**Date of issue:**
March 2021

**Affected publication:**
IOGP S-738, Supplementary Specification to NORSOK M-004 Insulation for Piping and Equipment, First Edition, December 2020

# ERRATA 1

*Table 1: The footnote references shown in red, strikethrough font below have been deleted.*

| | | |
|---|---|---|
| 1 Heat conservation | Aerogel, AES fibre [1)], Cellular glass [1)] or Mineral wool [1), 2)] | Aerogel, AES fibre [1)], Calcium silicate [1)], Cellular glass, Expanded perlite, FEF or Mineral wool ~~[1), 2)]~~ |

| | | |
|---|---|---|
| 4 Frost protection | Aerogel, Cellular glass [1)] or Mineral wool [1), 2)] | Aerogel, Cellular glass ~~[1)]~~ or Mineral wool ~~[1), 2)]~~ |

*Minor editorial corrections are shown with vertical revision marks only.*

International Association of Oil & Gas Producers

SPECIFICATION
S-738

March
2021

# Supplementary Specification to NORSOK M-004 Insulation for Piping and Equipment

JIP33
JOINT INDUSTRY PROGRAMME

**Revision history**

| VERSION | DATE | PURPOSE |
|---|---|---|
| 1.01 | March 2021 | Errata 1 |
| 1.0 | December 2020 | Issued for Use |


## Acknowledgements

This IOGP Specification was prepared by a Joint Industry Programme 33 Standardization of Equipment Specifications for Procurement organized by IOGP with support by the World Economic Forum (WEF).

# Foreword

This specification was prepared under Joint Industry Programme 33 (JIP33) "Standardization of Equipment Specifications for Procurement" organized by the International Oil & Gas Producers Association (IOGP) with the support from the World Economic Forum (WEF). Companies from the IOGP membership participated in developing this specification to leverage and improve industry level standardization globally in the oil and gas sector. The work has developed a minimized set of supplementary requirements for procurement, with life cycle cost in mind, resulting in a common and jointly agreed specification, building on recognized industry and international standards.

Recent trends in oil and gas projects have demonstrated substantial budget and schedule overruns. The Oil and Gas Community within the World Economic Forum (WEF) has implemented a Capital Project Complexity (CPC) initiative which seeks to drive a structural reduction in upstream project costs with a focus on industry-wide, non-competitive collaboration and standardization. The CPC vision is to standardize specifications for global procurement for equipment and packages. JIP33 provides the oil and gas sector with the opportunity to move from internally to externally focused standardization initiatives and provide step change benefits in the sector's capital projects performance.

This specification has been developed in consultation with a broad user and supplier base to realize benefits from standardization and achieve significant project and schedule cost reductions.

The JIP33 work groups performed their activities in accordance with IOGP's Competition Law Guidelines (November 2020).

# Table of Contents


Foreword ..... 1
Introduction ..... 4
1 Scope ..... 6
2 Normative references ..... 7
3 Terms and definitions ..... 9
4 Symbols and abbreviations ..... 11
5 Qualification requirements ..... 11
5.1 Qualification of personnel ..... 11
5.2 Qualification of insulation system ..... 13
5.3 Insulation procedure ..... 13
6 Materials ..... 14
6.1 Environmentally requirements ..... 14
6.2 Selection of insulation materials ..... 14
6.3 Selection of cladding ..... 15
6.4 Aluminium foils ..... 17
6.5 Sealers and sealing tape and gasket ..... 17
6.6 Perforated guards ..... 17
6.7 Accessories ..... 17
6.8 Insulating coating ..... 17
7 Design engineering ..... 18
7.1 Designing for insulation ..... 18
7.2 Calculation of insulation thickness ..... 18
7.3 Combination of insulation classes ..... 19
8 Installation and inspection ..... 20
8.1 General ..... 20
8.3 Vessel insulation ..... 20
8.4 Cladding ..... 20
8.5 Flanges and valves ..... 21
8.7 Drainage ..... 22
8.8 Instrument insulation ..... 22
8.9 Sealing of penetrations ..... 23
8.10 Inspection ..... 23
Annex A (informative) Key data for insulation ..... 24
Annex B (normative) General ..... 25
Annex C (informative) Test piece for site test ..... 26
Annex D (normative) Material data sheets (MDSs) ..... 27
Annex E (informative) Example insulation checklist ..... 40

## List of Tables

Table 1 - Selection of insulation material....15
Table 3 - Selection of cladding material ....15
Table 4 - Cladding thickness, SS304 and SS316 ....16
Table 8 - Steel banding and locking clips....17
Table 9 - Length of distance holders ....19

# Introduction

The purpose of this specification is to define a minimum common set of requirements for the procurement of insulation for piping and equipment in accordance with NORSOK M-004, 1st Edition, December 2018, Piping and equipment insulation for application in the petroleum and natural gas industries.

This specification follows a common document structure comprising the four documents as shown below, which together with the purchase order define the overall technical specification for procurement.


**JIP33 Specification for Procurement Documents**
**Supplementary Technical Specification**

This specification is to be applied in conjunction with the supporting data sheet, quality requirements specification (QRS) and information requirements specification (IRS) as follows.

**IOGP S-738: Supplementary Specification to NORSOK M-004 Insulation for Piping and Equipment**

This specification defines the technical requirements for the supply of the equipment and is written as an overlay to NORSOK M-004, following the NORSOK M-004 clause structure. Clauses from NORSOK M-004 not amended by this specification apply as written to the extent applicable to the scope of supply.

Modifications to NORSOK M-004 defined in this specification are identified as *Add* (add to clause or add new clause), *Replace* (part of or entire clause) or *Delete*.

**IOGP S-738D: Data Sheet for Insulation for Piping and Equipment**

The data sheet defines application specific requirements, attributes and options specified by the purchaser for the supply of equipment to the technical specification. The data sheet may also include fields for supplier provided information attributes subject to purchaser's technical evaluation. Additional purchaser supplied documents may also be incorporated or referenced in the data sheet to define scope and technical requirements for enquiry and purchase of the equipment.

**IOGP S-738Q: Quality Requirements for Insulation for Piping and Equipment**

The QRS defines quality management system requirements and the proposed extent of purchaser conformity assessment activities for the scope of supply. Purchaser conformity assessment activities are defined through the selection of one of four generic conformity assessment system (CAS) levels on the basis of evaluation of the associated service and supply chain risks. The applicable CAS level is specified by the purchaser in the data sheet or in the purchase order.

**IOGP S-738L: Information Requirements for Insulation for Piping and Equipment**

The IRS defines the information requirements, including contents, format, timing and purpose to be provided by the supplier. It may also define specific conditions which invoke information requirements.

The terminology used within this specification and the supporting data sheet, QRS and IRS follows that of NORSOK M-004 and is in accordance with ISO/IEC Directives, Part 2 as appropriate.

The data sheet and IRS are published as editable documents for the purchaser to specify application specific requirements. The supplementary specification and QRS are fixed documents.

The order of precedence (highest authority listed first) of the documents shall be:

a) regulatory requirements;

b) contract documentation (e.g. purchase order);

c) purchaser defined requirements (data sheet, QRS, IRS);

d) this specification;

e) NORSOK M-004.

# 1 Scope

*Replace section with*

This specification covers the minimum requirements for the procurement of insulation for equipment and packages for offshore/onshore installations. Insulation of pipes, equipment, vessels, tanks, valves, flanges and instrument tubing are covered. Thermal insulation, personnel protection, fire protection and acoustic protection for a normal operation temperature range of -200 °C to 800 °C is covered by this specification.

