



Exploration & Production

GENERAL SPECIFICATION

PIPING VALVES VESSELS

GS PVV 773

Thermal insulation (cyclic service)
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1. Scope

This standard specification defines the technical requirements concerning insulating materials and for the thermal insulation of equipment and piping for onshore and offshore installations. It concerns insulated equipment and piping for cold service which operates for periods at positive temperatures.

The following are excluded:

- Equipment and piping:
 - For hot service
 - For cold service
 - Buried
 - Subject to acoustic protection
- Instruments.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Standards

Reference	Title
ISO 2219	Expanded pure agglomerated cork for thermal insulation - Characteristics, sampling and packaging second edition
ASTM A525	Standard specification for general requirement for steel sheet, zinc-coated (Galvanised) by the hot-dip process
ASTM C552	Standard specification for cellular glass thermal insulation
ASTM C591	Specification for unfaced preformed rigid cellular polyurethane - Thermal insulation
ASTM C945	Practice for design consideration and spray application of a rigid. Cellular polyurethane insulation system on outdoor service vessels
ASTM C950	Repair of rigid cellular polyurethane roof insulation
ASTM C755	Selection of vapour retarders for thermal insulation
ASTM C585	Inner/outer diameters of rigid thermal insulation for nominal sizes of pipe/tubing, NBS system, practise
ASTM C549	Perlite loose fill for nominal sizes of pipe/tubing, NBS system, practise
ASTM C516	Vermiculate loose fill for nominal sizes of pipe/tubing, NBS system, practise
ASTM C647	Properties/test of mastics/coatings of thermal insulation, guide

Reference	Title
ASTM C921	Packaging material properties/testing
ASTM C168	Standard terminology relating to thermal insulating materials
ASTM C552	Standard specification for cellular glass thermal insulation
ASTM D2856	Standard test method for open-cell content of rigid cellular plastics by the air pycnometer
ASTM C871	Standard test methods for chemical analysis of thermal insulation. Materials of leachable chloride, fluoride, silicate, and sodium ions
ASTM C929	Standard practice for handling, transporting, shipping, storage, receiving and application of thermal insulation material for use in contact with austenitic stainless steel
ASTM D1621	Standard test method for compressive properties of rigid cellular plastics
ASTM C1046	In situ measurement of heat flux measurement of heat flux and temperature on building envelope component, practise
ASTM C461	Standard test method for mastics and coatings used with thermal insulation
ASTM C1033	Pipe insulation installed vertically, test
ASTM C687	Thermal resistance
ASTM C1104/1104M	Standard test method for determining the water vapour sorption of unfaced mineral fibre insulation
ASTM C165	Compressing properties, practice for measuring
ASTM E84	Standard test method for surface burning characteristics of building materials
ASTM E96	Standard test method for water vapour transmission of material
ASTM D1622	Standard test method for apparent density of rigid cellular plastics
ASTM C518	Heat flow meter test
ISO 844	Testing of rigid cellular plastics; compression test
ISO 845	Cellular plastics and rubbers; Determination of Apparent Density
ASTM C177	Standard test method for steady-state heat flux measurement and thermal transmission properties by means of the guarded-hot-sheet apparatus
ASTM C795	Standard specification for thermal insulation for use in contact with austenitic stainless steel
ASTM C871	Standard test methods for chemical analysis of thermal insulation. Materials for leachable chloride, fluoride, silicate, and sodium ions
ASTM C929	Standard practice for handling, transporting, shipping, storage, receiving and application of thermal insulation materials for use in contact with austenitic stainless steel

Reference	Title
ASTM D1621	Standard test method for compressive properties of rigid cellular plastics
ASTM C240	Standard test methods of testing cellular glass insulation block

Professional Documents

Reference	Title
Not applicable	

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS COR 350	External protection of offshore and related structures and equipment by painting
GS PVV 211	Pressure vessels according to ASME VIII div.1 or div.2
GS PVV 212	Pressure vessels according to PD 5500

3. Insulation systems

3.1 Design of systems

The thermal insulation systems are defined in the tables in the Appendices.

For special cases not covered by the Appendices, the Contractor shall submit any variant to the COMPANY for approval before use.

3.2 Use of the systems

The following parameters and criteria provide a quick guide for selecting the most appropriate system or systems for each situation.

3.2.1 Equipment configuration

- Horizontal and vertical vessels
- Piping

3.3 Definition of atmosphere or environment

Rural: Atmosphere distanced from all chemical and industrial activities and all urban centres, and unaffected by the maritime climate (air that is relatively pure and free of dust).

Industrial: Atmosphere characterised by the presence of dust and fumes (products of the direct or indirect combustion of carbon, sulphur, nitrogen, etc.), giving acid reactions to condensates ($\text{pH} < 6$).

Urban: Atmosphere characterised, like the industrial atmosphere, by the presence of dust and condensates with acid reactions ($\text{pH} < 6$).

Marine: Atmosphere which prevails at sea, along coastlines and immediately inland, and characterised by the presence in the air of sea water spray, more or less saline mist and by the absence of dust. Condensates are normally alkaline ($\text{pH} > 7$).

Note:

The urban atmosphere is treated as rural atmosphere.

The tropical atmosphere is treated as industrial or marine atmosphere, depending on the geographic location of the structure.

The atmosphere for "Offshore" structures is considered as a special case.

3.4 Parameters coding and identification of systems

3.4.1 Parameters coding

IN	Rural, urban and industrial
MA	Marine and tropical
OS	Offshore

SNNN/SNNN: two-part code comprising a sign (S) and three digits (NNN) indicating the minimum and maximum working temperatures.

Note:

The design temperature determines the type of insulation material to be selected.

The service temperature helps to determine the thermal insulation thickness.

For a given unit, it may be necessary to define two or more thermal insulation systems.

The systems defined in Appendix 1 must be used in conjunction with the installation principles in Appendix 3 and the material specification standards in Appendix 2.

Alternative protective jacketing may be used, depending on the area in which the equipment is installed.

4. Performance level

Class M: Cyclic service

The thermal efficiency or strength of the thermal insulation shall be guaranteed for a minimum of five years from the date of acceptance.

5. General conditions for execution

5.1 Conditions on materials

5.1.1 Supply and storage

All materials shall be procured according to the material specifications in Appendix 2. They shall be accompanied by certificates of conformity.

5.1.1.1 Insulating materials

The materials required for insulation shall be procured before commencement of operations, and shall remain in the original packaging, indicating the composition, type, density and thicknesses. They shall be stored sheltered from water and in accordance with the instructions in the Supplier's data sheets.

5.1.1.2 Fixing, sealing and vapour barrier materials (glues, mastics)

These shall be procured before commencement of operations, unless the shelf life of the products is shorter than the duration of the works, and shall be stored in their original packaging according to instructions in the Supplier's data sheets. In some cases, it may be necessary to store them in air-conditioned premises to prevent them becoming denatured.

5.1.1.3 Sampling of insulation, fixing, sealing and vapour barrier materials

The Contractor shall take a sample for each batch of materials used to verify their compliance.

The dimensions and the necessary quantities shall be determined according to the requirements of the specifications pertaining to checking of materials.

5.2 Preliminary conditions

The Contractor shall not commence installation operations until a report on the inventory of fixture has been prepared, indicating that:

- The thermal insulation supports (and insulation accessories) that are the responsibility of the equipment and piping Suppliers have been installed according to pressure vessel and piping trade practises
- All tests have been completed
- The surfaces have been appropriately protected in accordance with **GS COR 350** for carbon steels with a temperature of between -40°C and +120°C
- Collars and fixings on flanges, valves, nozzles, etc. have been inspected (after cooling the equipment or circuits).

5.3 Execution conditions

5.3.1 General

Cold service insulation operating in cyclic service conditions shall be implemented in two phases:

- In the first phase, in other words before tests, the following shall be insulated: equipment shells and heads, straight sections of piping, elbows, tees, connection points, etc.
- In the second phase, in other words after the equipment and circuits concerned have been tested, accessories such as flanges, valves, manholes and nozzles shall be insulated.

The Contractor shall obtain technical assistance from the Suppliers.

- Insulation shall be placed on dry, clean and degreased surfaces, treated if necessary with a corrosion proofing protection.
- Insulation shall only be fitted if the substrate temperature is at least 3°C above the dew point.
- No work shall be carried out while there is precipitation in the air, except under shelter and in a controlled atmosphere.
- Insulation shall be fitted in the second phase when the substrates have been de-iced by appropriate means and the surfaces have been dried (do not use a torch).
- If a sheet steel protective jacketing is fitted, the installation of M1 self-adhesive distancing straps is recommended between the vapour barrier and the sheet to ensure that the vapour barrier is not perforated by the fixing screws.
- On the first layer only, adhesive must not be used for service temperatures below -50°C and above +80°C.
- Expansion joints shall be water-tight.

5.3.2 Insulating material installation conditions

Insulation thicknesses: these shall comply with the information contained in the job specification.

The materials shall be applied according to the erection principles (Appendix 3).

Only healthy and dry materials shall be applied.

The minimum and maximum temperatures of the environment or the application surfaces shall be limited according to the Supplier's data sheets concerning the materials and products used.

Cut-outs in the insulation material shall be clean, and shall allow perfect juxtaposition of the items.

Insulation shall be mounted in zigzag fashion, and in the case of multi-layer insulation, the upper layer joints shall be offset from those of the lower layers.

The jointing of components shall be executed in accordance with the Supplier's instructions and Appendix 2 and Appendix 3.

Each layer of insulation shall be secured independently.

The tension of the retaining straps shall be such that the insulation is not damaged (before applying the vapour barrier, check that the straps have indeed been removed on the last layer in the case of a finish without sheet steel protective jacketing).

The number of expansion joints and the way in which they are executed shall be defined according to the Contractor's requirements.

5.3.3 Protective jacketing conditions

5.3.3.1 Vapour barrier

Before starting to fit the vapour barrier, make sure that the insulation and insulation limits comply with the specifications (if necessary, proceed with partial acceptance testing, see section 7).

Application of the vapour barrier shall immediately follow installation of the insulation.

Vapour barrier shall be applied in accordance with Appendix 3 and shall comprise at least two layers of mastic reinforced with a layer of reinforcing fabric.

At accessories such as supports, nozzles and inspection hatches, the cut-outs shall be made with precision and mastic sealants shall be used as appropriate.

Expansion joints shall be provided to absorb differential movements due to thermal variations.

Insulation of accessories such as flanges, valves and nozzles shall be provided by insulation fixed to "break joints" in accordance with Appendix 1.

5.3.3.2 Complete water tightness (offshore and marine environment)

Circular metallics collars shall be welded on piping and equipment to warranty the complete water tightness in complementary of the material mechanical protection and elastomer coat.

The thermal insulation supports and circular collars have been installed according to the insulation fabrication design documentation as per specification **GS PVV 211** and/or **GS PVV 212** (depending which is applicable).

In the case of water tight insulation, the materials used and the implementation conditions shall comply with Appendix 3.

They shall be covered by a minimum of two layers of elastomer coat type Hypalon^R or equivalent reinforced with compatible fiber glass fabric.

5.3.4 Equipment insulation

The insulating materials shall be fitted in accordance with sections 5, and according to Appendix 1 and information from the Suppliers.

5.3.5 Piping insulation

Insulation materials shall again be applied in accordance with sections 5, and according to Appendix 1 and information from the Suppliers.

On piping with diameters of less than 2", elbows may be made of angle iron, cut segments or machined.

Insulation of accessories such as flanges, valves and accessories shall be applied in the second phase using insulation fixed to "break joints" in accordance with Appendix 1.

5.4 Repair of execution defects

By agreement with the COMPANY, after determining the extent of the defects, the following methods of repair shall be applied.

5.4.1 Minor cladding defects

Minor defects shall be repaired locally, overlapping the adjacent parts.

