



NATIONAL PETROCHEMICAL COMPANY  
STANDARDS

ENGINEERING STANDARD  
FOR  
EXTERNAL INSULATION

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PART I HOT INSULATION

1 SCOPE

- 1.1 This standard covers minimum requirements for design and material for above ground, external insulation of piping and equipment operating between ambient temperature and 550°C for the purpose of heat conservation, process stabilisation, temperature maintenance, personnel protection and fire protection. Wherever necessary this standard indicates the basis for selecting a criterion.

2 GENERAL

- 2.1 This standard is suitable for use in outdoor service with normal process plant atmospheres. Alternative designs and materials would be specified by purchaser if necessary for corrosive atmosphere or potential leaks and spills of chemicals .
- 2.2 Purchaser shall specify the additional quantity of material to be ordered over and above the precise requirements to allow for damage, fitting wastage and spare material.
- 2.3 This standard does not cover insulation for boiler or fired heaters and associated air heaters, economisers, flue ducting and air ducting.
- 2.4 Piping, equipment, storage tanks and vessels requiring insulation shall normally be specified on the following project documents.
- a) Process and Instrument Diagrams (P&IDs).
  - b) Piping plans & Isometrics.
  - c) Instrument Piping Details and Schedules.
  - d) Vessel, Exchanger, Storage Tank and sphere documents and Insulation Schedules.

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e) Equipment supplier's General Arrangement Drawings. for equipment items in package plant.

2.5 The thickness of insulation given is the nominal thickness of the basic insulating medium.

2.6 Definition of terms used in this standard shall be in accordance with ASTM Standard C168. All ASTM Specification referred to shall be of latest edition.

### 3 DESIGN BASIS

#### 3.1 CRITERIA

3.1.1 Heat Conservation Insulation is designed for economic thicknesses and to limit cold surface temperatures below 65°C with 20°C ambient temperature in still air conditions.

3.1.2 Internally refractory lined piping and equipment and any other items for which heat loss is essential. shall not be insulated. (See para 3.3.5.4).

3.1.3 Hot piping vessels and equipment operating below 120°C shall not be insulated, unless required for process reasons or for personnel protection or to avoid thermal stress problems.

3.1.4 Hot piping, vessels and equipment operating at 120°C and above shall normally be insulated unless a loss of heat is desired.

3.1.5 Insulation is required for any of the following purposes, as will be indicated in P & IDs and line lists:

- Heat conservation. (H)
- Process stabilisation to assist process control.

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## al Tracing

- I) Steam tracing. (S)
- II) Electric tracing. (E)
- III) Hot water or solvent tracing (L)  
(liquid) .
- IV) Hot Oil tracing. (O)

## b) Jacketing

- I) Steam jacketing. (JS)
- II) Hot water or liquid jacketing. (JL)
- III) Hot Oil Jacketing. (JO)
- Fire hazard protection to prevent (F)  
fast boil off of liquid.
- Personnel protection. (P)

Personnel protection is applicable where exposed surface temperatures exceeds 65°C in normal or short-term operating conditions, over internally insulated piping and equipment where personnel protection is required, but insulation is not permitted, provide open mesh metal guards and for surfaces which are not internally insulated, provide insulation on that part of surfaces with which operating and maintenance personnel may come in contact while performing routine duties. The intent of P&IDs, line classification lists, Engineering drawings, etc., which designate insulation for personnel protection is to call attention only to the eligibility of such service. The actual extent of insulation shall be determined by Field Construction Personnel and/or operating personnel using the following criteria Exposed surfaces operating above 65°C and located within 1000 mm horizontally or 2100 mm vertically of a normal access, walkway or work area. Valves, flanges and unions shall not be insulated for personnel protection.

## 3.1.6

Instruments and associated piping subject to operating flow and/or temperature conditions prevailing in the connected piping or equipment shall be insulated to the same requirements as that of piping or equipment.



- 3.1.7 Insulation shall be designed to provide an absolute minimum clearance of 25 mm between the outside surface of any insulation finishing material and adjacent surfaces.
- 3.1.8 Where insulated piping is supported on steel shoes, the height of the shoe shall be such that the underside of the insulation finishing material is clear of the supporting structures upon which the shoe rests by 25 mm minimum.
- 3.1.9 Hydrostatic tests on pipe, vessels and equipment shall, if possible be completed before insulation is installed. If insulation is applied before testing, all welds and threads shall be left exposed until completion of testing.
- 3.1.10 Care shall be taken to avoid contact between dissimilar material which might cause galvanic corrosion.
- 3.1.11 All insulating and finish coatings, fabrics, mastics and sealants supplied per this standard, shall be certified by manufacturer, to be asbestos free.
- 3.1.12 Inspection openings shall be provided in the insulation at locations to be selected at *site* by the purchaser the removeable window shall be of the same basic material and thickness as the rest of the insulation and of sufficient rigidity to withstand handling.
- 3.1.13 Insulation which needs to be removed for maintenance purposes shall be fabricated in such a manner, that it is easily removeable and can be remounted with a minimum of work. Quick opening boxes and similar construction shall be used in that case.
- 3.1.14 Piping requiring insulation is indicated on the line schedule and P & I diagrams. The temperatures for which the piping is to be insulated shall be determined by the temperatures listed under the operating temperature in the line schedule.
- 3.1.15 Piping which is traced shall be covered with oversized pipe insulation to include the tracer lines. Union and tracer line loops shall be separately insulated. Oversized pipe insulation shall be in **accordance** with the following schedule.(TABLE 3.1.15.)

