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STEAM TURBINE BLANKET INSULATION SPECIFICATION

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1. General

The turbine insulation restrains the heat flow which results from the temperature differences due to convection and radiation between conductive medium or materials.

It prevents excessive heat losses from the equipment carrying steam or hot condensate; it furthermore protects against heat radiation and physical damage when touching the turbine.

During cooling down of the casings the insulation prevents inadmissible thermal stresses and subsequent asymmetrical distortion by reducing the wall temperature gradients of the insulated parts.

The selection and method of application of the insulation material comply with the specifications and instructions of the supplier.

- **The following applies principally:**
- **Material containing asbestos is forbidden**

In general there are two types of insulation and method of application:

- ◆ Spray insulation (not content of this specification see GMD0998777)
- ◆ **Re-usable insulation (matter of this specification)**

Re-usable insulation, consisting of blankets has the advantage of producing less dirt and dust during overhauls. Drying of the insulation which prolongs the time required for overhaul is not necessary.

Removable blankets are to be used to insulate piping, fittings, valve and turbine casings and equipment that requires periodic maintenance.

The blankets are typically prefabricated off-site based on dimensions given in the turbine casing drawings and verified by field measurements. All blankets must fit with no resulting air gaps or compression of the insulation. This is strictly monitored and adhered to in order to maintain the thermal effectiveness of the insulation system. The removable blankets are to be constructed so as to be easily installed and removed without special tools or skills.

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2. Definition of terms

2.1 Hot face

The surface of a blanket that is in direct contact with the surface being insulated

2.2 Cold surface

The surface of a blanket that is in direct exposure to ambient conditions.

2.3 Insulation filler

The thermal insulation material enclosed by the hot and cold face materials.

2.4 Parting line

The edges of a blanket that butt together when it is installed

2.5 Terminal ends

The edges of a blanket that are drawn around adjacent insulation, penetrations, supports, valve seams, tracers ,etc.

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2.6 Seams

Method of joining hot face and cold face materials (see detailed drawings for example)

2.7 Windflap

Overlapping lap of cold face material which is drawn around adjacent insulation to reduce possibility of water entry.

2.8 Gusset

Usually a separate piece of hot face material joining the hot face and cold face materials to assure full thickness of insulation filler at edges.

2.9 Lacing hooks

Special stainless steel disk with integral hook secured through blanket with a stainless steel pin and speed clip.

3.0 Materials

3.1 Insulation filler

The insulation materials have to be asbestos free and suitable to fulfill the defined requirements. The choice of materials are in charge of the supplier according to specification and thermal requirements.

3.2 Mounting hardware

All fasteners, washers, pins, clips, lacing hooks and lacing wire shall be stainless steel type.

3.3 Hot / cold enclosure material

In charge of supplier according to thermal and handling requirements (asbestos free)

3.4 Fabrication material

In charge of supplier according to thermal and handling requirements (asbestos free)

4.0 Identification tags and location drawing

Blankets shall be provided with permanent identification tags bearing the fabrication company's name and address, location and description of fitting, pattern number or other number which will allow the fabrication company to construct a new blanket without field measurements.

Three (3) sets of location drawings with locations for permanent and removable blankets identification numbers for the entire turbine and turbine valve insulation shall be provided.

Three (3) sets of drawings of each removable blanket indicating details of shape, size, thickness, tag number, material, etc. shall be provided.

5. Insulation of turbine and valve casings

5.1 Blanket design

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Blankets shall be custom designed and constructed for each individual item to be insulated. A close, conforming fit with **no gaps** at the seam is required. Close attention to penetrations, supports, tracers, etc. is important to minimize water entry.

Blankets shall be designed to overlap the adjacent insulation. The parting line of the blankets shall be designed at the low point to allow for drainage in the event of a leak.

Blankets are to be one-piece construction whenever possible. Large, thick or heavy blankets shall be fabricated with the appropriate heavier and stronger fabrics. If the finished blanket is heavier than 40 lb.(18kg) , it shall be fabricated in two pieces.

Blankets which will be subjected to mechanical or field abuse or which must be removed and installed frequently (blankets around the main stop, inlet and extraction control valves) will be fabricated using stainless steel wire mesh covering entire blanket.

Design of blankets must provide "boxed" edges to assure full thickness of insulation throughout the blanket.

