

Technical Specification

ST 14 MM0005 Technical Specification for Thermal Insulation

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1 General

The purpose of these stipulations is to define the general requirements for insulation of piping, tanks, and equipment.

Instructions in ISO 13732-1 shall be considered for safety insulation of equipment. See Table ZB.1 for correspondence between ISO 13732-1 and Directive 2006/42/EC. Safety procedure/protection to be defined, in case insulation is not applicable due to technology or other constraints. Supplier responsibility is to ensure that there are no sharp edges on the insulation cladding, which may cause safety risk for personnel.

This specification does not leave suppliers and their sub-suppliers without responsibility for the correct choice of the insulation materials and thicknesses based on the process and climatic conditions.

2 Reference standards

ST 04 MG0001	General Mill Standards
ST 04 MG0002	Units to be used
2006/42/EC	Machinery Directive
EN 10088-2	Stainless steels. Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes
ISO 13732-1	Ergonomics of the thermal environment. Methods for the assessment of human responses to contact with surfaces. Part 1: Hot surfaces
ISO 13732-3	Ergonomics of the thermal environment. Methods for the assessment of human responses to contact with surfaces. Part 3: Cold surfaces
EN ISO 12241	Thermal insulation for building equipment and industrial installations. Calculation rules.

3 Piping insulation, tanks, equipment

In order to prevent economically significant heat losses, economical thermal insulation is normally employed on piping, tanks and equipment with an operating temperature of over 50 °C and outdoor operating temperature of over 30 °C.

Maximum allowable temperature loss of the insulated surface is 120 W/m² outdoors and 135 W/m² indoors. The heat loss calculations are based on EN ISO 12241.

Protective insulation shall be used in applications where the surface temperature will exceed +50°C, in the area of possible contact.

3.1 Pipelines indoors (insulation class IN)

Insulation materials shall be selected according to chapter 3.7. Maximum allowable temperature loss of the insulated surface is 135 W/m². Minimum insulation thicknesses shall be according to Table 1 below. Thicker thicknesses can be used for example if needed covering the supports. For temperatures >350°C a special calculation of thickness and design of insulating material shall be made.

Table 1. Minimum insulation thicknesses. Indoors.

Pipe size		Temperature of contents (°C)					
DN	do, mm	50-100 °C	101-150 °C	151-200 °C	201-250 °C	251-300 °C	301-350 °C
15	21,3	30	30	40	50	70	80
20	26,9	30	30	40	50	70	90
25	33,7	30	30	40	60	70	90
32	42,4	30	30	40	60	70	90
40	48,3	30	30	40	60	80	100
50	60,3	30	30	50	60	80	100
65	76,1	30	40	50	70	80	110
80	88,9	30	40	50	70	90	110
100	114,3	30	40	50	70	90	120
125	139,7	30	40	50	70	90	120
150	168,3	30	40	60	80	100	130
200	219,1	30	40	60	80	100	130
250	273	30	40	60	80	110	140
300	323,9	30	40	60	90	110	140
350	355,6	30	40	60	90	110	150
400	406,4	30	40	60	90	110	150
450	457	30	40	60	90	120	160
500	508	30	40	60	90	120	160
600 - Plane		60	80	100	120	160	190

≥ at least two insulating material layers

Insulation thicknesses in Table 1 based on the following presumptions:

- Outer surface temperature max 50°C
- Ambient temperature 25°C
- Maximum temperature loss per 1 m² of the surface 135 W/m²

In case Supplier substitutes the prescribed insulation material the max allowable thermal loss shall comply with the prescribed values and overall thickness of the insulation material shall not exceed figures in the respective Tables.

3.2 Pipelines outdoors (Insulation class OU)

Insulation materials shall be selected according to chapter 3.7. Maximum allowable temperature loss of the insulated surface is 120 W/m². Minimum insulation thicknesses shall be according to Table 2 below. Thicker thicknesses can be used for example if needed covering the supports. For temperatures >350°C a special calculation of thickness and design of insulating material shall be made.

