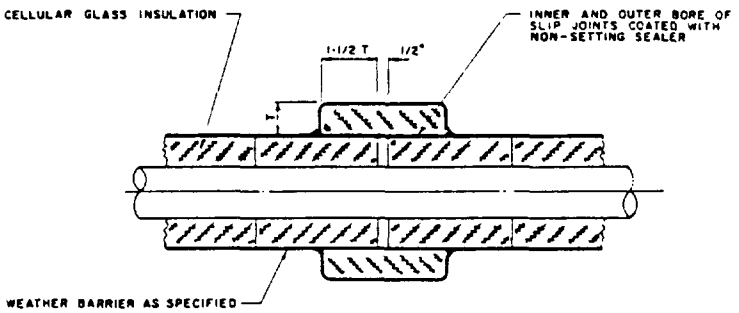
SPECIFICATIONS

For

Thermal Insulation
Material and Application

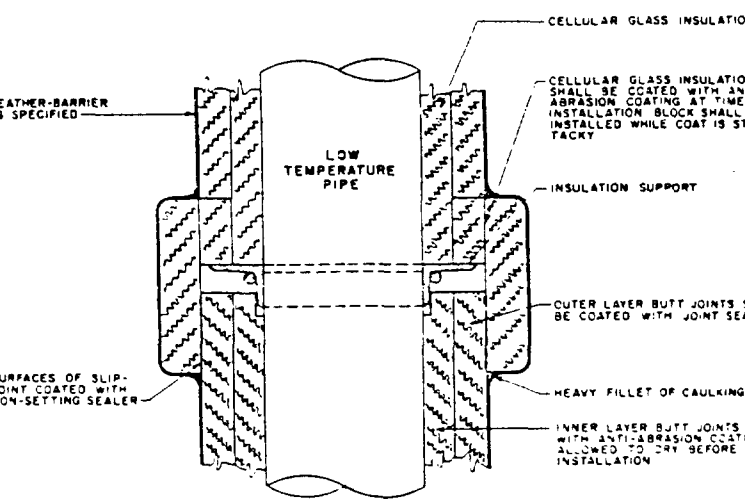
July 1961

SOUTH CHARLESTON
WEST VIRGINIA



APPLICATION OF CELLULAR GLASS INSULATION TO EXPANSION AND CONTRACTION JOINT IN HORIZONTAL PIPING

FIG 10-L-18



APPLICATION OF CELLULAR GLASS INSULATION TO VERTICAL EXPANSION AND CONTRACTION JOINT

FIG 10-L-19

II. B. 2. contd

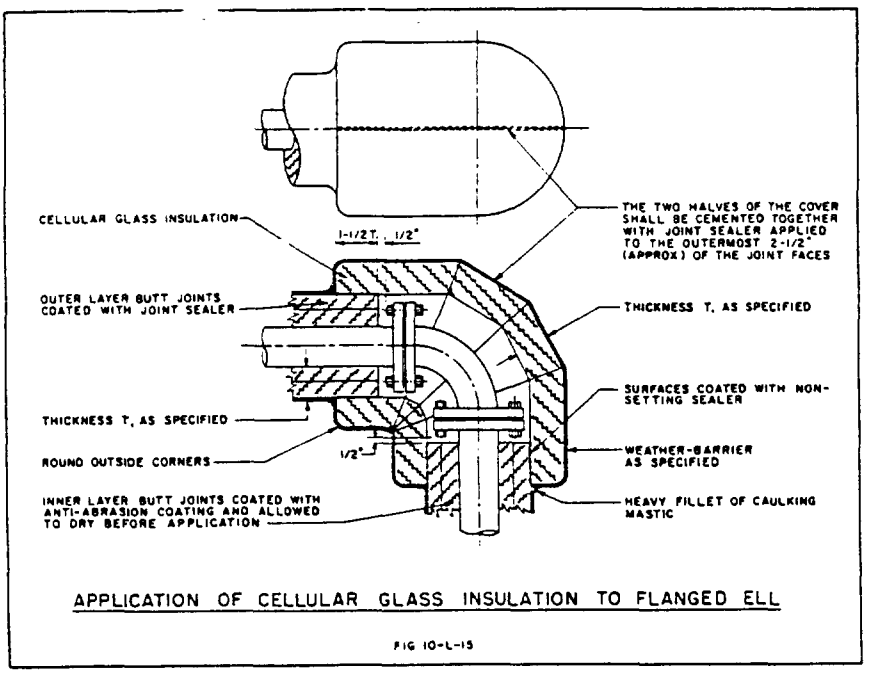
f. Traced Installations

Traced lines, where specified, shall be installed and insulated in accordance with the GENERAL SPECIFICATIONS, Part I. B. 16.

g. Weather-Barrier

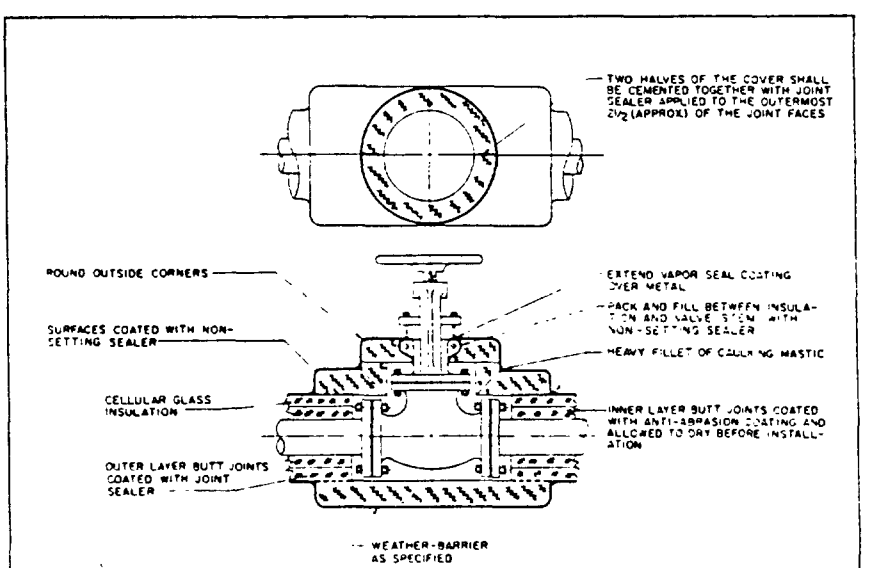
(1) Weather-barrier coating shall be applied in accordance with the GENERAL SPECIFICATIONS, Part I. B. 17.

(2) Weather-barrier consisting of stainless steel jacketing, if required, shall be applied in accordance with the GENERAL SPECIFICATIONS, Part I. B. 18. This requirement is indicated by the addition of the letter M to the specification designations, thus: 10-LM, 10-LSSM.



APPLICATION OF CELLULAR GLASS INSULATION TO FLANGED ELL

FIG 10-L-15



APPLICATION OF CELLULAR GLASS INSULATION TO FLANGED VALVE

FIG 10-L-16

(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.

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.

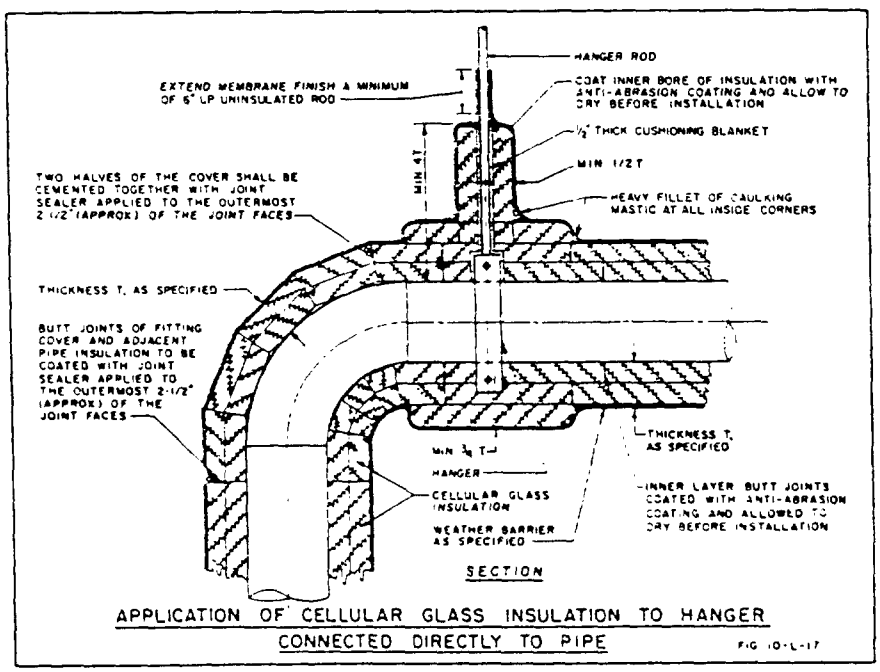
(3) Use and location of strap and tape shall be as described in the GENERAL SPECIFICATIONS, Part I. B. 6.

d. Supports and Hangers

(1) Where horizontal low temperature piping is supported on the outside of insulation surfaces, in accordance with UCCC Standard P-82, insulation shall be complete with weather-barrier applied before piping is placed in cradles. UCCC 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 UCCC Standard P-82, the insulation between cradle and pipe shall be the specified prefabricated vegetable cork.