5.2 Thickness calculation

The insulation supplier provides the complete thermal insulation of the turboset according to the drawing and part list "THERMAL INSULATION". The drawing and the part list are provided during the offer phase or when placing the order. This documents contain the specific order information according to the customer specification and the thermal requirements. The choice of the insulating material and the calculation of the insulation thickness are the duties of the insulation supplier who must accept full responsibility. If the **ALSTOM** insulation drawing contains data on the insulation thicknesses, they are for internal information only and not binding for the insulation supplier. The insulation thickness shall be chosen so that the heat loss do not exceed 79BTU/sq.ft./h. (250W/m²) based on the hot metal temperatures indicated on the applicable insulation drawing. The calculation of the insulation thickness can be based on an ambient temperature of 86°F (30°C). The temperature difference between ambient air and insulation surface does not exceed 36°F (20 °C) for an air velocity of 1mph..

Note: The lower turbine casing is to receive 20 % more insulation thickness than the upper casing.

The **ALSTOM** design department have to be informed in writing (entry in the table on drawing " Turbine insulation") of the thickness of the insulation.

5.3 Fabrication

5.3.1 Sewn blankets

Blankets are to be sewn inside out on all but one edge using parallel rows of lock stitching. The enclosure shall be turned outside out and the insulation filler material shall be fitted between the hot face and the cold face material. A closing seam or outside bound seam shall be used to complete the enclosure. Straps if required shall be located in such a way as to provide complete closure of the parting line and prevent the blanket from sagging.

Lacing hooks and quilting fasteners are to be secured to the blanket using "T" pins and speed clips. Excess pin length shall be cut off and remaining point turned 180°.

5.3.2 Hog ringed blankets

Blankets are to be fabricated using stainless steel hog rings. Edges of hot face and cold face materials shall be rolled and stapled every 1' (25mm) on center so no raw edges protrude, lacing hooks and quilting fasteners installed same as sewn blankets.

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5.4 Installation

Prior to installing any blankets, all cavities must be filled with loose tempmat material. For example: around and between all turbine casing bolts and valve bonnet bolts.

The turbine casing bolts must be protected from loose fill getting into the threads of the bolts (e.g. bolts with socket cap nuts where an opening in the nut would allow loose insulation to make contact with threads). Heat resistant aluminum foil or metal cladding (insulation lagging sheet metal) will be used to effectively close the openings and keep loose insulation out.

First blanket finished with stainless steel mesh shall be installed with all seams butted firmly together avoiding any cracks, the second layer blanket finished with fabric shall be installed in such a manner that they cover (overlap) all seams of the first layer blanket.

Both the fabrication and installation must be done using great care to eliminate all voids and open cavities.

An air space will be maintained at all bearing pedestals between the turbine casings and the bearing pedestals (see appendix 9.4). The air gap is required to allow gland steam to escape to atmosphere and not enter the bearing cavity in the event of a leak by. Special care must be taken when designing and applying blankets to this area to maintain at least 0.5" (12mm) air gap between the insulation cold face (outer surface) and the bearing cover/pedestal.

Insulation at the bearing pedestals will be performed in such a manner to allow a vertical lift of the bearing cover without interference from the insulation blankets on the turbine casings. A removable blanket may be fabricated and applied to allow the "no interference" lift of the bearing cover.

The split line insulation must be removable without affecting the integrity of the upper and lower casing.

Note: Avoid air gaps between casing lower part and insulation (sagging of insulation due to weight)

Dependent on the turbine or valve type there are two fastening possibilities for holding pins:

Variant 1 Discs welded to casing surface

Variant 2 Threaded holes (M10) on casing surface

The welded discs and threaded holes will be provided by **ALSTOM**

For Var1. weld pins to be welded to the discs to support the permanent and the removable blankets. See appendix 9.6

Material of discs ST37-2 (A245Grade B , C)

For Var 2. The holding pins shall be screwed into the M10 threaded holes to support the permanent and the removable blankets . See appendix 9.6

Pins are in the scope of the Insulation Blanket supplier . See appendix 9.6.3

LP- and admission steam valves, which are not **ALSTOM** design don't have any fastening possibilities for holding pins.

In this case a suitabel, equivalent fastening substructure, for example with metall strips shall be made.

Note: No welding is allowed on the turbine and turbine valve casings, except on the factory installed discs

A degree of prefabrication of the blankets must be 90% of the hole delivery scope, as a minimum. Only 10% fitting work at site is allowable in maximum. A detailed description of necessary fitting work is required.