Table 2. Minimum insulation thicknesses. Outdoors.

Pipe size		Temperature of contents (°C)					
DN	do, mm	50- 100 °C	101- 150 °C	151- 200 °C	201- 250 °C	251- 300 °C	301- 350 °C
15	21,3	30	40	50	70	80	90
20	26,9	30	40	50	70	80	100
25	33,7	30	40	50	70	90	100
32	42,4	30	40	50	80	90	110
40	48,3	30	40	60	80	90	110
50	60,3	30	50	60	80	100	110
65	76,1	30	50	60	80	100	120
80	88,9	30	50	60	90	100	130
100	114,3	40	50	70	90	110	130
125	139,7	40	50	70	90	110	140
150	168,3	40	50	70	100	120	140
200	219,1	40	50	70	100	120	150
250	273	40	60	70	100	130	150
300	323,9	40	60	80	110	130	160
350	355,6	40	60	80	110	130	160
400	406,4	40	60	80	110	130	160
450	457	40	60	80	110	130	180
500	508	40	60	80	110	140	180
600 - Plane		60	80	100	130	180	200

≥ at least two insulating material layers

Insulation thicknesses in Table 2 based on the following presumptions:

- Outer surface temperature max 50°C
- Ambient temperature -18°C
- Maximum temperature loss per 1 m² of the surface 120 W/m²

In case Supplier substitutes the prescribed insulation material the max allowable thermal loss shall comply with the prescribed values and overall thickness of the insulation material shall not exceed figures in the respective Tables.

3.3 Pipelines, insulation against condensation (Insulation class CO)

Insulation against condensation shall be used if the temperature of the surface is lower than the ambient temperature, e.g. cold-water pipelines. The aim of this insulation is to avoid problems caused by condensation.

Cellular rubber FEF shall be used in pipelines and equipment needed to be insulated against condensation. The thickness of insulation shall be 25 mm. Valves and flanges shall be insulated against condensation with cellular rubber casing.

3.4 Piping insulation, electric tracing (Insulation class FR)

Pipelines to be equipped with electric tracing shall be specified separately. Typically, pipelines that might freeze shall be heat traced.

The same insulation and cladding materials and thickness as for insulation class OU see chapter 3.2.

3.5 Pipelines protective insulation (Insulation class SI)

Protective insulation shall be used in applications where the surface temperature is > 50 °C and surface is in the area of possible contact, unless otherwise stated in the Contract or in the drawings. Exceptions needs to be separately agreed. The need for safety insulation is assessed according to ISO 13732 and local laws and regulations shall be followed.

Insulation materials shall be selected according to chapter 3.7.

The minimum insulation thickness for protective insulation shall be according to Table 3. Thicker thicknesses can be used for example if needed covering the supports.

Table 3. Minimum insulation thicknesses. Protective insulation.

Pipe size		Temperature of contents (°C)				
		≤ 150 °C	≤ 250 °C	≤ 350 °C	≤ 450 °C	≤ 500 °C
DN	de, mm					
15	21,3	30	40	60	100	100
20	26,9	30	40	80	100	120
25	33,7	30	40	80	100	120
32	42,4	30	50	80	120	140
40	48,3	30	50	80	120	140
50	60,3	40	50	80	120	140
65	76,1	40	50	100	140	160
80	88,9	40	60	100	140	160
100	114,3	40	60	100	140	180
125	139,7	40	60	120	160	180
150	168,3	40	80	120	160	200
200	219,1	40	80	120	180	200
250	273	40	80	140	180	220
300	323,9	40	80	140	180	220
350	355,6	40	80	140	200	220
400	406,4	40	80	140	200	240
450	457	40	100	140	200	240
500	508	40	100	160	220	260
600	610	40	100	160	220	260
700	711	60	100	160	240	280
800	813	60	100	180	240	280
900	914	60	100	180	260	300
1000	1016	60	120	180	260	300
1000 - Plane		60	120	200	260	300

Insulation thicknesses in Table 3 based on the following presumptions:

- Outer surface temperature max 50°C
- Ambient temperature 20°C
- Wind velocity 0 m/s
- The emissivity of covering material 0,1

It is Supplier (designer who define insulation thicknesses to drawings) responsibility to ensure (and increase insulation thickness if needed) that insulation is thick enough to meet the surface temperature requirements by local laws and regulations.

