

Standard specification of thermal insulation for piping

1. Scope This Japanese Industrial Standard specifies design and application standards of thermal insulation for exhaust gas piping and smoke ducts in engine room, general piping, heat trace piping and tanks, and antisweating for ventilating air ducts in ships.

Remarks: 1. General piping means steam piping, lubricating oil piping, fuel oil piping, thermal medium piping and hot water piping.

2. Exhaust gas piping and smoke ducts include those provided in a funnel stack.

2. Reference standards The following standards form part of the requirements of this Standard when quoted. The latest edition of these standards shall be applied.

JIS A 9504	Man made mineral fibre thermal insulation materials
JIS G 3302	Hot-dip zinc coated steel sheets and coils
JIS G 3313	Electrolytic zinc coated steel sheets and coils
JIS R 3414	Textile glass fabrics

3. Design standards

3.1 Scope Thermal insulation shall be applied to piping in which the temperature of internal fluid is 60°C or more, and antisweating, to areas subjected to deterioration by falling dew condensation except for cooling fresh water piping.

3.2 Temperature condition The thickness of heat insulating material shall be designed under the temperature condition that the surface temperature of heat insulating material assumes 55°C when the temperature of the engine room is 35°C.

3.3 Equation of calculation of thickness of heat insulating material The thickness of heat insulating material shall be determined by the following equations:

$$Q = \frac{2\pi(\theta_o - \theta_r)}{\frac{2}{\alpha \cdot d_1} + \frac{1}{\lambda} \ln \frac{d_1}{d_o}} = \frac{\pi \cdot (\theta_o - \theta_r)}{\frac{1}{\alpha \cdot d_1}} \quad (\text{Basic equation})$$

$$d_1 \cdot \ln \frac{d_1}{d_o} = \frac{2\lambda}{\alpha} \cdot \left(\frac{\theta_o - \theta_s}{\theta_s - \theta_r} \right) \quad (\text{Applied equation 1})$$

$$d_1 \cdot \ln \frac{d_1}{d_o} \geq \frac{-2\lambda}{\alpha} \cdot \left(\frac{\theta_o - \theta_s}{\theta_s - \theta_r} \right) \quad (\text{Applied equation 2})$$

where

- Q : heat transmission (W/m)
- d_o : inside diameter of heat insulating material (m)
- d_1 : outside diameter of heat insulating material (m)
- λ : heat transfer coefficient of heat insulating material (W/mK)
- α : heat transfer coefficient at surface (W/m²K) ($\alpha = 11.63$)
- θ_o : internal temperature (°C)
- θ_r : external (room) temperature (°C)
- $\ln$: natural logarithm
- θ_s : surface temperature of heat insulating material (°C)

- Remarks:**
- The left-hand side of the basic equation shows the heat transferred to the pipe surface from the inside of the pipe, whereas the right-hand side shows the heat radiation due to thermal conduction between the engine room and heat insulating material.
 - Applied equation 1 is a modified version of the basic equation.
 - In determining the thickness of heat insulating material, the left-hand side value (for each outside diameter of pipe and for each thickness of heat insulation material) and the right-hand side value of applied equation 2 shall be determined, the values of the left-hand side and the right-hand side thus determined shall then be compared, and the thickness shall be determined on the basis of the left-hand side value satisfying the conditions that the left-hand side value > the right-hand side value and that they are approximately equal.

4. Materials

4.1 Classification of heat insulating materials The classification and application of heat insulating materials shall be as given in Table 1.

Table 1 Classification of heat insulating materials

Classification	Material
Rockwool heat insulation board Rockwool heat insulation sleeve	JIS A 9504 - Rockwool
Glasswool heat insulation board Glasswool heat insulation sleeve	JIS A 9505 - Glasswool

Remark: Heat insulating material shall, as a rule, be manufactured by using rockwool and glasswool, but alternative materials may be used if they are considered to have equivalent heat insulating effects.
No asbestos materials shall be used.