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NOMINAL SIZE OF PREFORMED PIPING SECTIONS  
INSULATION MATERIAL OVER TRACED PIPE  
TABLE 3.1.15

| PIPE SIZE<br>( INCH )                  | 1/2" TRACER NOS. |                      |
|----------------------------------------|------------------|----------------------|
|                                        | ONE TRACER       | TWO OR THREE TRACERS |
| 1/2                                    | 1 1/4            | 1 1/4                |
| 3/4                                    | 1 1/4            | 1 1/2                |
| 1                                      | 1 1/2            | 2                    |
| 1 1/2                                  | 2 1/2            | 2 1/2                |
| 2                                      | 3                | 3                    |
| 3                                      | 3 1/2            | 4                    |
| 4                                      | 5                | 5                    |
| 6                                      | 7                | 7                    |
| 8                                      | 9                | 9                    |
| 10                                     | 11               | 11                   |
| 12                                     | 14               | 14                   |
| 14" & LARGER NEXT SIZE UP ON SCHEDULE. |                  |                      |

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3.1.16 Single thickness sectional pipe insulation shall be applied with longitudinal joints staggered and shall be secured with wire ties on 230 mm centers. Double thickness sectional pipe insulations shall be applied with all joints staggered and shall have inner layer secured by at least two wires per section with the outer layer secured by wire ties on 230 mm centers.

3.1.17 Equipment requiring insulation is Indicated on the insulation schedule and P&ID drawing. The temperature for which the equipment is to be insulated shall be the operating temperatures indicated on the equipment data sheets. For compressors and exchangers, the higher of the inlet or of the outlet temperatures as given in the insulation schedule and equipment data sheet shall be used.

3.1.18 External stiffening rings on the vessel and piping shall be insulated with the same thickness as required for the vessel or piping.

3.1.19 Vertical vessels, which have a marked decrease in the temperature from bottom to top, shall be insulated as follows:

Lower half of the vessels shall be insulated for the bottom service temperature and upper half may be insulated for the vessel's overall average temperature.

### 3.2 EXTENT OF INSULATION ON PIPING SYSTEMS

3.2.1 Insulated piping systems shall have straight pipe, bends, tees and pipe fittings completely insulated.

3.2.2 All valves and flanged joints shall be completely insulated only in steam, condensate service, hot oil lines and in lines which are trace heated or jacketed to maintain temperatures.

3.2.3 For bucket and float type traps the inlet piping and trap shall be insulated.

3.2.4 Insulation on inlet piping to thermostatic and thermodynamic steam traps shall terminate at approximately 500mm before the trap.

3.2.5 Steam trap outlet piping other than closed condensate recovery system shall not be insulated except for personnel protection reasons.



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- 3.2.6 Instrumentation to be insulated, such as level gauges, level controllers, level switches, dp cells, shall have their fluid containing sections and the associated piping completely insulated, including pipes, valves and fittings.
- 3.2.7 Insulation shall not be applied to the following, unless otherwise specified.
- 3.2.7.1 Piping which becomes hot intermittently, such as relief valves, vents, steam-out and snuffing steam systems, flare and blowdown systems.
- 3.2.7.2 Supports for piping, excluding pipe hangers to the extent covered by insulation.
- 3.2.7.3 Steam Traps (except as noted in paragraph 3.2.3).
- 3.2.7.4 Valves, including control valves and flanges in process piping systems (except as noted in 3.2.2 and 3.2.6 ).  
However, personnel protection insulation for these items shall be applied, as required.
- 3.2.7.5 Pipe Union fittings.
- 3.2.7.6 Thermowell bosses and pressure tappings.
- 3.2.7.7 Expansion joints, hinged joints and hose assemblies.
- 3.2.7.8 Sight flow indicators.
- 3.3 EXTENT OF INSULATION ON EQUIPMENT
- 3.3.1 Support skirts of insulated vertical vessel greater than 900 mm diameter shall be insulated both internally and externally for a minimum distance of 600 mm below the bottom tangent line. The insulation shall terminate not less than 300 mm above the support concrete or steelwork.
- 3.3.2 Support skirts of insulated vertical vessels of 900 mm and less shall be insulated externally only, as described in para 3.3.1 above.
- 3.3.3 Turbines and steam ends of reciprocating pump shall be insulated for heat conservation. As given on insulation schedule and equipment data sheets.
- 3.3.4 Liquid ends of pumps shall be insulated when heat traced or jacketed or when indicated on insulation schedule or on equipment data sheets,



