

**ENGINEERING SPECIFICATIONS**  
**INSULATION APPLICATION WORKS**  
**FOR**  
**CIVIL WORKS**  
**FOR**  
**HINDUSTAN PETROLEUM CORPORATION LTD.**  
**VISAKH REFINERY**



**DHT PROJECT**  
**TEIL JOB NO. : 6261**  
**DOCUMENT NO. : L-303**

| Rev. no. | Issue Date | Description     | Prepared by | Checked by | Approved by |
|----------|------------|-----------------|-------------|------------|-------------|
| A        | 29.12.2008 | For Bid Enquiry | UCM         | PRK        | SSV         |



**TOYO ENGINEERING INDIA LIMITED**  
MUMBAI INDIA

### **Revision History**

| Rev. | Date       | Description     |
|------|------------|-----------------|
| A    | 29.12.2008 | For Bid Enquiry |

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## 1. GENERAL

### 1.1. Scope

This construction specification covers specific requirement for external insulation of equipment and piping erected for Diesel Hydrotreater Project for M/s. HINDUSTAN PETROLEUM CORPORATION LTD. Visakh, Andhra Pradesh.

This specification shall apply to the thermal insulation for equipment and piping shown on the equipment engineering drawings and piping line schedule.

### 1.2. Codes and Standards

This specification refers to the following codes and standards.

- (1) American Society for Testing and Materials (ASTM)
  - 4) ASTM C533 : Specification for Calcium Silicate Block and Pipe Thermal Insulation
  - 5) ASTM C547 : Specification for Mineral Fiber Preformed pipe Insulation
  - 6) ASTM C553 : Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
  - 7) ASTM C592 : Specification for Mineral Fiber Blanket Insulation and Blanket-type Pipe Insulation
- (2) Indian Standard (IS)
  - 1) IS 9842 : Specification for Mineral Fiber Preformed pipe Insulation
  - 2) IS 8183 : Specification for Mineral Fiber Blanket Insulation and Blanket-type Pipe Insulation

### 1.3. Units

Unless otherwise specified, metric, celsius and kilogram units be applied as the measurement system for the drawings and documents to be submitted. Nominal sizes of piping components shall be in INCH system whose abbreviation is NPS.

### 1.4 Restrictions

- 1.4.1 Mineral wool containing more than 30 ppm chloride is not acceptable for use on the equipment/piping of austenitic steel.

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- 1.4.2 Insulation materials containing asbestos in any form shall not used.
- 1.4.3 No insulation material shall be applied between pipe and tracer except for spacers to prevent local overheating of the pipe.
- 1.4.4 Contact between dissimilar materials, which might cause galvanic corrosion, shall be avoided.
- 1.4.5 No flammable materials shall be attached to the insulation.

## 2. **EXTENT OF INSULATION**

### 2.1 Equipment and Piping

Extent of insulation for equipment & piping shall be specified in the engineering specification L-101.

This specification does not cover insulation for boiler or fired heater, associated air heaters, economisers, flue ducts & air ducts.

## 3 **EXECUTION OF WORKS**

### 3.1 Classification of Works

3.1.1 Classification of works shall be as specified in engineering specification L 101.

3.1.2 Equipment or piping which require thermal insulation is indicated by the work code shown in Equipment Engineering Drawing or Piping Line Schedule.

3.1.3 Instruments which require hot insulation are indicated by the work code in the Hook-up Drawing.

### 3.2 Materials

The materials to be used shall be as specified in the material specification given in engineering specification L –101. The materials shall be subjected to the material and dimensional inspection before being used.

### 3.3 Insulation Thickness

For insulation thickness refer to engineering specification L - 101.

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### 3.4 Surface Preparation

3.4.1 Equipment or piping shop-painted with anti-corrosive paint shall not be treated to strip off the paint, but they shall be wiped cleanly with cloth before insulation. But defective painting and rusted parts, if they exist, shall be treated as follows:

- (1) The defective paint and the rust on metal surface of equipment or piping shall be removed with a scraper, wire brush or sand paper, then scrub the surface clean.
- (2) Rust shall be removed with sufficient care so that the surface shall not be damaged.
- (3) Weld zone or heat treated portions shall be cleaned with sufficient care, for rust and scales are likely to form there.
- (4) Corners of the brackets on equipment or piping shall be cleaned carefully, for they often have rust or other foreign matters sticking there.