The scope of this specification includes the following:

— selection of insulation materials and cladding;

— material data sheet (MDS) for insulation materials and cladding;

— requirement for calculation of thickness for thermal and personnel protection;

— requirement for qualification of insulation system for fire and acoustic insulation;

— design requirement for proper installation of insulation;

— requirement for qualification of insulation installation personnel and inspection personnel;

— installation requirements;

— inspection requirements, including inspection checklist.

In all above areas, there is a high focus on reduced risk for corrosion under insulation.

The scope of this specification excludes the following:

— insulation of subsea equipment and piping (flowline risers);

— insulation of burners, furnaces or similar;

— insulation of buildings and civil structures;

— insulated ducting for heating, ventilation and air condition (HVAC);

— insulation of buried equipment and piping systems;

— insulation of flowlines and pipelines;

— pre-insulated manufactured tubing as a finished product;

— pre-insulated piping;

— spray-on passive fire protection (PFP);

— passive fire protection of structure, including piping and equipment supports with concrete based system;

— enclosures (thermal and acoustic);

— internal insulation (e.g. any kind of insulating refractory lining);

— pipe penetrations in bulkhead and deck;

— loose fill insulation;

— sprayed and in-situ formed foam;

— onshore field fabricated atmospheric storage tanks;

— explosion testing in connection to fire testing of insulation systems.

## 2 Normative references

*Delete from section*

ASTM E662, *Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials*

DNVGL-CP-0165, *Cable and pipe penetrations*

IACS UR S14, *Testing procedures for watertight compartments*

IMO 2010, *FTP Code Part 1 Non combustibility test*

IMO 2010, *FTP Code Part 2 Smoke and toxicity test*

IMO 2010, *FTP Code Part 3 Test for "A", "B", and "F" Class Divisions*

IMO 2010, *FTP Code Part 5 Test for surface flammability*

ISO 9865, *Textiles – Determination of water repellency of fabrics by the Bundesmann rain shower test*

NES713, *Toxicity Test Apparatus*

NORSOK C-002, *Architectural components and equipment*

NORSOK M-001, *Material selection*

NORSOK M-501, *Surface preparation and protective coating*

NORSOK S-001, *Technical Safety*

NORSOK S-002, *Working environment*

Marine Equipment Directive, Directive no.2014/90/EU

PSA, *The Facilities Regulations (Innretningsforskriften)*

PSA, *Technical and Operational Regulations (Teknisk og operasjonell forskrift for landanlegg)*

*Add to section*

ASTM A240M, *Standard Specification For Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications*

ASTM B209, *Standard Specification for Aluminium and Aluminium-Alloy Sheet and Plate*

ASTM C302, *Standard Test Method for Density and Dimensions of Preformed Pipe-Covering-Type Thermal Insulation*

ASTM C303, *Standard Test Method for Dimensions and Density of Preformed Block and Board-Type Thermal Insulation*

ASTM C533, *Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation*

ASTM C534 / C534M, *Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form*

ASTM C547, *Standard Specification for Mineral Fiber Pipe Insulation*

ASTM C552, *Standard Specification for Cellular Glass Thermal Insulation*

ASTM C553, *Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications*

*ASTM C591, Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation*

ASTM C592, *Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)*

ASTM C610, *Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation*

ASTM C612, *Standard Specification for Mineral Fiber Block and Board Thermal Insulation*

ASTM C680, *Standard Practice for Estimate of the Heat Gain or Loss and the Surface Temperatures of Insulated Flat, Cylindrical, and Spherical Systems by Use of Computer Programs*

ASTM C795, *Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel*

ASTM C892, *Standard Specification for High-Temperature Fiber Blanket Thermal Insulation*

ASTM C1729, *Standard Specification for Aluminum Jacketing for Insulation*

ASTM C1767, *Standard Specification for Stainless Steel Jacketing for Insulation*

ASTM D412, *Standard Test Methods for Vulcanized Rubber and Thermoplastics Elastomers — Tension*

ASTM D624, *Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers*

ASTM D751, *Standard Test Methods for Coated Fabrics*

ASTM D790, *Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials*

ASTM D1622, *Standard test Method for Apparent Density of Rigid Cellular Plastics*

ASTM D2583, *Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor*

ASTM D3039, *Standard test Method for Tensile Properties of Polymer Matrix Composite Materials*

ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*

ASTM E96, *Standard Test Methods for Water Vapor Transmission of Materials*

ASTM E136, *Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 °C*

ASTM E228, *Standard Test Method for Linear Thermal Expansion of Solid Materials With a Push-Rod Dilatometer*

EAD 040643-00-1201, *Fiber reinforced silica aerogel thermal insulation*

EN 485, *Aluminium and aluminium alloys – Sheet, strip and plate*

EN 14306, *Thermal insulation products for building equipment and industrial installations – Factory made calcium silicate (CS) products – Specification*

EN 14308, *Thermal insulation products for building equipment and industrial installations – Factory made rigid polyurethane foam (PUR) and polyisocyanurate foam (PIR) products – Specification*

EN 15501, *Thermal insulation products for building equipment and industrial installations – Factory made expanded perlite (EP) and exfoliated vermiculite (EV) products – Specification*

EN 10088–2, *Stainless steels – Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes*

IOGP S-715, *Supplementary Specification to NORSOK M-501 Coating and Painting for Offshore, Marine Coastal and Subsea Environments*

ISO 34, *Rubber, vulcanized or thermoplastics — Determination of tear strength*

ISO 6361, *Wrought aluminium and aluminium alloys — Sheets, strips and plates*

ISO 9223, *Corrosion of metals and alloys — Corrosivity of atmospheres — Classification, determination and estimation*

ISO 12623, *Thermal insulating products for building equipment and industrial installations — Determination of short-term water absorption by partial immersion of preformed pipe insulation*

ISO 29767, *Thermal insulating products for building equipment and industrial installations — Determination of short-term water absorption by partial immersion of performed pipe insulation*

UL1709, *Standard for Rapid Rise Fire Tests of Protection Materials for Structural Steel*

# 3 Terms and definitions

**3.5**
**temperature definitions**

*Add after second sentence*

Minimum operating temperature: minimum temperature including plant operation at unstable condition. Unstable condition includes start-up/shutdown, control requirements and process upsets.

*Replace last sentence with*

Material selection: **maximum operating temperature**, **Tm**, shall be used for insulation material selection for systems above ambient and **minimum operation temperature**, **Tl**, for systems below ambient.

The ambient temperature shall be used for the cladding selection. The temperature on the outer layer of the insulation material shall be calculated according to section 7.2.

**3.10**
**Insulation Class 3: Personnel protection**

*Replace definition with*

Protection of personnel from hot and cold surfaces to avoid burns and frostbite.

**3.13**
**Insulation class 6, 7, 8 and D: Acoustic insulation**

*Replace definition with*

Acoustic insulation is specified in order to ensure that noise emission from piping, valves, flanges and equipment meets the area noise requirements for the working environment. The definition of the classes of acoustic insulation is as given in ISO 15665, Clause 4 for class 6, 7 and 8 and as given in Annex F for class D. This standard specifies the minimum insertion loss for each class related to the diameter of the pipe on which it is to be applied.

**Class 6**
Minimum insertion loss shall be in accordance with the definition given in ISO 15665 for class A.
Valves and flanges shall be insulated when and as required by Company.

**Class 7**
Minimum insertion loss shall be in accordance with the definition given in ISO 15665 for class B.
Flanges to be insulated. Valves to be insulated when and as required by Company.

**Class 8**
Minimum insertion loss shall be in accordance with the definition given in ISO 15665 for class C.
Valves and flanges shall be insulated.

**Class D**
Minimum insertion loss shall be in accordance with the definition given in annex F for class D.
Valves and flanges shall be insulated.

*Add new term*

**3.15**
**blanket**
Flexible fibrous insulation product supplied rolled or flat and which may be faced or enclosed.

Note to entry 1: Also known as mat.