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- 3.3.5 Insulation shall not be applied to the following unless otherwise specified.
- 3.3.5.1 Pumps with operating temperature below 200°C unless pumped fluid has a pour point above minimum design ambient temperature.
- 3.3.5.2 Fans, compressors, blowers or other rotating or reciprocating equipment.
- 3.3.5.3 Liquid ends of pumps except as noted in the paragraph 3.3.5.1 above.
- 3.3.5.4 Internally insulated or refractory lined equipment unless specially designed for metal temperature control.
- 3.3.5.5 Heads of vessels enclosed by support skirts with vessel diameters 900 mm and less.
- 3.3.5.6 Internal surfaces of insulated vessel support skirts with vessel diameter 900mm or less.
- 3.3.5.7 Turbine casings to be insulated shall exclude shaft seal caps, shaft bearing housings, throttle valves, governors and supports.
- 3.3.5.8 Exchanger channel and covers; shell and channel flanges, & Exp. Joints.
- 3.3.5.9 Nozzles, manholes and handholes and flanges of equipment.
- 3.3.5.10 Surfaces of coolers and condensers.
- 3.3.5.11 Nameplates of all equipment items.
- 3.3.5.12 Thermowell bosses and pressure tappings.



4 INSPECTION

- 4.1 All materials furnished and/or used in connection with the insulation work shall be subject to inspection and approval by purchaser, in order to assure the use of material of the type and quality, which meet the requirements of this standard. It is the responsibility of insulation contractor to ensure adequate precautions against damage and deterioration are taken during the storage of insulation, jacketing and ancillary materials.
- 4.2 Storage of insulation material shall be indoors, in an area where relative humidity does not exceed 85% ,
- 4.3 Installation procedure shall be subject to inspection by purchaser or by his representative and any material which has been improperly installed or excessively damaged shall be removed and replaced properly with undamaged material.
- 4.4 Inspection and approval of materials and workmanship by purchaser shall not relieve insulation contractor of any of his responsibilities what so ever.
- 4.5 Prior to insulation work commencing on any particular section, purchaser should be satisfied that all insulation supports on vessels, vertical pipelines and shoes on horizontal pipelines have been correctly installed. Additionally all thermal tracing lines are properly in place and all metal surfaces are clean and free of foreign or spattered materials.
- 4.6 All insulation application shall be performed during dry weather; uncompleted and exposed surfaces should be protected at all time against dampness, condensation or rain. All insulation applied in one day shall have the mastic, fabric or metal weatherproofing applied the same day and any exposed ends shall be temporarily protected with weatherproofing. Insulation showing any evidence of moisture shall be removed and replaced.

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4.7 Prior to the release of any equipment and piping to the insulation applicator, all valves, gauges, etc. shall be inspected tested and repaired prior to application of insulation.

4.8 Care shall be taken to ensure that all moving parts(working parts) of instrument, valves and equipment are protected when insulation is applied. Until all insulation materials, such as sealer and mastic, have been removed from the moving parts, the insulation work shall be considered incomplete.

## 5 MATERIALS

### 5.1 GENERAL

5.1.1 All materials (Insulation, jacketing and ancillary materials) shall be of high quality and good appearance. Unless otherwise specified in the project specifications, materials for *insulation will* be selected from the *materials* described below and shall not be used over the limit temperatures given in ASTM Specification or by the manufacturer.

5. .2 Insulation materials shall be of low chloride content, chemically inert, non-sulfureous, rot proof, vermin proof, impervious to hot water and steam, non-injurious to health and non-corrosive to steel and aluminium (even if soaked in water at ambient temperatures for extended periods).

5.1.3 Insulation and jacketing material backed with paper or other flammable material is not acceptable.

5.1.4 Many common flammable liquids such as oil, butanol, diethanolamine and hexanol will react and start fires when they leak into inorganic absorbent insulations. Such absorbent insulations can store large quantities of combustible liquids in case a leak occurs. This could be a decisive factor when specifying and evaluating alternative materials .

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5.1.5 Insulation materials have been classified into two categories water absorbing and non-water absorbing. Non-water absorbing insulant like cellular glass is recommended for services up to 125°C.

Water absorbing insulants like fibrous insulants and calcium silicate can be used for all temperatures. But for low temperature (i.e. up to 125°C) services a suitable moisture barrier shall be used. Since the substrata is at too low temperature to evaporate moisture, rain or hose water absorbed.

## 5.2 INSULATION MATERIAL

### 5.2.1 Fibrous Material (Rock & Glass Wool)

5.2.1.1 Shall be a preformed insulation and of long fibered rock or. glass material processed from a molten state into fibrous form bonded with a binder and suitable for the intended operational temperature range from ambient to 550°C. Slagwool is not acceptable.

5.2.1.2 Unless otherwise specified herein, insulation material shall strictly conform to all the requirements of standards listed below .

- ASTM C-547 pipe Insulation Mineral  
CLASS 2&3 Fiber Preformed

- ASTM C-592 Mineral Fiber Blanket  
CLASS II Insulation & Blanket  
Type Pipe Insulation  
(Metal Mesh Covered).

- ASTM C-612 Mineral Fiber Block &  
CLASS 3, 4 & 5 Board Thermal Insulation.

- ASTM C-553 Mineral fiber blanket (for  
CLASS B-4 expansion joint  
only).