(3) Hangers attached directly to piping shall be insulated as shown in Figure 10-L-17.



APPLICATION OF CELLULAR GLASS INSULATION TO HANGER CONNECTED DIRECTLY TO PIPE

FIG 10-L-17

e. Expansion and Contraction Joints

(1) Expansion and contraction joints shall be installed, as per Figure 10-L-18 or 19, 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 limits, expansion and contraction shall be provided for in the flange cover, and expansion-contraction joints in insulation will not be required.

II. SPECIFICATION 10-OX — Cellular Glass

Scope

This Specification describes the essential requirements for the purchase and application of preformed cellular glass thermal insulation, for use on equipment and piping in oxygen service normally operating at temperatures below 70 F. It is applicable to both indoor and outdoor service.

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

A. MATERIAL

1. Composition

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

2. Properties

Cellular glass insulation shall have the following properties:

Alkalinity	pH shall be between 6.9 and 7.5.
Capillarity	After 7 days on wet surface, gain in weight shall be 0%.
Coefficient of Expansion	Shall average 4.6×10^{-6} per degree F.
Combustibility	Shall be incombustible.
Compressive Strength	Shall be not less than 100 psi when tested in accordance with ASTM C 240, latest revision.
Density	Shall be not less than 8 lb per cu ft, nor more than 11 lb per cu ft, when tested in accordance with ASTM C 303, latest revision.
Flexural Strength	Shall be not less than 75 psi when tested in accordance with ASTM C 203, latest revision.
Hygroscopicity	Two-inch cubes dried at 220 F to constant weight, then exposed to air at 70 F and 90% relative humidity for 14 days, shall not gain any weight.
Resistance to Acids	Shall be impervious to common acids and fumes except hydrofluoric and hot phosphoric.
Shear Strength	Shall be not less than 65 psi.
Specific Heat	Shall average 0.20 BTU per lb per degree F.
Temperature Limit	Maximum temperature without mechanical, thermal, or chemical failure shall be not less than 800 F.
Tensile Strength	Shall be not less than 75 psi.
Thermal Conductivity	When tested in accordance with ASTM C 177, latest revision, or ASTM C 335, latest revision, the thermal conductivity at the given mean temperatures shall not exceed the following values:

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

Thermal Diffusivity	Shall average 0.42 sq ft per day.
Water Absorption	After 24 hour submersion, shall not exceed 0.2% by volume (surface only).
Vapor Transmission	When tested in accordance with ASTM C 355, latest revision, shall have a WVT of zero grains per sq ft per hour.

II. A. contd

3. Accessory Materials

a. Cushioning Material for Equipment and Piping - 2-1/2-lb per cu ft density TWL Fiberglas or approved equal white glass wool blanket 1 inch thick.

b. Stainless Steel Wire - 0.0475-inch diameter, Type 304, cold drawn, bright annealed, 18 gage.

c. Stainless Steel Insulation Strap - 1/2-inch by 0.020-inch, Type 304, or approved equal.

d. Stainless Steel Clips - Double-pronged, Type 304, A. J. Gerrard, Techalloy double-pronged seal, or approved equal.

e. Strap Anchor Clip - A. J. Gerrard's strap hanger.

f. Pipe Insulation Support - As shown in Figure 10-OX-17.

g. Anti-Abrasion Coating - Keene's cement or approved equal.

h. Weather-Barrier Coating - PVA-Vimasco No. WC-1 or approved equal.

i. Reinforcing Cloth - Glass fabric, 10 by 10 thread count, Perma Glas Mesh, Glass Mesh 10-S, Benjamin Foster Open Weave No. 10, or approved equal.

j. Fabricating Cement - Keene's cement or approved equal.

k. Adhesive Cement - Vimasco "J" seal "S", or approved equal.

l. Joint Sealer - Vimasco Lax-Seal F or approved equal.

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

B. APPLICATION

1. Equipment

a. Insulation Supports

Equipment shall be provided with insulation supports as specified in the GENERAL SPECIFICATIONS, Part I. B. 5.

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 the GENERAL SPECIFICATIONS, Part I. B. 2.

c. Cushioning Blanket

(1) On vertical equipment, two layers of the specified cushioning blanket shall be applied over the top head and compressed to 1-inch thickness, and one layer to the sides and bottom head and compressed to 1/2-inch thickness, before application of the cellular glass insulation. Blanket shall be secured in place with a minimum amount of stainless steel wire. Cellular glass insulation shall then be applied over the blanket in the manner described in this Specification. Cushioning blanket shall not be considered as part of the specified insulation thickness.

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

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 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.

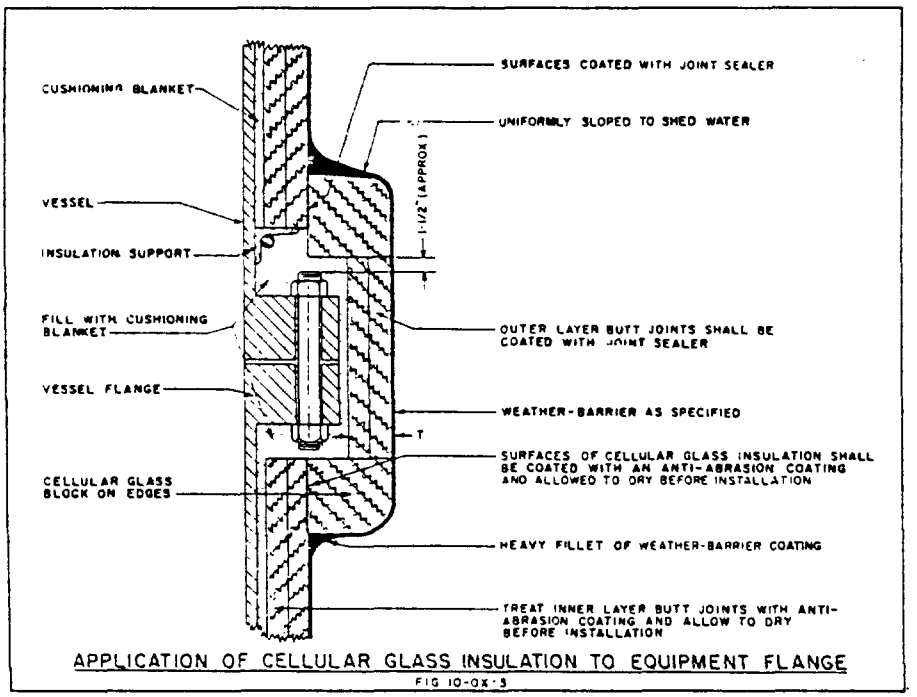
(4) All butt edges and ends of insulation fabricated for inner layer or layers shall be given a smooth brush or spray coat of the specified anti-abrasion coating and allowed to dry for a minimum of 1/2 hour, but preferably 2 hours, before application of insulation to equipment.

(5) All butt edges and ends of outermost layer (or single layer) of formed insulation shall be sealed with a buttered coat of the specified joint sealer. 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.

