SPECIFICATION FOR THERMAL INSULATION - PIPING FOR

LIGO VACUUM EQUIPMENT

Hanford, Washington
and
Livingston, Louisiana

JAN 21 1997

PREPARED BY: Dave Moore

QUALITY ASSURANCE [signature]

TECHNICAL DIRECTOR: [signature]

PROJECT MANAGER: [signature]

REV LTR.	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
1	DM 1/19/97	DMW 1-15-97	Added Figure B-7 for insulating filter, DEO # 0411 Fig. D-3, & revised Fig D-1
0	DM 10/25/96	BGS 10/28/96	Initial release DEO # 0334

PROCESS SYSTEMS INTERNATIONAL, INC.				SPECIFICATION	
INITIAL APPROVALS	PREPARED	DATE	APPROVED	DATE	Number A V049-2-163 LIGO-E970008-01-V	Rev. 1
	DMoore	10/25/96	BGS	10/28/96		

TABLE OF CONTENTS

ATTACHMENTS

1.0 SCOPE/GENERAL

1.1 This document outlines methods and procedures for the fabrication and installation of insulation systems which are defined as follows:

Cold Insulation - Polyisocyanurate foam
(-)320^{0}F to 300^{0}F

Hot/Cold Insulation - Polyisocyanurate foam for Outer Layer, Fiberglass Blanket for Inner Layer (-)320^{0}F to 350^{0}F

1.2 All material shall be suitable for continuous outdoor and indoor service.

Ambient Temperature: 10^{0}F to 100^{0}F
Relative Humidity: 50 to 100%

1.3 Insulation identification can be determined from the following legend:

Insulation Classes

C = Cold Conservation
HC = Hot/Cold Conservation
PC = Personnel Protection Cold
PH = Personnel Protection Hot

1.4 The extent of surfaces to be insulated shall be defined by one or more of the following:

Piping and Instrumentation Diagrams
General Piping Isometrics Arrangement Drawings
This Specification

1.5 In addition to piping; insulation shall be applied to all pipe nipples, fittings, flanges, unions, valves and projections through the base insulation unless otherwise noted.

1.6 SPECIFICATION COMPLIANCE

The equipment shall comply with any drawings, data sheets, standards, codes and specifications referred to or attached as part of this specification. Any applicable national, state, or local codes or regulations shall be considered as part of this specification. The Vendor is responsible for compliance with such standards, specifications, codes and requirements.

2.0 MATERIALS

Acceptable insulation materials are listed in Paragraph 5.5 of this specification. Vendor may quote equivalent materials. However, all "equivalent" materials must be approved by the Purchaser prior to use.

3.0 THICKNESS OF INSULATION

Insulation thickness shall be as designated on the Piping and Instrumentation Diagrams.

Any discrepancies shall be brought to the attention of PSI for resolution. The other documents provided are for arrangement and dimension information.

4.1 Special Insulation Codes

FP3	1" Fiberglass inner 2" Polyisocyanurate outer
F1.5	1 1/2" Fiberglass

4.0 INSTALLATION

4.1 GENERAL

1. The attached illustrations are included as a guide for fabrication and installation of insulation systems.
2. Insulating materials shall be protected from moisture at all times.
3. All insulation shall be installed butted together.
4. Insulation showing any evidence of moisture shall be rejected.
5. Insulation shall not be applied to any surface where there is any evidence of moisture or frost.
6. All material applied in one day shall have the vapor barrier applied in the same day. Exposed ends shall be temporarily protected by extending the vapor barrier over the exposed ends and onto the bare pipe or equipment.
7. All outer surfaces of insulation shall be covered with a continuous vapor barrier.
8. There shall be no discontinuities in the vapor barrier.

9. Plastic pipe jacketing shall be installed as the final covering on the insulation.

4.2 VALVES, FLANGES, AND PIPE FITTINGS

a. Valves and flanges shall be insulated to provide coverings that can be removed easily without destroying the covering or the pipe insulation and its vapor barrier. Pipe insulation shall extend to the flange or valve and shall be vapor sealed against the pipe. Insulation shall be beveled so that bolts may be removed without damage to adjacent insulation. Insulation thickness shall be equal to the pipe insulation thickness where clearances are sufficient. Where clearances are inadequate, the insulation may be trimmed as required.

b. Valve stems on cryogenic valves shall be insulated half way between the pipe centerline and packing flange.

4.3 PIPE SUPPORTS

Piping shall be insulated in a normal manner around supports except when an attached figure is supplied to indicate more extensive application or insulation boundary is required.

4.4 MATERIALS DESCRIPTION

All materials must comply with the following requirements. Caution shall be exercised in job site storage and handling to assure that the completed system will be dry, mechanically sound and meet all requirements of this specification. Defective materials shall be replaced.

4.4.1 Preformed Section 2 lb/cu. ft. Polyisocyanurate

Acceptable Materials:

a. Dow Trymer 2000 or PSI approved equal.

4.4.2 Preformed Section Fiberglass

Acceptable Material:
Owens Corning SSL-II Pipe Insulation

4.4.3 Joint Sealant and Vapor Stop Mastic

Acceptable Material:

a. B.F. 95-44 Elastolar Sealant, manufactured by H.B. Fuller Company, Foster Division, Houston, Texas. To be purchased in both of the following container sizes:

5 gallon containers - for trower
11 fluid ounce tubes - for hand caulking guns

b. Dow Corning Silastic 736 or approved equal.

c. Pittseal 111, manufactured by Pittsburgh Corning Corporation.

d. Foamseal 30-45, manufactured by Foster Division of Amchem.

e. S-31 Sealant, manufactured by Mastics and Adhesives Company.

4.4.4 Filament Tape 1" Wide Rolls

Acceptable Material:

a. 3-M Scotch Brand Filament Tape No. 898 manufactured by Minnesota Mining and Manufacturing Company.

b. Mystic Tape No. 6491, manufacturing by Mastik Tape, Division of Borden Chemicals, Borden, Inc., Northfield, Illinois.

4.4.5 Membrane

Polyester fabric cloth having an 8 x 8 or similar size weave pattern. Glass cloth is not suitable for use with the B.F. 60-30 vapor barrier mastic.

Acceptable Material:

MAST-A-FAB, polyester fabric, 8 x 8 weave pattern. Manufacture by Foster Division of Amchem Products.

4.4.6 Vapor Barrier Mastic

Acceptable Material:

a. B.F. 60-30 (dark brown - trowel grade) manufactured by H.B. Fuller Company, Foster Products Division.

b. Rust-Ban Vapalon FR manufactured by Matcole Company, Inc.

c. Elastometric Coating EC-26 manufactured by Mastics and Adhesives Company

4.4.7 3 PCF Fiberglass Blanket

Industrial glass blanket without backing, 3 lb/cu. foot density, 1" thick or as required.

4.4.8 1 PCF Fiberglass Blanket

Industrial glass blanket without backing, 1 lb/cu. foot density, 1/2" thick (to fill voids).

4.4.9 Tie Wire

16 gauge, soft annealed galvanized wire.

4.4.10 Plastic Pipe Jacketing

a. Plastic pipe jacketing shall be Zeston 2000 PVC (white) or approved equal.

b. Jacketing form and thickness to be used shall be as follows:

1. Piping - 0.03" cut and curled.
2. Fittings -0.03" preformed.
3. Jacket bonding adhesive shall be Perma-bond solvent welding adhesive, or approved equal

ATTACHMENT A
COLD INSULATION - ILLUSTRATIONS
TABLE OF CONTENTS

TYPICAL PIPING INSULATION COLD SERVICE

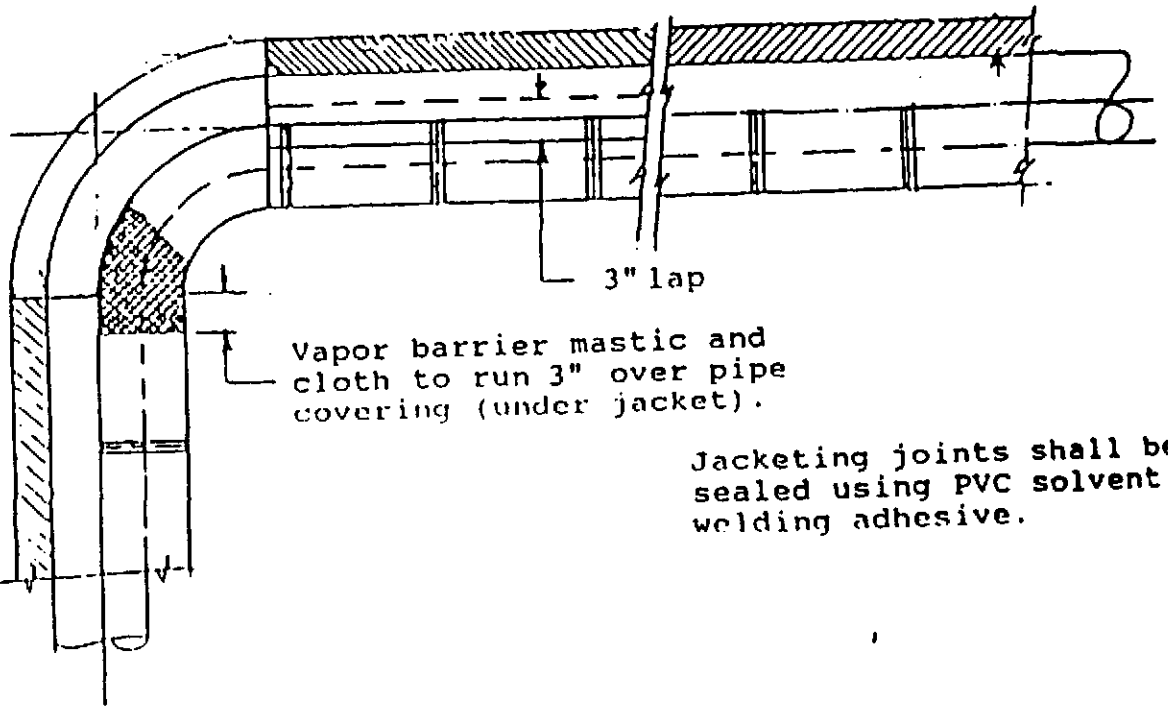
Metal must be clean, dry and free from frost, rust, etc.