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6. Insulation of internal pipes (if applicable)

6.1 Steam inlet pipes (turbine internal pipes)

The variant to be used when installing the thermal insulation is indicated on the drawing. The pipes will be provided with insulation made of mats on wire mesh or blankets.

When using mats or blankets at least two (2) layers shall be fitted with staggered joints.

When using mats a jacket of galvanized steel or aluminium sheet shall be provided to cover the insulation.

The insulation must be easily removable in the region of pipe flanges.

6.2 Cross over pipes

The LP-cross over pipes will be provided with insulation made of mats on wire mesh. At least two (2) layers shall be fitted with staggered joints. Mats shall be fixed by means of steel tape.

As a final step the piping shall be covered with a jacket of 1mm (0,04") galvanized steel or aluminium sheet. Deviate particulars to compare in drawing or part list.

The jacket of the cross over pipe shall be fixed to the pipe with supports.

The wire netting mats shall be installed with staggered joints in between the supporting structure, and fastened by means of the mat hooks.

The bellow expansion joints and flanged joints shall be provided with removable sheet – metal caps.

The insulation thicknesses for these caps are similar to those of the respective pipes.

7. Remarks for outdoor arrangement

For outdoor installation the turbine parts which are located above the foundation floor are usually protected with a sound/weather enclosure.

The turbine parts which rise underneath the foundation floor are not protected.

Climatic conditions e.g.wind can lead to a different heat flow at the upper and lower part of the turbine.

To avoid negative effects on the turbine additional measures have to be taken: e.g. an additional wind tight layer of blankets at the lower part of turbine.

8. Additional data on drawing and part list " Thermal insulation"

In addition to this specification some order specific information are given in the drawing and part list "Thermal insulation"

The important data are:

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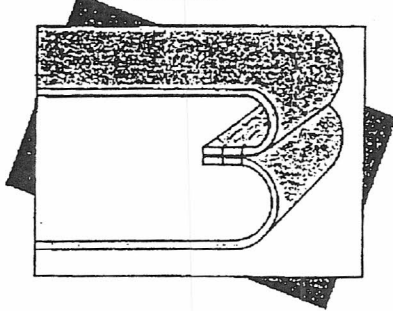
- ♦ Layout of turbine
- ♦ Temperature values and areas where these temperatures occur
- ♦ Arrangement information: Indoor/ outdoor
- ♦ Climatic conditions: ambient temperature, wind loading
- ♦ Type of insulation for turbine parts given by position
- ♦ Necessary detail information (if applicable)
- ♦ Material specification for jacket sheets (if applicable)
- ♦ Deviations from this specification
- ♦ Variant for fastening points on turbine casings.(see appendix 9.6)
- ♦ Test plan

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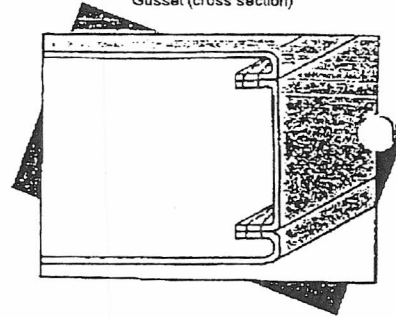
9. Appendix

9.1 Example of seams construction

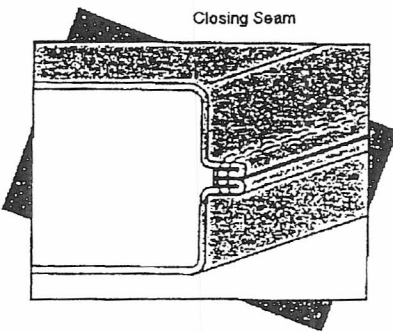
Inside Seam



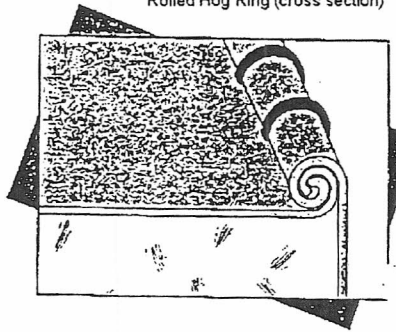
Gusset (cross section)