II. B. 1. contd

g. Expansion Joints

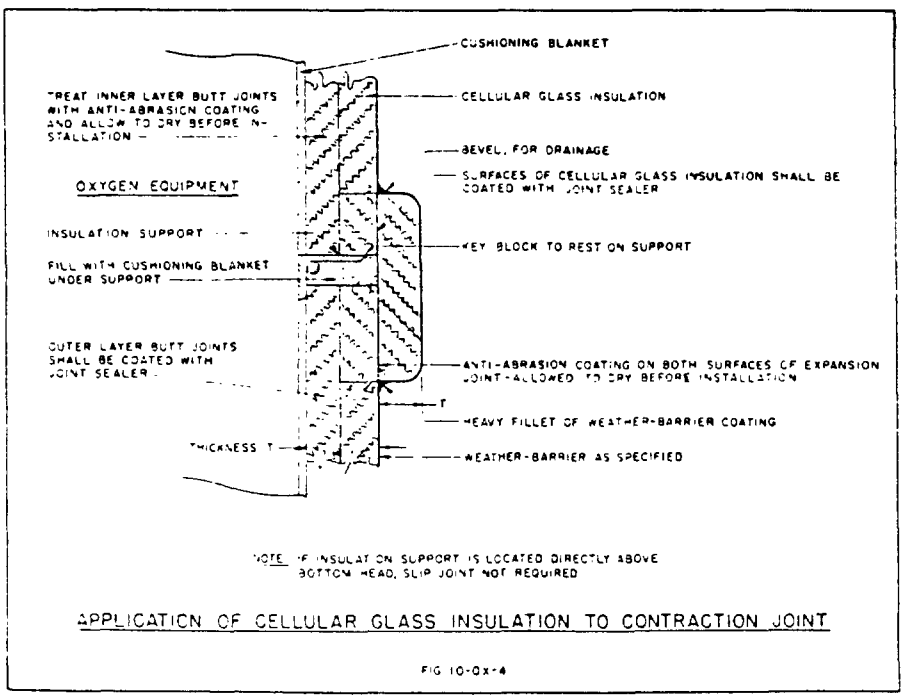
(1) Cellular glass applications shall be provided with expansion-contraction joints at vessel flanges, constructed as shown in Figure 10-OX-3. Where movement is likely to occur, anti-abrasion coating shall be applied to surfaces of insulation, as shown, to provide proper slip joint.



APPLICATION OF CELLULAR GLASS INSULATION TO EQUIPMENT FLANGE

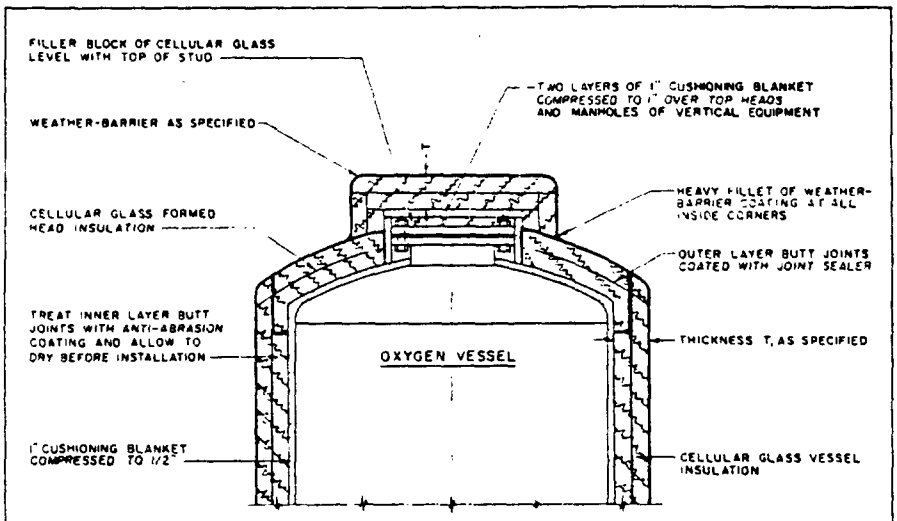
FIG 10-OX-3

(2) Longitudinal 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.



APPLICATION OF CELLULAR GLASS INSULATION TO CONTRACTION JOINT

FIG 10-OX-4



APPLICATION OF CELLULAR GLASS INSULATION TO VESSEL HEAD AND NOZZLE

FIG 10-OX-1

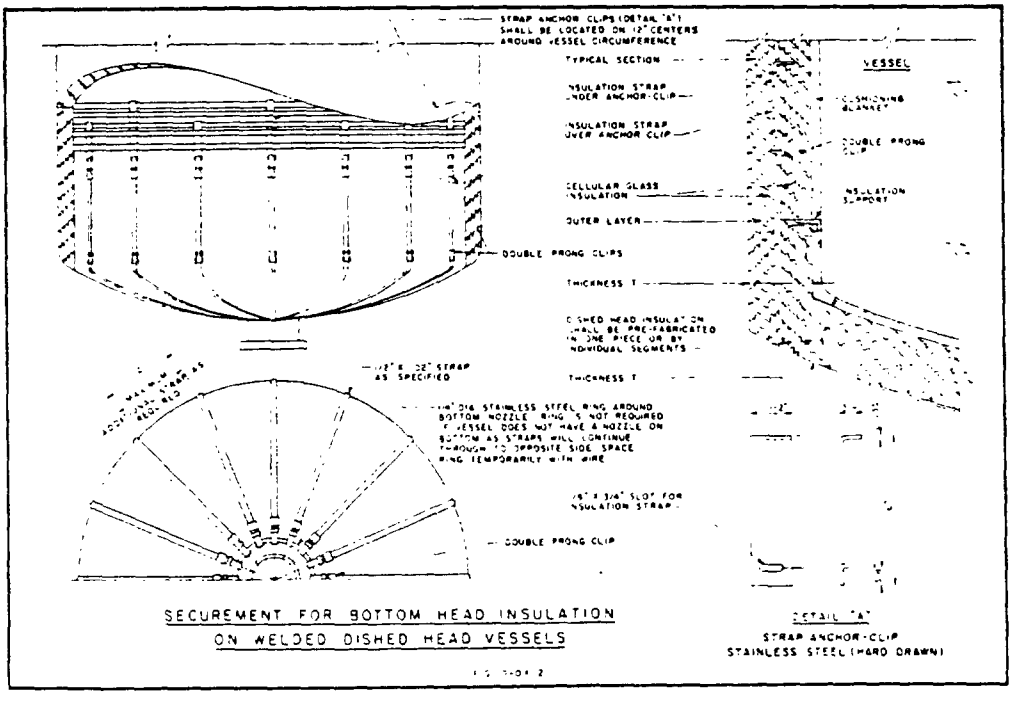
e. Flat Surfaces

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

f. 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. Insulation shall be secured to irregular surfaces with stainless steel wire.

(2) Inner layer or layers of cellular glass insulation on bottom heads of vertical equipment, or heads of horizontal equipment, shall be held in place with specified stainless steel strap secured to insulation supports, as shown in UCCC Standards IS-31, IS-36, and IS-42. 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.