5.4.2 Insulation system execution defects

The elements shall be removed and replaced.

6. Technical content of tenders

Tenders shall include the following details for thermal insulation systems:

- Methods and means used to install the insulation
- Data sheets for the proposed materials, and their sources
- Certificates issued by approved laboratories (concerning trials and tests relating to the proposed materials)
- Detailed length measurements for each item of equipment, and summary by type of equipment and insulation classes
- A Quality Assurance Plan (QAP), including in particular:
 - A nominal functional organisation chart
 - The presence of a specialist inspector
 - The list of installation and inspection phases, and their associated procedures
 - List of installation and inspection equipment
 - Resources provided for protection against adverse climatic conditions.

7. Tests, inspections and acceptance

7.1 Tests

During the work, the Contractor shall check the following points, in accordance with the systems selected. The results of these checks shall be recorded in the control sheets.

- Conformity of thermal insulation supports
- Condition of surfaces to which the thermal insulation is applied
- Climatic conditions of application
- Surface temperatures
- Quality of materials (compliance with specifications)
- Thickness and number of layers
- Quality of implementation

- Effectiveness of fixings and sealants (remove excess overflow from joints and straps before applying the vapour barrier)
- Quality of application of the vapour barrier and sealing at terminations (first phase)
- Finishing
- Compliance with specifications.

7.2 Inspection

As part of the QAP, the Contractor shall determine the inspection operations and submit them to the COMPANY. These actions are linked to the various phases of execution and checking (see section 7).

7.3 Acceptance

7.3.1 Quality control

During acceptance testing, a check shall be run to ensure that all the checkings listed in section 7 (tests) have been carried out and that the results are satisfactory.

7.3.2 Thermal efficiency

Thermal efficiency shall be at least equal to that specified by the COMPANY.

After startup of the installation, the following checks shall be carried out:

- Absence of condensation and frost (according to design climatic parameters)
- Surface temperature
- Absence of ice on insulation (indicating bad workmanship)
- Heat gains using infrared cameras, according to the indications and requirements of the COMPANY (resources - locations of measurements - duration - number of measurements, etc.).

The results of the tests shall be confirmed by a report.

A second check shall be carried out before the end of the warranty period.

Acceptance test operations shall be confirmed by a report.

The **Contractor** shall guarantee that the insulation has been executed in strict compliance with this document. The system is defined in the insulation thickness tables.

8. Technical documentation

The technical documentation submitted by the Contractor on completion of the work shall include:

- Certificates of conformity of the insulating materials
- Certificates connected with tests and inspections by approved laboratories
- Particular execution standards
- Miscellaneous inspection forms



- Reports of tests and checks of thermal efficiency and effectiveness
- Acceptance test report.



Appendix 1

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List of thermal insulation systems

Parameters of choice Equipment	Env (2)	Service temperature		Type of insulation	Type of jacket	System N°		Remarks
Vertical or horizontal drums and tanks		LOW	HIGH					
	IN/MA	-50°C	+70°C	PIR (1)	Without jacketing	001		
					Lacquered galvanised steel sheet	002		
					Stainless steel sheet	003		
	IN/MA OS	-80°C	+170°C	CELLULAR GLASS	Without jacketing	004		
					Lacquered galvanised steel sheet	005		OS not concerned
					Stainless steel sheet	006		
Note: (1) Polyisocyanurate foam (2) In France: ambient temperature "Amb" is 20°C								

Parameters of choice Equipment	Env (2)	Service temperature		Type of insulation	Type of jacket	System N°		Remarks
PIPING	IN/MA	LOW -50°C	HIGH +70°C	PIR (1)	Without jacketing	007		
					Lacquered galvanised steel sheet	008		
					Stainless steel sheet	009		
	IN/MA OS	-80°C	+170°C	CELLULAR GLASS	Without jacketing	010		
					Lacquered galvanised steel sheet	011		OS not concerned
					Stainless steel sheet	012		
Note: (1) Polyisocyanurate foam (2) In France: ambient temperature "Amb" is 20°C								

**Description of system N° 001
To be used with standard drawing(s)
Appendix 3 no. 01 to 05**

Components	Description	References	Requirements	Remarks
Insulation	Rigid polyisocyanurate foam	N° 36	If total thickness < 50 mm, 1 layer with longitudinal + circumferential retaining straps If total thickness > 51 mm, multilayered max layer thickness 50 mm without retaining straps	
Bonding material	Adhesive	N° 520	Min consumption 2.5 kg/m ²	The bonding adhesives and jointing mastic must be proven compatible with and chemically neutral to the equipment's anticorrosive system
Sealant	Mastic	N° 530 or 531 or 532 or 533	Min consumption 3 kg/m ²	
Fixing	Adhesive tape	N° 579	Min 2 per segment	
Vapour barrier	Mastic	N° 580 or (581*)	Min consumption 4 kg/m ² in two layers	
	Linen cloth	N° 610	100 mm overlap minimum	
Jacketing material	NOT SPECIFIED			
Jacket fixing				
Water-proofing sealants				

Note: No incompatibility of adhesion between mastics 886.05/886.06 and HYPALKOTE coating.

Description of system N° 002
To be used with standard drawing(s)
Appendix 3 no. 01 to 05

Components	Description	References	Requirements	Remarks
Insulation	Rigid polyisocyanurate foam	N° 31	If total thickness < 50 mm, 1 layer with longitudinal + circumferential retaining straps If total thickness > 51 mm, multilayered max layer thickness 50 mm without retaining straps	
Bonding material	Adhesive	N° 520	Min consumption 2.5 kg/m ²	The bonding adhesives and jointing mastic must be proven compatible with and chemically neutral to the equipment's anticorrosive system
Sealant	Mastic	N° 530 or 531 or 532 or 533	Min consumption 3 kg/m ²	
Fixing	Adhesive tape	N° 579	Min 2 per segment	
Vapour barrier	Mastic	N° 590	Min consumption 4 kg/m ² in two layers	
	Linen cloth	N° 610	100 mm overlap minimum	
Spacer	Elastomer	N° 690	Thickness 19 mm min	
Jacketing material	Flat lacquered galvanised steel sheets		Quality Plastisol Finish/State 100/E Heads, shell and covers 0.63 mm	
Jacket fixing	Self-tapping screws		Stainless steel cheese-head self-tapping screws, dia 4.8 x 15.9 mm + neoprene spacers	Fixing sheets to sheets
	Straps		Stainless steel, 16 x 0.5 mm min	Retaining sheets (3)
Water-proofing sealants	Preformed cords	N° 534	Diameter according to swage	Applied continuously
	Neutral silicon mastic in cartridges	N° 535		For sealing the finishing work

Note: (3) If necessary, retaining strap on elevated equipment or piping jacket sheets exposed to wind.

**Description of system N° 003
To be used with standard drawing(s)
Appendix 3 no. 01 to 05**

Components	Description	References	Requirements	Remarks
Insulation	Rigid polyisocyanurate foam	N° 36	If total thickness < 50 mm, 1 layer with longitudinal + circumferential retaining straps If total thickness > 51 mm, multilayered max layer thickness 50 mm without retaining straps	
Bonding material	Adhesive	N° 520	Min consumption 2.5 kg/m ²	The bonding adhesives and jointing mastic must be proven compatible with and chemically neutral to the equipment's anticorrosive system
Sealant	Mastic	N° 530 or 531 or 532 or 533	Min consumption 3 kg/m ²	
Fixing	Adhesive tape	N° 579	Min 2 per segment	
Vapour barrier	Mastic	N° 590	Min consumption 4 kg/m ² in two layers	
	Linen cloth	N° 610	100 mm overlap minimum	
Spacer	Elastomer	N° 690	Thickness 19 mm min	
Jacketing material	Flat stainless steel sheets		Quality Z8 C 17 or Z3 CND 17.13.03 0S Finish/State MAT Heads, shell and covers 0.50 mm	
Jacket fixing	Self-tapping screws		Stainless steel cheese-head self-tapping screws, dia 4.8 x 15.9 mm + neoprene spacers	Fixing sheets to sheets
	Straps		Stainless steel, 16 x 0.5 mm min	Retaining sheets (3)
Water-proofing sealants	Preformed cords	N° 534	Diameter according to swage	Applied continuously
	Neutral silicon mastic in cartridges	N° 535		For sealing the finishing work

Note: (3) If necessary, retaining strap on elevated equipment or piping jacket sheets exposed to wind.



**Description of system N° 004
To be used with standard drawing(s)
Appendix 3 no. 01 to 05**

Components	Description	References	Requirements	Remarks
Insulation	Cellular glass	N° 31	Minimum thickness of each layer: 40 mm	
Bonding material	Adhesive	N° 520	Min consumption 2.5 kg/m ²	First layer applied dry (without bonding, without sealant) The bonding adhesives and jointing mastic must be proven compatible with and chemically neutral to the equipment's anticorrosive system
Sealant	Mastic	N° 530 or 531 or 532 or 533	Min consumption 3 kg/m ²	
Fixing	Adhesive tape	N° 579	Min 2 per segment	
Vapour barrier	Mastic	N° 580 or (581*)	Min consumption 4 kg/m ² in two layers	
	Linen cloth	N° 610	100 mm overlap minimum	
Jacketing material	NOT SPECIFIED			
Jacket fixing				
Water-proofing sealants				

Note: *No incompatibility of adhesion between mastics 886.05/886.06 and HYPALKOTE coating.

Description of system N° 005
To be used with standard drawing(s)
Appendix 3 no. 01 to 05

Components	Description	References	Requirements	Remarks
Insulation	Cellular glass	N° 31	Minimum thickness of each layer: 40 mm	
Bonding material	Adhesive	N° 520	Min consumption 2.5 kg/m ²	First layer applied dry (without bonding, without sealant) The bonding adhesives and jointing mastic must be proven compatible with and chemically neutral to the equipment's anticorrosive system
Sealant	Mastic	N° 530 or 531 or 532 or 533	Min consumption 3 kg/m ²	
Fixing	Adhesive tape	N° 579	Min 2 per segment	
Vapour barrier	Mastic	N° 590	Min consumption 4 kg/m ² in two layers	
	Linen cloth	N° 610	100 mm overlap minimum	
Spacer	Elastomer	N° 690	Thickness 19 mm min	
Jacketing material	Flat lacquered galvanised steel sheets	N° 650	Quality Plastisol Finish/State 100/E Heads, shell 0.63 mm and covers	
Jacket fixing	Self-tapping screws		Stainless steel cheese-head self-tapping screws, dia 4.8 x 15.9 mm + neoprene spacers	Fixing sheets to sheets
	Straps		Stainless steel, 16 x 0.5 mm min	Retaining sheets (3)
Water-proofing sealants	Preformed cords	N° 534	Diameter according to swage	Applied continuously
	Neutral silicon mastic in cartridges	N° 535		For sealing the finishing work

Note: (3) If necessary, retaining strap on elevated equipment or piping jacket sheets exposed to wind.

Description of system N° 006
To be used with standard drawing(s)
Appendix 3 no. 01 to 05

Components	Description	References	Requirements	Remarks
Insulation	Cellular glass	N° 31	Minimum thickness of each layer: 40 mm	
Bonding material	Adhesive	N° 520	Min consumption 2.5 kg/m ²	First layer applied dry (without bonding, without sealant) The bonding adhesives and jointing mastic must be proven compatible with and chemically neutral to the equipment's anticorrosive system
Sealant	Mastic	N° 530 or 531 or 532 or 533	Min consumption 3 kg/m ²	
Fixing	Adhesive tape	N° 579	Min 2 per segment	
Vapour barrier	Mastic	N° 590	Min consumption 4 kg/m ² in two layers	
	Linen cloth	N° 610	100 mm overlap minimum	
Spacer	Elastomer	N° 690	Thickness 19 mm min	
Jacketing material	Flat stainless steel sheets		Quality Z8 C 17 or 23 CND 17.13.03 0S Finish/State MAT Heads, shell and covers 0.50 mm	
Jacket fixing	Self-tapping screws		Stainless steel cheese-head self-tapping screws, dia 4.8 x 15.9 mm + neoprene spacers	Fixing sheets to sheets
	Straps		Stainless steel, 16 x 0.5 mm min	Retaining sheets (3)
Water-proofing sealants	Preformed cords	N° 534	Diameter according to swage	Applied continuously
	Neutral silicon mastic in cartridges	N° 535		For sealing the finishing work

Note: (3) If necessary, retaining strap on elevated equipment or piping jacket sheets exposed to wind.