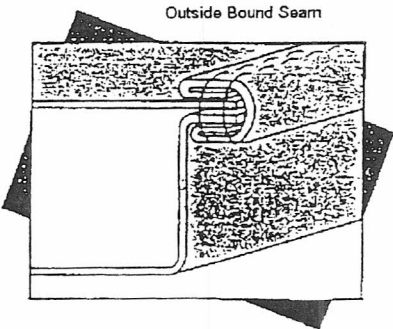
Closing Seam



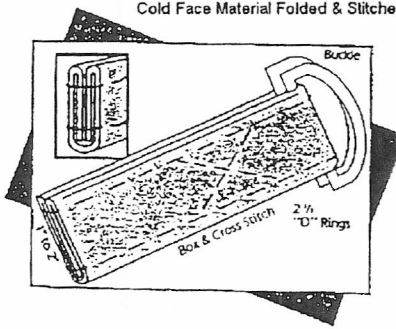
Rolled Hog Ring (cross section)



Outside Bound Seam



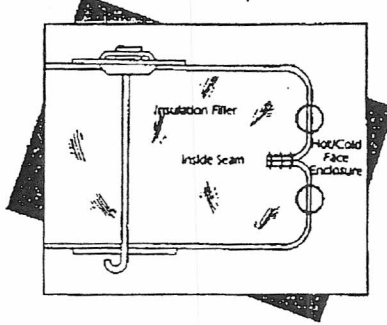
Strap Construction
Cold Face Material Folded & Stitched



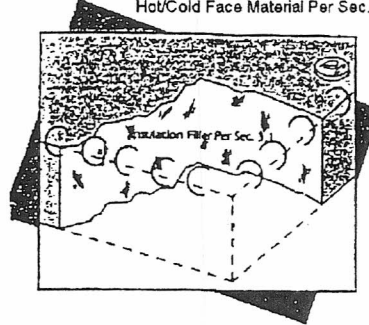
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9.2 Construction for applications up to 500°F (260°C)

Thickness per Sec. 4.1.1

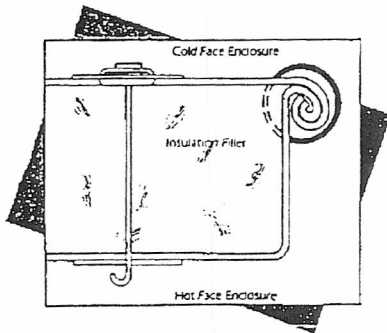


Hot/Cold Face Material Per Sec. 3.2

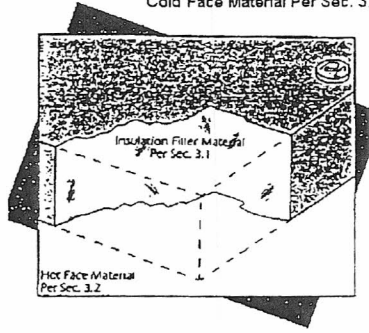


9.3 Construction for applications from 500°F (260°C) up to 1800°F (980°C)

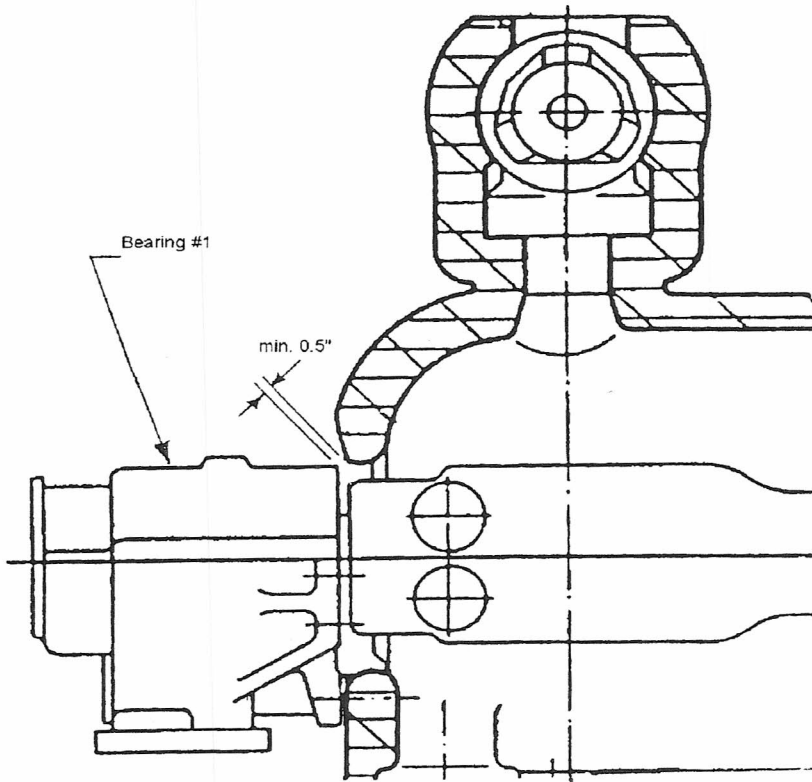
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Cold Face Material Per Sec. 3.2