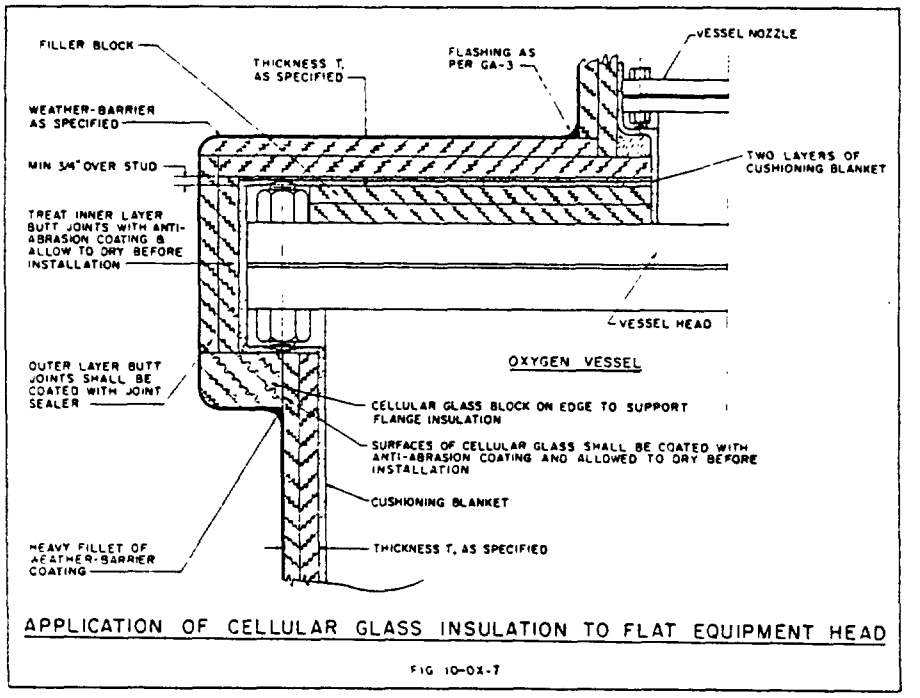


SECUREMENT FOR BOTTOM HEAD INSULATION ON WELDED DISHED HEAD VESSELS

II. B. 1. 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-7.



APPLICATION OF CELLULAR GLASS INSULATION TO FLAT EQUIPMENT HEAD

FIG 10-OX-7

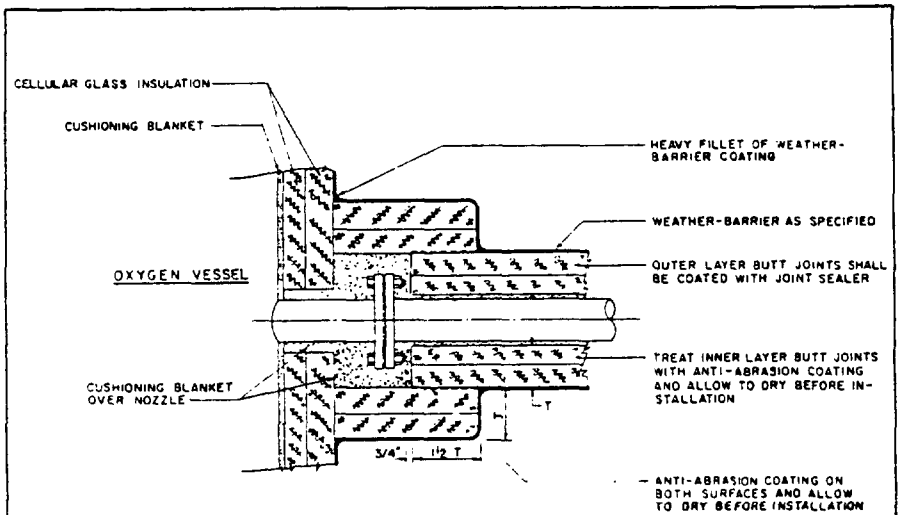
(2) All top nozzles on insulated equipment shall be provided with flashing as shown in Figure GA-3 of the GENERAL SPECIFICATIONS.

j. Vessel Legs

(1) Vessel 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.

(2) Re-entrant space between channel flanges shall be filled with block, cemented in place with the specified adhesive cement. Surface of fire-resistant material abutting tank leg insulation shall be coated with weather-barrier coating. Installation shall be as shown in Figure 10-OX-8.

(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-abrasion coating shall be applied to surfaces of insulation to provide proper slip joint.

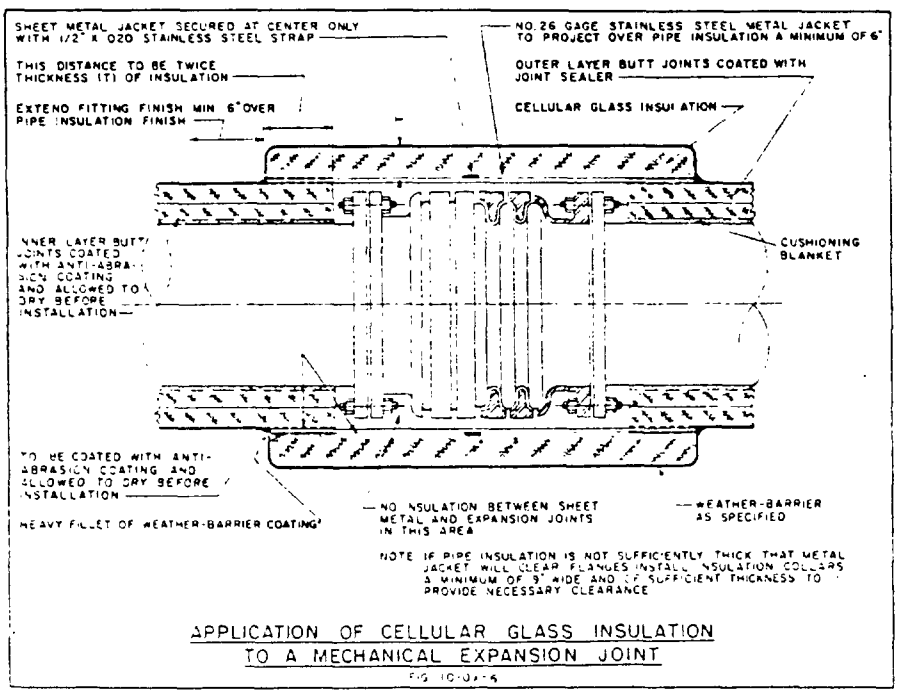


APPLICATION OF CELLULAR GLASS INSULATION TO NOZZLE

FIG. 10-OX-5

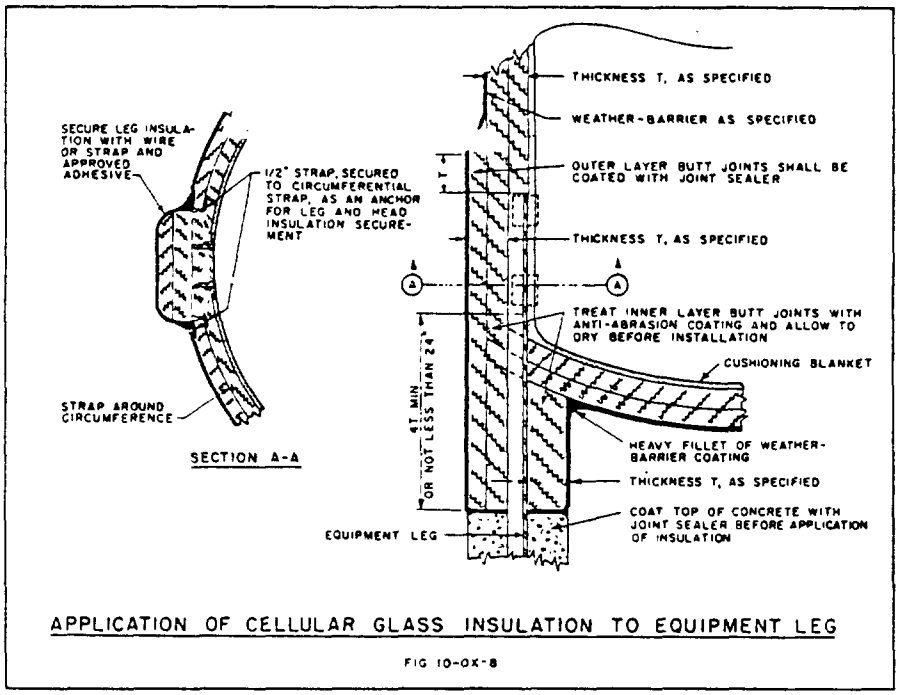
h. Mechanical Expansion Joints

Corrugated mechanical expansion joints in piping (usually listed as equipment items) shall be insulated as shown in Figure 10-OX-6. Where movement is likely to occur, anti-abrasion coating shall be applied to surfaces of insulation to provide proper slip joint.