4.2 Classification of covering materials Covering materials of thermal insulation shall be classified as given in Table 2.

Table 2 Classification of covering materials

Classification	Material
Hot-dip zinc-coated steel sheets and coils	JIS G 3302 - Hot-dip zinc-coated steel sheets and coils
Electrolytic zinc-coated steel sheets	JIS G 3313 - Electrolytic zinc-coated steel sheets
Glass cloth	JIS R 3414 - Glass cloth
Glass cloth lined with aluminium foil	—
Canvas cloth	JIS L 3102 - Cotton canvas

Remark: Covering materials for thermal insulation shall, as a rule, be as given in the table, but alternative materials may be used if they are considered to have equivalent effects.

5. Standard practices of work

5.1 Standard practices of work by service application The application standards shall, as a rule, be as follows:

It is recommended that the thickness of each heat insulating material should be determined in accordance with Tables 4, 5, 7, 8, 9 and 10.

(1) **Insulation of exhaust gas piping and smoke ducts** The application areas and the materials of thermal insulation for exhaust gas piping and smoke ducts shall be as given in Table 3 and Fig. 1.

Remark: 1. The thickness of insulation materials shall be determined in accordance with Table 4.

2. The thickness of insulation materials are determined in accordance with Table 4, but for other insulation materials applying the calculation formula as set in 3.5.

(2) **Thermal insulation of general piping** The areas of application and heat insulating materials for general piping shall be as given in Table 4 and Fig. 2. It is recommended that the thickness of heat insulating material shall be as given in Table 4.

Table 3

Area of application	Material applied
Pipe	Thermal insulation material
Flange	Thermal insulation material
Valve	Thermal insulation material

Table 3 Work area and materials

Areas of application		Material	
		Heat insulating material	Covering material
Piping	Up to funnel deck	Rockwool heat insulating board	Hot-dip zinc-coated steel sheets and coils or electrolytic zinc-coated steel sheets
	Within funnel stack (Up to a height of 2 m above funnel deck)	Rockwool heat insulating sleeve	Glass cloth
Flange joints		Rockwool heat insulating board	Glass cloth lined with aluminium foil or glass cloth

- Remarks:
1. Since the thickness of heat insulating material is calculated on the basis of the case where rockwool is used, thickness of heat insulating with other materials shall be calculated by using the calculation equation shown in 2.3.
 2. The heat insulating material shall be lashed securely to prevent it from falling apart.
 3. Hexmeshed wire nets may not necessarily be applied.
 4. No thermal insulation may be applied to areas within a funnel stack above the height of 2 metres or more from funnel deck.

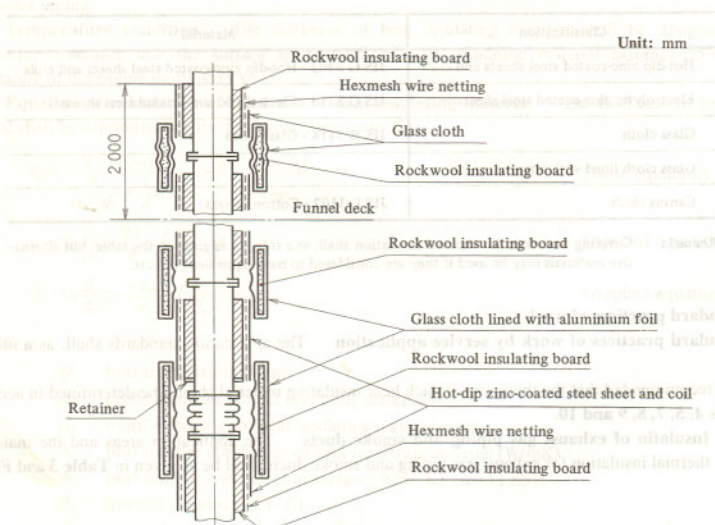


Fig. 1