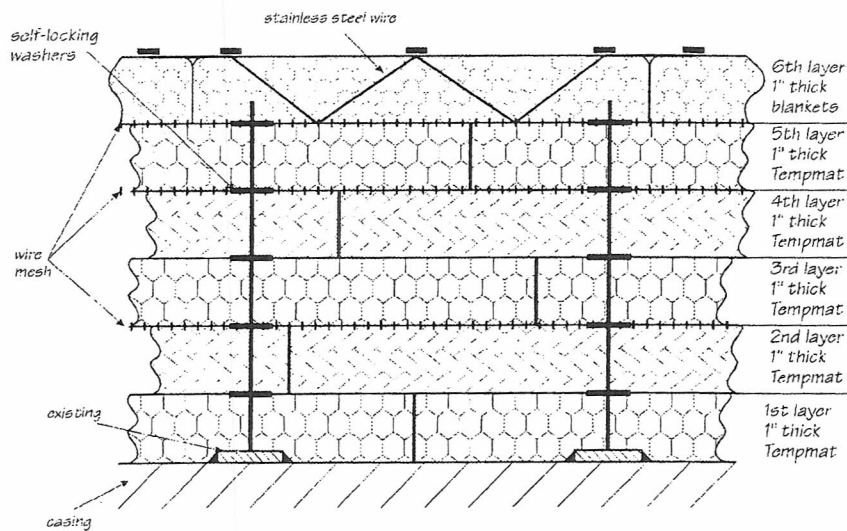
9.4 Maintaining air space at all bearing pedestals



Example: Front bearing pedestal

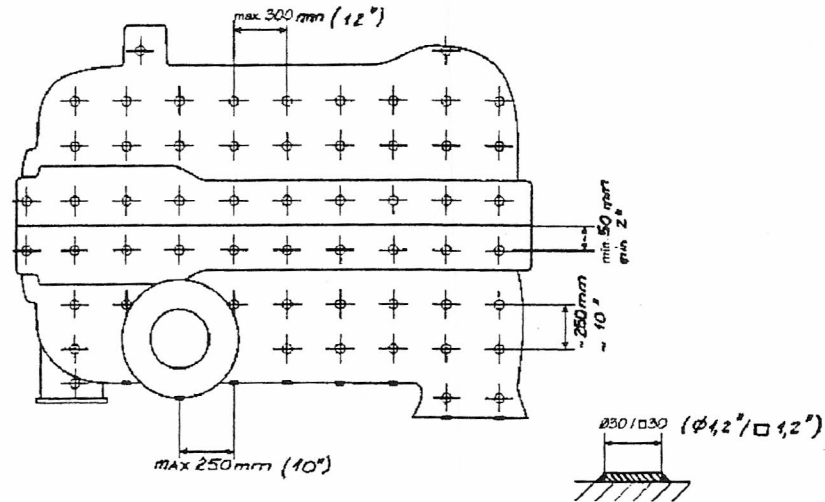
9.5 Permanent insulation (example)