3.6 Valve, flanges and instruments

Valves shall be covered with pipe insulation and valve stem shall be provided with a cut-out.

The insulation material of valve and flange boxes is rock wool wired mat. Insulation materials according to chapter 3.7. The insulation thickness shall be minimum same as pipe insulation thickness defined above in tables 1, 2 or 3.

Valves, flanges and instruments shall be equipped with removable boxes with latches. The latches shall be of stainless steel. Box material shall be same as corresponding pipe cladding. Box material thicknesses are defined in the chapter 3.8. Box modules shall be dimensioned for manhandle installation and removal.

Normal fixing by concealed riveting but when electrical traced, cladding materials shall be fixed using sheet screws. Special attention shall be paid to watertight jointing of the insulation cladding.

3.7 Insulating Materials

Insulating material shall be mineral wool, Insulation material shall be chemically indifferent and non-sulfurous and slightly alkaline. It is also water and water steam resistant. Moreover, it resists decay and it does not mold. Insulation for temperature above 500°C shall be designed case by case. Density of insulation material shall be:

- min 80 kg/m³ for surface temperature up to 350°C
- min 100 kg/m³ for surface temperature above 350°C

Preformed mineral wool sections shall be used for pipe insulation.

Elbows DN < 400 shall be insulated with segments cut from preformed mineral wool pipe sections. Elbows DN > 400 shall be insulated with Prefabricated mineral wool elbow sections.

Two insulating material layers shall be used when temperature is over 250 °C and insulating thickness is over 120 mm.

It is recommended to use 1st layer from sibril and rest in rock wool when the temperature is above 350°C.

For small tanks (diameter < 3000mm) mineral wool wire net mat shall be used. For bigger tanks mineral wool slab shall be used.

In walk-on areas of tank, ducts and equipment, e.g. roofs, mineral wool slabs with a loading capacity of at least 12 kN/m² is used.

3.8 Cladding

Cladding materials shall be aluminum sheet. If corrosive conditions required stainless steel material 1.4307 or 1.4404 shall be used.

Minimum recommended thicknesses of aluminum sheet:

Pipes	DN \leq 300	thickness 0.60 mm
	DN \leq 800	thickness 0.80 mm
	DN > 800 and plane	thickness 1.0 mm

Valve and flange boxes thickness 1.0 mm

For corrosive conditions insulation cover material shall be austenitic steel sheet 1.4307 or 1.4404 of minimum recommended thicknesses:

Pipes	DN \leq 500	thickness 0.50 mm
	DN > 500 and plane	thickness 0.80 mm

Valve and flange boxes thickness 1.0 mm

The seam joints of the cladding shall be waterproof and thermal expansion shall be taken into account. Minimum overlaps are:

Bodies:

- cylindrical the min. overlap for longitude and circumferential joints is 80 mm
- other the min. overlap for longitude and circumferential Joints is 50 mm.

Pipelines:

- min. 80 mm overlap in longitudinal connections
- min 20 mm overlap in circumferential connections

4 Insulation of tanks and equipment

The insulation materials are presented in chapter 3.7.

If the tank manufacturer has not extended the roof of the tank over the tank wall insulation, the Supplier shall design the implementation. The purpose is to protect tank wall insulation against water in case of leakage in the roof structure.

Sampling and impulse line piping shall be equipped with detachable inspection doors.