Description of system N° 007
To be used with standard drawing(s)
Appendix 3 no. 01 to 05

Components	Description	References	Requirements	Remarks
Insulation	Rigid polyisocyanurate foam	N° 36	If total thickness < 50 mm, 1 layer with longitudinal + circumferential retaining straps If total thickness > 51 mm, multilayered max layer thickness 50 mm without retaining straps	
Bonding material	Mastic	N° 531 or (530 or 533*)	Min consumption 3 kg/m ² 1st layer only	The bonding adhesives and jointing mastic must be proven compatible with and chemically neutral to the equipment's anticorrosive system
Bonding material	Adhesive	N° 521	Min consumption 2.5 kg/m ² Last layer	
Sealant	Mastic	N° 530 or 531 or 532 or 533	Min consumption 3 kg/m ²	.
Fixing	Adhesive tape	N° 579	Min 2 per segment	
Vapour barrier	Mastic	N° 580 or (581*)	Min consumption 4 kg/m ² in two layers	
	Linen cloth	N° 610	100 mm overlap minimum	
Jacketing material	NOT SPECIFIED			
Jacket fixing				
Water-proofing sealants				

Note: No incompatibility of adhesion between mastics 886.05/886.06 and HYPALKOTE coating.

Description of system N° 008
To be used with standard drawing(s)
Appendix 3 no. 01 to 05

Components	Description	References	Requirements	Remarks
Insulation	Rigid polyisocyanurate foam	N° 31	If total thickness < 50 mm, 1 layer with longitudinal + circumferential retaining straps If total thickness > 51 mm, multilayered max layer thickness 50 mm without retaining straps	
Bonding material	Mastic	N° 530 or 532 or 533	Min consumption 3 kg/m ² 1st layer only	The bonding adhesives and jointing mastic must be proven compatible with and chemically neutral to the equipment's anticorrosive system
Bonding material	Adhesive	N° 521	Min consumption 2.5 kg/m ² Last layer	
Sealant	Mastic	N° 530 or 531 or 532 or 533	Min consumption 3 kg/m ²	
Fixing	Adhesive tape	N° 579	Min 2 per segment	
Vapour barrier	Mastic	N° 590	Min consumption 4 kg/m ² in two layers	
	Linen cloth	N° 610	100 mm overlap minimum	
Spacer	Elastomer	N° 690	Thickness 19 mm min	
Jacketing material	Flat lacquered galvanised steel sheets		Quality Plastisol Finish/State 100/E Heads, shell and covers 0.63 mm	
Jacket fixing	Self-tapping screws		Stainless steel cheese-head self-tapping screws, dia 4.8 x 15.9 mm + neoprene spacers	Fixing sheets to sheets
	Straps		Stainless steel, 16 x 0.5 mm min	Retaining sheets (3)
Water-proofing sealants	Preformed cords	N° 534	Diameter according to swage	Applied continuously
	Neutral silicon mastic in cartridges	N° 535		For sealing the finishing work

Note: (3) If necessary, retaining strap on elevated equipment or piping jacket sheets exposed to wind.

Description of system N° 009
To be used with standard drawing(s)
Appendix 3 no. 01 to 05

Components	Description	References	Requirements	Remarks
Insulation	Rigid polyisocyanurate foam	N° 36	If total thickness < 50 mm, 1 layer with longitudinal + circumferential retaining straps If total thickness > 51 mm, multilayered max layer thickness 50 mm without retaining straps	
Bonding material	Mastic	N° 530 or 532 or 533	Min consumption 3 kg/m ² 1st layer only	The bonding adhesives and jointing mastic must be proven compatible with and chemically neutral to the equipment's anticorrosive system.
Bonding material	Adhesive	N° 521	Min consumption 2.5 kg/m ² Last layer	
Sealant	Mastic	N° 530 or 531 or 532 or 533	Min consumption 3 kg/m ²	
Fixing	Adhesive tape	N° 579	Min 2 per segment	
Vapour barrier	Mastic	N° 590	Min consumption 4 kg/m ² in two layers	
	Linen cloth	N° 610	100 mm overlap minimum	
Spacer	Elastomer	N° 690	Thickness 19 mm min	
Jacketing material	Flat stainless steel sheets		Quality Z8 C 17 or Z3 CND 17.13.03 OS Finish/State MAT Heads, shell and covers 0.50 mm	
Jacket fixing	Self-tapping screws		Stainless steel cheese-head self-tapping screws, dia 4.8 x 15.9 mm + neoprene spacers	Fixing sheets to sheets
	Straps		Stainless steel, 16 x 0.5 mm min	Retaining sheets (3)
Water-proofing sealants	Preformed cords	N° 534	Diameter according to swage	Applied continuously
	Neutral silicon mastic in cartridges	N° 535		For sealing the finishing work

Note: (3) If necessary, retaining strap on elevated equipment or piping jacket sheets exposed to wind.

Description of system N° 010
To be used with standard drawing(s)
Appendix 3 no. 01 to 05

Components	Description	References	Requirements	Remarks
Insulation	Cellular glass	N° 31	Minimum thickness of each layer: 40 mm	
	Anti-abrasive	N° 500	Max consumption 0.70 kg/m ² When the first layer cannot be bonded	Apply to 1st layer Assemble when hardened Temperature limit +120°C
Bonding material	Mastic	N° 531 or (530 or 533*)	Min consumption 3 kg/m ² 1st layer applied dry	The bonding adhesives and jointing mastic must be proven compatible with and chemically neutral to the equipment's anticorrosive system
Bonding material	Adhesive	N° 521	Min consumption 2.5 kg/m ² Last layer	
Sealant	Mastic	N° 530 or 531or 532 or 533	Except 1st layer if temp. < -50°C Min consumption 3 kg/m ²	
Fixing		N° 579	Min 2 per segment	
Vapour barrier	Mastic	N° 580 or (581*)	Min consumption 4 kg/m ² in two layers	
	Linen cloth	N° 610	100 mm overlap minimum	
Jacketing material	NOT SPECIFIED			
Jacket fixing				
Water-proofing sealants				

Note: No incompatibility of adhesion between mastics 886.05/886.06 and HYPALKOTE coating.

Description of system N° 011
To be used with standard drawing(s)
Appendix 3 no. 01 to 05

Components	Description	References	Requirements	Remarks
Insulation	Cellular glass	N° 31	Minimum thickness of each layer: 40 mm	
	Anti-abrasive	N° 500	Max consumption 0.70 kg/m ² When the first layer cannot be bonded	Apply to 1st layer Assemble when hardened Temperature limit +120°C
Bonding material	Mastic	N° 532 or 530 or 533	Min consumption 3 kg/m ² 1st layer applied dry	
Bonding material	Adhesive	N° 521	Min consumption 2.5 kg/m ² Last layer	The bonding adhesives and jointing mastic must be proven compatible with and chemically neutral to the equipment's anticorrosive system
Sealant	Mastic	N° 530 or 531 or 532 or 533	Except 1st layer if temp. < -50°C Min consumption 3 kg/m ²	
Fixing		N° 579	Min 2 per segment	
Vapour barrier	Mastic	N° 590	Consumption 4 kg/m ² in 2 layers min	
	Linen cloth	N° 610	100 mm overlap minimum	
Spacer	Elastomer	N° 690	Thickness 19 mm min	
Jacketing material	Flat lacquered galvanised steel sheets		Quality Plastisol Finish/State 100/E Heads, shell 0.63 mm and covers	
Jacket fixing	Self-tapping screws		Stainless steel cheese-head self- tapping screws, dia 4.8 x 15.9 mm + neoprene spacers	Fixing sheets to sheets
	Straps		Stainless steel, 16 x 0.5 mm min	Retaining sheets (3)
Water-proofing sealants	Preformed cords	N° 534	Diameter according to swage	Applied continuously
	Silicon mastic in cartridges	N° 535		For sealing the finishing work

Note: (3) If necessary, retaining strap on elevated equipment or piping jacket sheets exposed to wind.

Description of system N° 012
To be used with standard drawing(s)
Appendix 3 no. 01 to 05

Components	Description	References	Requirements	Remarks
Insulation	Cellular glass	N° 31	Minimum thickness of each layer: 40 mm	
	Anti-abrasive	N° 500	Max consumption 0.70 kg/m ² When the first layer cannot be bonded	Apply to 1st layer Assemble when hardened Temperature limit +120°C
Bonding material	Mastic	N° 530 or 532 or 533	Except 1st layer if temp. < -50°C Min consumption 3 kg/m ²	
Bonding material	Adhesive	N° 521	Min consumption 2.5 kg/m ² Last layer	
Sealant	Mastic	N° 530 or 531 or 532 or 533	Except 1st layer if temp. < -50°C Min consumption 3 kg/m ²	
Fixing		N° 579	Min 2 per segment	
Vapour barrier	Mastic	N° 590	Consumption 4 kg/m ² in 2 layers min	
	Linen cloth	N° 610	100 mm overlap minimum	
Spacer	Elastomer	N° 690	Thickness 19 mm min	
Jacketing material	Flat lacquered galvanised steel sheets		Quality Plastisol Finish/State 100/E Heads, shell 0.63 mm and covers	
Jacket fixing	Self-tapping screws		Stainless steel cheese-head self-tapping screws, dia 4.8 x 15.9 mm + neoprene spacers	Fixing sheets to sheets
	Straps		Stainless steel, 16 x 0.5 mm min	Retaining sheets (3)
Water-proofing sealants	Preformed cords	N° 534	Diameter according to swage	Applied continuously
	Silicon mastic in cartridges	N° 535		For sealing the finishing work

Note: (3) If necessary, retaining strap on elevated equipment or piping jacket sheets exposed to wind.