*Add new term*

**3.16**
**boxes**
Insulation enclosed in metal cladding in two or more parts and secured by ex-center locks to be used on flanges, valves, instruments, small equipment, etc. for quick removal and re-installation of the insulation.

Note to entry 1: Also known as enclosure in ISO 15665.

*Add new term*

**3.17**
**cladding**
Rigid, semi rigid or flexible frequent pre-formed material that provides mechanical and/or environmental protection to insulation.

Note to entry 1: Also known as jacketing.

*Add new term*

**3.18**
**cryogenic temperature**
Temperature between -100 °C and -200 °C.

*Add new term*

**3.19**
**insulating jacket**
Flexible assembly of insulation material totally enclosed in fabric that is designed to fit individual items forms.

Note to entry 1: Also known as mattress and as insulation blanket in North America.

*Add new term*

**3.20**
**scrim**
Reinforcing mesh that is included within the thickness of the material. Scrim (cloths) provides tension reinforcement and puncture resistance.

*Add new term*

**3.21**
**non-contact insulation system**
Insulation system with no direct contact between the surface of the pipe/equipment and the insulation material.

*Add new term*

**3.22**
**insulating coating**
Coating that reduces the heat flux of a metal surface and that is used for personnel protection to avoid burns. Insulating coating does not necessarily provide corrosion protection.

# 4 Symbols and abbreviations

*Add to section*

| | |
|---|---|
| CS | Calcium Silicate |
| CSPE | Chlorosulphonated Polyethylene |
| EP | Expanded Perlite |
| EPDM | Ethylene Propylene Diene Monomer |
| FEM | Flexible Elastomeric Membrane |
| GA | General Arrangement |
| MDS | Material Data Sheet |
| NCTI | Netherlands Centre for Technical Insulation |
| NIA | National Insulation Association (US) |
| PIR | Polyisocyanurate |

# 5 Qualification requirements

## 5.1 Qualification of personnel

*Replace section 5.1.1 title with*

### 5.1.1 Qualification of insulation system installation personnel

*Replace first paragraph with*

Personnel installing insulation and cladding shall be individually qualified by the certified organization as specified in the data sheet, the insulation material manufacturer, the non-metallic cladding manufacturer or the insulation contractor.

*Add to first paragraph*

If personnel are qualified by insulation materials manufacturer, non-metallic cladding manufacturer or insulation contractor, a qualification procedure shall be established.

*Add to first paragraph*

The qualification procedure shall cover the evaluation of the personnel competences in theoretical and practical aspects.

*Delete second paragraph*

*Delete third paragraph*

*Replace fourth paragraph with*

The theoretical part of the qualification shall include:

— knowledge of health and safety hazard including waste handling;

— use of protection equipment;

— insulation materials;

— cladding material;

— application of insulation materials;

— application of cladding;

— surface requirements of insulation systems ;

— prevention of ingress of moisture in the insulation system;

— drainage to avoid accumulation of trapped water in the insulation system.

*Delete fifth paragraph*

*Replace sixth paragraph with*

The practical part of the qualification shall be performed in accordance with the sections of the insulation procedure specification (IPS) related to the equipment/packages to be insulated.

*Delete seventh paragraph*

*Replace first sentence of eighth paragraph with*

The theoretical and practical training and testing shall be documented.

*Delete second sentence of eighth paragraph*

### 5.1.2 Qualification of supervisors, foremen and QC personnel

*Replace first paragraph with*

Personnel carrying out inspection or verification shall be qualified by FROSIO (Inspector level III), NCTI or NIA.

*Add NOTE to first paragraph*

NOTE FROSIO Inspector level II may carry out the inspection work under the supervision of an inspector level III.

*Replace second paragraph with*

Supervisors and foremen shall have three years of documented insulation work experience corresponding to the work described in this specification.

*Replace third paragraph with*

QC and supervision personnel shall be familiar with the requirements of this specification.

## 5.2 Qualification of insulation system

*In first sentence, delete "when required Type Approved/Certified"*

*In second list item, add after "Class 6,7 and 8"*

and D

*Delete third list item*

### 5.2.1 Class 5 and F Insulation

*In first paragraph, replace first sentence with*

Fire insulation system (including removable jackets or boxes) shall be tested and documented in accordance with the specified fire type and duration for the equipment location area, e.g.:

*Delete first list item of first paragraph*

*In second list item of first paragraph, add after EN 1363-2*

, ISO 834-3 or UL1709

*Delete last sentence of second list item of first paragraph*

*Delete second and third sentence of third item of first paragraph*

*Delete fourth list item of first paragraph*

*Replace section 5.2.2 title with*

### 5.2.2 Class 6, 7, 8 and D: Acoustic insulation

*In first paragraph, replace "All systems" with*

For class 6,7, 8 and D, the insulation system

*Add to section*

Acceptance criteria for class D shall be as given in Table F1.

### 5.2.3 Sealing of penetrations

*Delete section 5.2.3*

## 5.3 Insulation procedure

### 5.3.1 Insulation procedure specification (IPS)

*In first paragraph, replace first sentence with*

A detailed IPS shall be established.

*Replace second list item of second paragraph with*

— technical data sheet and material safety data sheet for all type of materials;

### 5.3.2 Drawings for penetration seals

*Delete section 5.3.2*

### 5.3.3 Inspection and test plan (ITP)

*In first sentence of first paragraph, delete "both" and "and inspection log"*

# 6 Materials

## 6.1 Environmentally requirements

*Delete section 6.1*

## 6.2 Selection of insulation materials

*Delete second sentence of first paragraph*

*Delete third sentence of second paragraph*

*Delete third paragraph*

*Replace first sentence of fourth paragraph with*

The insulation materials shall be as per MDSs in Annex D:

*Add to list*

— Calcium Silicate (CS);

— Expanded Perlite (EP);

— Polyisocyanurate (PIR).

**Table 1 - Selection of insulation material**

*Replace Table 1 with*

| Insulation class | Offshore + Onshore with corrosivity category C5 or higher according to ISO 9223, Annex C | Onshore with corrosivity category C4 or lower according to ISO 9223, Annex C |
|---|---|---|
| 1 Heat conservation | Aerogel, AES fibre [1)], Cellular glass [1)] or Mineral wool [1), 2)] | Aerogel, AES fibre [1)], Calcium silicate [1)], Cellular glass, Expanded perlite, FEF or Mineral wool |
| 2 Cold medium conservation | Aerogel, Cellular glass or PIR [3)] | Aerogel, Cellular glass, FEF or PIR |
| 3 Personnel protection | Tn ≤ 250 °C: Insulating coating or personnel guards | Tn ≤ 250 °C: Insulating coating or personnel guards |
| | Tn ≥ 250 °C: as class 1 | Tn ≥ 250 °C: as class 1 |
| | Tn < -10 °C: Personnel guards | Tn < -10 °C: Personnel guards |
| 4 Frost protection | Aerogel, Cellular glass [1)] or Mineral wool [1), 2)] | Aerogel, Cellular glass or Mineral wool |
| 5 Fire protection | As per qualified system (5.2.1) | As per qualified system (5.2.1) |
| 6, 7, 8 and D Acoustic insulation | As per qualified system (5.2.2) | As per qualified system (5.2.2) |
| 9 External condensation and icing protection | Aerogel or Cellular glass [1)] | Aerogel, Cellular glass, FEF or PIR |

**Notes**

1) At Tn < 180 °C, AES, Calcium silicate, Cellular glass and mineral wool shall only be used as part of a non-contact insulation system or used as a secondary (outer layer) insulation material applied over e.g. aerogel. Minimum 20 mm air gap between insulation material and metallic surface of flange/valve in insulation boxes is a type of non-contact insulation.