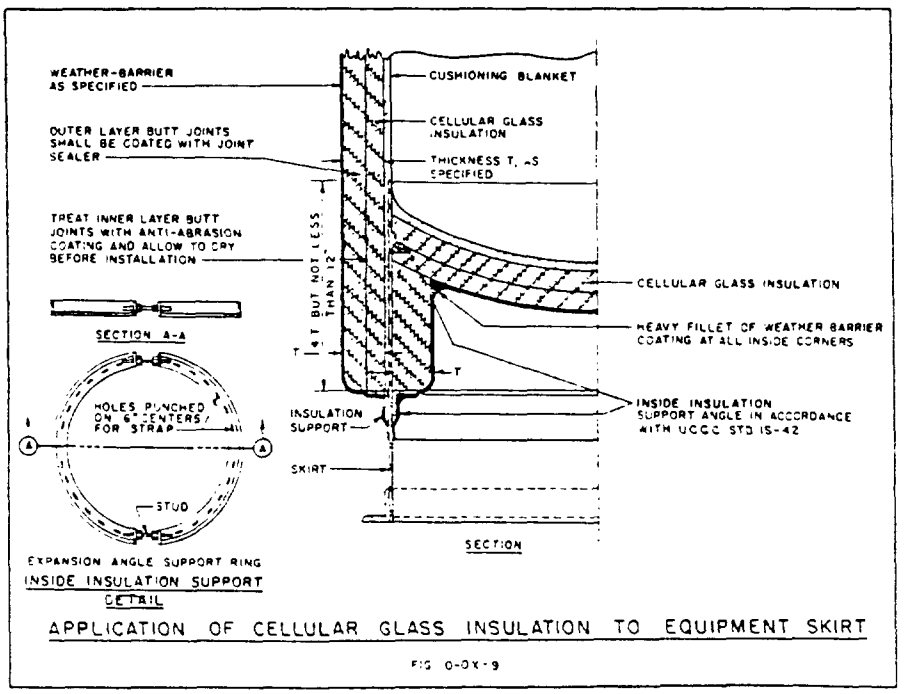
APPLICATION OF CELLULAR GLASS INSULATION TO A MECHANICAL EXPANSION JOINT

FIG. 10-OX-6



k. **Vessel Skirts**

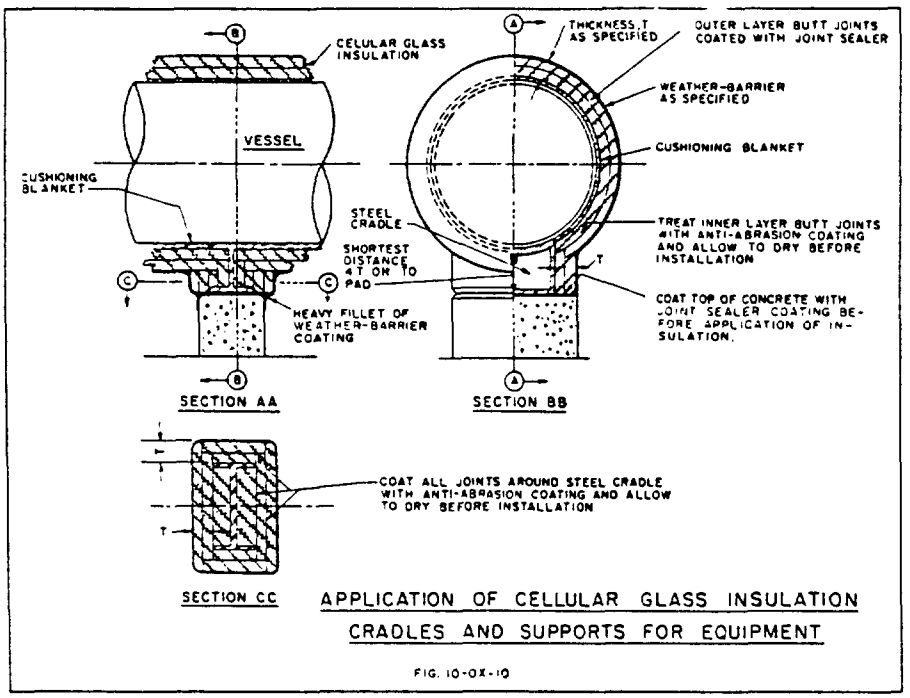
Skirts supporting vertical equipment shall be insulated inside and outside. Insulation shall extend downward, from junction of inside of skirt with insulated bottom head, a distance of not less than four times the thickness of insulation, but never less than 1 foot. Thickness of insulation over skirts 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 UCCC Standard IS-42. Installation shall be as shown in Figure 10-OX-9.



II. B. 1. contd

1. Equipment Supports

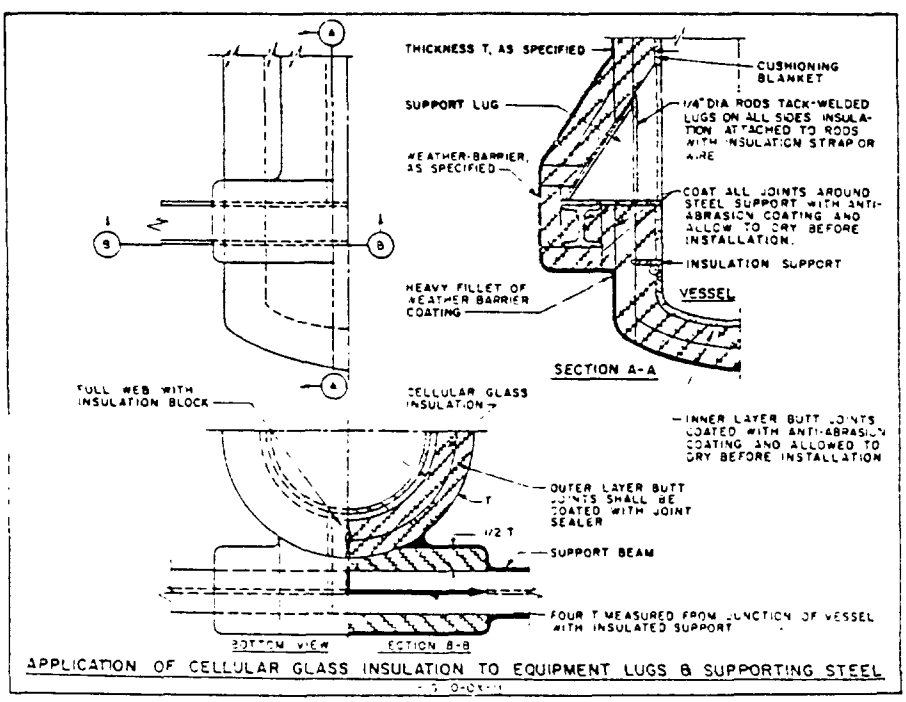
(1) Where equipment is supported on cradles, vessel insulation shall extend over cradles as shown in Figure 10-OX-10.



APPLICATION OF CELLULAR GLASS INSULATION CRADLES AND SUPPORTS FOR EQUIPMENT

FIG. 10-OX-10

(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-11.



APPLICATION OF CELLULAR GLASS INSULATION TO EQUIPMENT LUGS & SUPPORTING STEEL

10-OX-11

m. Weather-Barrier

(1) Weather-barrier coating shall be applied in accordance with the GENERAL SPECIFICATIONS, Parts I. B. 9. and 17.

(2) Weather-barrier consisting of stainless steel jacketing, if required, shall be applied in accordance with the GENERAL SPECIFICATIONS, Part I. B. 18. This requirement is indicated by the addition of the letter M to the specification designati thus: 10-OXM.

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

2. Piping

a. Pipe Insulation

(1) Pipe insulation shall be supported as specified in the GENERAL SPECIFICATIONS, Part I. B. 5.

(2) Insulation in excess of 2-1/2-inch total thickness shall be applied in multiple layers as specified in the GENERAL SPECIFICATIONS, Part I. B. 2.

(3) Pipe Insulation shall be applied in a staggered position, in accordance with Figures GA-1 and GA- 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.

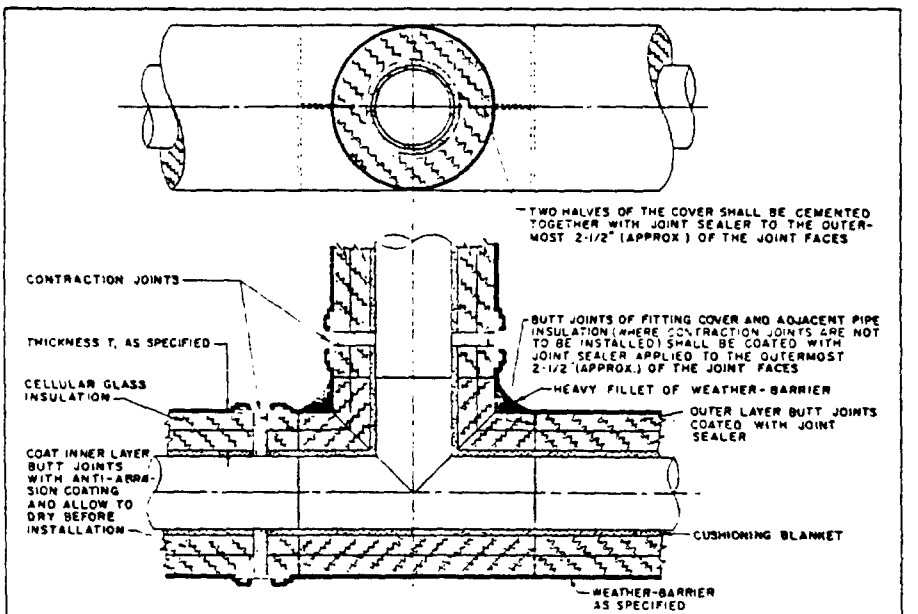
(7) Butt edges and ends of all inner layers of insulation shall be given a smooth brush or spray coat of anti-abrasion coating and allowed to dry for a minimum of 1/2 hour, but preferably 2 hours, before application. Care shall be exercised to obtain a thin, even coat of sufficient thickness only to cover and fill the cut cells of the insulation.