Appendix 2

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List of materials and accessories with codes

Material/Equipment	Form	Numbering
Insulations		
Expanded cellular glass	Panels, pipe sections or segments	31
Polyurethane foam (PUR)	Drum (injection)	35
Polyisocyanurate foam (PIR)	Panels, pipe sections or segments	36
Adhesives		
Two-part adhesive without solvent	Drum	520
Two-part adhesive with acetate solvent	Drum	521
Sealing mastic with aliphatic solvent	Drum	530
Sealing mastic with aromatic solvent	Drum	531
Sealing mastic with aliphatic solvent	Drum	532
Sealing mastic with aliphatic solvent	Drum	533
Anti-abrasive		
Anti-abrasive coating on cellular glass	Drum	500
Vapour barrier		
Jacket sealing mastic	Drum	580
Jacket sealing mastic	Drum	581
Jacket sealing mastic	Drum	590
Reinforcing fabric	Roll	610
Accessories		
Spacer	Tape	690
Insulating spacer	Plate	571
Supports	Steel section bar	573
Self-adhesive tape	Roll	579
Water-proofing sealants		
Sealant	Preformed cords	534
Silicon mastic	Cartridge	535

Thermal insulation material specifications N° 031

Insulating material: Expanded cellular glass			Form: Panels, pipe sections or segments			
Properties	Documents		Min/max values		Remarks	
	Reference	Appld				
Product						
Apparent density	Prod data sheet	*	T4: 120 kg/m ³ +/- 10%			
			S3: 135 kg/m ³ +/- 10%			
Percentage of cells closed	ASTM D 2856	*	100%			
	Prod data sheet					
Service temperature limits	Prod data sheet	*	- 260°C to 430°C		Specify service T°C	
Thermal conductivity	ASTM C 177	*	W/m°C			
	ASTM C 518	*	Tm° C		T4	S3
	Prod data sheet	*	-100	.	0.027	0.028
			0	.	0.041	0.043
			100	.	0.062	0.063
			200	.	0.087	0.090
			300	.	0.111	0.122
Response to flame	Decree dated 30/06/83 modified 28/08/91	*	M0			
	ASTM E 84					
Specific heat	Prod data sheet	*	0.20 Kcal/kg°C or 0.84 kJ/kg°C			
Water vapour permeability	ASTM E 96	*	None			
	Prod data sheet					
Water absorption	ASTM C 240		None, apart from temporary surface retention			
	Prod data sheet	*				
Coefficient of linear expansion	ISO 2896		9 x 10 ⁻⁶ /°C or 9 x 10 ⁻⁶ /°C			
	Prod data sheet	*				
Dimensional stability	ASTM D 2126					
	Prod data sheet	*	Perfect			
Compressive strength	ASTM C 240	*				
	ASTM C 165	*	T4: 7 kg/cm ²			
	Prod data sheet		S3: 9 kg/cm ²		Average value at break	
Flash point	ASTM C 240	*				
	ASTM C 165	*	T4: 4 kg/cm ²			
	Prod data sheet		S3: 5 kg/cm ²			
Resistance to chemical agents	Prod data sheet	*	All common acids except fluoric acid and strongly alkaline solutions			

Thermal insulation material specifications N° 035

Insulating material: Polyurethane foam (PUR)			Form: Drum		
Properties	Documents		Min/max values		Remarks
	Reference	Appld			
Product			Liquid foam to be injected		
Apparent density	ASTM D 1622	*	50 kg/m³ min		
	ISO 845	*			
	Prod data sheet	*			
Percentage of cells closed	ASTM D 2856	*	90 to 95%		
	Prod data sheet				
Service temperature limits	Prod data sheet	*	-170 to 100°C		
Thermal conductivity	ASTM C 177	*	Ti°C	W/m°C	Ti°C = fluid temperature
		*	-165	0.015	
	Prod data sheet	*	-70	0.023	
			0	0.020	
			50	0.024	
Response to flame	Decree dated 30/06/83 modified 28/08/91	*	M1		
	ASTM E 84				
Specific heat	Prod data sheet	*	5500 Cal/kg		
Water vapour permeability	ASTM E 96		30 to 20 g/m²/24 h		
	ISO R 1663				
Water absorption	ASTM D 2842		5% by volume		
	ISO DIS 2896	*			
	Prod data sheet				
Coefficient of linear expansion	ASTM D 196	*	70 * 10 ⁻⁶ m/m°C		
	ASTM C 696	*			
	Prod data sheet				
Dimensional stability	ASTM D 2126				
	Prod data sheet				
Compressive strength	ASTM D 1621		190 to 350 Kpa		
	DIN 52421	*			
	Prod data sheet				
Flash point	ASTM C 203		200 to 550 Kpa		
	DIN 53423	*			
	Prod data sheet				
Resistance to chemical agents	ASTM C 871		Excellent resistance except to concentrated acids and methanol		
	Prod data sheet	*			

Note: To be used only for locally filling of valve boxes or similar.

Thermal insulation material specifications N° 036

Insulating material: Polyisocyanurate foam (PIR)			Form: Panels, pipe sections or segments	
Properties	Documents		Min/max values	Remarks
	Reference	Appld		
Product			Expanded foam using FORANE 141 B	
Apparent density	ASTM D 1622	*	50 kg/m ³ min up to 120 kg/ m ³	
	ISO 845	*		
	Prod data sheet	*		
Percentage of cells closed	ASTM D 2856	*	90 to 95%	
	Prod data sheet			
Service temperature limits	Prod data sheet	*	-170 to 100°C	
Thermal conductivity (material aged at least one month)	ASTM C 177	*	Ti°C	W/m°C
		*	-165	0.015
	Prod data sheet	*	-70	0.023
			0	0.020
			50	0.024
Response to flame	Decree dated 30/06/83 modified 28/08/91	*	M1	
	ASTM E 84			
Specific heat	Prod data sheet	*	0.40 Kcal/kg°C	
Water vapour permeability	ASTM E 96		30 to 25 g/m ² /24 h	
	ISO R 1663			
Water absorption	ASTM D 2842		5% by volume	
	ISO DIS 2896	*		
	Prod data sheet			
Coefficient of linear expansion	ISO 2896	*	130 to 70 * 10 ⁻⁶ m/m°C	
	Prod data sheet			
Dimensional stability	ASTM D 2126		24h/100°C ± 1	
	Prod data sheet	*	24h/-15°C -0.2 to +0.8	
			24h/70°C 95% HR +1 to +2	
Compressive strength	ISO 844	*	350 to 380 kPa	
	Prod data sheet			
Flash point	ISO 1209	*	500 to 600 kPa	
	Prod data sheet			
Resistance to chemical agents	ASTM C 871		Excellent resistance except to concentrated H ₂ SO ₄ , methylene, acetone and methanol	
	Prod data sheet	*		

Note: Material aged at least one month.



Thermal insulation material specifications N° 520

Adhesive: Two-part adhesive			Form: Drum	
Properties	Documents		Min/max values	Remarks
	Reference	Appld		
Apparent density	Prod data sheet	*	1.31 to 1.40 ± 0.03 kg/l	
Dry extract	Prod data sheet	*	100%	
Solvent type	Prod data sheet	*	No solvent	
Service temperature limits	Prod data sheet	*	-70 to 150°C	
Response to flame	Decree dated 30/06/83 modified 28/08/91	*	Inflammable	
Dry film thickness	Prod data sheet	*	2 to 2.2 mm	
Water vapour transmission			0.5 to 2g/m ² /24h for 2 to 2.2 mm dry film	
	Method B	*		
Water vapour permeability			0.007 g/m ² /24h/cm/mmHG	
	ASTM E 96			
	Method E	*		
Resistance to hydrocarbons, oils and greases			Good	
		*		
Flash point	Part A Prod data sheet	*	Greater than 105°C	
	Part B Prod data sheet	*	Greater than 200°C	
	Mixture		Greater than 105°C	
Application delay	Prod data sheet		Approximately 45 minutes "effective application time"	
		*		

Note: ENDOPRENE 888/01 adhesive 81.82 or equivalent.



Thermal insulation material specifications N° 521

Adhesive: Two-part adhesive			Form: Drum	
Properties	Documents		Min/max values	Remarks
	Reference	Appld		
Apparent density	Prod data sheet	*	1.31 to 1.40 ± 0.03 kg/l	
Dry extract	Prod data sheet	*	93 to 95%	
Solvent type	Prod data sheet	*	Acetates	
Service temperature limits	Prod data sheet	*	-70 to 150°C	
Response to flame	Decree dated 30/06/83 modified 28/08/91	*	Inflammable	
Dry film thickness	Prod data sheet	*	2 to 2.2 mm	
Water vapour transmission			0.5 to 2g/m ² /24h for 2 to 2.2 mm dry film	
	Method B	*		
Water vapour permeability	ASTM E 96		0.007 g/m ² /24h/cm/mmHG	
	Method E	*		
Resistance to hydrocarbons, oils and greases			Good	
		*		
Flash point	Part A Prod data sheet	*	Greater than 105°C	
	Part B Prod data sheet	*	Greater than -2°C	
	Mixture		Greater than 33°C	
Application delay			Approximately 4 hours "effective application time"	
	Prod data sheet	*		

Note: ENDOPRENE 888/00 adhesive 81.80 or equivalent.



Thermal insulation material specifications N° 530

Adhesive: Sealing mastic			Form: Drum	
Properties	Documents		Min/max values	Remarks
	Reference	Appld		
Apparent density	Prod data sheet	*	1.38 to $\pm$ 0.05 g/ml	
Dry extract	Prod data sheet	*	93% to $\pm$ 2%	
Solvent type			Aliphatic	Compatibility on anti-corrosion coating to be verified
	Prod data sheet	*		
Service temperature limits	Prod data sheet	*	-80 to 100°C	
Response to flame	LCCP report		M2	
Dry film thickness	Prod data sheet	*	2 mm	
Water vapour transmission	ISO 2528		1.07 g/m ² /24 h for 2 mm dry film	
	Method B			
Resistance to hydrocarbons, oils and greases				

Note: Mastic 886/05 type product.

If covered with MONOLAR, use product data sheet N° 531.



Thermal insulation material specifications N° 532

Adhesive: Sealing mastic			Form: Drum	
Properties	Documents		Min/max values	Remarks
	Reference	Appld		
Apparent density	Prod data sheet	*	1.40 to $\pm$ 0.05 g/ml	
Dry extract	Prod data sheet	*	97% to $\pm$ 1%	
Solvent type				Compatibility on anti-corrosion coating to be verified
	Prod data sheet	*		
Service temperature limits	Prod data sheet	*	-80 to 120°C	
Response to flame	Decree dated 30/06/83 modified 28/08/91	*	M4	
Dry film thickness	Prod data sheet	*	2 mm	
Water vapour transmission	ISO 2528	*		
Resistance to hydrocarbons, oils and greases				

Note: Mastic 30.45 type product.

If covered with MONOLAR, use product data sheet N° 531.



Thermal insulation material specifications N° 533

Adhesive: Sealing mastic			Form: Drum	
Properties	Documents		Min/max values	Remarks
	Reference	Appld		
Apparent density	Prod data sheet	*	1.40 to ± 0.05 g/ml	
Dry extract	Prod data sheet	*	90%	
Solvent type			Aliphatic	Compatibility on anti-corrosion coating to be verified
	Prod data sheet	*		
Service temperature limits	Prod data sheet	*	-80 to 100°C	
Response to flame	LCCP report		M1	
Dry film thickness	Prod data sheet	*	2 mm	
Water vapour transmission	ISO 2528		1.07 g/m ² /24 h for 2 mm dry film	
	Method B			
Resistance to hydrocarbons, oils and greases				

Note: Mastic 886/06 type product.

If covered with MONOLAR, use product data sheet N° 531.



Thermal insulation material specifications N° 531

Adhesive: Sealing mastic			Form: Drum	
Properties	Documents		Min/max values	Remarks
	Reference	Appld		
Apparent density	Prod data sheet	*	1.52 to ± 0.06 kg/l	
Dry extract	Prod data sheet	*	92%	
Solvent type	Prod data sheet	*	Aromatic	Compatibility on anti-corrosion coating to be verified
Service temperature limits	Prod data sheet	*	-130°C to +70°C	
Response to flame	Decree dated 30/06/83 modified 28/08/91	*	Inflammable	
Dry film thickness	Prod data sheet	*	1.8 mm	
Water vapour transmission	Method B		1.3 to 0.3 g/m ² /24 h for 1.8 mm dry film	
Water vapour permeability	ASTM E 96	*		
	Method E			
Resistance to hydrocarbons, oils and greases				
Flash point	Prod data sheet	*	Approximately 51°C	

Note: FLEXTRA 95.50 type mastic product must be used if covering a MONOLAR type vapour barrier.



Thermal insulation material specifications N° 500

Anti-abrasive material: Anti-abrasive coated on cellular glass			Form: Drum	
Properties	Documents		Min/max values	Remarks
	Reference	Appld		
Apparent density	Prod data sheet	*	1.66 to 1.80 ± 0.05 kg/l	
Dry extract	Prod data sheet	*	53 to 64%	
Solvent type	Prod data sheet	*	Aromatic	
Service temperature limits			-200 to +120°C	For temperature more than 120°C use adapted antiabrasive*
	Prod data sheet	*		
Response to flame	Decree dated 30/06/83 modified 28/08/91	*	M1	
Flash point	Prod data sheet	*	Below 5°C	

Note: Anti-abrasion product 886/10, 30.16 or similar, to be applied to the surface of the cellular glass in contact with the vessel or piping.