Insulation for fittings, valves, flanges, etc. shall be prefabricated using same material and thickness as adjacent piping. Install fitting covers before pipe insul. Seal joints with mastic joint sealer.

Apply plastic jacketing over pipe and fittings per Para. 5.5.10. All laps to be at least 3" and sealed.

Longitudinal joints shall be 45° below horizontal centerline of pipe and lapped to shed water.

Thickness of insulation in accordance with the Piping and Instrumentation Diagrams.



Sharp edges of insulation shall be smoothed prior to application of finish.

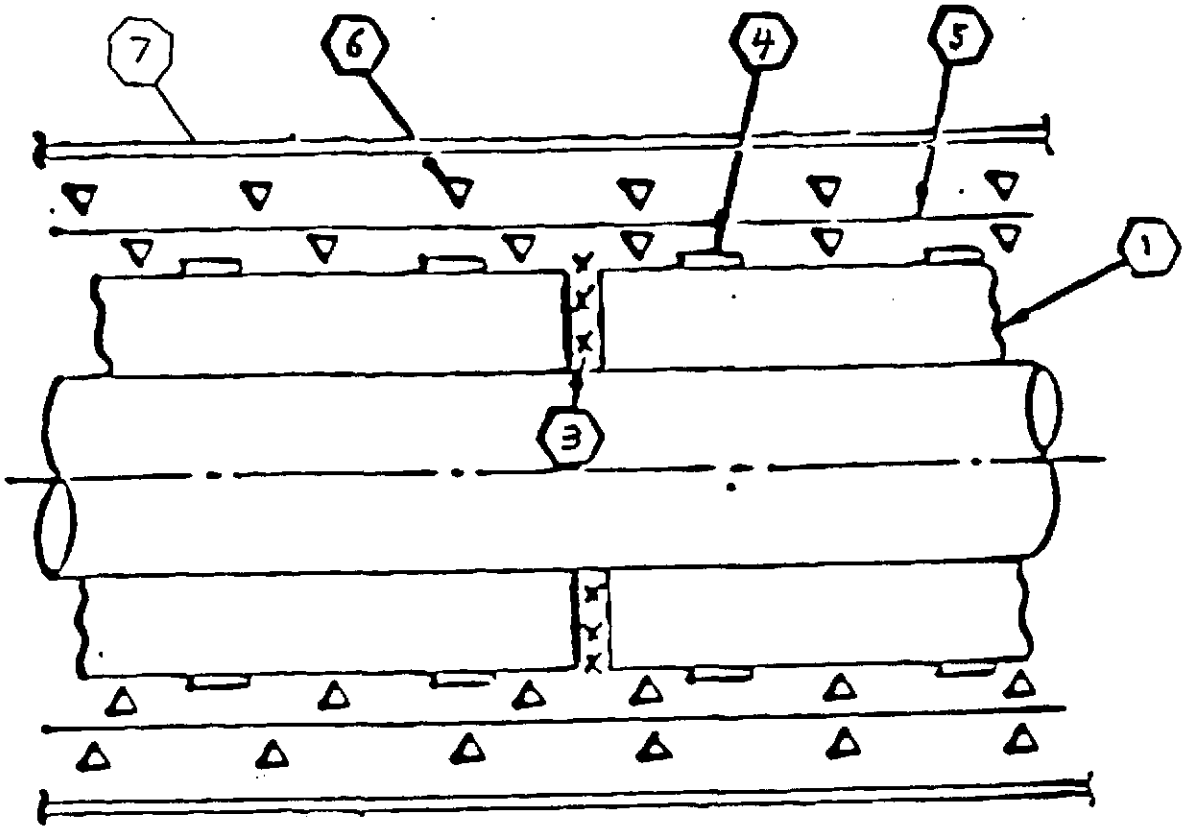
Vapor barrier mastic and cloth to run 3" over pipe covering (under jacket).

Jacketing joints shall be sealed using PVC solvent welding adhesive.

Use "S" clips to support jacket on vertical pipe.

FIGURE B-1

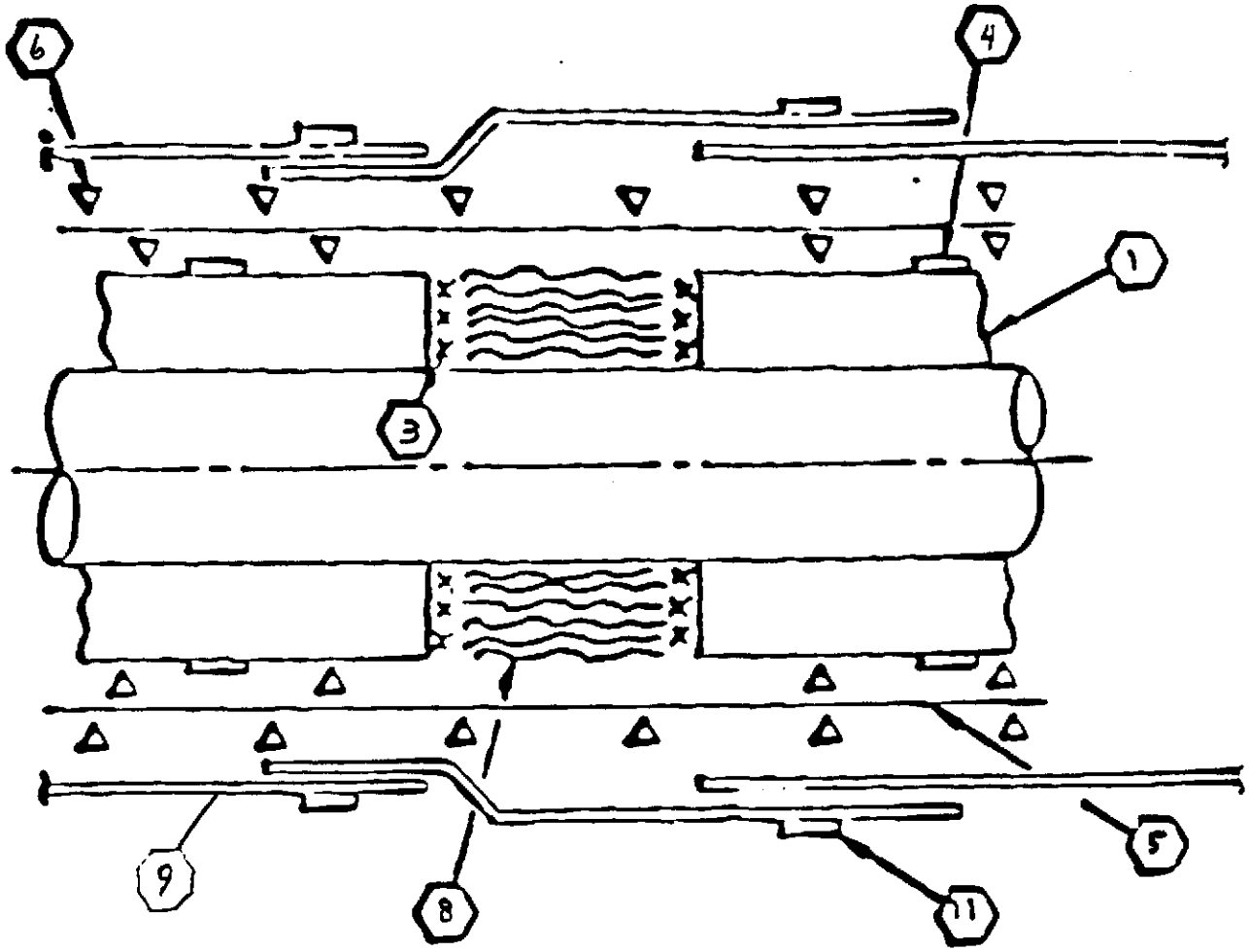
POLYISOCYANURATE INSULATION - TYPICAL PIPE SECTION



[1] Polyisocyanurate
[3] Joint Sealant and Vapor Stop Mastic
[4] Filament Tape
[5] Membrane
[6] Vapor Barrier Mastic
[7] PLASTIC PIPE JACKET

Use wire to secure inner layers and tape to secure outer layers of insulation. Use a minimum of 3 wraps per segment. Overlap tape ends 50% of pipe circumference.