5 Insulation work

Insulation work shall follow the local mill practices, instructions and specifications. For details of the type not specified in the abovementioned standards, work methods and quality requirements generally followed in insulation field are to be complied with. The Contractor is obligated to deliver the description, and if needed also the drawing of the deviation in working method to the supervisor of the Purchaser for approval before the insulation work. If local

mill instructions are not available Supplier shall propose insulating system, including detail solutions, for Purchaser's approval.

Areas with a surface temperature that exceeds the average temperature of the application by more than 10 °C may comprise a maximum of 0,5 % of the total insulated area. The temperature is measured 1 meter distance from the object.

Thermal expansion and the breaks in heat flow must be taken into consideration in all piping, tanks, channels, boiler and equipment according to abovementioned standards.

For cutting of plastic coated sheets, no methods, such as cutting wheels, that result in the sheet temperature of more than 100 °C are not allowed, even if the cut is to be finished with plate shears, since a jet of sparks will damage the surroundings and the coating.

A Ø 10 mm hole shall be made in the center of the chamber in steam trap boxes for leak testing.

Welded, sleeved valves DN < 100 are insulated by making a required cut-out in the preformed pipe insulation whereby the insulation of the pipe extends over the valve. The valve stem shall be provided with a cut-out if necessary.

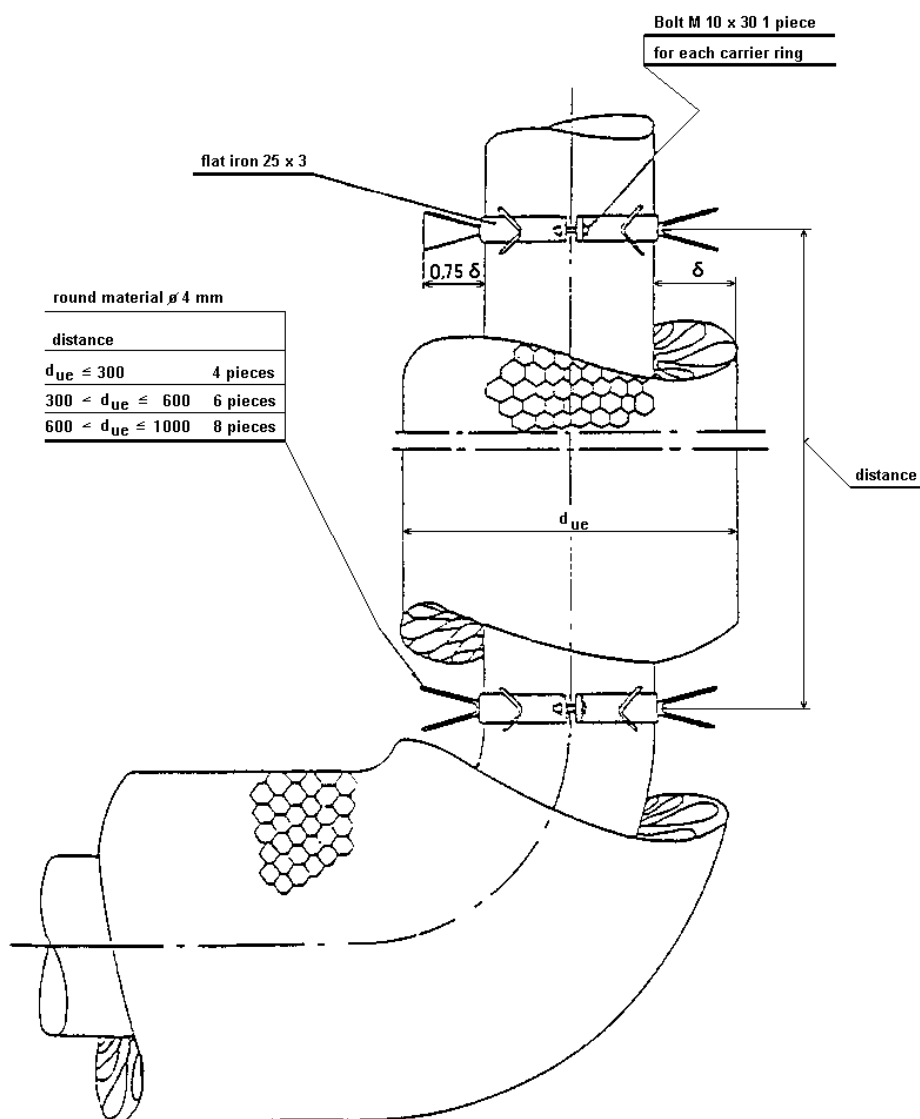
Mud separators and similar parts are insulated in the same way as valves. Small, sequential high-pressure valves are insulated in the same box if possible.