2) In mechanically ventilated room with no sprinkler/deluge system, mineral wool may be used directly on pipes/vessels with Tn > 40 °C. Indoor areas with regular cleaning or testing of seawater deluge system are not considered dry.

3) Only for cryogenic temperature.

NOTE For insulation of equipment and piping in service with self-igniting fluid (i.e. ethylene oxide) an insulation materials with closed cell structure (i.e. cellular glass) that is non-reactive to the fluid shall be used.

## 6.3 Selection of cladding

**Table 3 - Selection of cladding material**

*Replace Table 3 with*

| Insulation class | Cladding material |
|---|---|
| All, except class 5 or F | Stainless steel: SS316 [1)]<br>GRP<br>FEM with reinforcement<br>FEM without reinforcement<br>For onshore only: Aluminium alloy: 3003 H14 or 3105 H14 |
| 5 or F | Cladding to be tested and documented as part of the system |

**Note**

1) SS304 may be used onshore with corrosivity category C4 or lower according to ISO 9223, Annex C, if specified by the purchaser.

### 6.3.1 Metallic cladding

#### 6.3.1.1

*Replace first paragraph with*

Type of stainless steel cladding shall be one of the following:

— ASTM 240M type SS316;

— EN 10088-2 number 1.4401;

— ASTM 240M type SS304;

— EN 10088-2 number 1.4301.

The stainless steel cladding shall have 2D finish.

The thickness of the stainless steel cladding shall be according to Table 4 or ASTM C1767.

**Table 4 - Cladding thickness, SS304 and SS316**

*Replace Table 4 with*

| Thickness, minimum | OD < 250 mm | 250 mm ≤ OD ≤ 900 mm | OD > 900 mm |
|---|---|---|---|
| SS304 and SS316 2D sheet | 0,5 mm | 0,7 mm | 0,9 mm |

#### 6.3.1.2 Aluminium alloy

*Replace first paragraph with*

Aluminium cladding shall be type 3003 H14 or 3105 H14 according to ISO 6361, ASTM B209 or EN 485.

Thickness of aluminium cladding shall be according to Table 5 or ASTM C1729.

#### 6.3.1.3 Aluzinc

*Delete section 6.3.1.3*

### 6.3.2 Non-metallic cladding

*Replace first paragraph with*

Non-metallic cladding shall be according to MDS GRP, MDS FEM with reinforcement or MDS FEM without reinforcement in Annex D.

*Delete second paragraph*

*Delete third paragraph*

*Delete fourth paragraph*

*Delete Table 7*

*Delete fifth paragraph*

*Delete sixth paragraph*

## 6.4 Aluminium foils

*Delete second paragraph*

*Add to section*

If materials others than aluminium foil are used for vapour barrier, the MDSs shall be included in the IPS and be approved by Company.

## 6.5 Sealers and sealing tape and gasket

*Add to section*

Flexibility shall be documented by test reports or track record field experience.

*Add to section*

The test shall be according to ISO 12944-9, Annex B Cyclic aging test.

*Add to section*

The joint sealer after the test shall remain flexible and be well bounded to the substrate without surface cracks when visually examined under X7 magnification.

## 6.6 Perforated guards

*Delete fourth paragraph*

## 6.7 Accessories

*Replace second sentence of first paragraph with*

For aluminium cladding, direct contact between the aluminium cladding and SS316 accessories shall be avoided by using a polymer gasket, washer, etc.

**Table 8 - Steel banding and locking clips**

*Add NOTE to Table 8*

| |
|---|
| NOTE The values are minimum values. |

*Add new section*

## 6.8 Insulating coating

Company approved insulating coating for class 3 shall be applied in accordance with the supplier's recommendations.

# 7 Design engineering

## 7.1 Designing for insulation

*In first paragraph, replace "P&IDs', and piping isometrics" with*

P&IDs', GAs and piping isometrics

*Delete second paragraph*

*Delete ninth paragraph*

*Delete tenth paragraph*

### 7.1.3 Insulation of valves and flanges

*Delete first paragraph*

*Delete third sentence of second paragraph*

*Delete fourth sentence of second paragraph*

*In third paragraph, replace "suitable for quick removal and reinstallation." with*

used.

*Delete fourth paragraph*

*In first sentence of fifth paragraph, replace "which shall be frequently subject for inspection and maintenance" with*

when specified

*Delete third sentence of fifth paragraph*

*In first sentence of sixth paragraph, replace "with the "roof tile" principles" with*

for water shedding

*Add to sixth paragraph*

The top of the box shall have 10° incline from the horizontal plane on top of the box.

*Add to section*

An extended valve stem or extended bonnet shall be used to accommodate the specified box insulation thickness.

## 7.2 Calculation of insulation thickness

### 7.2.1 Class 1,2,4 and 9

*In first paragraph, add after "EN ISO 12241"*

or ASTM C680

*Replace second paragraph with*

For thermal calculations on non-contact insulation systems, the thermal conductivity of annular gap/void provided by the spacer system shall be accounted for in thickness calculations.

### 7.2.2 Class 3

*Add before first paragraph*

Where normal operation temperature exceeds the values given in the data sheet, personnel protection class 3 shall be used.

*Replace second sentence of first paragraph with*

Guards installed for normal operating temperatures under and including 250 °C shall be made of perforated SS316 plate or insulating coating.

*Replace third sentence of first paragraph with*

For normal operating temperatures above 250 °C, the insulation thickness shall be calculated in accordance with EN ISO 12241 or ASTM C680.

**Table 9 - Length of distance holders**

*Replace Table 9 with*

| Nominal pipe size (DN) | Normal operation temperature (°C) | |
|---|---|---|
| | 60 ˚C ≤ Tn ≤ 250 ˚C | Tn < -10 °C |
| DN < 250 mm | 50 mm | 50 mm |
| DN ≥ 250 mm | 100 mm | 50 mm |

*Delete fourth paragraph*

### 7.2.3 Class 5 and F

*Delete third paragraph*

## 7.3 Combination of insulation classes

### 7.3.1 General

*Replace first paragraph with*

For insulation systems with combinations of insulation classes, the insulation system shall fulfil the insulation requirement for each insulation class.

*Delete second paragraph*

### 7.3.2 Thermal insulation and/or personnel protection combined with fire protection

*Delete section 7.3.2*

### 7.3.3 Thermal insulation and/or personnel protection combined with acoustic insulation

*Delete section 7.3.3*

### 7.3.4 Fire protection combined with acoustic insulation

*Delete section 7.3.4*

### 7.3.5 Thermal insulation and/or personnel protection combined with fire protection and acoustic insulation

*Delete section 7.3.5*

# 8 Installation and inspection

## 8.1 General

*In first sentence, replace "P&ID, piping isometric, data sheets and IPS" with*

P&ID, GA, piping isometric, data sheets and IPS

### 8.1.1 Workmanship

*Delete fifth paragraph*

### 8.1.3 Insulation with vapour barrier

*Add to end of first list item of third paragraph*

for cryogenic temperatures

## 8.3 Vessel insulation

### 8.3.2 Segment insulation of vessel

#### 8.3.2.1 Insulation with vapour barrier

*Delete first paragraph*

## 8.4 Cladding

### 8.4.1 Metallic cladding

*Replace first sentence of first paragraph with*

All cladding seams shall be installed to shed water.

*In first sentence of second paragraph, replace "pipelines" with*

pipes

*Add to second paragraph*

Longitudinal seams shall be crimped 30 mm from the edge on one side for OD < 150 mm and 50 mm from the edge on one side for OD ≥ 150 mm.

*Add to second paragraph*

Longitudinal seams shall be staggered.