FIGURE B-2
POLYISOCYANURATE INSULATION - EXPANSION JOINT

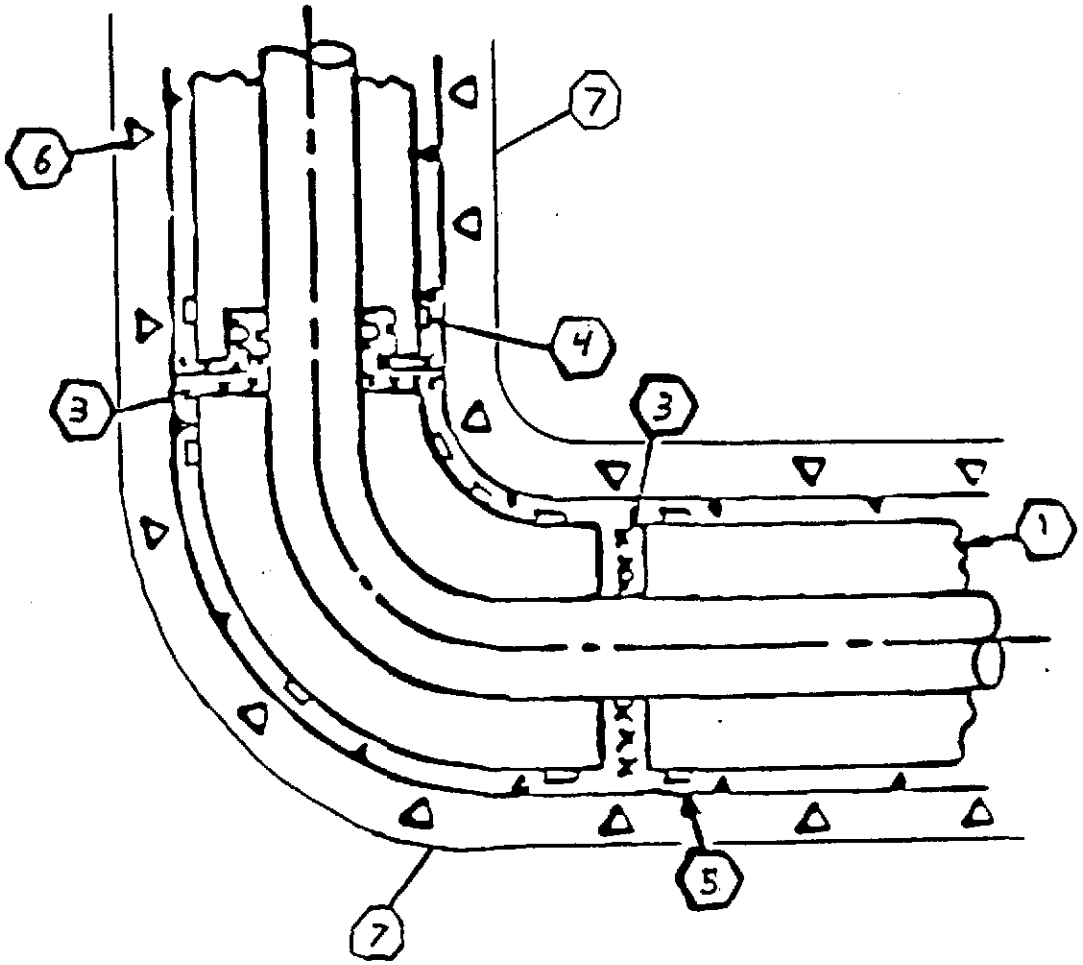


KEY

[1] Polyisocyanurate
[3] Joint Sealant and Vapor Stop Mastic
[4] Filament Tape
[5] Membrane
[6] Vapor Barrier Mastic
[8] 1 PCF FIBERGLASS BLANKET
[9] PLASTIC PIPE JACKET

Use wire to secure inner layers and tape to secure outer layers of insulation. Use a minimum of 3 wraps per segment. Overlap tape ends 50% of pipe circumference.

FIGURE B-3
POLYISOCYANURATE INSULATION ELBOW

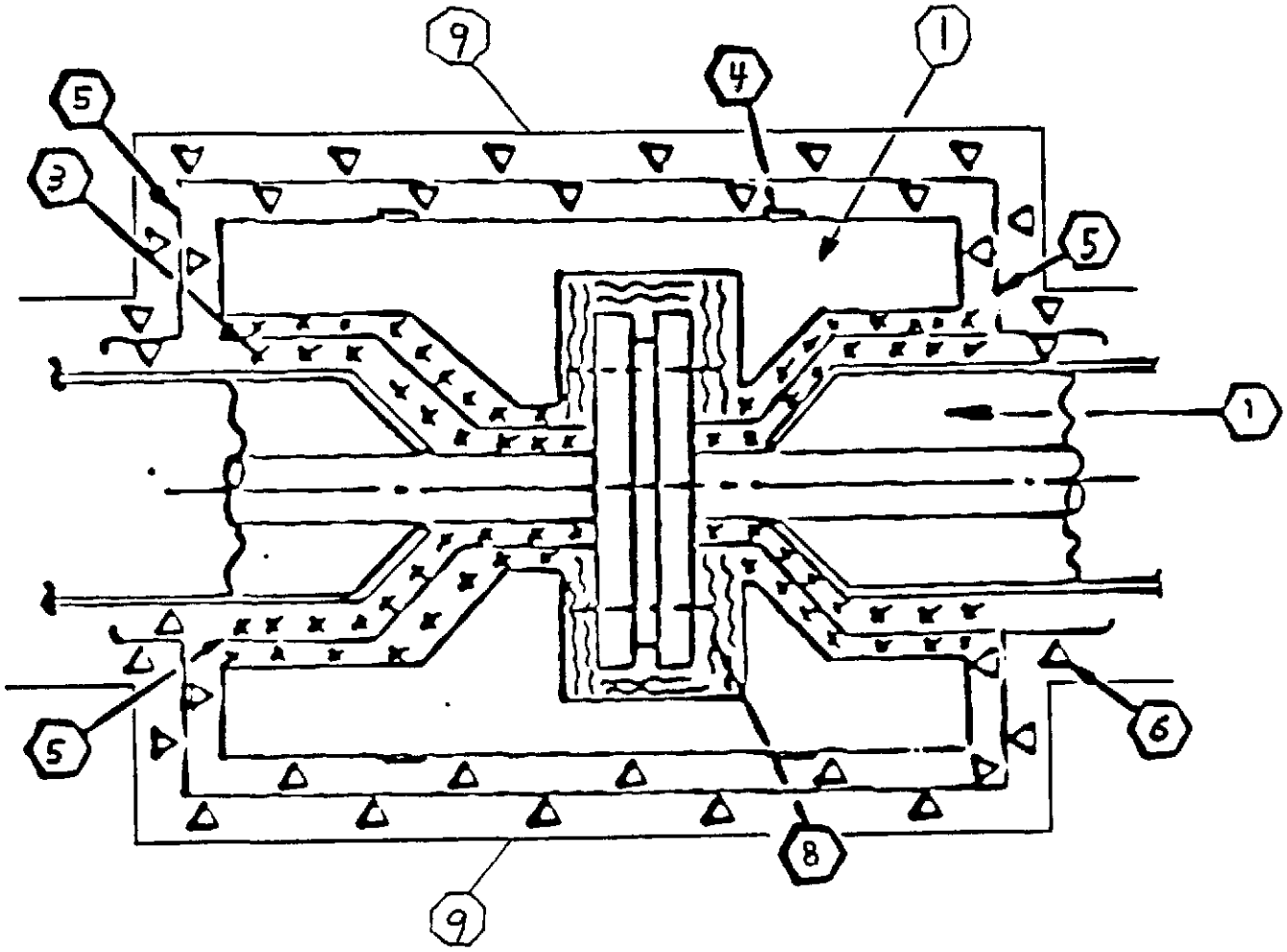


KEY

[1] Polyisocyanurate
[3] JOINT SEALANT AND VAPOR STOP MASTIC
[4] FILAMENT TAPE
[5] MEMBRANE
[6] VAPOR BARRIER MASTIC
[7] PLASTIC PIPE JACKET