(8) When scheduled for installations where severe vibration is expected, entire surface area shall be coated with anti-abrasion coating as called for in Part II. B. 2. a. (7).

b. Fitting, Flange, and Valve Covers

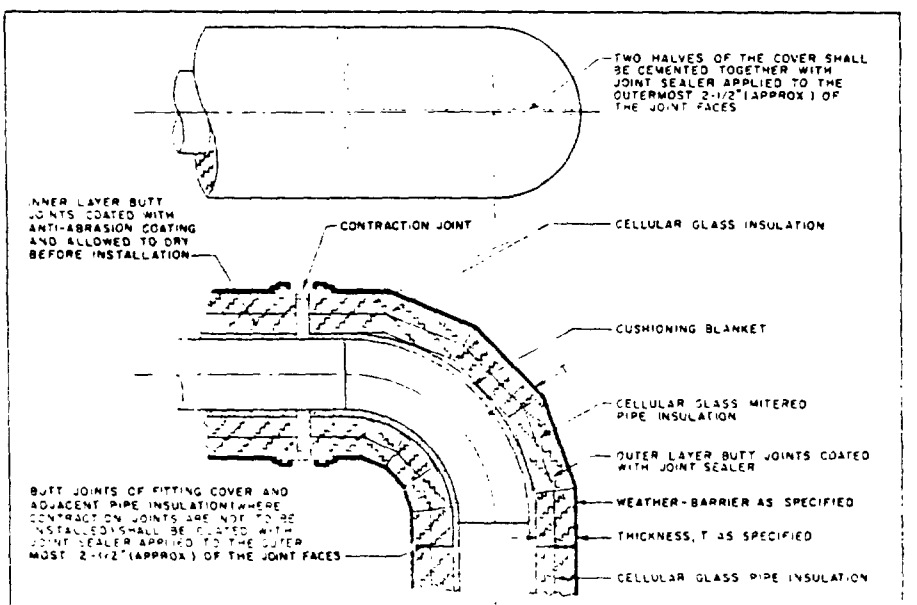
(1) Welded fitting covers shall be fabricated to an inside diameter 1 inch greater than the outside diameter of the welded fitting to allow for cushioning material.

(2) Fitting, flange, and valve covers shall be shop-fabricated in accordance with UCCC Dimensional Standards Fabrication Manual or ASTM Recommended Practice C 450, latest revision. Installation of typical fittings and valves is shown in Figures 10-OX-12, 10-OX-13, 10-OX-14, 10-OX-15, and 10-OX-16.