Apply insulation after the anti-abrasive mastic has hardened.

This product must not be used if the layer concerned is bonded.

*For temperature between -80°C to +250°C a product type HTAA (M0) of Pittsburgh Corning or equivalent could be used.



Thermal insulation material specifications N° 580

Vapour barrier material: Jacket sealing mastic			Form: Drum	
Properties	Documents		Min/max values	Remarks
	Reference	Appld		
Apparent density	Prod data sheet	*	1.10 approx. at 20°C	
Dry extract	Prod data sheet	*	30% +/- 2% by volume	
Solvent type			Aliphatic and/or aromatic	
	Prod data sheet	*		
Service temperature limits	Prod data sheet	*	-30 to 120°C	
Response to flame	LNE report N° 601979		M1	
	LCPP			
Water vapour transmission	NF H 00-030		0.2 g/m ² /24 h for 1.15 mm dry film	
	Method B			
Water vapour permeability	ASTM E 96		0.00134 g/m ² /h/mmHg	
	Method E			
Resistance to hydrocarbons, oils and greases			Good	
Weather resistance			Excellent	
Dry film thickness	Prod data sheet	*	1.15 mm	

Note: MONOLAR or similar type product, to be used as vapour barrier if there is no jacketing sheet.



Thermal insulation material specifications N° 581

Vapour barrier material: Jacket sealing mastic			Form: Drum
Properties	Documents		Requirements
	Reference	Appld	
Product			Mastic thinned with solvent for finishing
Dry extract	Volume	ISO 2811	1.23 ± 0.05 (kg/l) Manual
	Weight	Prod data sheet	1.26 ± 0.05 (kg/l) Airless 50%
Solvent type	Prod data sheet	*	
Service temperature limits	Prod data sheet	*	- 40 to +80°C
Response to flame	Deptl decree	*	M1 (non inflammable)
Water vapour transmission	ISO 2528		< 0.32 g/m²/24 h for 1.5 mm dry film
	Prod data sheet		
	LNE report N° 606 0037		
Water vapour permeability	Prod data sheet		0.000623 g/m²/h/mmHg
Resistance to hydrocarbons, oils and greases		*	

Note: HYPALKOTE or similar type product, to be used as vapour barrier when there is no jacketing sheet.



Thermal insulation material specifications N° 590

Vapour barrier material: Jacket sealing mastic			Form: Drum	
Properties	Documents		Min/max values	Remarks
	Reference	Appld		
Apparent density	Prod data sheet	*	1.20 approx. at 20°C	
Dry extract	Prod data sheet	*	51 to 60% ± 2% "Manual"	
			51 to 60% ± 2% "Airless"	
Solvent type			Aliphatic and/or aromatic	
	Prod data sheet	*		
Service temperature limits	Prod data sheet	*	-40 to 100°C	
Response to flame	Decree dated 30/06/83 modified 28/08/91	*	M1	
	LCPP			
Water vapour transmission		*	0.2 to 0.5 g/m ² /24 h for 2 to 2.7 mm	
	Method B			
Water vapour permeability	ASTM E 96	*	0.0009 g/m ² /24h/cm/mmHg	
	Method E			
Resistance to non-oxidizing mineral dilute acids and bases		*	Good	
Weather resistance		*	Good	
Dry film thickness	Prod data sheet	*	2 to 2.7 mm	
Flash point	Prod data sheet	*	33 to 38°C approx.	

Note: ISOLARM IGN 671/65, mastic C.I 65.05 type product or equivalent, to be used if non-UV stable sheet steel jacketing is planned, otherwise use product data sheet 580 or 581.



Thermal insulation material specifications N° 610

Vapour barrier material: Reinforcing fabric			Form: Roll	
Properties	Documents		Min/max values	Remarks
	Reference	Appld		
Composition	Prod data sheet	*	Woven glass fibre fabric	
Weight per m ²	Prod data sheet	*	57 grammes/m ²	
Thickness	Prod data sheet	*	20/100 mm	
Weft	Prod data sheet	*	3.7 filaments/cm	
Response to flame	Decree dated 30/06/83 modified 28/08/91	*	M0	
Warp	Prod data sheet	*	2 x 3.7 filaments/cm	
Tearing strength	Prod data sheet	*		
	Warp		50 kg/5 cm	
	Weft		50 kg/5 cm	

Note: Product type 557 Fix 15 HEXCEL GENIN or similar.



Thermal insulation material specifications N° 690

Jacketing material: Self-adhesive elastomeric spacer			Form: Roll	
Properties	Documents		Min/max values	Remarks
	Reference	Appld		
Product		*	Flexible elastomer foam with adhesive surface	
Compressibility under load		*	25% distortion under 15 daN/dm ²	
	Prod data sheet			
Response to flame	LNE report N° 487/331.01	*	M1	
	Prod data sheet			
Water absorption	Prod data sheet	*	< 15% by volume	
Service temperature limits	DIN 267		-40 to +90°C	
	Prod data sheet	*		
Section	Prod data sheet	*	19 x 25 mm	
Chemical resistance	Prod data sheet		Insensitive to most chemical agents	



Thermal insulation material specifications N° 571

Fixing material: Insulating block			Form: Sheet	
Properties	Documents		Min/max values	Remarks
	Reference	Appld		
Product	Prod data sheet	*	Reticulated PVC	
Service temperature	Prod data sheet	*	Min -200° - Max +70°	
Apparent density	ISO 845	*	130 kg/m ³	
Compressive stress	ISO 844	*	3 Mpa	
Response to flame	Decree dated 30/06/83 modified 28/08/91	*	M1	

Product	Prod data sheet	*	BAKELISED wood	
Service temperature	Prod data sheet	*	Min -200° - Max +100°	
Density	Prod data sheet	*	1360 kg/m ³	
Compressive stress	ISO 844	*	260 Mpa	
Response to flame	Decree dated 30/06/83 modified 28/08/91	*	M4	

Product	Prod data sheet	*	Rigid polyurethane foam	
Service temperature	Prod data sheet	*	Min -200° - Max +70°	
Apparent density	ISO 845	*	240 kg/m ³	
Compressive stress	ISO 844	*	3.5 Mpa	
Response to flame	Decree dated 30/06/83 modified 28/08/91	*	M4	



Thermal insulation material specifications N° 573

Fixing material: Supports			Form: Steel section bar	
Properties	Documents		Min/max values	Remarks
	Reference	Appld		
Product	Prod data sheet	*	1 - Galvanised steel e 24-2	
Galvanisation			Rich class C	
Width	Prod data sheet	*	30 to 60 mm	
Thickness	Prod data sheet	*	3 to 6 mm	

Note:



Thermal insulation material specifications N° 579

Accessory: Self-adhesive tape			Form: Roll	
Properties	Documents		Min/max values	Remarks
	Reference	Appld		
Composition	Prod data sheet	*	Weft and warp glass fibre reinforced polypropylene film	
Support thickness	Prod data sheet	*	35 microns	
Adhesive	Prod data sheet	*	Hot melt	
Adhesion	Prod data sheet	*	1500 g/cm	
Breaking load	Prod data sheet	*	28 kg/cm	
Service temperature limits	Prod data sheet	*	80°C	
Width	Prod data sheet	*	50 mm	

Note:



Thermal insulation material specifications N° 534

Sealing material: Sealant			Form: Preformed cords	
Properties	Documents		Min/max values	Remarks
	Reference	Appld		
Product			Silicon	
Dry extract: volume	Prod data sheet	*	36 to 52% $\pm$ 2%	
Service temperature limits	Prod data sheet	*	-40 to 120°C	
Adhesion	Prod data sheet	*	1500 g/cm	
Response to flame	Decree dated 30/06/83 modified 28/08/91		M1	
Water vapour transmission	Method B	*	0.98 g/m ² /24 h for 1 mm	
Water vapour permeability	ASTM E 96	*	0.002 g/m ² /24h/cm/mmHg	
	Method E			
Resistance to hydrocarbons, oils and greases				
		*		

Note:



Thermal insulation material specifications N° 535

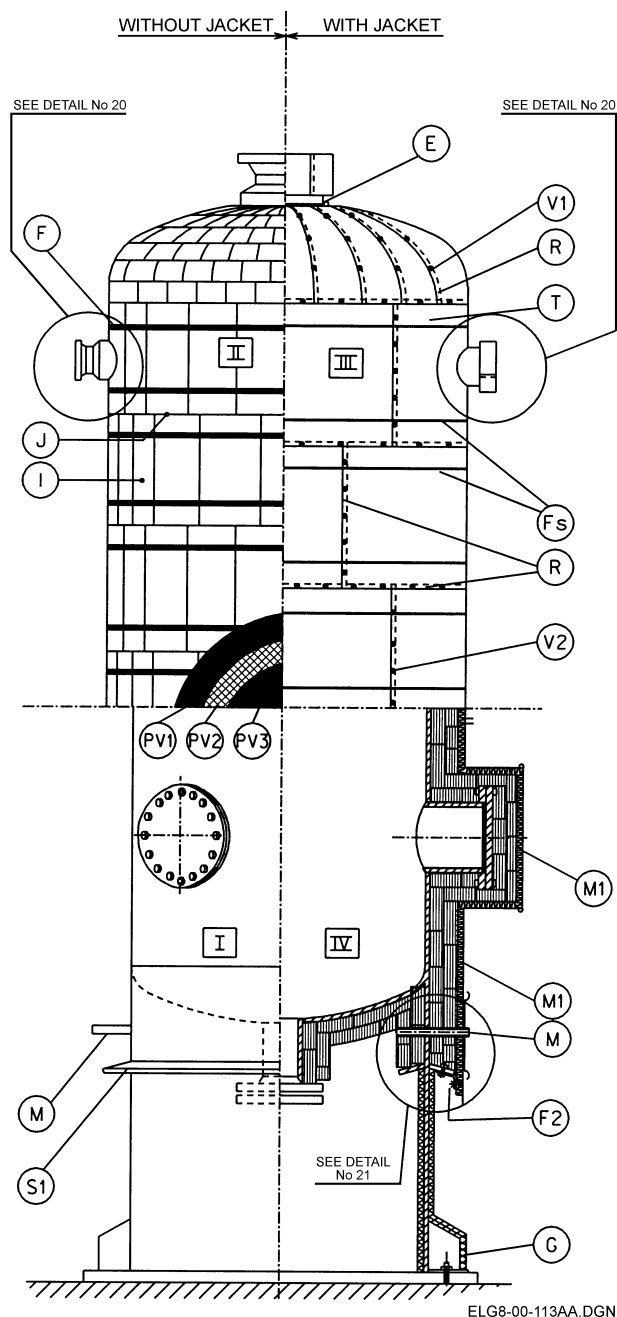
Sealing material: Neutral silicon mastic			Form: Cartridge	
Properties	Documents		Min/max values	Remarks
	Reference	Appld		
Product			Silicon	
Dry extract: volume	Prod data sheet	*	95 to 97%	
Solvent type	Prod data sheet	*	Aliphatic and/or aromatic	
Service temperature limits	Prod data sheet	*	-60 to 250°C	
Response to flame	Decree dated 30/06/83 modified 28/08/91		M1	
Water vapour transmission		*	0.98 g/m ² /24 h for 1 mm	
Water vapour permeability	ASTM E 96	*	0.002 g/m ² /24h/cm/mmHg	
	Method E			
Resistance to hydrocarbons, oils and greases				
		*		
Flash point	Prod data sheet	*	38°C approx.	