FIGURE B-4

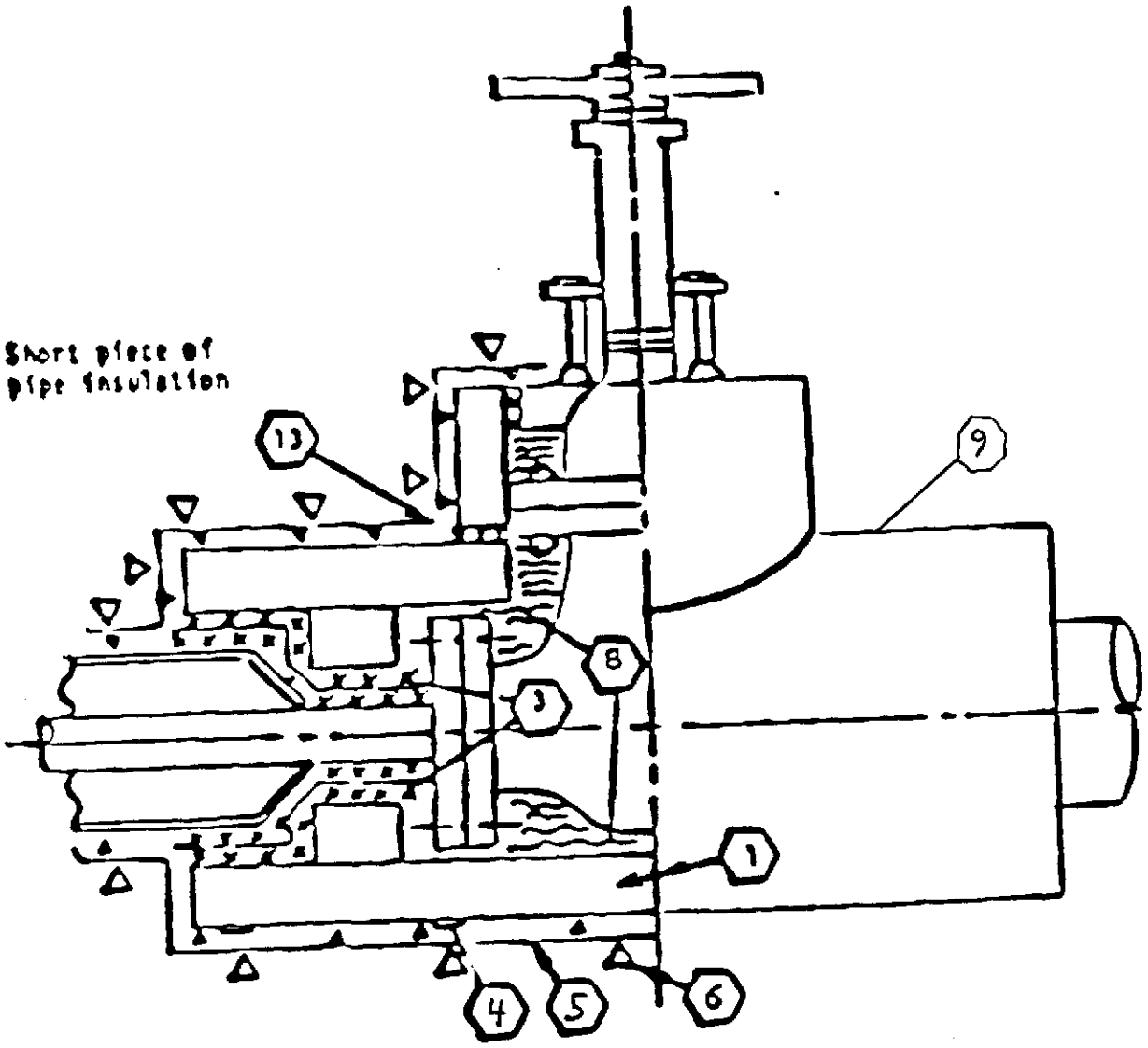
POLYISOCYANURATE INSULATION FLANGE



KEY

[1] Polyisocyanurate
[3] JOINT SEALANT AND VAPOR STOP MASTIC
[4] FILAMENT TAPE
[5] MEMBRANE
[6] VAPOR BARRIER MASTIC
[8] 1 PCF FIBERGLASS BLANKET
[9] PLASTIC PIPE JACKET

FIGURE B-5
POLYISOCYANURATE INSULATION VALVE



KEY

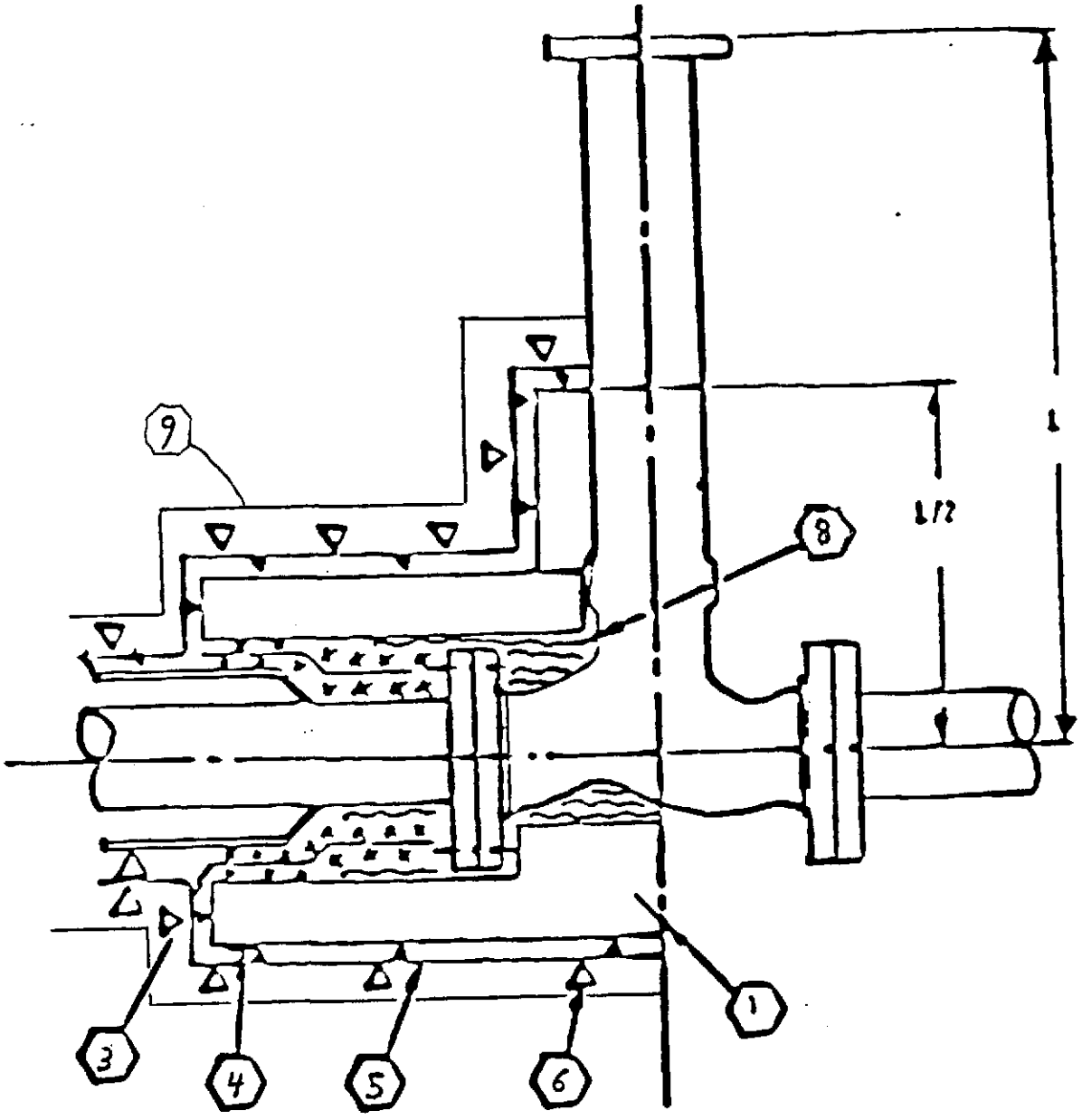
[1] Polyisocyanurate
[3] JOINT SEALANT AND VAPOR STOP MASTIC
[4] FILAMENT TAPE
[5] MEMBRANE
[6] VAPOR BARRIER MASTIC
[8] 1 PCF FIBERGLASS BLANKET
[9] PLASTIC PIPE JACKET
[13] SILICONE SEALANT

1. EXTEND JOINT SEALANT AND VAPOR STOP MASTIC AND GLASS CLOTH SEVERAL INCHES PAST THE INSULATION AND ONTO THE VALVE BONNET TO ASSURE THAT A GOOD VAPOR STOP IS FORMED.

2. INSULATION TO BE INSTALLED IN TWO HALVES. VAPOR SEALED AGAINST PIPE JACKET, BONNET, ETC.

Number
Rev.
Attach. A

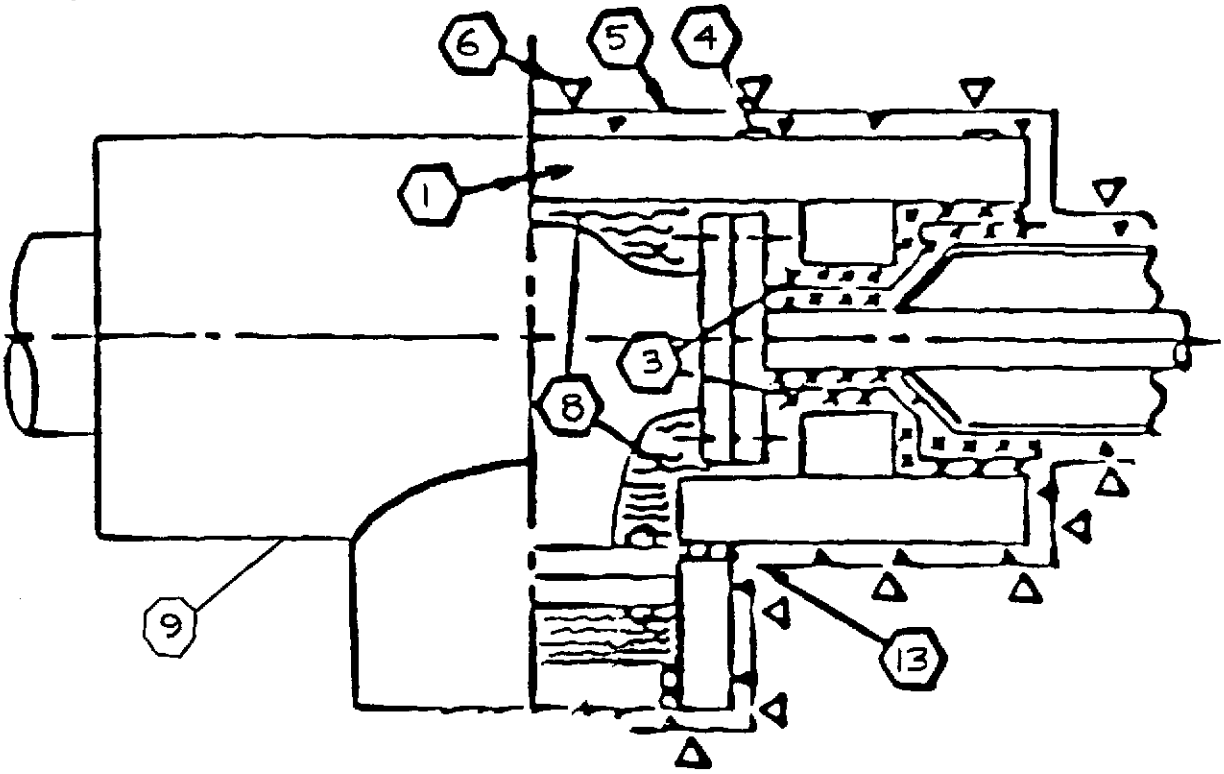
FIGURE B-6
POLYISOCYANURATE INSULATION EXTENDED STEM VALVE



KEY

[1] Polyisocyanurate
[3] JOINT SEALANT AND VAPOR STOP MASTIC
[4] FILAMENT TAPE
[5] MEMBRANE
[6] VAPOR BARRIER MASTIC
[8] 1 PCF FIBERGLASS BLANKET
[9] PLASTIC PIPE JACKET

