



NATIONAL PETROCHEMICAL COMPANY  
STANDARDS

MATERIAL STANDARD  
FOR  
INSULATION

NPCS-MS-TP-01

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## FIGURE 1

## FIGURE 2

## FIGURE 3

## FIGURE 4

## FIGURE 5

## FIGURE 6



1 SCOPE

1.1 This standard covers the minimum requirements governing the selection of insulation and accessory materials including physical properties, testing, etc.

1.2 References to the term "vendor" in this standard shall define the person or company responsible to purchaser for the supply of insulation and accessory materials as contractually defined.

1.3 References to the term "purchaser" in this standard define National Petrochemical Company, "NPC".

2 DOCUMENT PRIORITY

All conflicts between the requirements of this standard, referenced specifications, drawings, manufacturer's recommendations, the requisition or the governing contract *shall* be referred to purchaser for clarification, before proceeding with manufacture and or delivery.

3 BASIC DESIGN REQUIREMENTS

Insulation and accessory material shall be designed and manufactured for field application in accordance with the specifications, national standards and design codes listed in *section* 4 of this standard.

4 STANDARDS AND CODES

The codes and industry standards referenced in this standard shall be of latest edition and as follows:

- ASTM American Society for Testing and Materials.

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|             |                                                                                                                      |
|-------------|----------------------------------------------------------------------------------------------------------------------|
| ASTM A 3.67 | Standard Specification<br>for Stainless and<br>Heat-Resisting<br>Chromium-Nickel Steel<br>Plate, Sheet and<br>Strip. |
| ASTM B 209  | Standard Specification<br>for Aluminum and<br>Aluminum Alloy Sheet<br>and Plate.                                     |
| ASTM C 165  | Standard Recommended<br>Practice for Measuring<br>Compressive Properties<br>of Thermal<br>Insulations.               |
| ASTM C 177  | Standard Test Method<br>for Thermal<br>Transmission<br>Properties by Means of<br>the Guarded Hot Plate.              |
| ASTM C 303  | Standard Test Method<br>for Density of<br>Performed Block-Type<br>Thermal Insulation.                                |
| ASTM C 390  | Standard Criteria for<br>Sampling and<br>Acceptance of<br>Performed Thermal<br>Insulation Lots.                      |
| ASTM C 547  | Specification for<br>Mineral Fibre<br>Performed Pipe<br>Insulation.                                                  |
| ASTM C 552  | Standard Specification<br>for Cellular Glass<br>Block and Pipe Thermal<br>Insulation.                                |
| ASTM C 612  | Specification for<br>Mineral Fibre<br>Performed Pipe<br>Insulation.                                                  |



|             |                                                                                                                             |
|-------------|-----------------------------------------------------------------------------------------------------------------------------|
| ASTM C 623  | Standard Test Method for Young's Modulus, Shear Modulus, and Poisson's Ratio for Glass and Glass-Ceramics by Resonance.     |
| ASTM C 795  | Specification for Wicking-Type Thermal Insulation for Use Over Austenitic Stainless Steel.                                  |
| ASTM C 871  | Methods for Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Silicate and Sodium Ions.             |
| ASTM E 84   | Standard Test Method for Surface Burning Characteristics of Building Materials.                                             |
| ASTM E 96   | Standard Test Methods for Water Vapour Transmission of Materials.                                                           |
| ASTM E 398  | Standard Test Method for Water Vapour Transmission Rate of Sheet Materials Using a Rapid Technique for Dynamic Measurement. |
| ASTM D 1621 | Standard Test Method for Compressive Properties of Rigid Cellular Plastic.                                                  |
| ASTM D 1622 | Standard Test Method for Apparent Density of Rigid Cellular Plastics.                                                       |
| ASTM D 1623 | Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastic.                                 |

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ASTM D 2856

Standard Test Method  
for Open Cell content  
of Rigid Cellular  
Plastics by Air  
Pycnometer.

ASTM D 3014

Standard Test Method  
for Flame Height Time  
of Burning and Loss of  
Weight of Rigid  
Cellular Plastic in  
Vertical Position.

- BSI

British Standards  
Institution.

BS 476, Part 4

Fire Test on Building  
Materials and  
Structures,  
Non-Combustibility  
Test for Materials.

BS 476, Part 7

Fire Tests on Building  
Materials and  
Structures Surface  
Spread of Flame Test  
for Material.

BS 874, Part 1

Methods for  
Determining Thermal  
Insulation Properties,  
with Definitions of  
Thermal Insulation  
Terms.

BS 1449, Part 1

Steel Plate, Sheet  
and Strip,  
Specification for  
Carbon and Carbon  
Manages Sheet and  
Strip.