Note:



Appendix 3

Principles of assembly no. 01 – Vertical vessel on skirt (all Ø).....	50
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I Preparation of pressure vessel

(GS PVV 211 and/or GS PVV 212)

M = Vent for skirt

S1 = Internal and external terminations

II Fitting insulation/Vapour barrier

I = Insulation in segment or pipe section form (double layer for thicknesses ≥ 80 mm)

J = Lap jointing mastic

F = Adhesive tape binding if necessary (minimum 2 per segment)

PV1 = First layer of mastic-bonding

PV2 = Reinforcing fabric

PV3 = Second layer of mastic-smoothing

III Fitting protective Jacketing, Finishing

E = Termination

Fs = Safety strap (for all vessels) minimum two per sheet

R = Overlap (mini 30 mm) with mastic sealant for vertical swage

T = Jacket sheet with swage

V1 = Screw fixing sheet to sheet

V2 = Screw fixing sheets to steel frame (to be applied in area of overlap if possible)

IV Cross-section

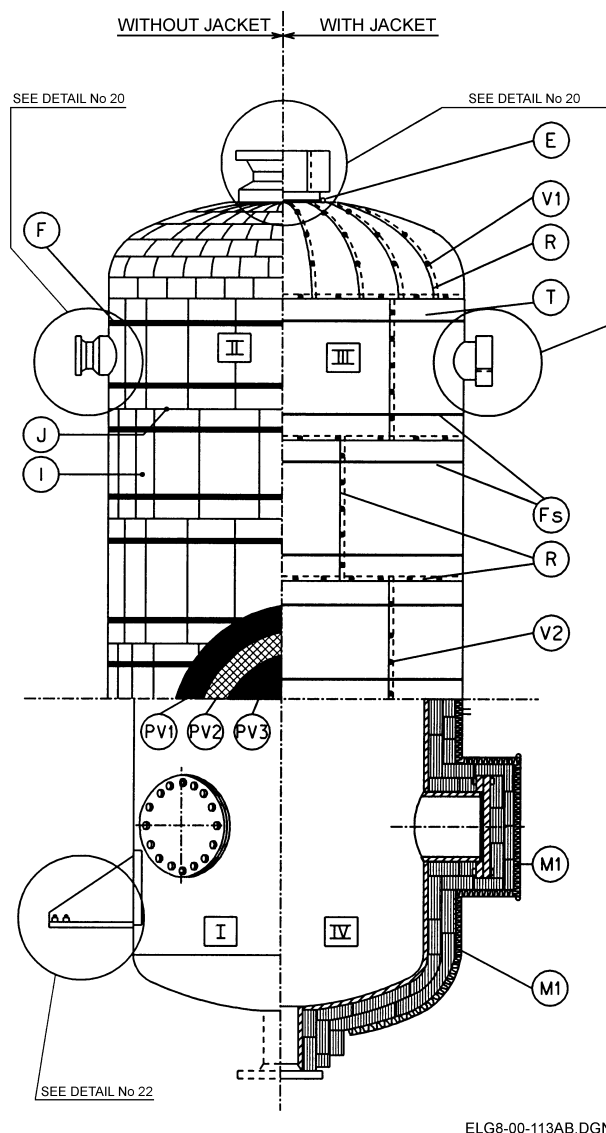
F2 = Anti-corrosion treated binding or flat iron, boiled at C4

M1 = Spacer Providing physical protection of vapour barrier

Variant

G = Fireproofing

Principles of assembly no. 01 – Vertical vessel on skirt (all Ø)



I Preparation of pressure vessel

(GS PVV 211 and/or GS PVV 212)

II Fitting insulation/Vapour barrier

I = Insulation in segment or pipe section form (double layer for thicknesses ≥ 80 mm)
 J = Lap or staggered jointing mastic
 F = Adhesive tape binding if necessary (minimum 2 per segment)
 PV1 = First layer of mastic-bonding
 PV2 = Reinforcing fabric
 PV3 = Second layer of mastic-smoothing

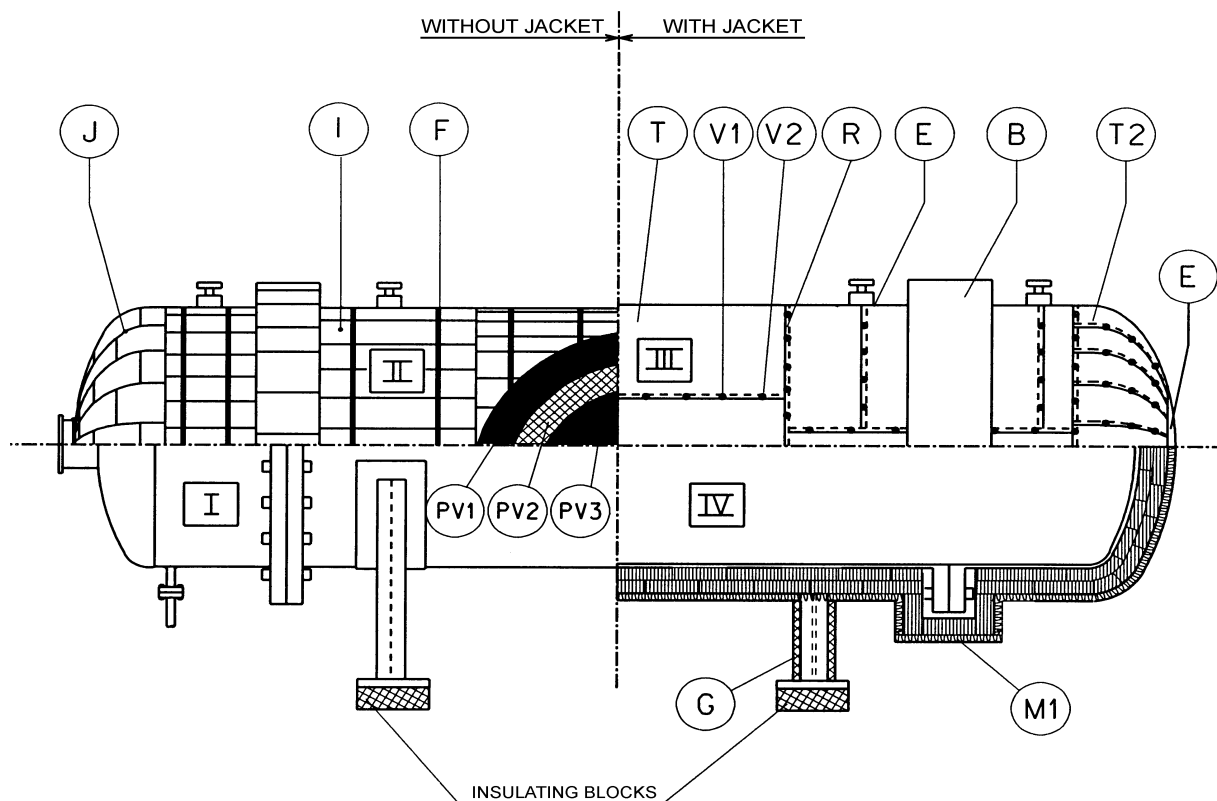
III Fitting protective Jacketing, Finishing

E = Termination
 Fs = Safety strap (for all vessels) minimum two per sheet
 R = Overlap (mini 30 mm) with mastic sealant for vertical swage
 T = Jacket sheet with swage
 V1 = Screw fixing sheet to sheet
 V2 = Screw fixing to steel frame to be applied where necessary for large capacity tanks

IV Cross-section

M1 = Spacer providing physical protection of vapour barrier

Principles of assembly no. 02 – Vertical vessel on lateral support (all Ø)



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I Preparation of pressure vessel

(GS PVV 211 and/or GS PVV 212)

II Fitting insulation/Vapour barrier

I = Insulation in segment or pipe section form (double layer for thicknesses $\geq$ 80 mm)

J = Lap jointing mastic

F = Adhesive tape binding if necessary (minimum 2 per segment)

PV1 = First layer of mastic-bonding

PV2 = Reinforcing fabric

PV3 = Second layer of mastic-smoothing

III Fitting protective Jacketing, Finishing

B = Sheet steel cover

E = Termination

R = Overlap (mini 30 mm) with jointing mastic for vertical swage

T = Jacket sheet with swage

V1 = Screw fixing sheet to sheet

V2 = Screw fixing to steel frame to be applied where necessary for large capacity tanks

T2 = Flat sheet with flat swage and continuous silicon seal:

- head made up of segments for ext $\varnothing < 1000$ mm

- shaped or conical head allowing for ext $\varnothing < 1000$ mm

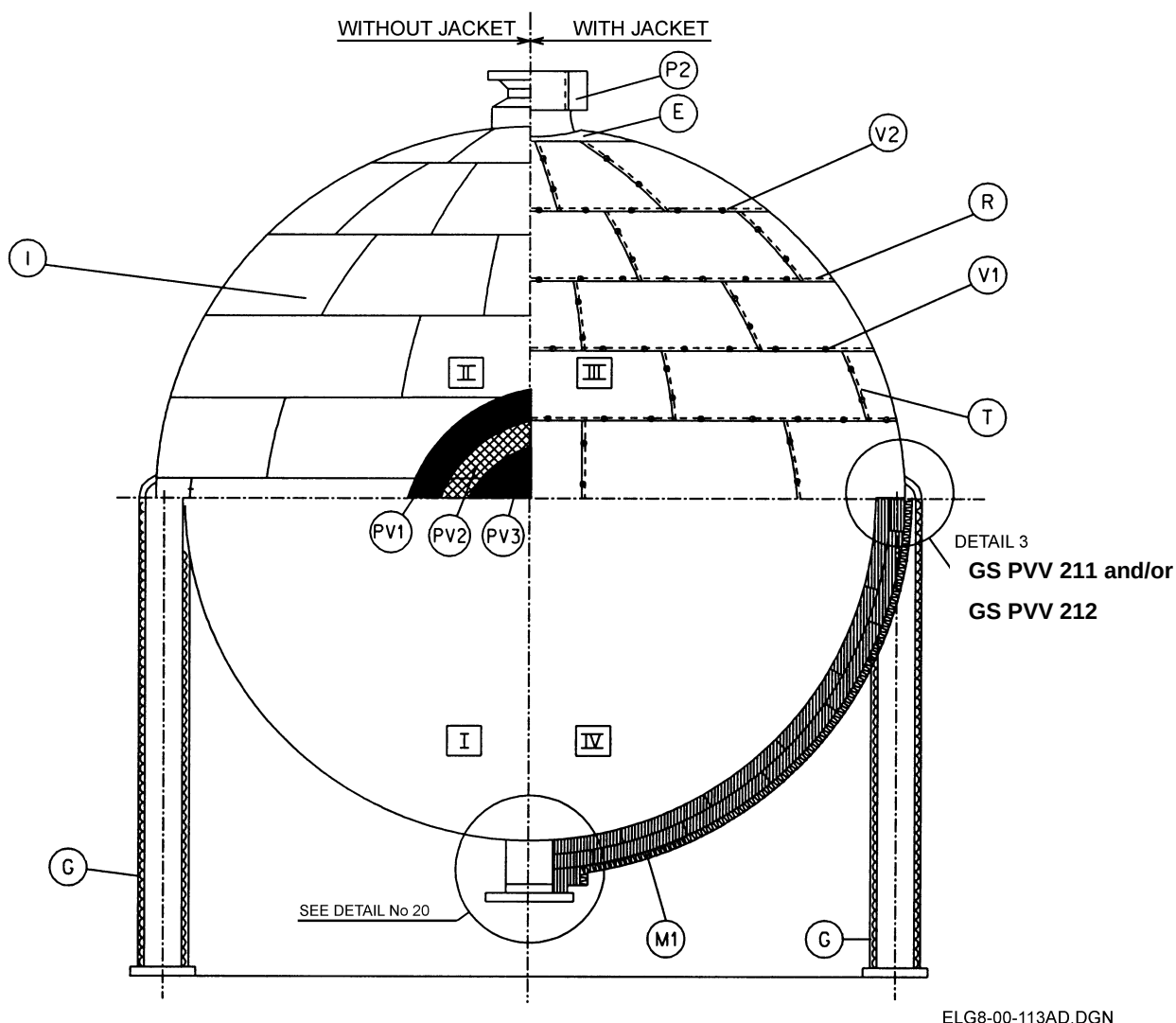
IV Cross-section

M1 = Spacer providing physical protection of vapour barrier

Variant

G = Fireproofing

Principles of assembly no. 03 – Horizontal vessel on saddles (all $\varnothing$)