*In first sentence of third paragraph, replace "pipelines" with*

pipes

*In first sentence of seventh paragraph, add before "sealant"*

flexible, non-hardening elastomeric

*Add to seventh paragraph*

The sealant shall be applied prior to the closure of the seam.

*Add to seventh paragraph*

The sealant shall be (25 +/- 5) mm wide and (3 +/- 1) mm thick.

*Add to seventh paragraph*

The sealant shall be applied to display continuously external 2 to 3 mm of sealant at completed seam.

*Delete twelfth paragraph*

*Add to fourteenth paragraph*

Metal bands shall be installed on circumferential overlaps and in the middle of circumferential overlaps with a minimum c/c of 250 mm.

### 8.4.2 Non-metallic cladding

*Delete first paragraph*

*Replace second sentence of second paragraph with*

If the maximum temperature of piping exceeds the maximum service temperature of the non-metallic cladding, a special termination solution against piping shall be made.

### 8.4.3 GRP

*Replace section with*

The installation of GRP cladding shall be according to MDS GRP.

## 8.5 Flanges and valves

### 8.5.1 General

*Add to second paragraph*

Insulation boxes shall overlap with minimum insulation thickness on connection pipes.

*Add to section*

All cut-outs in the insulation boxes shall be sealed to avoid water ingress.

### 8.5.2 Surface material for jackets

*Replace first sentence of first paragraph with*

The jacket shall prevent water ingress.

*Replace second sentence of first paragraph with*

The material shall have an adequate wear resistance to withstand frequent handling and normal wear and tear.

*Replace third sentence of first paragraph with*

The surface material shall be tested for reaction to fire according to ASTM E84 or EN 13501-1.

*Delete second paragraph*

*Delete guidance note*

*Add to section*

Material properties for surface material and sewing thread shall be documented and included in the IPS.

### 8.5.3 Insulation materials for prefabricated boxes

*Add to section*

For insulation classes without a vapour barrier, there shall be a minimum 20 mm air gap between flange/valve and the insulation material except for penetrations in the box (pipe, stem, etc.).

### 8.5.4 Insulation boxes with vapour barrier

*Delete first sentence of first paragraph*

*Delete second sentence of first paragraph*

*Delete second paragraph*

### 8.5.6 Identification

*Delete third paragraph*

## 8.7 Drainage

*In first paragraph, replace "10" with*

15

## 8.8 Instrument insulation

*Delete section*

## 8.9 Sealing of penetrations

*Delete section*

## 8.10 Inspection

*Add Note*

NOTE Annex E provides a checklist of typical inspection activities related to installation of insulation.

# Annex A
(informative)
# Key data for insulation

*Delete Annex A*

# Annex B
(normative)
# General

*Delete Annex B*

# Annex C
(informative)
# Test piece for site test

*Delete Annex C*

# Annex D
(normative)
# Material data sheets (MDSs)

*Replace section with*

The materials shall be delivered in accordance with the standard referred to in the MDS. In addition, the MDS specifies the selected options in the referred standard and additional requirements which shall be added or shall supersede the corresponding requirements in the referred standard. For tests, specified in the MDS for insulation materials, that are not included in the insulation material standard given in the MDS, the tests shall be material or product qualification tests and shall not be regular production tests. The tests specified in the MDS for non-metallic cladding shall be material or product qualification tests and shall not be regular production tests. Where the MDS does not specify any additional requirements, all the requirements of the referred standard apply. The latest edition of the referred standard shall apply unless a specific year of issue is specified by the purchaser.

*Replace MDS AES with*

| **MATERIAL DATA SHEET** | **MDS AES** | **Rev. 01** |
|---|---|---|
| **TYPE OF MATERIAL: Alkali Earth Silicate (AES)** | | |
| **Standard** | **Grade / Type** | **Additional requirements** |
| **ASTM C892**<br>*(EN standard not available. ASTM standard to be used in Europe)* | Type II, grade 6 and 8 | Section 11.1.9<br>ASTM E84 and ASTM E136 |
| **General** | This MDS specifies the selected options in the referred standard and additional requirements which shall be added or shall supersede the corresponding requirements in the referred standard.<br>Products shall meet the requirements for bio-soluble fibres in Note Q of Regulation (EC) No. 1272/2008. | |
| **Products** | AES insulation products are supplied in slabs and blankets. | |
| **Application** | AES can be used for class 1 and 3.<br>At normal operation temperatures < 180 °C, AES can only be used as part of a non-contact insulation system or as a secondary (outer layer) insulation material applied over e.g. aerogel. | |
| **MATERIAL DATA AND PROPERTIES (additional testing and acceptance criteria)** | | |
| **Standard** | **ASTM C892** | |
| Traces of water soluble ions and pH | Section 11.1.9 | |
| Reaction to fire | ASTM E136 and ASTM E84 | |
| **INSTALLATION REQUIREMENTS** | | |
| General | Installation according to installation manual from Manufacturer.<br>For classes 5, 6, 7 and 8, installation shall be done as described in the relevant test reports / installation instructions for the qualified systems. | |

*Replace MDS AG with*

| **MATERIAL DATA SHEET** | **MDS AG** | **Rev. 01** |
|---|---|---|
| **TYPE OF MATERIAL: Aerogel (AG)** | | |
| **Standard** | **Grade / Type** | **Additional requirements** |
| **ASTM C1728** | Type I: Grade 1B<br>Type III: Grade 1A and 2A | Section 7.11 |
| **EAD 040643-00-1201** | | Section 2.2.1 (Acceptance criteria)<br>Section 2.2.2<br>EN 14607 / EN 14707<br>EN 13468 |
| **General** | This MDS specifies the selected options in the referred standard and additional requirements which shall be added or shall supersede the corresponding requirements in the referred standard. | |
| **Products** | Blankets | |
| **Application** | Aerogel can be used for all insulation classes. | |
| **MATERIAL DATA AND PROPERTIES (additional testing and acceptance criteria)** | | |
| **Standard** | **ASTM C1728** | **EAD 040643-00-1201** |
| Maximum service temperature | | EN 14706 / EN 14707 |
| Water absorption | | Section 2.2.2 |
| Traces of water soluble ions and pH | Section 7.11 | EN 13468, Acceptance criteria:<br>Figure 1 in ASTM C795<br>pH-value = 7-12,5 |
| Reaction to fire | | Section 2.2.1, Acceptance criteria: minimum B-s1, d0 |
| **INSTALLATION REQUIREMENTS** | | |
| General | Installation according to installation manual from Manufacturer.<br>For classes 5, 6, 7 and 8, installation shall be done as described in the relevant test reports / installation instructions for the qualified systems. | |