FIGURE B-7
POLYISOCYANURATE INSULATION- FILTER

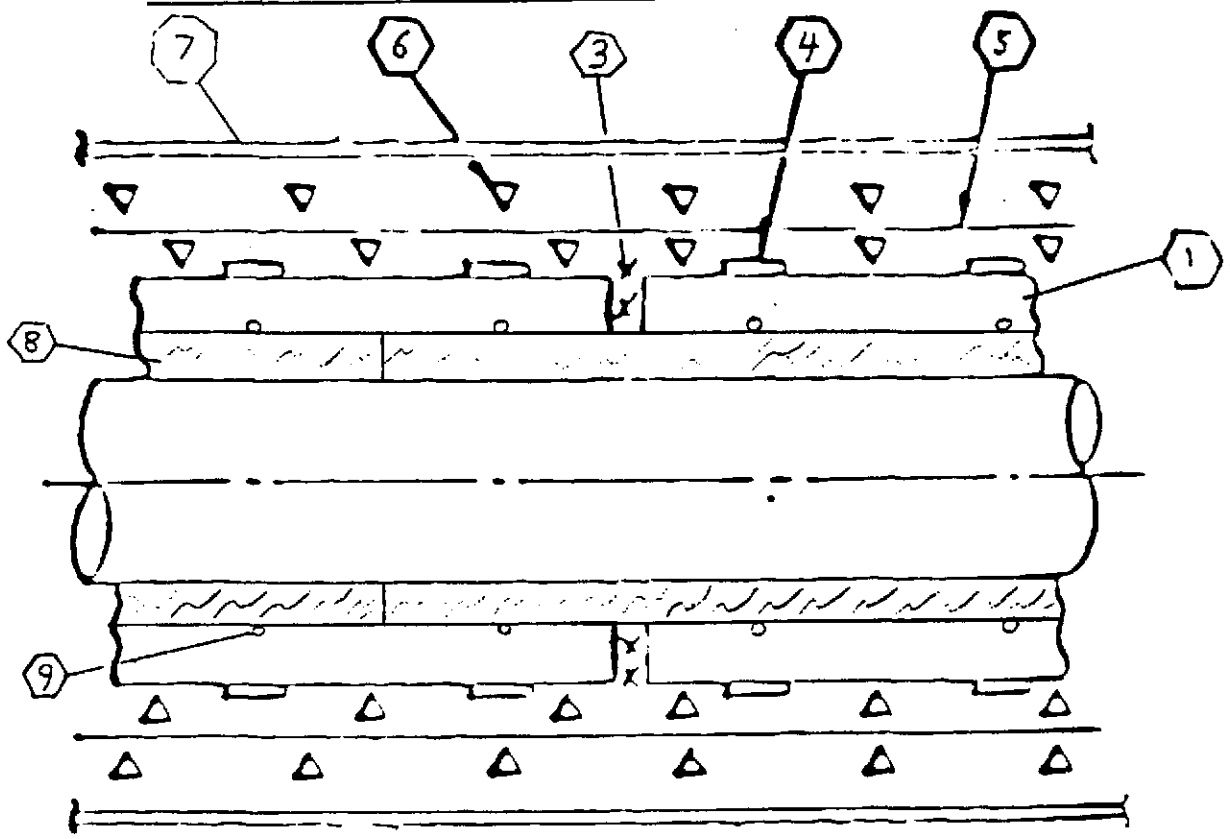


KEY

[1] Polyisocyanurate
[3] JOINT SEALANT AND VAPOR STOP MASTIC
[4] FILAMENT TAPE
[5] MEMBRANE
[6] VAPOR BARRIER MASTIC
[8] 1 PCF FIBERGLASS BLANKET
[9] PLASTIC PIPE JACKET
[13] SILICONE SEALANT

FIGURE C 1

POLYISOCYANURATE INSULATION - TYPICAL PIPE SECTION
WITH FIBERGLASS INNER LAYER

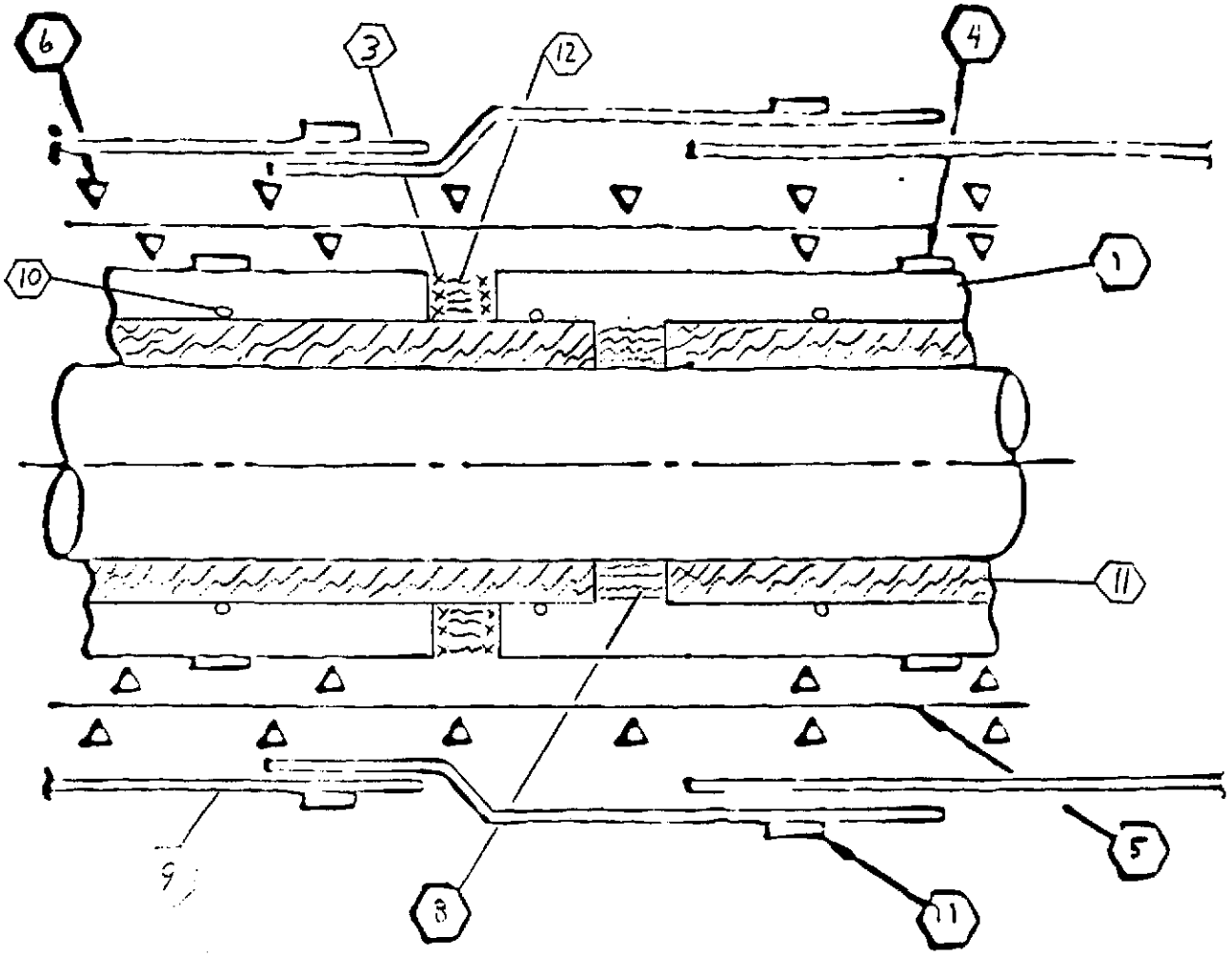


[1] Polyisocyanurate
[3] Joint Sealant and Vapor Stop Mastic
[4] Filament Tape
[5] Membrane
[6] VAPOR BARRIER MASTIC
[7] PLASTIC PIPE JACKET
[8] FIBERGLASS INNER LAYER
[9] 16 GAUGE WIRE

Use wire to secure inner layers and tape to secure outer layers of insulation. Use a minimum of 3 wraps per segment. Overlap tape ends 50% of pipe circumference.