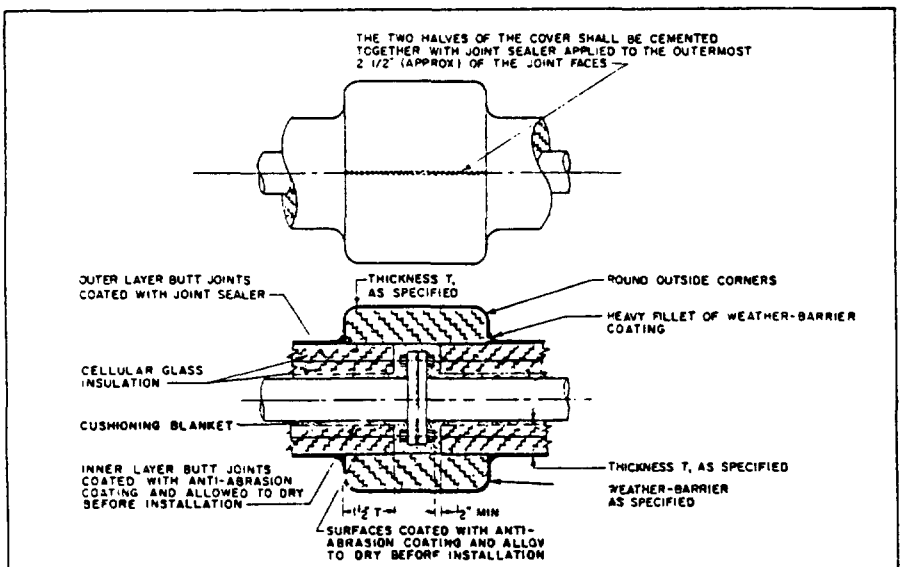
APPLICATION OF CELLULAR GLASS INSULATION TO WELDED TEE

FIG 10-OX-13



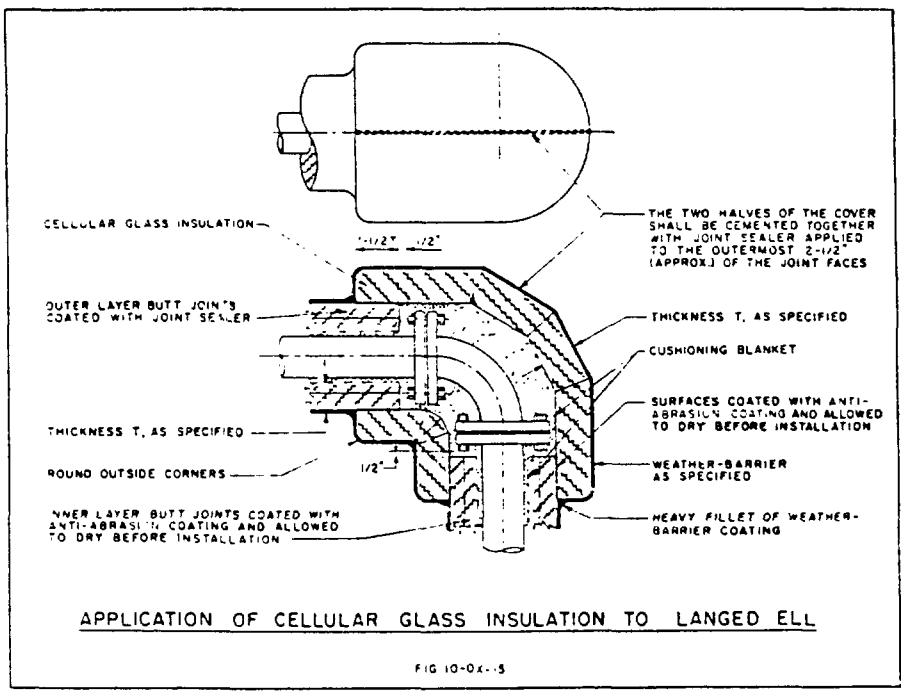
APPLICATION OF CELLULAR GLASS INSULATION TO WELDED ELL

FIG 10-OX-12



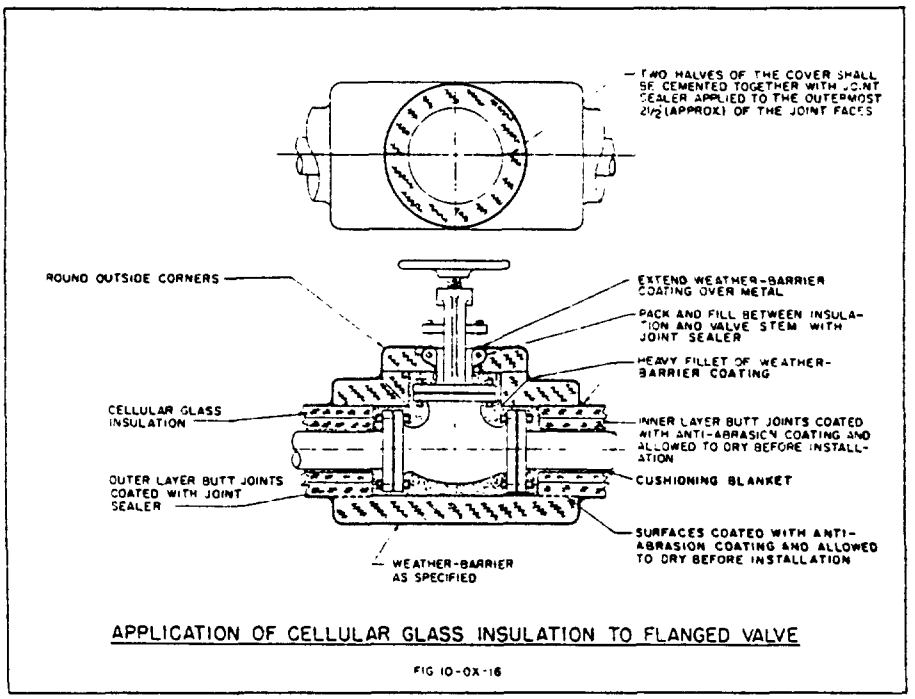
APPLICATION OF CELLULAR GLASS INSULATION TO LINE FLANGE

FIG 10-CX-14



APPLICATION OF CELLULAR GLASS INSULATION TO LANGED ELL

FIG 10-CX-15



APPLICATION OF CELLULAR GLASS INSULATION TO FLANGED VALVE

FIG 10-OX-16

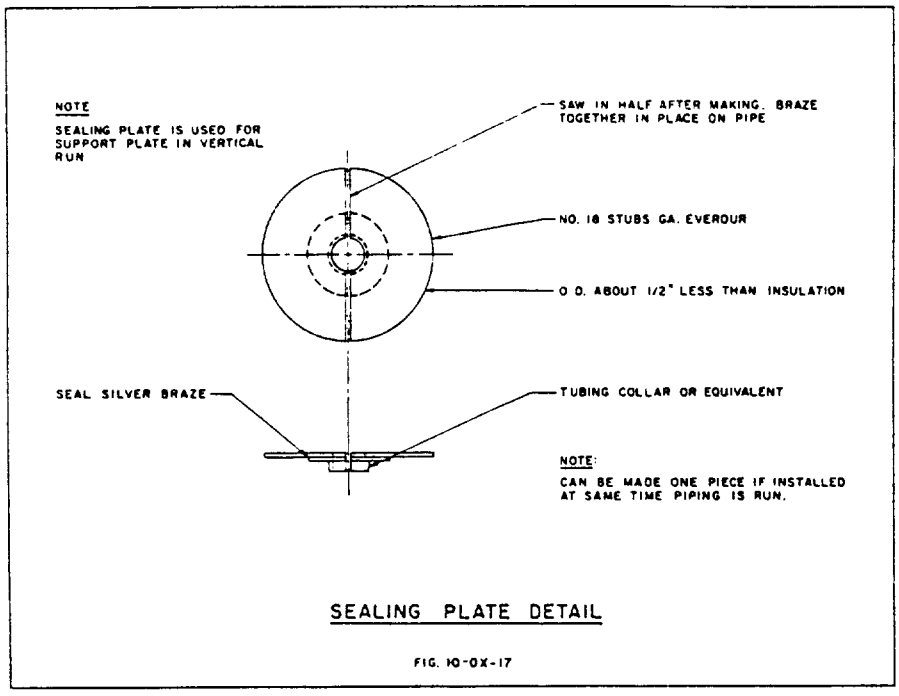
(3) All valves shall be packed and filled around valve stem and packing gland assembly with joint sealer, to avoid water pockets.

(4) Cementing of shop assemblies shall be done with the specified 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. Sealing Plate

(1) This plate, shown in Figure 10-OX-17, shall be used wherever insulation is terminated. A typical installation is shown in Figure 10-OX-21.

(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-19.



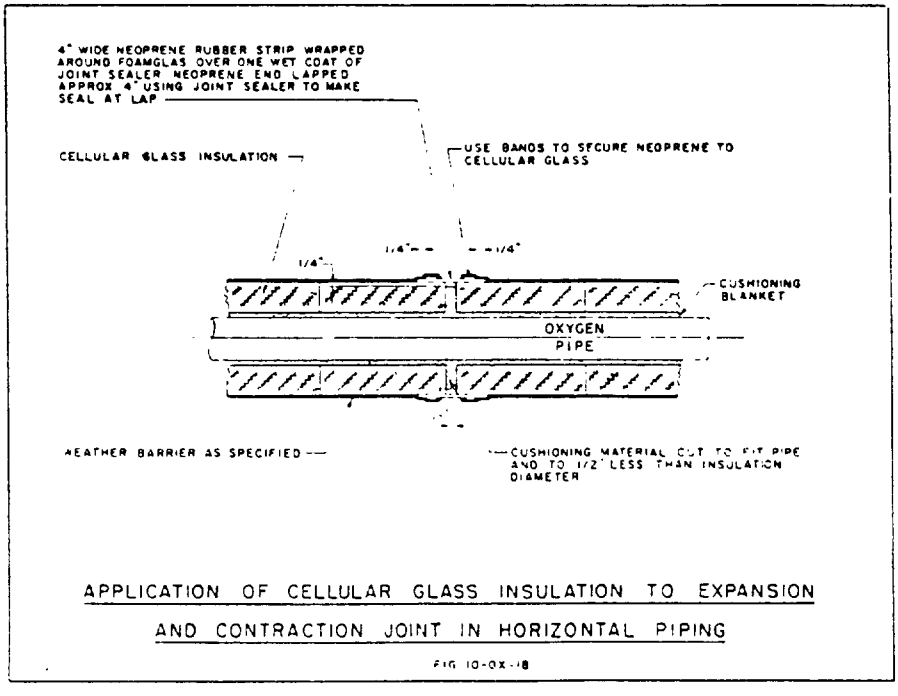
SEALING PLATE DETAIL

FIG. 10-OX-17

d. Expansion and Contraction Joints

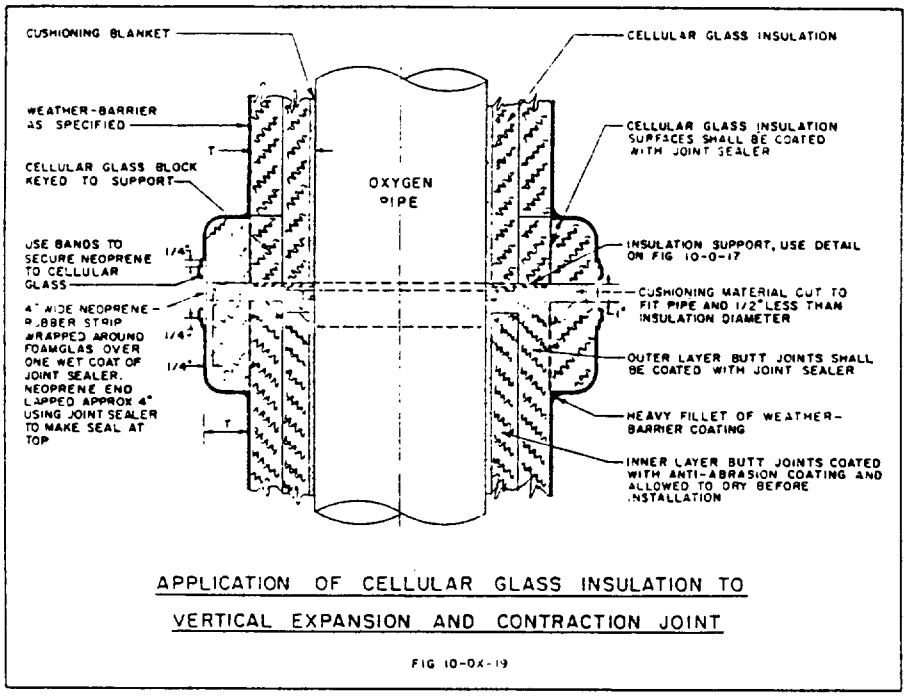
(1) Expansion and contraction joints shall be installed as shown in Figures 10-OX-18 and 10-OX-19, in both horizontal and vertical straight run piping, at 10-foot intervals.

(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-20 and 10-OX-21.



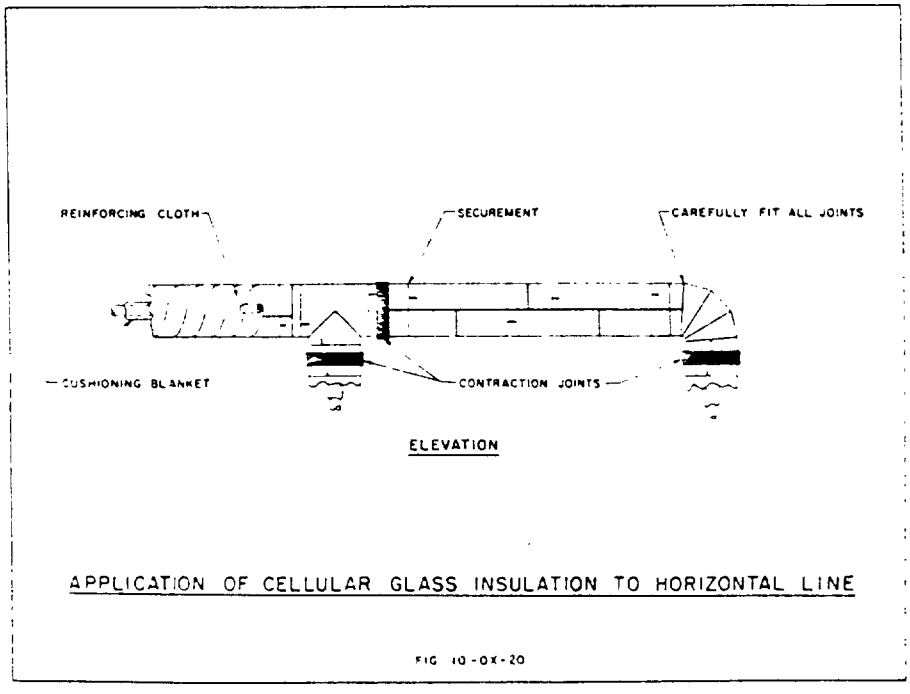
APPLICATION OF CELLULAR GLASS INSULATION TO EXPANSION AND CONTRACTION JOINT IN HORIZONTAL PIPING