*Replace MDS CG with*

| **MATERIAL DATA SHEET** | **MDS CG** | **Rev. 01** |
|---|---|---|
| **TYPE OF MATERIAL: Cellular glass (CG)** | | |
| **Standard**<br>*Either ASTM or EN standard shall be used.* | **Grade / Type** | **Additional requirements** |
| **ASTM C552** | Grade 6 | Section 12.10<br>ASTM E136 and ASTM E228 |
| **EN 14305** | | Section 4.2.4 (Acceptance criteria)<br>Sections 4.3.2, 4.3.3, 4.3.4, 4.3.10, 4.3.11, 4.3.12, C.6 and C.7 |
| **General** | This MDS specifies the selected options in the referred standard and additional requirements which shall be added or shall supersede the corresponding requirements in the referred standard. | |
| **Products** | Cellular glass insulation products are supplied as prefabricated piping and equipment elements / sections. The product shall be delivered with anti-abrasive coating if used directly on piping / equipment. | |
| **Application** | CG can be used for thermal insulation for all insulation classes.<br>At normal operation temperatures < 180 °C, cellular glass can only be used as part of a non-contact insulation system or as a secondary (outer layer) insulation material applied over e.g. aerogel for offshore and onshore with corrosivity category C5 or higher according to ISO 9223, Annex C.<br>CG can be use alone or in combination with other materials for class 5, 6,7 and 8 as per qualified system.<br>For temperature above +180 °C, an outside reinforcement mesh/coating should be used. | |
| **MATERIAL DATA AND PROPERTIES (additional testing and acceptance criteria)** | | |
| **Standard** | **ASTM C552** | **EN 14305** |
| Maximum service temperature | | Section 4.3.2 |
| Minimum service temperature | | Section 4.3.3 |
| Density | | Section C.7 |
| Water absorption | | Section 4.3.10 |
| Traces of water soluble ions and pH | Section 12.10 | Section 4.3.12, Acceptance criteria:<br>Figure 1 in ASTM C795<br>pH-value = 7-12,5 |
| Reaction to fire | ASTM E136 | Section 4.2.4, Acceptance criteria: A1 |
| Compressive strength | | Section 4.3.4,<br>Acceptance criteria: Level CS(Y) 500 |
| Water vapour diffusion resistance | | Section 4.3.11,<br>Acceptance criteria: $\mu \approx \infty$ |
| Coefficient of thermal expansion/ contraction | ASTM E228 | Section C.6 |

| **MATERIAL DATA SHEET** | **MDS CG** *(continued)* | **Rev. 01** |
|---|---|---|
| **INSTALLATION REQUIREMENTS** | | |
| General | Installation according to installation specification from Manufacturer.<br>For classes 5, 6, 7 and 8 installation shall be done as described in the relevant test reports / installation instructions for the qualified systems.<br>Anti-abrasive coating shall be used to prevent damage to cellular glass and coating systems. The anti-abrasive coating shall be completely dry before the insulation material is mounted. The anti-abrasive coating shall be suitable at maximum operation temperatures.<br>After wet applied anti-abrasive coating is applied, the surface shall have a smooth finish.<br>For systems without vapour barrier, no sealant shall be used in the longitudinal and circumferential CG joints.<br>For system with vapour barrier and a single layer application, all longitudinal and circumferential CG joint shall be sealed with a joint sealant. For a multi-layer application, only the longitudinal and circumferential CG joint of the uppermost layer shall be sealed with joint sealant. | |
| Piping | CG shall be prefabricated as pipe insulation elements according to dimensions and shape. To cover fittings and other irregular surfaces, sections may be cut and fitted on site.<br>Minimum thickness up to DN150 shall be 30 mm. Above DN150, minimum thickness shall be 40 mm. | |
| Vessel | CG vessel (DN200) segments shall be mechanically fastened and tightened with metal bands. For ≤ DN150 segments, glass fibre reinforced tape shall be used. | |
| CG with non-metallic cladding | Prefabricated CG with factory applied non-metallic cladding shall be joint sealed with suppliers recommended sealant. | |

*Add new MDS CS*

| **MATERIAL DATA SHEET** | **MDS CS** | **Rev. 01** |
|---|---|---|
| **TYPE OF MATERIAL: Calcium silicate (CS)** | | |
| **Standard**<br>*Either ASTM or EN standard shall be used.* | **Grade / Type** | **Additional requirements** |
| **ASTM C533** | Type 1 | |
| **EN 14306** | | Section 4.2.4 (Acceptance criteria)<br>Sections 4.3.2, 4.3.5 and D.9 |
| **General** | This MDS specifies the selected options in the referred standard and additional requirements which shall be added or supersede the corresponding requirements in the referred standard. | |
| **Products** | The products are manufactured in the form of boards, pipe section, segments and prefabricated ware. | |
| **Application** | CS can be used onshore with corrosivity category C4 or lower according to ISO 9223, Annex C for systems with continuously temperature higher than 180 °C. | |
| **MATERIAL DATA AND PROPERTIES (additional testing and acceptance criteria)** | | |
| **Standard** | **ASTM C533** | **EN 14306** |
| Maximum service temperature | | Section 4.3.2 |
| Density | | Section D.9 |
| Traces of water soluble ions | | Section 4.3.5, Acceptance criteria:<br>Figure 1 in ASTM C795<br>pH=7-12,5 |
| Reaction to fire | | Section 4.2.4, Acceptance criteria: Class A |
| **INSTALLATION REQUIREMENTS** | | |
| General | Installation according to installation manual from Manufacturer.<br>For classes 5, 6, 7 and 8, installation shall be done as described in the relevant test reports / installation instructions for the qualified systems. | |

*Add new MPS EP*

| **MATERIAL DATA SHEET** | **MDS EP** | **Rev. 01** |
|---|---|---|
| **TYPE OF MATERIAL: Expanded Perlite (EP)** | | |
| **Standard**<br>*Either ASTM or EN standard shall be used.* | **Grade / Type** | **Additional requirements** |
| **ASTM C610** | | ASTM C302 / ASTM C303 |
| **EN 15501** | | Section 4.2.4 (Acceptance criteria)<br>Sections 4.3.2, 4.3.5, 4.3.7 and E.8 |
| **General** | This MDS specifies the selected options in the referred standard and additional requirements which shall be added or supersede the corresponding requirements in the referred standard. | |
| **Products** | The products are manufactured in the form of boards, pipe sections, segments and prefabricated ware. | |
| **Application** | EP can be used onshore with corrosivity category C4 or lower according to ISO 9223, Annex C for systems with temperature higher than ambient. | |
| **MATERIAL DATA AND PROPERTIES (additional testing and acceptance criteria)** | | |
| **Standard** | **ASTM C610** | **EN 15501** |
| Maximum service temperature | | Section 4.3.2 |
| Density | ASTM C302 / ASTM C303 | Section E.8 |
| Water absorption | | Section 4.3.7 |
| Traces of water soluble ions and the pH value | | Section 4.3.5, Acceptance criteria:<br>Figure 1 in ASTM C795<br>pH=7-12,5 |
| Reaction to fire | | Section 4.2.4, Acceptance criteria: Class A |
| **INSTALLATION REQUIREMENTS** | | |
| General | Installation according to installation manual from Manufacturer.<br>For classes 5, 6, 7 and 8, installation shall be done as described in the relevant test reports / installation instructions for the qualified systems. | |

*Replace MDS FEF with*

| **MATERIAL DATA SHEET** | **MDS FEF** | **Rev. 01** |
|---|---|---|
| **TYPE OF MATERIAL: Flexible Elastomeric Foam (FEF)** | | |
| **Standard**<br>*Either ASTM or EN standard shall be used.* | **Grade / Type** | **Additional requirements** |
| **ASTM C534 / C534M** | Grade 3 | ASTM D1622 |
| **EN 14304** | | Section 4.2.4 (Acceptance criteria)<br>Sections 4.3.2, 4.3.3, 4.3.5 and 4.3.6 and D4 |
| **General** | This MDS specifies the selected options in the referred standard and additional requirements which shall be added or supersede the corresponding requirements in the referred standard.<br>Either ASTM or EN standard shall be used. | |
| **Products** | Flexible Elastomeric Foam products with or without factory -applied non-metallic cladding are delivered in prefabricated pipe section, rolls and slabs. | |
| **Application** | FEF can be used for instrument tubing with diameter DN ≤ 32 mm for all insulation classes for temperatures ≤ 110 °C.<br>FEF can also be used for thermal insulation of piping and equipment for onshore with corrosivity category C4 or lower according to ISO 9223, Annex C. | |
| **MATERIAL DATA AND PROPERTIES (additional testing and acceptance criteria)** | | |
| **Standard** | **ASTM C534 / C534M** | **EN 14304** |
| Maximum service temperature | | Section 4.3.2 |
| Minimum service temperature | | Section 4.3.3 |
| Density | ASTM D1622 | Section D4 |
| Water absorption | | Section 4.3.5 |
| Traces of water soluble ions | | Section 4.3.6, Acceptance criteria:<br>Figure 1 in ASTM C795<br>pH=7-12,5 |
| Reaction to fire | | Section 4.2.4, Acceptance criteria: minimum Dl-s3,d0 |
| **INSTALLATION REQUIREMENTS** | | |
| General | Installation according to installation manual from Manufacturer.<br>For classes 5, 6, 7 and 8, installation shall be done as described in the relevant test reports / installation instructions for the qualified systems. | |