Attach. A

FIGURE C2
POLYISOCYANURATE INSULATION - EXPANSION JOINT



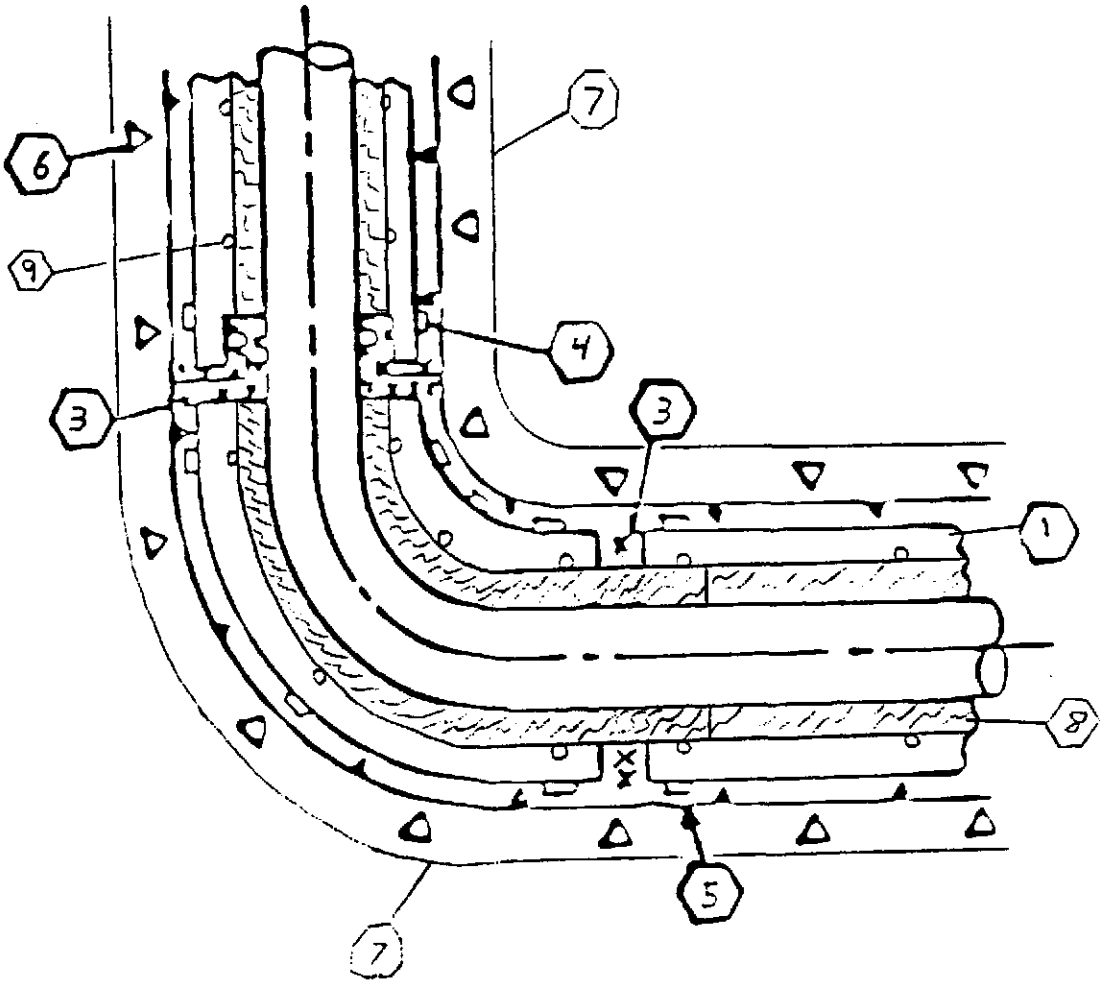
KEY

[1] Polyisocyanurate
[3] Joint Sealant and Vapor Stop Mastic
[4] Filament Tape
[5] Mesh Jacket
[6] Vapor Barrier Mastic
[8] 3 PCF FIBERGLASS BLANKET (2" THICK MIN)
[9] PLASTIC PIPE JACKET
[10] 16 GAUGE WIRE
[11] FIBERGLASS FINNER
[12] FIBERGLASS TAPE OR POLYISOCYANURATE

Use wire to secure inner layers and tape to secure outer layers of insulation. Use a minimum of 3 wraps per segment. Overlap tape ends 50% of pipe circumference

SPECIFICATION
Number A V049-2-163 Rev 1

FIGURE C3
POLYISOCYANURATE INSULATION ELBOW
WITH FIBERGLASS INNER LAYER

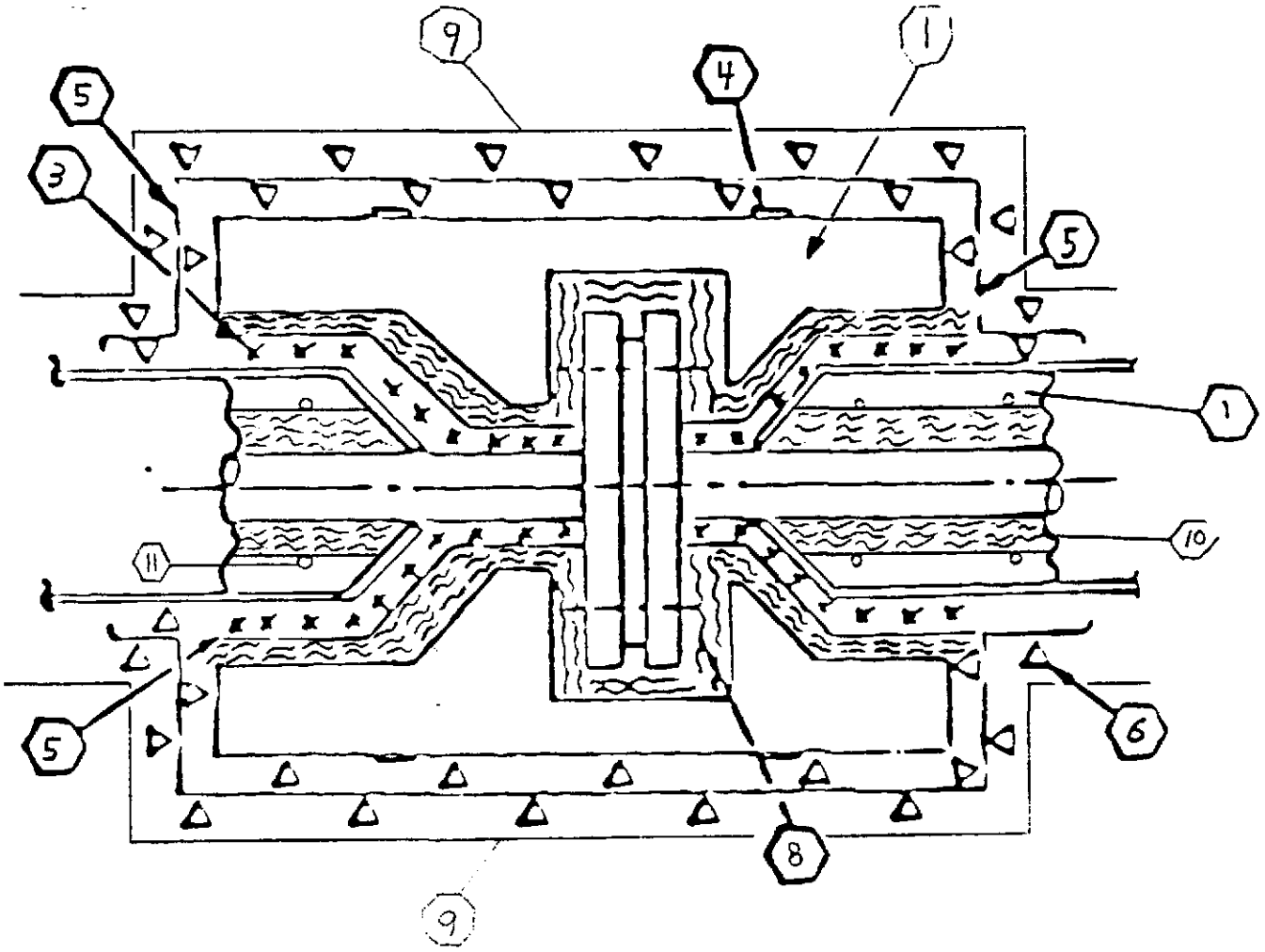


KEY

[1] Polyisocyanurate
[3] JOINT SEALANT AND VAPOR STOP MASTIC
[4] FILAMENT TAPE
[5] MEMBRANE
[6] VAPOR BARRIER MASTIC
[7] PLASTIC PIPE JACKET
[8] FIBERGLASS INNER LAYER
[9] S GAUGE WIRE