3.4.2 The thermal insulating materials shall be installed only after oil, grease, rust and other foreign matters are completely eliminated from the equipment or piping and their surfaces are completely dry (Due care shall be taken with the rust removal operation of Par. 3.4.1).

### 3.5 General Requirements for Hot insulation Works

3.5.1 Hot insulation of equipment shall comply with the following requirements: (See Fig.1).

- (1) Cylindrical surface of equipments shall be insulated with block and secured in place with steel bands. The use of steel bands shall comply with material specification given in engineering specification L -101.
- (2) The head of the equipment shall be insulated by using blocks trimmed to fit along the surface provided with floating rings positioned at the center of the head, and the blocks shall be secured with wires or steel bands binding radially
- (3) The gaps shall be filled with the water - kneaded powder of the same material.
- (4) Where the insulation thickness is 75 mm or more, multilayer insulation shall be used, and the lengthwise and breadthwise joints of multi-layer shall be staggered each other.
- (5) Where welding pins or studs are to be used, the block shall be cut or bored with the accuracy in relation to the size and the intervals of the

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welding pins or studs. The gaps resulted from the cutting or boring shall be filled with the water-kneaded powder of the same material or rock wool insulating material.

- (6) As a rule, asphalt roofing shall not be used. But the asphalt roofing, if its use is specified, shall not come in contact with the high-temperature parts projecting from the heat insulating material, such as the nozzles and brackets of equipment ; it shall be apart from them by more than 50 mm, if there is any possibility of contact.
- (7) Aluminium sheets shall be used for insulation jacketing excepting irregular surfaces.
- (8) Where mastic coating is required on the irregular surface, weather-proof mastic (asphalt emulsion) shall be applied.
- (9) The longitudinal joints of the jacket shall be made in deep “Z” joint and the circumferential joints shall be lapped above 50 mm in order that no rain water will infiltrate.
- (10) When the corrugated sheets are to be used for jacketing, the longitudinal and the circumferential joints shall be lapped above 50 mm.
- (11) Water proof measures such as throating or sealing with water proof material shall be taken for the parts projecting from the block, such as the manholes, nozzles, sight glass, lugs etc.
- (12) Where the corrugated sheets are to be used for jacketing, heads of equipment shall be coated with coating material such as mastic etc. and plain aluminium sheet shall be used for jacketing the heads.
- (13) Jacket shall be secured with the steel bands, but also, shall have “Z” clip in order to avoid their sliding down the use of steel bands shall comply with material specification given in L - 101.
- (14) Some measures shall be devised so that no gap may result from thermal expansion contraction.
- (15) The insulating covers to be used for the detachable item such as the flanges of manhole or nozzle, safety valve and liquid level gauge attached on equipment shall be of the separable type. As a rule, the heat insulating material shall be rockwool, and the insulating covers shall be hinged and screwed.
- (16) A minimum clearance of 25mm between the outside surface of any insulation finished and adjacent equipments, pipes or structural members shall be maintained.

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3.5.2 Hot insulation of piping shall comply with the following requirement. (See Figs. 2 to 5).

- (1) As a rule, moulded pipe covering shall be secured by the galvanized iron wires or steel bands, and a set of moulded pipe covering shall be secured at two points. The use of galvanised iron wires and steel bands shall comply with material specification given in the engineering specification L - 101.
- (2) The moulded pipe covering for the bent portions shall be cut and shaped in the same manner as the lobster bends are formed. The resultant gaps shall be filled with the water-kneaded powder of the same material.
- (3) As a rule, the asphalt roofing may not be used. But the asphalt roofing, when its use is specified, shall not come in contact with the high-temperature portions such as the cuts or ends of the moulded pipe coverings at the pipe hangers, pipe shoes, flanges or branch ; it shall be separated by more than 50 mm from where there is any possibility of contact.
- (4) Where the insulation thickness is 75 mm or more, the multilayer of moulded pipe coverings or blocks shall be used. Also the circumferential and longitudinal joints or multilayer shall be staggered with each other.
- (5) As a rule, the insulation jacket shall be of plain Aluminium sheets. Where mastic coating is required, weather-proof mastic (asphalt emulsion) shall be applicable.
- (6) The longitudinal joints shall be made in above 20 mm “Z” joint and the circumferential joints made in above 50 mm “butt strap”.
- (7) The position of “Z” joint in the horizontal piping shall be within 45 - 0° from the pipe bottom so that rain water may not infiltrate.
- (8) When the corrugated sheets is used for jacketing, laps in the longitudinal direction shall be 30 - 50 mm and the laps in the circumferential direction above 50 mm. The position of the longitudinal joints shall comply with the foregoing requirement (7), and in the joint the upper course shall be overlapped on lower course so that no rain water may infiltrate. Each joint of jacket shall be applied with water proof material such as mastic.
- (9) Sufficient measures such as throating or sealing with water proof material shall be taken to prevent the infiltration of rain water at the positions of the sheets cut out for the pipe hanger, pipe shoes etc.