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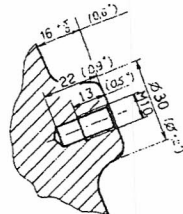
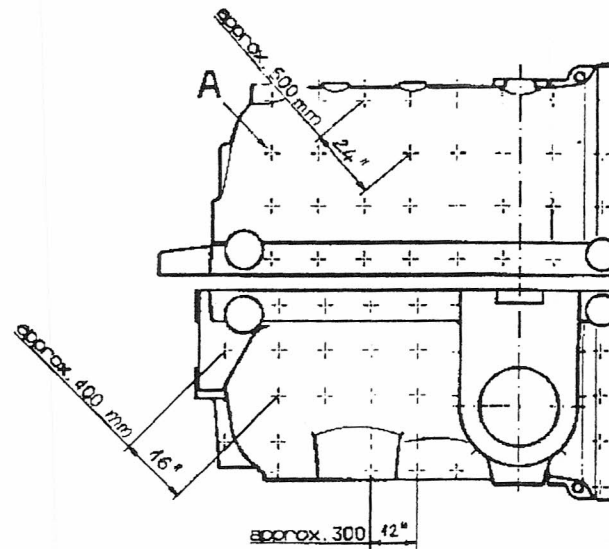


9.6 Placement of studs

9.6.1 Variant 1: welded discs

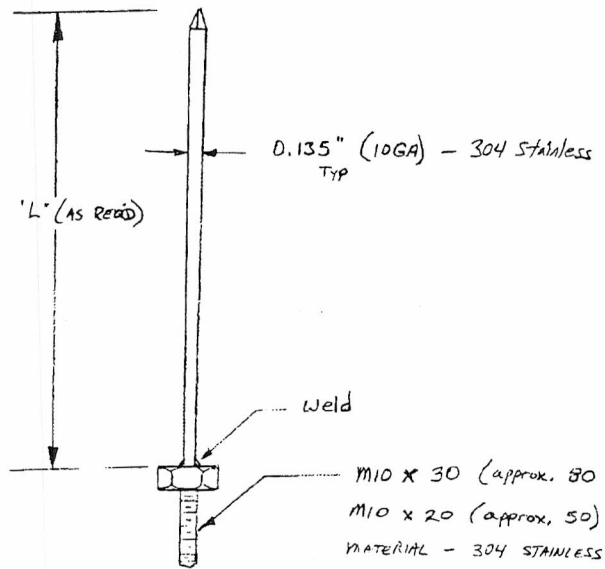


9.6.2 Variant 2: threaded holes

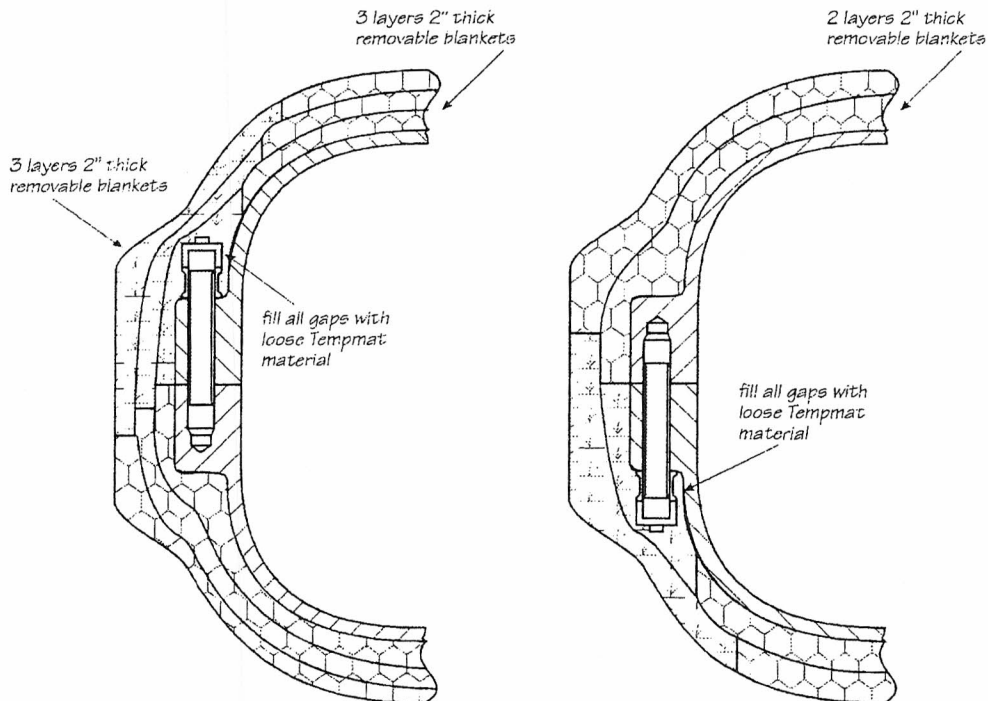


9.6.3 Pins

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9.7 Insulation of flanges



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