FIG. 10-OX-18



APPLICATION OF CELLULAR GLASS INSULATION TO VERTICAL EXPANSION AND CONTRACTION JOINT

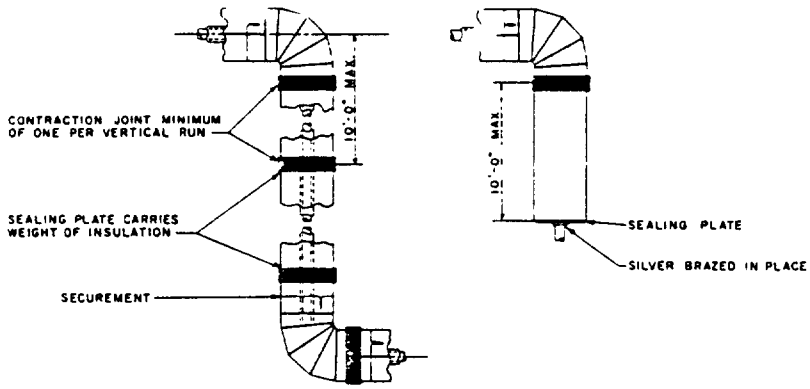
FIG 10-0X-19



ELEVATION

APPLICATION OF CELLULAR GLASS INSULATION TO HORIZONTAL LINE

FIG 10-0X-20



APPLICATION OF CELLULAR GLASS INSULATION TO VERTICAL RUNS OF LINE

FIG. 10-OX-21

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.

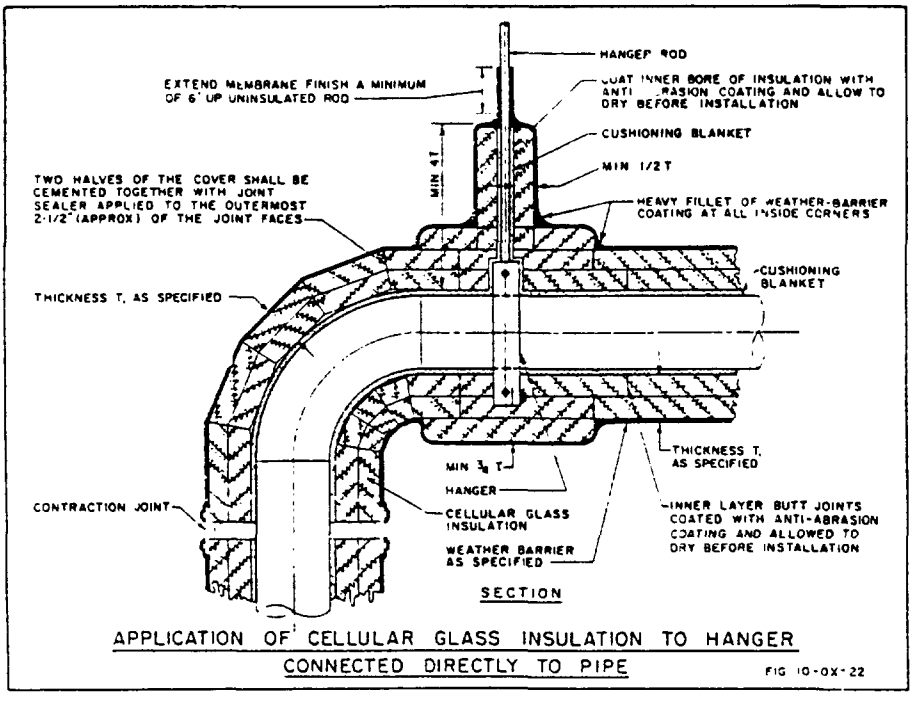
(2) All inner layers and outer layers less than 4 1/2 inches in outside diameter shall be secured with stainless steel wire.

(3) Use and location of strap and wire shall be as described in the GENERAL SPECIFICATIONS, Part I. B. 6.

f. Support and Hangers

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

(2) Hangers attached directly to piping shall be insulated as shown in Figure 10-OX-22.



g. Traced Installations

Traced lines, where specified, shall be installed and insulated in accordance with the GENERAL SPECIFICATIONS, Part I. B. 16.

h. Weather-Barrier

(1) Weather-barrier coating shall be applied in accordance with the GENERAL SPECIFICATIONS, Part I. B. 17.

(2) Weather-barrier of stainless steel jacketing, if required, shall be applied in accordance with the GENERAL SPECIFICATIONS, Part I. B. 18. This requirement is indicated by the addition of the letter M to the specification designation, thus: 10-OXM.

II. SPECIFICATION 14-J — Preformed Flexible Plasti Foam

Scope

This Specification describes the essential requirements for the purchase and application of preformed flexible plast foam insulation for use on indoor piping up to and including 3 inch I.P.S. normally operating at temperatures from 32 up to and including 200 F.

A. MATERIAL

1. Composition

Insulation shall consist of preformed flexible foamed plastic having a closed cellular structure.

2. Properties

Preformed flexible plastic foam insulation shall have the following properties:

Combustibility	Shall be self-extinguishing.
Density	Shall be not less than 6.5 lb per cu ft, nor more than 7.5 lb per cu when tested in accordance with ASTM C 302, latest revision.
Resistance to Acids	Shall be resistant to common acids.
Resistance to Caustics	Shall be resistant to common caustics.
Shrinkage	Shall be not more than 3% at 200 F.
Specific Heat	Shall average 0.41 Btu per lb per degree F.
Temperature Limit	Maximum temperature without mechanical, thermal, or chemical failu shall be not less than 200 F.
Thermal Conductivity	When tested in accordance with ASTM C 177, latest revision, or AST C 335, latest revision, the thermal conductivity at the following mea temperatures shall not exceed the following values:

Mean Temp °F	Btu/inch, hr sq ft, °F
75	.28
120	.29

Water Absorption	After 24 hours submersion, shall not exceed 0.5% by weight.
Water Vapor Transmission	When tested in accordance with ASTM C 355, latest revision shall not e ceed 0.1 gram per sq ft per hour.

3. Accessory Materials

a. Adhesive - Armstrong No. 520 or approved equal.

b. Tape - Dutch Brand Trantex V-10 or approved equal.

c. Reinforcing Cloth - Glass fabric, 10 by 10 thread count, Perma-Glas Mesh, Twinsburg-Miller, Benjam Foster Open Weave or approved equal.

d. Lagging Coating (color as specified) - Resin base, Benjamin Foster Lagtone, Armstrong Insulcolor, Vi masco Viny-Lag, or approved equal.

B. APPLICATION

1. Concealed Straight Piping

a. Preformed pipe covering shall be placed on the pipe by slipping it over the end of the pipe or cutting it longitudinally so that the insulation can be opened up sufficiently to permit placing it on the pipe. Wherever joint has a tendency to open up, it shall be secured with the specified tape.

b. All butt joints shall be joined and sealed by a thin coat of the specified adhesive. The adhesive shall be allowed to dry to a non-tacky state. After the adhesive has dried, the surfaces of the joint shall be pressed firmly together.

c. Where pipes, pipe fittings or supports extend beyond the insulation, the edges of the insulation shall be sealed with a fillet of adhesive.

2. Concealed Bent Piping

Insulation shall be installed on bent piping as described in Part II. B. 1. The outer surface of the insulation shall be wrapped with a lapped layer of tape to prevent opening of longitudinal joint.

3. Fittings

a. Fitting covers which can be fabricated of molded pipe covering shall be prefabricated in accordance with ASTM Recommended Practice C 4507 using adhesive as fabrication cement.

b. Fitting covers larger than those which can be made with molded pipe covering shall be field fabricated of sheet insulation of specified thickness or multiple layers of sheet insulation built to specified thickness. The sheet insulation shall be tightly fitted with all joints sealed with specified adhesive. The outer surface of the insulation shall be secured in place by wrapping with a lapped layer of tape.

4. Piping and Fittings Exposed to View

a. Insulation of piping and fitting shall be installed as described in Parts II. B. 1, 2 and 3.

b. The specified reinforcing cloth shall be adhered to the insulation surface with the specified lagging coating to provide a smooth, even surface. After the coating has dried, a second coat shall be applied to the cloth, in sufficient thickness to provide a smooth, evenly textured, colored surface.