BS 1449, Part 2

Steel Plate, Sheet  
and Strip,  
Specification for  
Stainless and Heat  
Resisting Steel Plate,  
Sheet and Strip.

BS 1470

Wrought Aluminium and  
Aluminium Alloys for  
General Engineering  
Purposes: Plate, Sheet  
and Strip.

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|                 |                                                                                      |
|-----------------|--------------------------------------------------------------------------------------|
| BS 2972         | Methods of Test for Thermal Insulating Materials.                                    |
| BS 3958, Part 2 | Thermal Insulation Materials, Calcium Silicate Performed Insulation.                 |
| BS 3958, Part 4 | Thermal Insulation Materials, Bonded Performed Man-Made Mineral Fibre Pipe Sections. |
| BS 3958, Part 5 | Thermal Insulation Materials, Bonded Man-Made Mineral Fibre Slabs.                   |

## 5 MATERIALS-GENERAL

- 5.1 All materials shall be of high quality, good appearance and shall not have any deleterious action on *the* surface to be insulated. All insulation and non-metallic accessory materials shall be formulated without the addition of any form of asbestos, including the tremolite, anthrophyllite and actinolite species of asbestos minerals.
- 5.2 Insulation materials shall be chemically inert, non-sulphurous, rotproof, verminproof, impervious to hot water and steam, non-injurious to health and non-corrosive to Steel. Insulation materials shall have no form of flammable materials attached to them.
- 5.3 Insulation materials and their application, including all ancillary fastening, coating, sealing, sheeting and other accessories shall comply with applicable national and local government legislation, including safety and health requirements.
- 5.4 Performed insulating material shall be transported to site in properly constructed waterproof cartons or crates; flexible insulation in polythene bags or sacks. Plastic composition shall be packed in weatherproof bags.

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- 5.5 Packing of fragile insulation material shall be accomplished in such a manner as to avoid breakages, using soft interleaving materials and where necessary an infill such as waste mineral fibre insulation to fill vulnerable voids in cartons/crates/cases.
- 5.6 All insulation materials shall be made easily identifiable with the pipe size, thickness and where appropriate the equipment number, clearly marked on each carton/crate/case.
- 5.1 Generic references to the thermal insulation materials such as rock wool, mineral wool, mineral fibre, etc., shall be interpreted in accordance with the definition given in ASTM C 547, ASTM 612, BS 3958 Part 6, as man made mineral fibre made from rock, slag or glass, processed from a molten state into a fibrous form with a suitable binder. For the purposes of this standard, materials of a rock composition (diabase, Silica Ore, basalt or similar types) shall be acceptable. Materials made from slag (in part or in whole) shall not be acceptable. Materials made of glass shall only be permitted where specified as an expansion joint filler.
- 5.8 Original manufacturer's product data sheets and product safety data sheets for various insulating and accessory materials together with samples of insulating materials shall be provided for approval of purchaser. Product safety data sheets shall include information concerning general composition, physical data, hazards and precautions during and after application, toxicity/first aid, storage, spillage and waste disposal.
- 5.9 Vendor shall nominate manufacturer of all insulation and ancillary materials and shall provide technical back-up to demonstrate that such materials meet all the technical requirements of the specification. In cases of non-compliance, the reason shall be clearly stated. Once approved, no change in the source of supply shall be permitted without the approval of the Purchaser.



## INSULATION MATERIALS

### .1 MINERAL FIBRE

.1.1 Performed mineral fibre insulation shall be of a rock composition as per clause 5.7 complying with Physical characteristics listed in BS 3958, Parts 4 and 5 and where these do not conflict, physical characteristics listed in ASTM C612 and C547. The material shall comply with the following overriding requirements :

.1.1.1 Combustibility; Non-combustible when tested in accordance with BS 476, Part 4.

.1.1.2 Chemical requirements; Less than 10 ppm Chloride, when tested in accordance with Section 22 of BS 2972, and less than 10 ppm Fluoride, with a combined halide content no greater than 15 ppm. The material shall be qualified for use on austenitic Stainless Steel in accordance with ASTM C795 by conforming to the preproduction test requirements of ASTM C692 and the confirming quality control requirements for chemical analysis of ASTM C871. The material shall have a maximum nitrate content of 5 ppm.

.1.1.3 Shot content; Less than 6% by weight of shot exceeding 250 microns when tested in accordance with Section 14 of BS 2972, and less than 31% by weight of shot/coarse fibres between 63 microns and 250 microns.

.1.1.4 Content of Sulphur compounds; Less than one half percent by *weight*.