*Replace MDS MW with*

| **MATERIAL DATA SHEET** | **MDS MW** | **Rev. 01** |
|---|---|---|
| **TYPE OF MATERIAL: Mineral wool (MW)** | | |
| **Standard**<br>*Either ASTM or EN standard shall be used.* | **Grade / Type** | **Additional requirements** |
| ASTM C547<br>(pipe section) | Type II | Section 11.1.10, ASTM E136 and ISO 12623/ISO 29767 |
| ASTM C553<br>(mats without mesh) | Type VII | Section 11.9, ASTM E136 and ISO 12623/ISO 29767 |
| ASTM C592<br>(mats, wired mats) | Type II | Section 11.11, ASTM E136 and ISO 12623/ISO 29767 |
| ASTM C612<br>(block and boards) | Type IVB | Section 12.10 and ASTM E136 and ISO 12623/ISO 29767 |
| EN 14303 | | Section 4.2.4 (Acceptance criteria)<br>Sections 4.3.2, 4.3.5, 4.3.7 and B.2 |
| **General** | This MDS specifies the selected options in the referred standard and additional requirements which shall be added or supersede the corresponding requirements in the referred standard.<br>Products shall meet the requirements for bio-soluble fibres in Note Q of Regulation (EC) No. 1272/2008. | |
| **Products** | Mineral wool products are supplied as mandrel wound pipe sections, wired mats, mats and slabs.<br>Wired mats shall be supplied with stainless steel (SS304) stitching wire and mesh in corrosive environments ≥ C5 according to ISO 9223, Annex C. Galvanized stitching wire and mesh can be used in corrosive environments ≥ C4 according to ISO 9223, Annex C. | |
| **Application** | All insulation classes except class 2 and 9.<br>In corrosive environments ≥ C5 according to ISO 9223, Annex C and at normal operation temperatures < 180 °C, MW shall only be used as part of a non-contact insulation system or used as a secondary (outer layer) insulation material applied over e.g. aerogel. | |
| **MATERIAL DATA AND PROPERTIES (additional testing and acceptance criteria)** | | |
| **Standard** | **ASTM C547/C553/C592/C612** | **EN 14303** |
| Maximum service temperature | | Section 4.3.2 |
| Density | | Section B.2 |
| Water absorption | ISO 12623/ISO 29767, Acceptance criteria: maximum 0,2 kg/m$^2$ | Section 4.3.5, Acceptance criteria: maximum 0,2 kg/m$^2$ |
| Traces of water soluble ions and pH | Sections 11.1.10, 11.9, 11.11 and 12.10<br>(ASTM C547/C553/C592/C612) | Section 4.3.7, Acceptance criteria:<br>Figure 1 in ASTM C795<br>pH-value = 7-12,5 |
| Reaction to fire | ASTM E136 | Section 4.2.4, Acceptance criteria: A1 |

| **MATERIAL DATA SHEET** | **MDS MW** *(continued)* | **Rev. 01** |
|---|---|---|
| **INSTALLATION REQUIREMENTS** | | |
| General | Installation according to installation manual from Manufacturer.<br>For classes 5, 6, 7 and 8, installation shall be done as described in the relevant test reports / installation instructions for the qualified systems. | |

*Add new MDS PIR*

| **MATERIAL DATA SHEET** | **MDS PIR** | **Rev.01** |
|---|---|---|
| **TYPE OF MATERIAL: Polyisocyanurate (PIR)** | | |
| **Standard**<br>*Either ASTM or EN standard shall be used.* | **Grade / Type** | **Additional requirements** |
| **ASTM C591** | Type II | Section 12.9 |
| **EN 14308** | | Sections 4.3.2, 4.3.3, 4.3.5, 4.3.6.1, 4.3.6.2, 4.3.7, 4.3.8 and D.9 |
| **General** | This MDS specifies the selected options in the referred standard and additional requirements which shall be added or supersede the corresponding requirements in the referred standard. | |
| **Products** | The products are manufactured in the form of boards, pipe sections, segments and prefabricated ware. | |
| **Application** | PIR can be used onshore with corrosivity category C4 or lower according to ISO 9223, Annex C for systems with temperature lower than ambient. | |
| **MATERIAL DATA AND PROPERTIES (additional testing and acceptance criteria)** | | |
| **Standard** | **ASTM C591** | **EN 14308** |
| Maximum service temperature | | Section 4.3.2 |
| Minimum service temperature | | Section 4.3.3 |
| Density | | Section D.9 |
| Water absorption | | Sections 4.3.6.1 and 4.3.6.2,<br>Acceptance criteria: max 1 % (volume) |
| Traces of water soluble ions and the pH value | | Section 4.3.8, Acceptance criteria:<br>Figure 1 in ASTM C795<br>pH= 7-12,5 |
| Reaction to fire | Section 12.9 | Section 4.2.4, Acceptance criteria: min Dl-s3,d0 |
| Close cell content | | Section 4.3.7, Acceptance criteria: minimum 90 % |
| **INSTALLATION REQUIREMENTS** | | |
| General | Installation according to installation manual from Manufacturer.<br>For classes 5, 6, 7 and 8, installation shall be done as described in the relevant test reports / installation instructions for the qualified systems. | |

*Delete MDS PBFP*

*Replace MDS GRP with*

| **MATERIAL DATA SHEET** | **MDS GRP** | **Rev. 01** |
|---|---|---|
| **TYPE OF MATERIAL: Weather resistant glass fibre reinforced polymer (GRP) cladding** | | |
| **General** | This specification describes the minimum requirements for a GRP for cladding purposes. | |
| **Products** | Laminate based on glass fibre reinforced polyester and/or vinyl ester resins. The material can be supplied as prefabricated shells or as wet material by curing on site. | |
| **Standard** | NA | |
| **Application** | GRP is used for external areas subjected to mechanical loads or where a water tight cladding is required. | |
| **MATERIAL DATA AND PROPERTIES** | | |
| General requirements | The cladding material shall have a maximum material temperature resistance: ≥ 90 °C. | |
| | Layer thickness: ≥ 1,5 mm | |
| | **Standard** | **Acceptance criteria** |
| Mechanical properties | ISO 178 / ASTM D790 | Bending strength: ≥ 130 MPa |
| | ISO 527 / ASTM D3039 | Tensile strength: ≥ 50 MPa |
| | ISO 527 /ASTM D3039 | Elongation at break: ≥ 1 % |
| | ASTM D2583 | Barcol hardness shall be specified by Supplier. |
| Reaction to fire | One of the following:<br>ASTM E84 or<br>EN 13501-1 | Tests shall be documented. |
| Aging test | ISO 12944-9<br>(Exposure cycling test condition) | It shall be documented that the material (including system for joining) will maintain minimum 90 % of its tensile strength/elongation properties after the accelerated aging. The GRP can be tested with or without a UV durable topcoat. |
| Additional requirements | Depending on design life and risk for direct sunlight exposure, GRP may be required protected by a UV durable topcoat, with quality in line with topcoat in system 1 (IOGP S-715). The coating can be pre-applied to the prefabricated shells or site applied. | |
| | GRP shall be antistatic and fulfil the requirements in EN 13463-1:2009/ISO 80079-36, Annex D (except high voltage spray electrode test). | |
| General | Installation according to installation manual from Manufacturer.<br>GRP cladding shall be pre-cured before installation. | |