I Preparation of pressure vessel

(GS PVV 211 and/or GS PVV 212)

II Fitting insulation/Vapour barrier

I = Insulation in segment or pipe section form (double layer for thicknesses ≥ 80 mm)
 J = Lap jointing mastic
 F = Adhesive tape binding if necessary (minimum 2 per segment)
 PV1 = First layer of mastic-bonding
 PV2 = Reinforcing fabric
 PV3 = Second layer of mastic-smoothing

Variant

G = Fireproofing

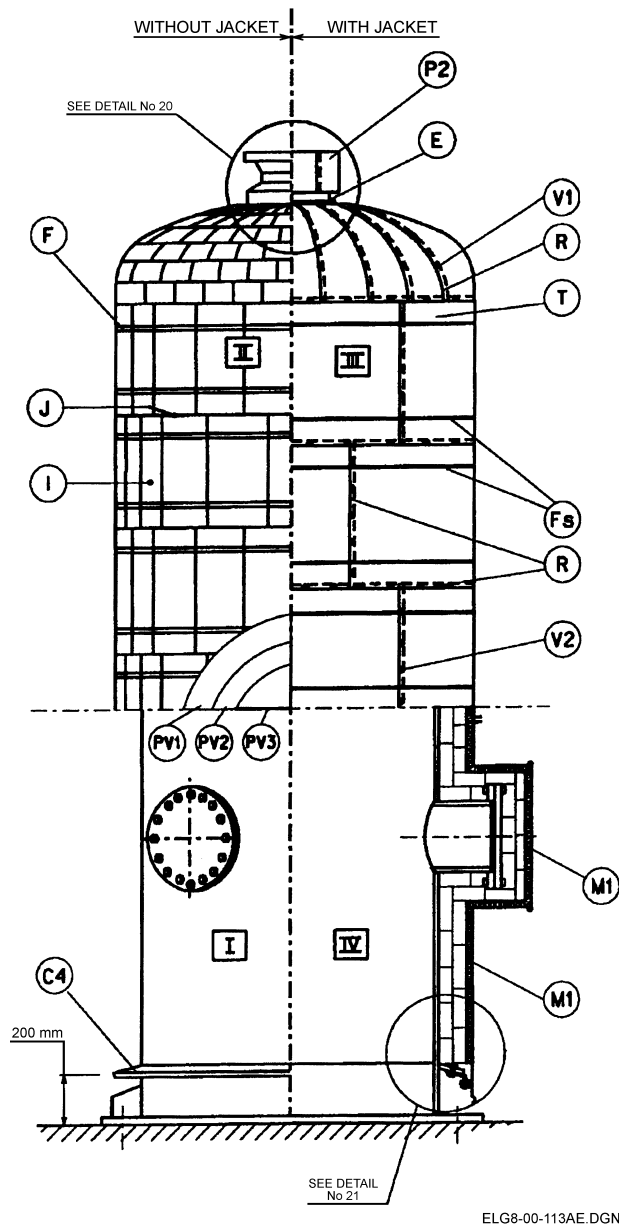
III Fitting protective Jacketing, Finishing

E = Finition
 R = Overlap (mini 30 mm) with jointing mastic for vertical swage
 T = Jacket sheet with swage
 V1 = Screw fixing sheet to sheet
 V2 = Screw fixing to steel frame to be applied where necessary for large capacity tanks

IV Cross-section

M1 = Spacer providing physical protection of vapour barrier
 P2 = Manhole casing

Principles of assembly no. 04 – Spherical vessel on legs



I Preparation of pressure vessel

(GS PVV 211 and/or GS PVV 212)

C4 = Termination

II Fitting insulation/Vapour barrier

I = Insulation in segment or pipe section form (double layer for thicknesses ≥ 80 mm)

J = Lap jointing mastic

F = Retaining adhesive binding if necessary (minimum 2 per segment)

PV1 = First layer of mastic-bonding

PV2 = Reinforcing fabric

PV3 = Second layer of mastic-smoothing

III Fitting protective Jacketing, Finishing

E = Termination

Fs = Safety strap (for all vessels) minimum to per sheet

R = Overlap (mini 30 mm) with jointing mastic for vertical swage

T = Jacket sheet with swage

V1 = Screw fixing sheet to sheet

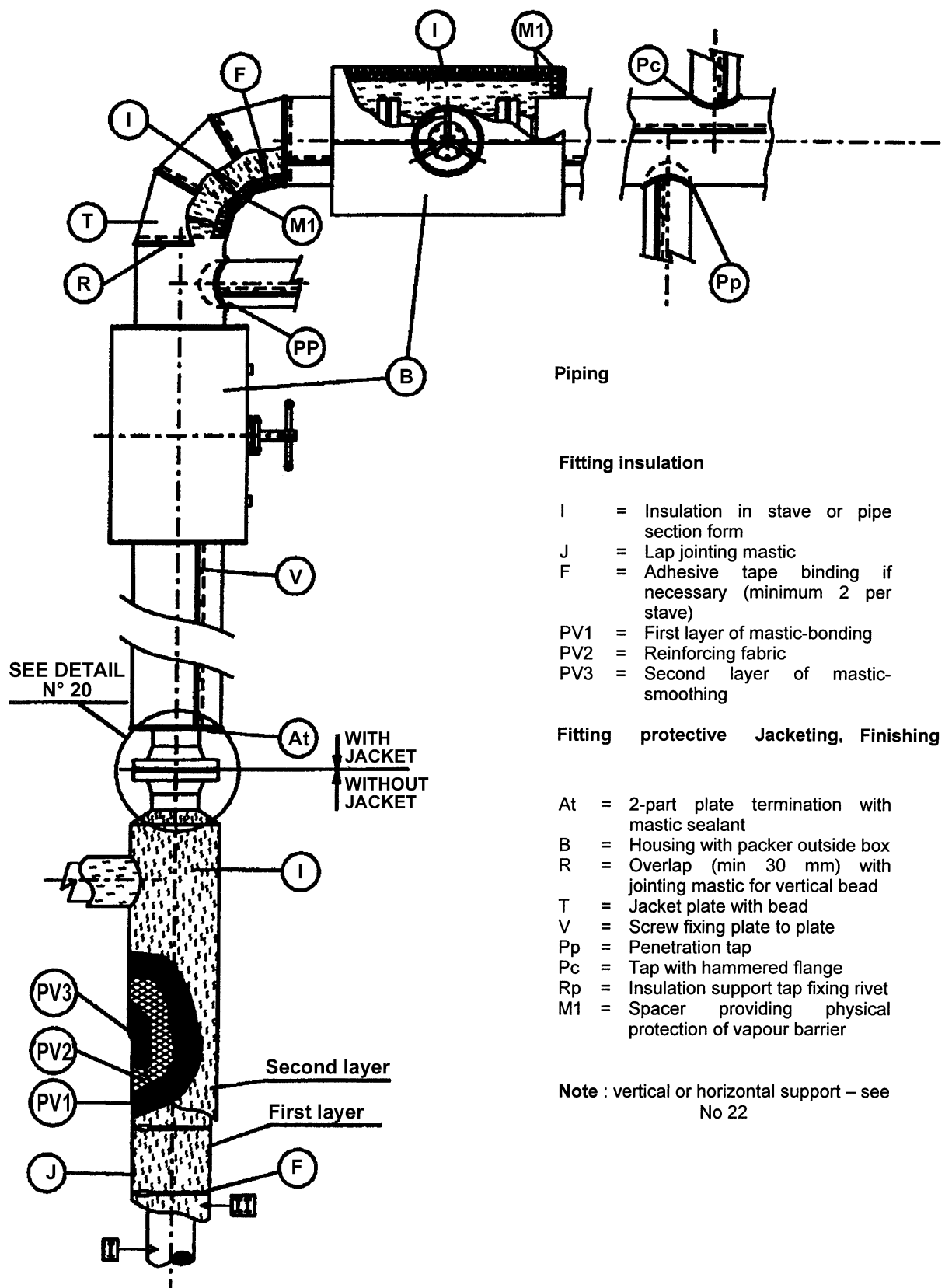
V2 = Screw fixing to steel to be applied where necessary for large capacity tanks

IV Cross-section

M1 = Spacer providing physical protection of vapour barrier

P2 = Manhole casing

Principles of assembly no. 05 – Flat bottomed storage vessel



Piping

Fitting insulation

- I = Insulation in stave or pipe section form
- J = Lap jointing mastic
- F = Adhesive tape binding if necessary (minimum 2 per stave)
- PV1 = First layer of mastic-bonding
- PV2 = Reinforcing fabric
- PV3 = Second layer of mastic-smoothing

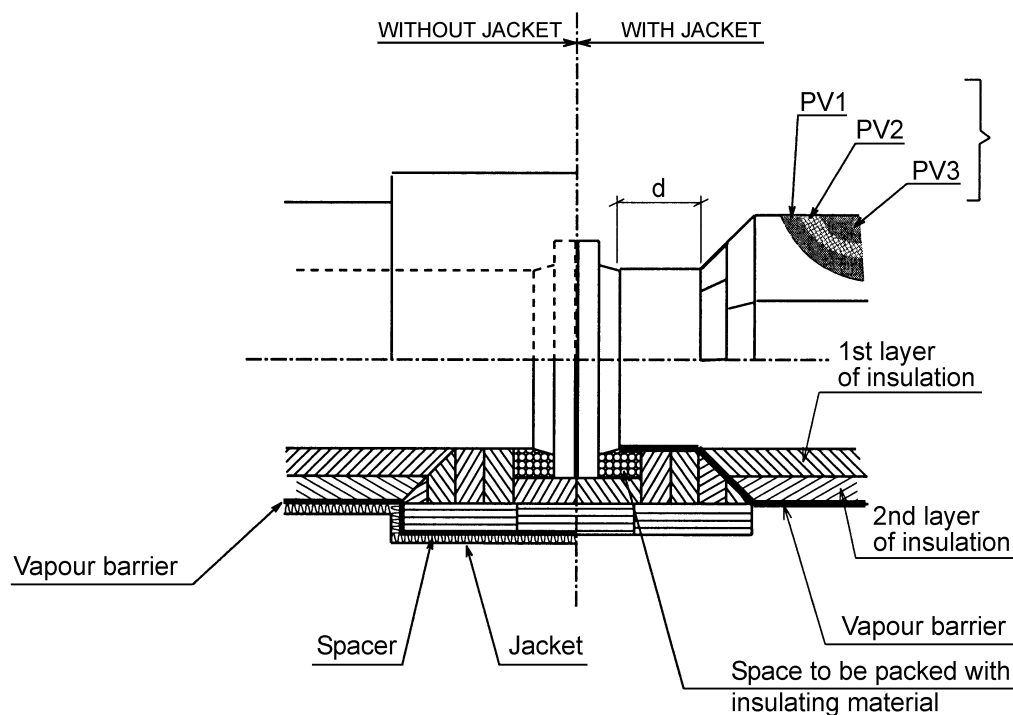
Fitting protective Jacketing, Finishing

- At = 2-part plate termination with mastic sealant
- B = Housing with packer outside box
- R = Overlap (min 30 mm) with jointing mastic for vertical bead
- T = Jacket plate with bead
- V = Screw fixing plate to plate
- Pp = Penetration tap
- Pc = Tap with hammered flange
- Rp = Insulation support tap fixing rivet
- M1 = Spacer providing physical protection of vapour barrier