FIGURE C 4

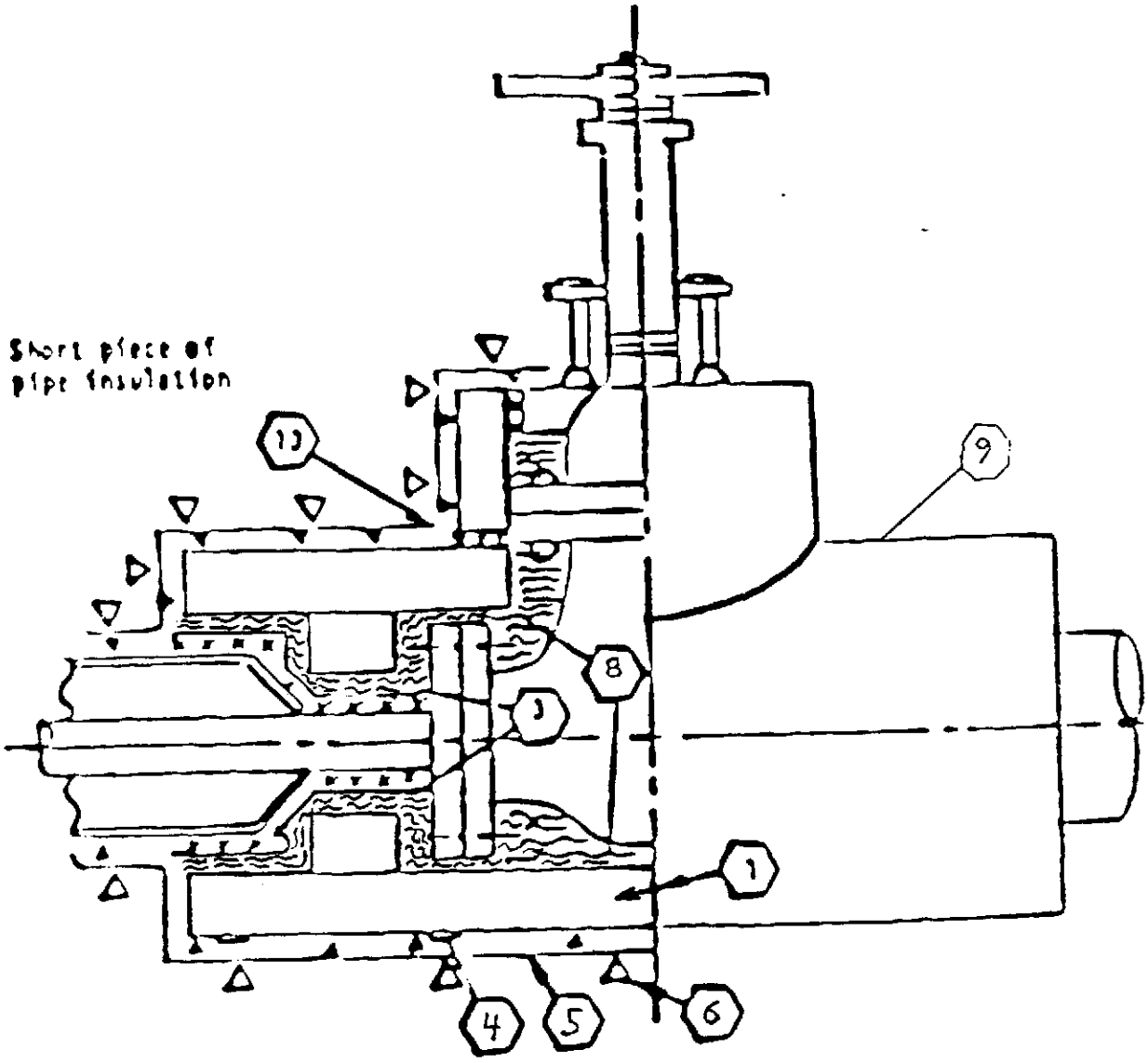
POLYISOCYANURATE INSULATION FLANGE
WITH FIBERGLASS INNER LAYER



KEY

[1] Polyisocyanurate
[3] JOINT SEALANT AND VAPOR STOP MASTIC
[4] FILAMENT TAPE
[5] MEMBRANE
[6] VAPOR BARRIER MASTIC
[8] 3 PCF FIBERGLASS BLANKET (1" MIN THK.)
[9] PLASTIC PIPE JACKET
[10] FIBERGLASS INNER LAYER
[11] 16 GAUGE WIRE

FIGURE C.5
POLYISOCYANURATE INSULATION VALVE
WITH FIBERGLASS INNER LAYER



KEY

[1] Polyisocyanurate
[3] JOINT SEALANT AND VAPOR STOP MASTIC
[4] FILAMENT TAPE
[5] MEMBRANE
[6] VAPOR BARRIER MASTIC
[8] 3 PCF FIBERGLASS BLANKET (MIN THK)
[9] PLASTIC PIPE JACKET
[13] SILICONE SEALANT

1. EXTEND JOINT SEALANT AND VAPOR STOP MASTIC AND GLASS CLOTH SEVERAL INCHES PAST THE INSULATION AND ONTO THE VALVE BONNET TO ASSURE THAT A GOOD VAPOR STOP IS FORMED.

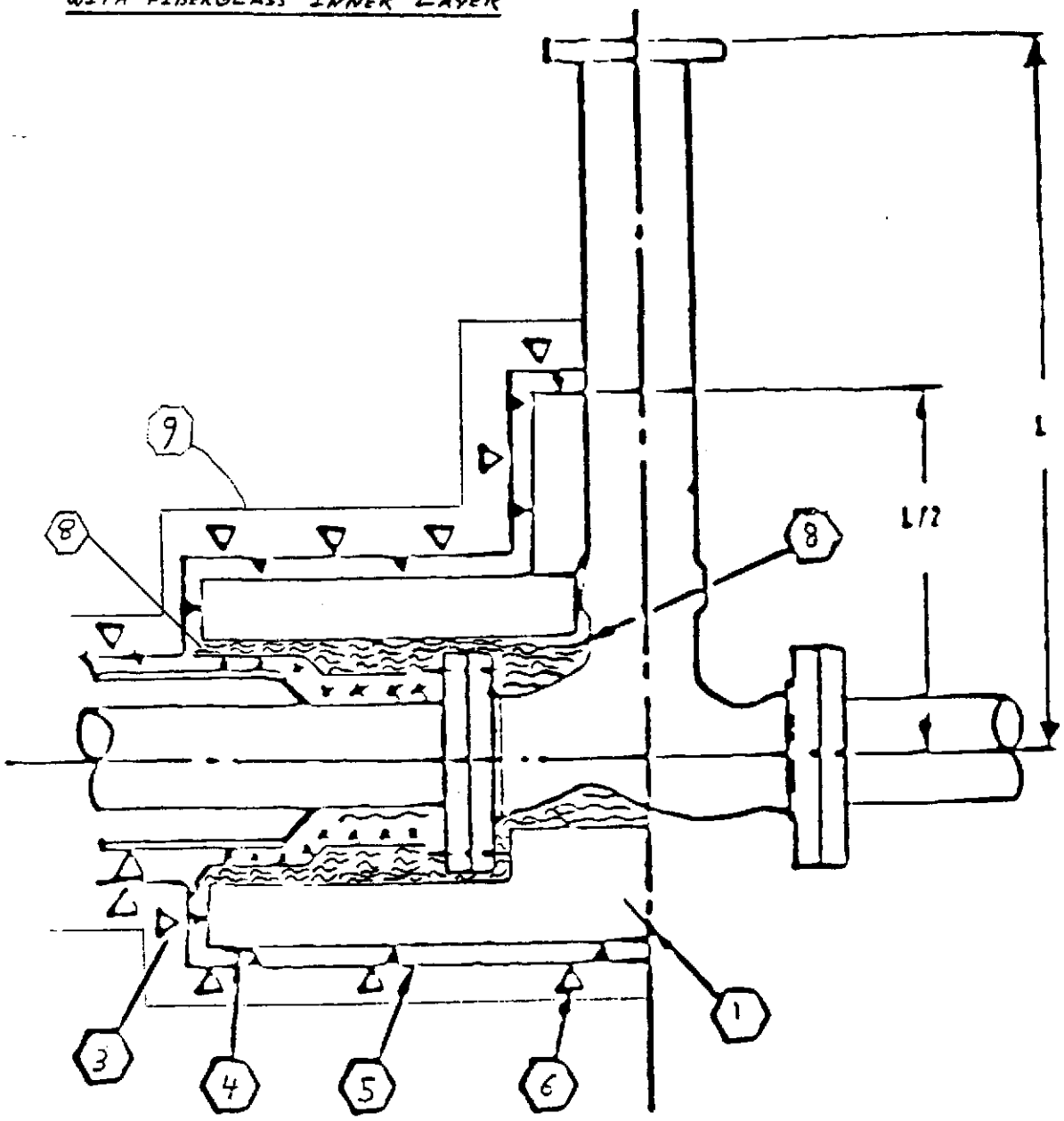
2. INSULATION TO BE INSTALLED IN TWO HALVES. VAPOR SEALED AGAINST PIPE JACKET, BONNET, ETC.

Attach. A
Pg 14 of 19

FIGURE C.6

POLYISOCYANURATE INSULATION EXTENDED STEM VALVE

WITH FIBERGLASS INNER LAYER



KEY

[1] Polyisocyanurate
[3] JOINT SEALANT AND VAPOR STOP MASTIC
[4] FILAMENT TAPE
[5] MEMBRANE
[6] VAPOR BARRIER MASTIC
[8] 3 PCF FIBERGLASS BLANKET (1" MIN THK)
[9] PLASTIC PIPE JACKET