*Add new MDS FEM with reinforcement*

| **MATERIAL DATA SHEET** | **MDS FEM with reinforcement** | **Rev. 01** |
|---|---|---|
| **TYPE OF MATERIAL: Weather resistant flexible elastomeric membrane (FEM) with reinforcement** | | |
| **General** | This specification describes the minimum requirements for a FEM for cladding purposes. | |
| **Products** | Woven glass scrim reinforced Chlorosulphonated Polyethylene (CSPE) polymeric covering where the CSPE content of the polymer content is greater than 30 %. | |
| **Standard** | NA | |
| **Application** | FEM is a water proof cladding system designed to prevent water ingress into the insulation material. | |
| **MATERIAL DATA AND PROPERTIES** | | |
| General requirements | The cladding material shall have an applicable temperature range from -50 °C to + 100 °C. | |
| | Layer thickness: ≥ 1 mm | |
| | **Test standard** | **Acceptance criteria** |
| Mechanical properties | ASTM D751 (Trapezoidal tear test) or<br>ASTM D624 (Trouser tear test) / ISO 34-1 (Method A) | Trapezoidal tear strength (ASTM D751) ≥ 80 N<br>Tear strength (ASTM D624 or ISO 34-1) ≥ 25 N/mm |
| | ASTM D751 or<br>ASTM D412 / ISO 37 | Breaking strength in machine direction ≥ 10 MPa |
| | ASTM D751 or<br>ASTM D412 / ISO 37 | Elongation at break in machine direction ≥ 200 % |
| | ASTM D751 | Puncture resistance ≥ 100 N |
| Reaction to fire | ASTM E84 / EN 13501-1 | Tests shall be documented. |
| Aging test | ISO 12944-9, Annex B<br>(Exposure cycling test condition) | It shall be documented that the material (including system for joining) will maintain min. 90 % of its tensile strength/elongation properties after the accelerated aging. |
| Water vapour permeance | ASTM E96, procedure E /<br>EN 12086 | Acceptance criteria: max 0,001 g/($m^2$ ·h ·mm Hg) |
| General | Installation according to installation manual from Manufacturer. | |

*Add new MDS FEM without reinforcement*

| **MATERIAL DATA SHEET** | **MDS FEM without reinforcement** | **Rev. 01** |
|---|---|---|
| **TYPE OF MATERIAL: Weather resistant flexible elastomeric membrane (FEM) without reinforcement** | | |
| **General** | This specification describes the minimum requirements for a FEM for cladding purposes. | |
| **Products** | Chlorosulphonated Polyethylene (CSPE) polymeric covering where the CSPE content of the polymer content is greater than 30 % without woven glass scrim reinforcement<br>Ethylene Propylene Diene Monomer (EPDM) polymeric covering | |
| **Standard** | NA | |
| **Application** | FEM is a water proof cladding system designed to prevent water ingress into the insulation material. | |
| **MATERIAL DATA AND PROPERTIES** | | |
| General requirements | The cladding material shall have an applicable temperature specified by the supplier in the material data sheet. | |
| | Layer thickness: ≥ 1 mm | |
| | **Test standard** | **Acceptance criteria** |
| Mechanical properties | ASTM D624 / ISO 34 | Tear strength ≥ 5 N/mm |
| | ASTM D412 / ISO 37 | Breaking strength ≥ 4 MPa |
| | ASTM D412 / ISO 37 | Elongation at break ≥ 150 % |
| Reaction to fire | ASTM E84 / EN 13501-1 | Tests shall be documented. |
| Aging test | ISO 12944-9, Annex B<br>(Exposure cycling test condition) | It shall be documented that the material (including system for joining) will maintain min. 90 % of its tensile strength/elongation properties after the accelerated aging. |
| Water vapour permeance | ASTM E96, procedure E /<br>EN 12086 | Acceptance criteria: max 0,001 g/($m^2$ ·h ·mm Hg) |
| General | Installation according to installation manual from Manufacturer. | |

*Add new Annex E*

# Annex E
(informative)
# Example insulation checklist

This checklist is for typical inspection activities related to installation of insulation.

This checklist can be part of the ITP.

| | | Accepted, date and signature | Comments |
|---|---|---|---|
| **1.** | **Before insulation installation** | | |
| 1.1 | Materials according to specification | | |
| 1.1.1 | Material type at site as specified in IPS | | |
| 1.1.2 | Product data sheet for the materials according to IOGP S-738 | | |
| 1.2 | Materials stored protected from weather and from any risk of degradation | | |
| 1.3 | Surface to be insulated clean and dry | | |
| 1.4 | Coating under insulation complete (when applicable) | | |
| 1.5 | Hydraulic testing complete and system released for insulation | | |
| 1.6 | Heat tracing installation complete (when applicable) | | |
| 1.7 | Clearance around items to be insulated according to specification | | |
| 1.8 | Stem extension for valves installed | | |
| 1.9 | Correct type of support installed and installed correctly | | |
| **2.** | **Installation of insulation materials** | | |
| 2.1 | Insulation installed where required according to P&ID, GA, etc. | | |
| 2.2 | Thickness and number of layers as specified in IPS | | |
| 2.3 | Insulation joints staggered according to IPS | | |
| 2.4 | Insulation properly fitted | | |
| 2.5 | Insulation layers secured (type and dimensions) according to IPS | | |
| 2.6 | Expansion joints installed according to IPS (when applicable) | | |
| 2.7 | Vapour barrier installed according to IPS (when applicable) and undamaged | | |
| **3.** | **Installation of cladding** | | |
| 3.1 | Cladding material as specified in IPS (type, thickness, finish, etc.) | | |

| | | | |
|---|---|---|---|
| 3.2 | Cladding installed to shed water | | |
| 3.3 | Cladding overlap according to IPS | | |
| 3.4 | Cladding secured according to IPS | | |
| 3.5 | Sealant applied to avoid any ingress of water | | |
| 3.6 | Drain holes installed according to IPS | | |
| 3.7 | Dripping edge installed according to IPS | | |
| 3.8 | S-clips installed according to IPS (when applicable) | | |
| **4.** | **Boxes and jackets for flanges and valves** | | |
| 4.1 | Allowance for bolt removal according to specification | | |
| 4.2 | Overlap with pipe according to specification | | |
| 4.3 | Identification plate according to specification, installed | | |
| 4.4 | Jackets according to IPS<br>— Insulation material and surface material<br>— Fasteners | | |
| 4.5 | Removable boxes according to IPS<br>— Insulation wrapped in aluminium foil<br>— 10° incline on top<br>— Foldout<br>— Drain holes at lowest point of box<br>● System without vapour barrier: drain hole through the insulation system<br>● System with vapour barrier: drain hole only in cladding<br>— Minimum 20 mm air cap around flange/valve inside the box, except at penetrations in the box (not for systems with vapour barrier)<br>— Sealing in all penetrations | | |

**Registered Office**
City Tower
Level 14
40 Basinghall Street
London EC2V 5DE
United Kingdom

T +44 (0)20 3763 9700
reception@iogp.org

**Brussels Office**
Avenue de Tervuren 188A
B-1150 Brussels
Belgium

T +32 (0)2 790 7762
reception-europe@iogp.org

**Houston Office**
15377 Memorial Drive
Suite 250
Houston, TX 77079
USA

T +1 (713) 261 0411
reception-americas@iogp.org

www.iogp.org