Pipe support clamps shall be covered and locally extended insulation thickness shall be used if necessary.

Expansion elements allowing movement of ducts and insulation must be installed on all hot pipes, channels, equipment, and boiler at suitable intervals. The flue breaks must be installed at suitable intervals for the hot objects such as boiler and channels according to the temperature of the object to avoid the thermal flow.

The sagging of insulation in vertical pipes must be prevented for example according to the Figure 2 below using work methods and quality requirements generally followed in insulation field. The Contractor is obligated to deliver the description of the deviation in working method to the supervisor of the Purchaser for approval before the insulation work. Material of carrier ring shall be Hot dip galvanized when temperature is < 300°C.

Figure 2 Insulating carrier ring



With pipes $DN \geq 200$ and $T_s < 250$ °C single tongue-and-groove joints shall be used. When $T_s > 250$ °C and $s > 120$ mm two courses of insulation grooves overlapped to be used.

Penetration of insulated pipes through walls and roofs shall follow the local mill practices and instructions. The Contractor is obligated to deliver the description and if needed also the drawing of the missing parts to the supervisor of the Purchaser for approval before the insulation work.

Preformed pipe insulation with a maximum external diameter of 400 mm is fastened with Ø 0.9 mm galvanized and annealed wire every 300 mm. Preformed pipe insulation with an

external diameter of more than 400 mm is strapped with 12 mm nylon straps fastened with the appropriate buckles. On pipes with a temperature of more than +120 °C, 12 mm wide steel straps are used. Strapping distance is 300 mm, or at least one strap per element.

When wired mat is used it shall be sewn with $T_s < 200\text{ °C}$ Ø 0.9 mm galvanized and annealed wire through net meshes, $T_s > 250\text{--}450\text{ °C}$ with non-galvanized wire and $T_s > 450\text{ °C}$ stainless steel wire through net meshes or with similar material.

No fixing pins may be welded on pressurized parts by the insulation Supplier. Insulation shall be fastened on pressurized parts with tightening straps or by some other approved method. The Contractor is obligated to deliver the description and if needed also the drawing of the deviation in working method to the supervisor of the Purchaser for approval before the insulation work.

Wired insulation mat and slabs are fastened onto the insulation surface of equipment, tanks, sheet ducts and boiler with resistance welded pins Ø 4 mm, 6 pcs/m², or with steel bands.

6 Testing and checking

Assembly company is obliged to perform tests and checking on a customer's request, before, during and after assembly to the suitable extend. In the following, the tests and checking's are performed by a random selection.

Before assembly:

- Stating the density of wool
- Thickness and material of sheet plate

During assembly:

- Observing the filing density

After assembly:

- Observing the density of insulation and a cladding in accordance with values and data are stated in a project

During the trial operation, during the guarantee period, eventually

- Checking the surface temperature (thermal insulation) around ladders, platforms, etc. (contact protection)

7 Guarantee

The precondition for the material is that insulation materials and thicknesses shall correspond to the given instructions and standards. The insulation work shall be performed so that the pipelines are tight against dropping and flowing liquid, thermal expansion has been taken into consideration, insulation and cladding materials are tightly fastened and there are no heat losses which deviate from normal conditions.