Note : vertical or horizontal support – see No 22

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Principles of assembly no. 06 – Piping



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d = minimum distance for removing bolts
 PV1 = 1st keying mastic layer
 PV2 = reinforcing fabric
 PV3 = 2nd finishing mastic layer

Principles of assembly no. 20 – Lagged piping

A – Insulated tank

Supplied by
Insulation contractor :

Cold insulation

M8 bolt

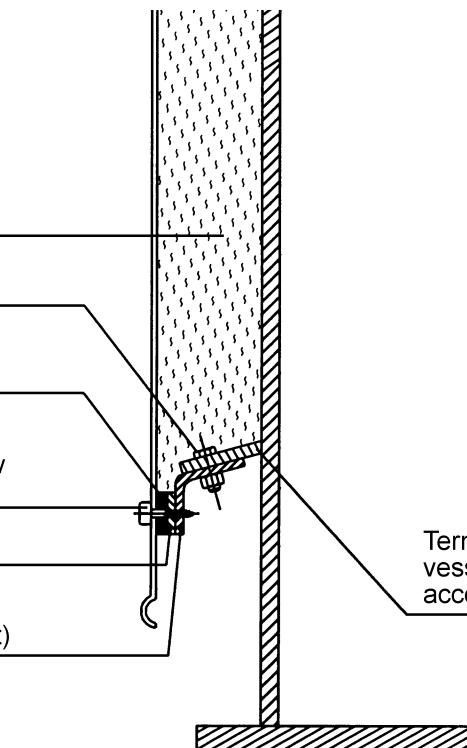
Insulating block 50 x 50 x 5
or continuous 50 x 5

Hex headed thread-forming screw
M6.3 x 19 mm

Continuous flat bar 50 x 5

Flat bar 50 x 5
Every 500 mm maximum (bracket)

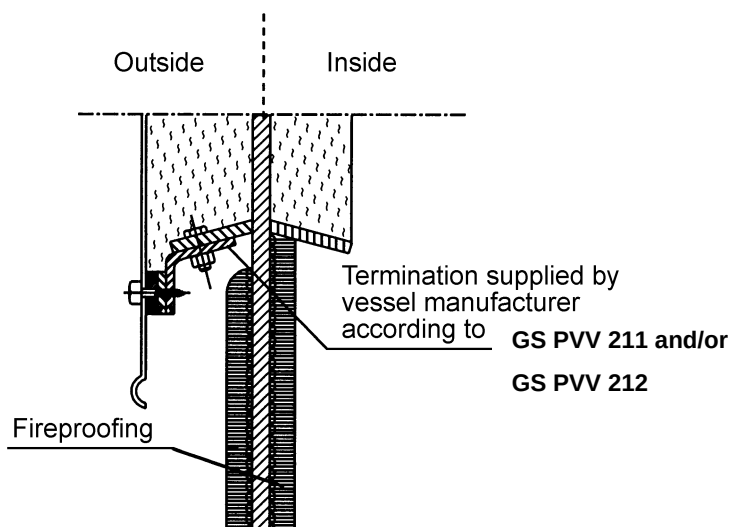
Termination supplied by
vessel manufacturer
according to **GS PVV 211 and/or
GS PVV 212**



B – Fireproofed skirt

Shell not fireproofed

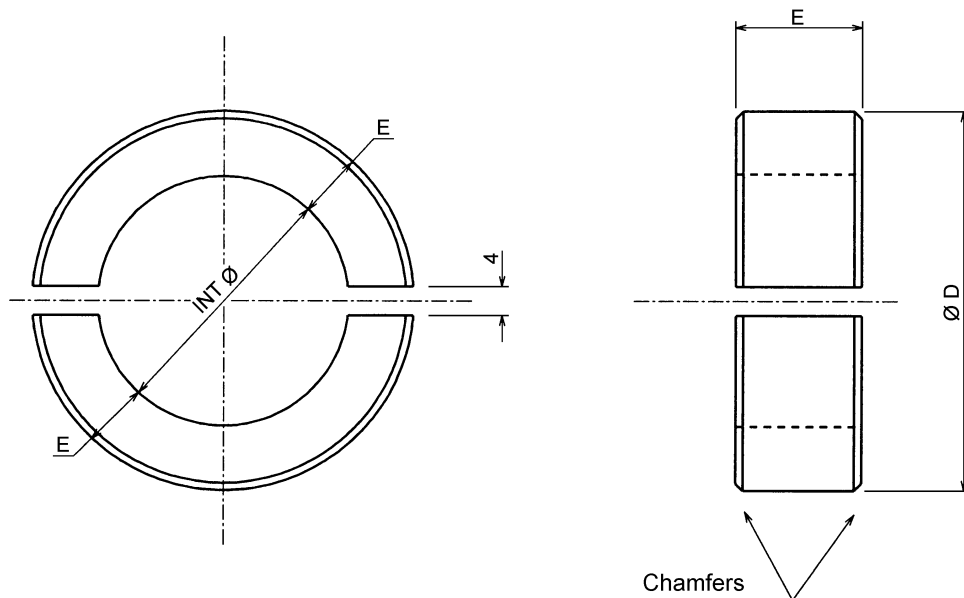
Outside Inside



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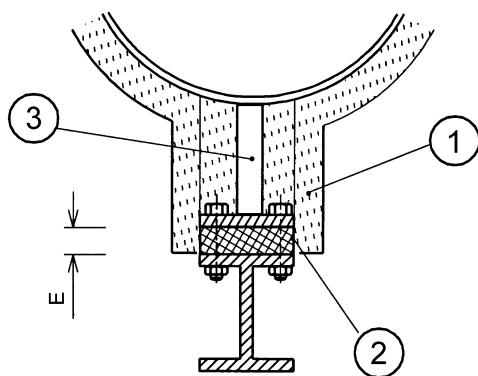
Principles of assembly no. 21 – Insulation on base deflector (on termination)

A – Sliding support

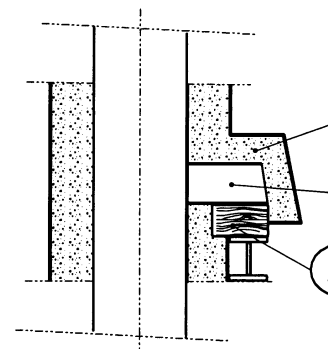


E = Minimum piping insulation thickness
 Materials: minimum 90 kg/m³ PVC foam
 minimum 120 kg/ m³ polysocyanurate foam
 bakelised wood

B – Vessel fixing or support points



- ① Cold insulation
- ② Insulating block
- ③ Steel support

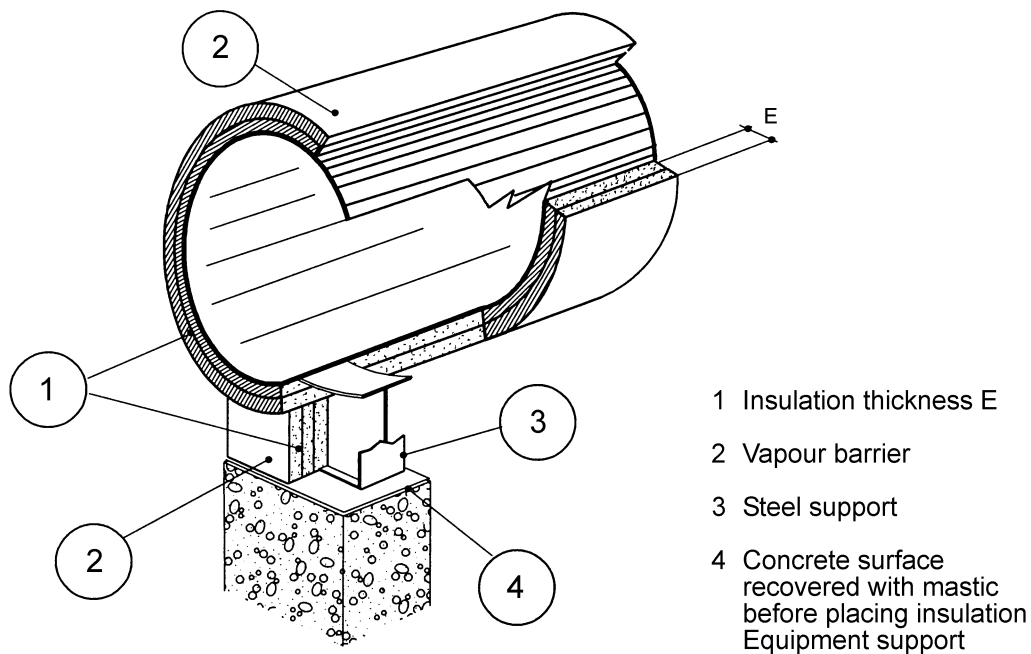


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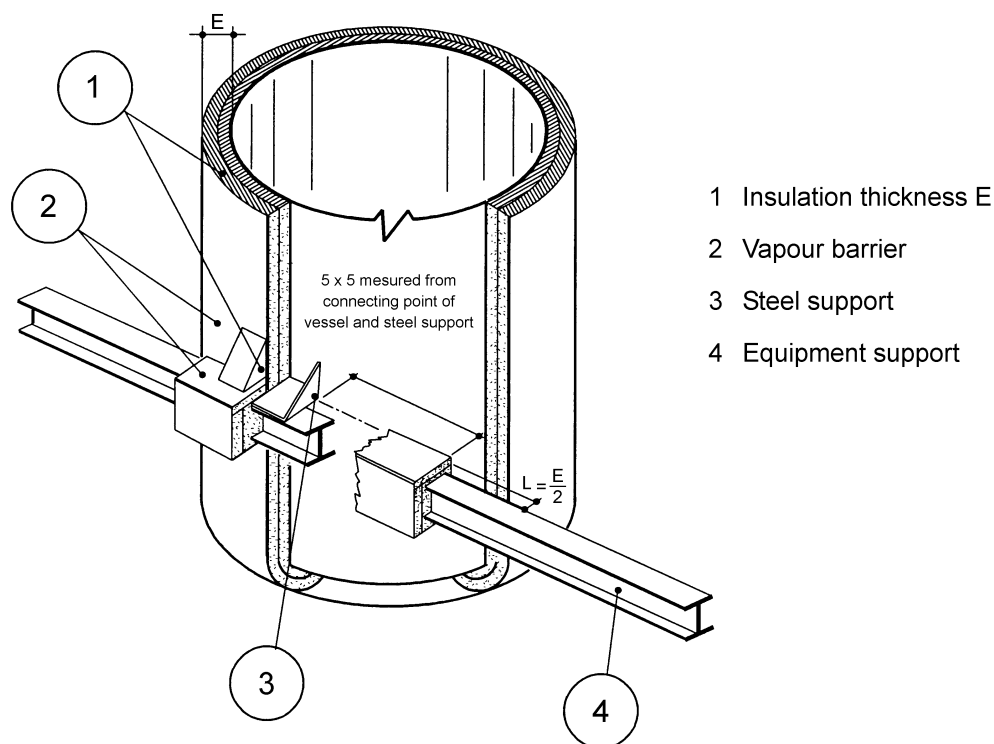
E = Minimum piping insulation thickness
 Materials: minimum 200 kg/m³ PVC foam
 minimum 240 kg/ m³ polysocyanurate foam
 bakelised wood

Principles of assembly no. 22 – Piping support

Insulation of equipment support, equipment on saddles



Insulation of equipment support, equipment on beams



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Principles of assembly no. 23 - Vessel support