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- (10) The vertical piping shall be furnished with stopper that prevents the jacket from sliding down.
- (11) The jacketing on the bends shall be of the “lobster winding”.
- (12) As a rule, Galvanised steel bands shall be used for securing the jacket. The uses shall comply with specific job requirement, materials specification given in the engineering specification L - 101
- (13) Some measures shall be devised so that no gap may result from thermal expansion-contraction.
- (14) The hot insulation of the tracing lines shall be such that the moulded pipe covering to be used corresponds to the total dimension of the main pipe and the trace pipe. The trace line with the nominal diameter 3/8 B and below shall be of rockwool insulating material and the finishing shall be applied with metal sheets or coating material such as mastic.
- (15) Hot insulation shall not be made where bolts and nuts are fitted on the flange. but rock wool insulating material shall be filled in the separable - type cover for the flange The separable - type covers shall be hinged and screwed. The insulation procedure for valve bodies shall come under the same requirements.

- 3.5.3 The works for the instruments and pressure lead piping shall comply with the requirements for insulation of piping.
- 3.5.4 Specific job requirement shall be complied with when hot insulation is not given to the flange or valve body because of operating temperature, internal fluid or the requirement of hot bolting, or when some special methods are taken for hot insulation.
- 3.5.5 When thermontrace cement is used as envelope for traced lines. Aluminum foil wrapping is not required to be used. Specific Job Requirements shall be complied with when Thermontrace is used for the trace piping as per the engineering specification L - 101.
- 3.5.6 The extent of the works for personnel protection insulation shall be subject to work condition prescribed in Specification Job requirement given in the engineering specification L - 101. The insulation thickness, when the block or moulded pipe covering is used, shall be the one corresponding to 100<sup>0</sup>C. Also, rock wool insulating material shall be used for the parts with irregular surfaces. In each case the insulation finishing with metal sheets or coating material shall be given in accordance with the shape.
- 3.5.7 Specific Job Requirements shall be complied with for execution of anti-sweat insulation, prevention of freezing etc.

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### 3.6 General Requirements for cold insulation Works

3.6.1 Cold insulation of equipment shall comply with the following requirements: (See Fig.1).

- (1) After surface preparation works have been done as described in Par. 3.4, cold insulation material shall be fixed with adhesive. If foam glass is used, anti-abrasion paste shall be applied as adhesive.
- (2) If the operating temperature is  $-30^{\circ}\text{C}$  or below, non-asphaltic sealing or moisture-proofing materials having enough flexibility at the temperature shall be applied.
- (3) If foam polystyrene material is used, neither high-temperature molten asphalt nor oily mastic of asphalt base shall be used. In this case, adhesive or moisture-proofing material composed mainly of vinylacetate dissolved in alcohol shall be applied.
- (4) If polyurethane material is used one coat of 40 DFT polyurethane primer shall be applied on the steel surface before application of the polyurethane material
- (5) The cold insulation material shall be applied to have close fit to the curved shape of shell and head of equipment without producing gap and be fastened with galvanized or stainless steel bands. The selection of these bands shall be as specified in material specification given in the engineering specification L - 101.
- (6) If the insulation thickness exceeds 75mm, two or more layers shall be applied. The lengthwise and breadthwise joints of the multiple layer insulation shall be staggered each other.
- (7) To the joints of insulation material, sealing material shall be applied for moisture-proofing and air-tightness.
- (8) As auxiliary supports of the insulation materials, bamboo nail, plastic pin or, if necessary, wooden frame may be used.
- (9) On the outside of the insulation material, mastic as a moisture barrier and then lagging cloth of glass cloth as a reinforcement and finally again the mastic shall be applied. In this case, thickness of the primary layer of mastic shall be about 3mm and next layer shall be applied after the primary layer has been dried enough.
- (10) After the mastic layer has been completed, metal sheet jacket shall be applied for finish, except for irregular surfaces, where painting shall be applied over the mastic surface.