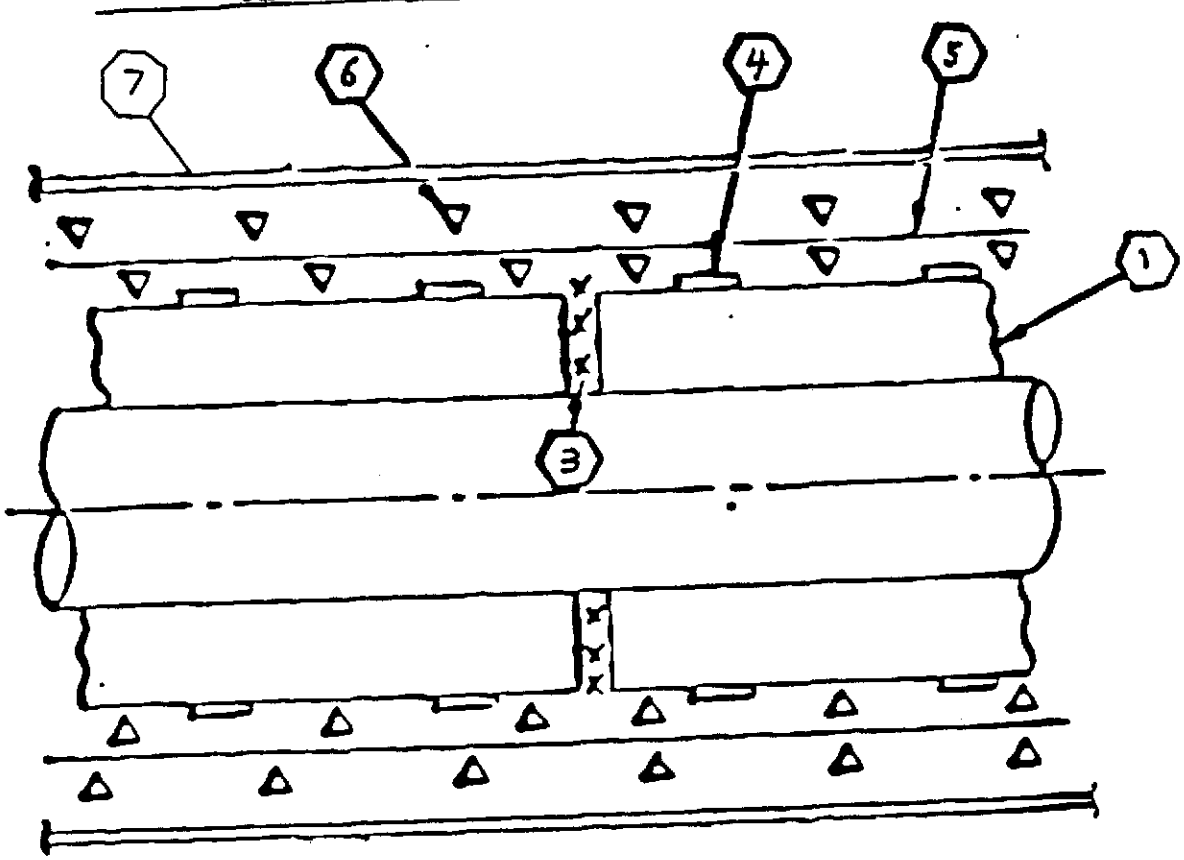
A Tech. A

SPECIFICATION

Number A V049-2-163 Rev 1

FIGURE D-1

FIBERGLASS INSULATION - TYPICAL PIPE SECTION



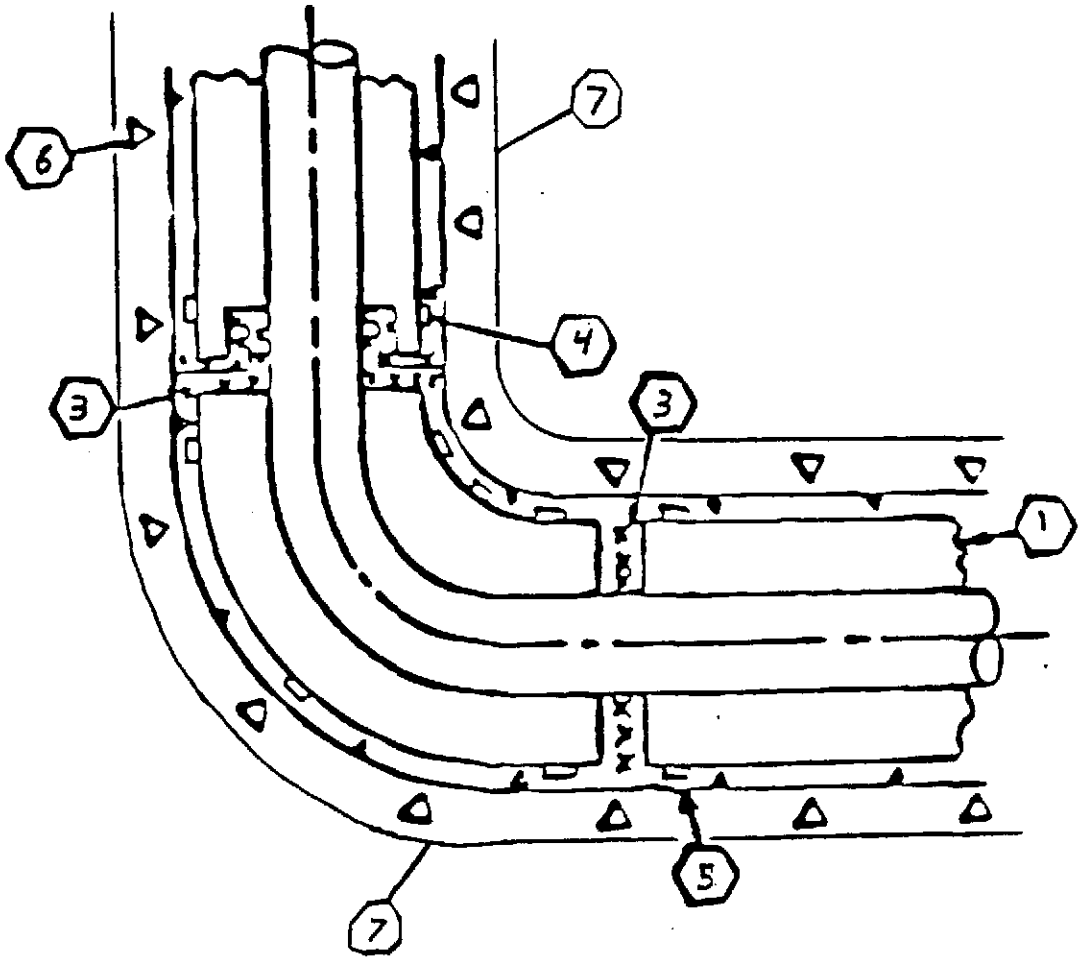
[1] Fiberglass
[3] Joint Sealant and Vapor Stop Mastic
[4] Filament Tape
[5] Membrane
[6] Vapor Barrier Mastic
[7] PLASTIC PIPE JACKET. SUBSTITUTE METALLIC PIPE JACKET WHEN INSULATING ELECTRIC HEATERS.

Use wire to secure inner layers and tape to secure outer layers of insulation. Use a minimum of 3 wraps per segment. Overlap tape ends 50% of pipe circumference.

Number A

Rev.

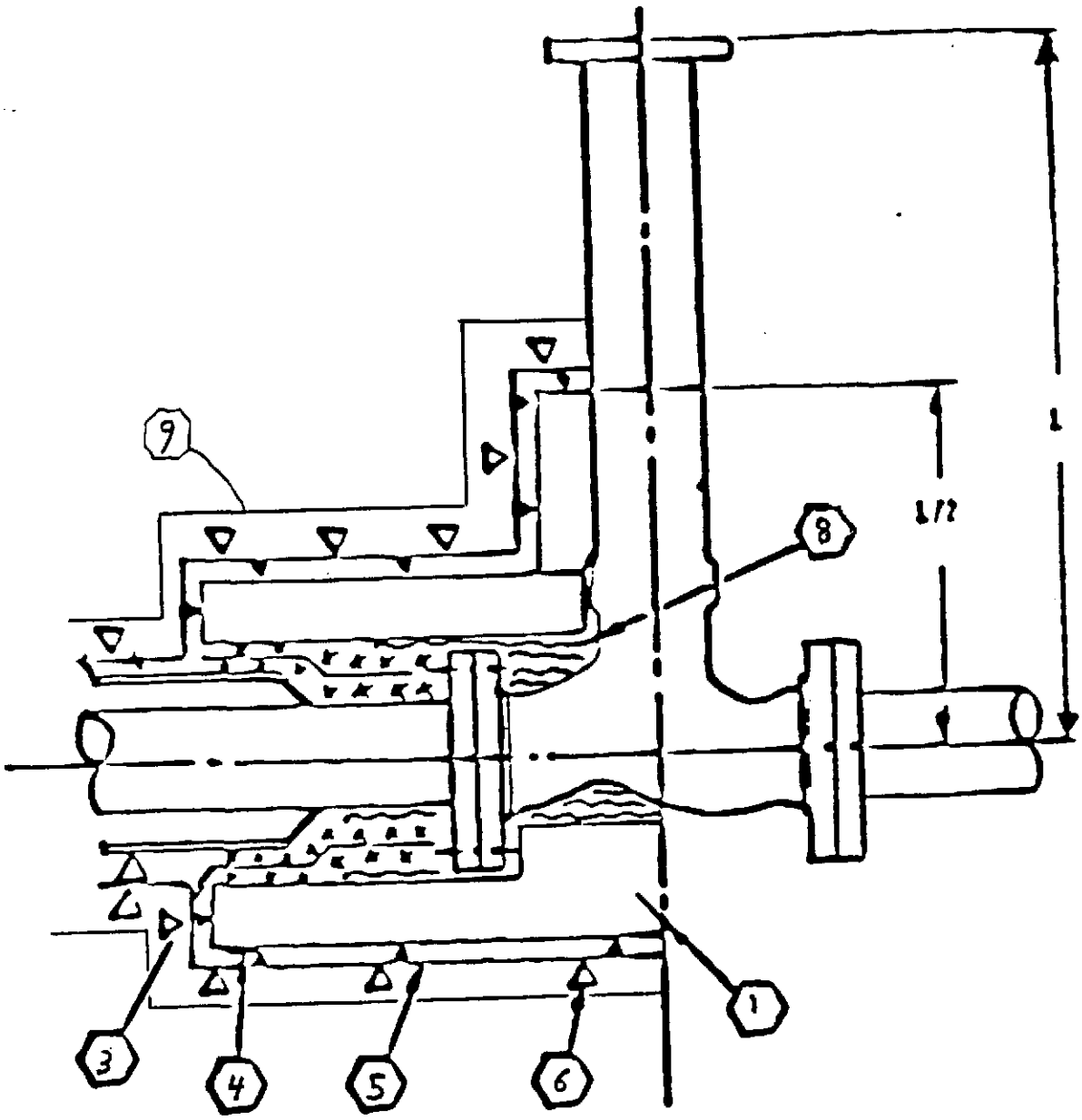
FIGURE D-2
FIBERGLASS INSULATION ELBOW



KEY

[1] Fiberglass
[3] JOINT SEALANT AND VAPOR STOP MASTIC
[4] FILAMENT TAPE
[5] MEMBRANE
[6] VAPOR BARRIER MASTIC
[7] PLASTIC PIPE JACKET

FIGURE D-3
FIBERGLASS INSULATION EXTENDED STEM VALVE



KEY

[1] Fiberglass
[3] JOINT SEALANT AND VAPOR STOP MASTIC
[4] FILAMENT TAPE
[5] MEMBRANE
[6] VAPOR BARRIER MASTIC
[8] 1 PCF FIBERGLASS BLANKET
[9] PLASTIC PIPE JACKET