.1.1.5 Alkalinity; PH of between 7 and 8 when tested in accordance with Appendix C of BS 3958, Parts 4 and 5.

.1.1.6 Optimum service temperature range; 21°C to 650°C.

.1.1.7 Binder; Resin impregnation during manufacture prior to compressing and curing.

.1.1.8 Thermal conductivity; No greater than the following, when tested in accordance with Section 4 of BS 2972.

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| <u>MEAN TEMP. (°C)</u> | <u>K VALUE KCal/m.h°C</u> |                   |
|------------------------|---------------------------|-------------------|
|                        | <u>Slab/Sections</u>      | <u>Mattresses</u> |
| 50                     | 0.032                     | 0.031             |
| 100                    | 0.037                     | 0.037             |
| 150                    | 0.043                     | 0.044             |
| 200                    | 0.061                     | 0.051             |
| 250                    | 0.061                     | 0.061             |
| 300                    | 0.072                     | 0.071             |
| 350                    | 0.084                     | 0.084             |
| 400                    | 0.097                     | 0.097             |

- 6.1.1.9 Water Retention; when tested in accordance with an authoritative modification to Section eleven of BS 2972 approved by Purchaser, to cover test specimens of preformed pipe section, size NPS 10 x 25 mm thick x 25 mm deep, as well as the flat slab sample specified in the Standard. The following maximum acceptance values shall be achieved:

Partial immersion

0.2 Kg/m<sup>2</sup> @ 20°C  
0.2 Kg/m<sup>2</sup> @ 250°C

Total immersion

20 Kg/m<sup>3</sup> @ 20°C  
20 Kg/m<sup>3</sup> @ 250°C

- 6.1.1.10 Proportion of fine fibres; 28% or less of fibres less than 3 microns diameter in the bulk fibrous material.

- 6.1.1.11 Facings for flexible mattresses; facings shall comprise 20 gage X 25 mm mesh wire netting sewn with wire ties at close regular intervals in such a way as to ensure that these can not be pulled through during storage, handling and fabrication. The wire mesh shall be Stainless Steel for application to Stainless Steel vessel heads and galvanised for other applications. The facing shall be on both sides.

- 6.1.2 The following minimum densities and forms of performed mineral fibre shall be used:

- 6.1.2.1 Pipework; Pipe sections 125 to 155 kg/m<sup>3</sup> density, either in two halves or in one piece hinged (snap-on) for all sizes up to maximum commercially available pipe size. For larger diameters, factory cut bevelled lags 140 kg/m<sup>3</sup> density shall be employed.



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- 6.1.2.2 Heat traced pipework; Pipe sections as 6.1.2.1, but oversized generally up to the next commercially available size to accommodate parent line and its accompanying tracer, refer to NPCS-ES-TP-02.
- 6.1.2.3 Equipment having a diameter up to maximum commercially available pipe size; pipe sections as 6.1.2.1.
- 6.1.2.4 Vertical equipment having a diameter exceeding maximum commercially available pipe size; bevelled lags/rigid slabs 140 kg/m<sup>3</sup> for all single, inner and outer layers.
- 6.1.2.5 Horizontal equipment having a diameter exceeding maximum commercially available pipe size; bevelled lags/rigid slabs 120 kg/m<sup>3</sup> for all single, inner and outer layers.
- 6.1.2.6 Flexible mattresses for equipment heads shall be of the following density:
- a) 90 to 100 kg/m<sup>3</sup> up to 500°C operating temperature.
  - b) 128 kg/m<sup>3</sup> between 501 and 650°C operating temperature.
- 6.1.2.7 Flanges and valves; Slabs for; lining of removable boxes, minimum 140 kg/m<sup>3</sup>.
- 6.1.2.8 Shells of cone-roof tanks; Semi-rigid slabs 55 kg/m<sup>3</sup>.
- 6.1.2.9 Roofs of cone-roof tanks; Rigid slabs 200 kg/m<sup>3</sup>.
- 6.1.3 For hot face temperatures up to 650°C, the concentration of organic bonding material for all specified insulation densities shall not constitute a fire risk through the incidence of welding sparks or through an internal self-heating phenomenon (punking) over the range of insulation thicknesses and individual layers proposed by purchaser. Manufacturer of the material shall demonstrate to the requirements of section 18 of BS 2972 that the degree of self-heating does not exceed safe limits.
- 6.1.4 In cold insulation for packing out voids and cavities where required within preformed insulation systems, the mineral fibre shall be supplied in a roll form suitable for packing to a density 90/110 kg/m<sup>3</sup>. To achieve this density uniformly, 90 kg/m<sup>3</sup> wired matts may be used; the wire netting or other backing being discarded on application.