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- (11) To prevent infiltration of rain water, longitudinal joints of the jacket shall be "Z" joint and circumferential ones shall have 50mm or more lap length with caulking material filled in.
- (12) When corrugated sheets are used for jacketing, both longitudinal and circumferential joints shall have lap length of 50mm or more, with caulking material filled in.
- (13) As water-proofing measures, throating or application of sealing material shall be made at the parts where supports, lugs and others protrude through the insulation material.
- (14) Cold insulation material shall be applied in such a way that sealing is assured even when gap is produced at the joints due to contraction caused by temperature change.
- (15) For the skirt of equipment, the cold insulation shall be applied in length of four or more times the insulation thickness.
- (16) The metal jacketing shall be fastened with bands and supported by stays in order to prevent slip-down. The selection of the bands shall be as specified in material Specification given in the engineering specification L - 101 .
- (17) For irregular surfaces such as manholes and nozzle flanges etc. combination of formed insulation board and glass wool or rock wool shall be applied to fit to the shape of them and jacketing works shall be done to have moisture/water-proof construction in accordance with Par.3.6.1(8) and (9).
- (18) Cold insulation for the attachments of equipment shall be done in the same manner as for the equipment. For the irregular surfaces, glass wool, rock wool etc. shall be applied to fit to the shape and finish works shall be done in accordance with Par. 3.6.1(8) and (9).

3.6.2 Cold insulation of piping shall comply with IS 7240 and with the following requirement. (See Figs. 2 to 7 )

- (1) Cold insulation materials to be used shall be as specified in material Specification given in the engineering specification L - 101 .
- (2) After surface preparation works have been done as described in Par.3.4, the cold insulation material shall be applied. If foam glass is used, this shall be applied after anti-abrasion paste is applied.
- (3) To the joints of the insulation materials, sealing material shall be applied to assure moisture-proof and air-tight construction.

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- (4) If the insulation thickness exceeds 75mm, two or more layers shall be applied. The joints of the multiple layer insulation shall be staggered each other.
- (5) The insulation material shall be fastened by galvanized or stainless steel wires or bands. The selection of these bands shall be as specified in material Specification given in the engineering specification L - 101 .
- (6) On the outside of the insulation material, mastic as a moisture barrier and then glass cloth as a reinforcement and finally again the mastic shall be applied to have 6mm total thickness of the sandwiched layer. In this case, thickness of the primary layer of mastic shall be about 3mm and next layer shall be applied after the primary layer has been dried enough.
- (7) After the mastic layer has been completed, plain metal sheet jacket shall be applied for finish.
- (8) Longitudinal joints of jacketing shall be "Z" joint and circumferential joints shall be butt strap. Lap length shall be 20mm or more for the former and 50mm or more for the later.
- (9) When corrugated sheets are used for jacketing, both longitudinal and circumferential joints shall have lap length of 50mm or more and shall be fastened with steel bands after applying caulking material.
- (10) The position of "Z" joints in the horizontal piping shall be within 45-0° from the pipe bottom so that rain water can not infiltrate.
- (11) Jacketing of vertical piping shall be equipped with stays to prevent slip-down.
- (12) Sufficient moisture/water-proofing measures such as throating or application of sealing material shall be made at the parts of the jacketing sheets cut out for pipe hangers, pipe shoes etc.
- (13) Cold insulation material shall be applied in such a way that sealing is assured even when gap is produced at the joints due to contraction caused by temperature change.
- (14) For irregular surfaces such as flanges, valves etc. combination of formed insulation board and glass wool or rock wool shall be applied to fit to the shape of them and jacketing works shall be done to have moisture/water-proof construction in accordance with Par.3.6.2(6) and (7).
- (15) If the operating temperature is -30°C or below, non-asphaltic sealing or moisture-proofing material having enough flexibility at the temperature shall be applied.

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(16) If foam polystyrene material is used, high-temperature molten asphalt or oily mastic of asphalt base shall not be used. In this case, adhesive or moisture-proofing material composed mainly of vinylacetate dissolved in alcohol shall be applied.

(17) Cold insulation work for instruments attached to piping shall be done in the same manner as for piping.

### 3.7 Wall Thickness Inspection Holes for Equipment and Piping

3.7.1 The detachable caps on the inspection holes at suitable interval to be provided in the hot insulated parts for the measurement of wall thickness of the equipment or piping shall be so devised that they never fall off nor allow the infiltration of rain water.

3.6.2 As a rule, the size of the inspection holes shall be 100-150 x 100 - 150 mm.

## 4 INSPECTION

### 4.1 Witness Inspection

PMC shall witness the insulation application at all stages & final completion.

### 4.2 Inspection and Test Records

The records of the following inspection and tests shall be submitted.

- (1) Materials Certificate
- (2) Inspection Records of Dimensional Check
- (3) For inspection items not specified in this specification, relevant IS/ASTM shall be applicable.

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#### 4.3 Items, Methods and Acceptance Standard of Inspection.

Items, methods and acceptance standard of tests and inspection shall be as follows:

| Items                | Methods and acceptance Standard  |
|----------------------|--|
| Surface preparation  | The surface shall be inspected visually. There shall be no adhesion of rust, oil, soil/sand, rain water or other foreign matter.   |
| Materials inspection | <p>The following items shall be checked for materials to be used.</p> <p>(a) <b>Materials specification:</b> Materials to be used (insulation materials, jacket plates, wires, bands etc.) shall be checked. These shall be as specified in material Specification given in engineering specification L-101.</p> <p>(b) <b>Thickness measurement:</b> Thickness shall be measured with measuring tools. This shall be as required in the specification.</p> <p>(c) <b>Appearance:</b> Appearance of materials to be used shall be checked visually. There shall be no crack, injury, deformation or moisture absorption.</p> |

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| Items                      | Methods and acceptance Standard  |
|----------------------------|--|
| Inspection during the work | <p>The followings shall be checked visually and with measuring tools, in accordance with the Specification and Drawings.</p> <ul style="list-style-type: none"> <li>(a) Procedure: The procedure of insulation work shall be in accordance with the Engineering Specifications.</li> <li>(b) Thickness: Insulating thickness shall be in accordance with the Specifications and Drawings.</li> <li>(c) Binding: Insulation materials shall be bound securely and firmly.</li> <li>(d) Caulking at joint: Caulking of joint part of insulation material shall be sufficient to leave no gap.</li> <li>(e) Expansion (and contraction) countermeasure: Countermeasure for thermal expansion shall be provided.</li> <li>(f) Staggering of joint: When 2 or more layers are stacked, joints of insulation material shall be staggered.</li> <li>(g) Fixing wire: Material and size of steel wire shall be in conformity with the Specification.</li> <li>(h) Lap length: For work using moisture-proofing sheet, its lap length at longitudinal and circumferential joints shall be 30mm or more.</li> <li>(i) Jacketing material: Material and thickness of jacketing sheet shall be in conformity with the Specification.</li> <li>(j) "Z" joint and lap length of jacket: Position of "Z" joint and lap length shall be as specified.</li> </ul> |

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Inspection after measuring completion of works

The followings shall be checked visually and with tools, in accordance with the Specifications and Drawings.

- (a) Penetrated part of insulating material: Water-proofing shall be enough there.
- (b) Insulation around flanges. Valves etc: Insulation material with suitable water-proofing shall be applied correctly around them.
- (c) Insulation thickness: The thickness tolerance shall be within -3mm of the design thickness.
- (d) Appearance of jacketing: There shall be no loose part, no extreme cave-in or injury.
- (e) Termination treatment: Water-proofing shall be enough, particularly check whether enough length of insulation at skirt or support is taken or not.