

Piping and equipment insulation

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Foreword

The NORSOK standards are developed by the Norwegian petroleum industry to ensure adequate safety, value adding and cost effectiveness for petroleum industry developments and operations. Furthermore, NORSOK standards are, as far as possible, intended to replace oil company specifications and serve as references in the authorities' regulations.

The NORSOK standards are normally based on recognised international standards, adding the provisions deemed necessary to fill the broad needs of the Norwegian petroleum industry. Where relevant, NORSOK standards will be used to provide the Norwegian industry input to the international standardisation process. Subject to development and publication of international standards, the relevant NORSOK standard will be withdrawn.

The NORSOK standards are developed according to the consensus principle generally applicable for most standards work and according to established procedures defined in NORSOK A-001.

The NORSOK standards are prepared and published with support by The Norwegian Oil Industry Association (OLF), The Federation of Norwegian Industry, Norwegian Shipowners' Association and The Petroleum Safety Authority Norway.

NORSOK standards are administered and published by Standards Norway.

Introduction

Edition 3 of this NORSOK standard is updated and partly rewritten based on industry experience over the last years.

A new clause is added on piping penetrations and qualification of new products.
Test requirements for acoustic insulation have been updated in accordance with ISO 15665.
Thickness tables for insulation classes have been deleted in this edition.

Annex A is for information only.

1 Scope

This NORSOK standard covers the minimum requirements for thermal, acoustic, personnel protection, fire protection and pipe penetration insulation of pipe work, equipment, vessels, tanks, valves, flanges etc. for offshore/onshore installations and not for sub-sea installation.

This NORSOK standard does not cover refractory or insulation of heating, ventilation and air conditioning (HVAC) related items.

2 Normative and informative references

The following standards include provisions and guidelines which, through reference in this text, constitute provisions and guidelines of this NORSOK standard. Latest issue of the references shall be used unless otherwise agreed. Other recognized standards may be used provided it can be shown that they meet or exceed the requirements the referenced standards.

2.1 Normative references

BS 5970:2001,	Code of practice for thermal insulation of pipe work and equipment
DNV Standard for Certification, 2.9 Type Approvals 8-471.19-1,	
EN 822,	Thermal-insulating products for building applications – Determination of length and width
EN 823,	Thermal-insulating products for building applications – Determination of thickness
EN 1604,	Thermal-insulating products for building applications – Determination of dimensional stability under specified temperature and humidity conditions
EN 1608,	Thermal-insulating products for building applications – Determination of tensile strength parallel to faces
EN 1609,	Thermal insulating products for building applications – Determination of short term water absorption by partial immersion
EN 12667,	Thermal performance of building materials and products – Determination of thermal resistance by means of guarded hot plate and heat flow meter methods – Products of high and medium thermal resistance
EN 12939,	Thermal performance of building materials and products – Determination of thermal resistance by means of guarded hot plate and heat flow meter methods – Thick products of high and medium thermal resistance
IACS UR S. 14.2.3,	Hose testing
IMO Resolution A.653 (16),	Recommendations on Improved Fire Test Procedures for Surface Flammability of Bulkhead, Ceiling and Deck Finish Materials
IMO Resolution MSC 41 (64),	Interim standard for measuring smoke and toxic products of combustion for plastic piping in dry conditions (level 1 and 2)
IMO Resolution A.754 (18),	Recommendation on Fire Resistance Tests for “A”, “B” and “F” Class Divisions
ISO 37,	Rubber, vulcanized or thermoplastic – determination of tensile stress-strain properties
ISO 834,	Fire-resistance tests – Elements of building constructions – (all parts)
ISO 834-1,	Fire-resistance tests – Elements of building construction – Part 1: General requirements
ISO 5660-1,	Reaction-to-fire tests – Heat release, smokes production and mass loss rate – Part 1: Heat release rate (cone calorimeter method)
ISO 9364,	Continuous hot-dip aluminium/zinc-coated steel sheet of commercial, drawing and structural qualities
ISO 15665,	Acoustics – Acoustics insulation for pipes, valves and flanges (including Corrigendum 1)
ISO 20340,	Paints and varnishes – Performance requirements for protective paint system for offshore and related structures
Marine Equipment Directive,	Skipsutstyrsdirektivet
NORSOK S-002,	Working Environment
NORSOK M-501,	Surface Preparation and Protective Coating

NS-EN 10215,	Continuously hot-dip aluminium-zinc (AZ) coated steel strip and sheet – Technical delivery conditions
NS-EN 12086,	Thermal-insulating products for building applications
NS-EN 1363-1,	Fire resistance tests – Part 1: General requirements
NS-EN ISO 1182,	Reaction to fire tests for building products – Non-combustibility test
OTI 95634	Jet Fire Resistance Test of Passive Fire Protection Materials
PTIL “Innretningsforskriften”, prEN 14303	Thermal insulation products for building equipment and industrial installations – Factory made mineral wool (MW) products – Specification
prEN 14304	Thermal insulation products for building equipment and industrial installations – Factory made flexible elastomeric foam (FEF) products – Specification
prEN 14305	Thermal insulation products for building equipment and industrial installations – Factory made cellular glass (CG) products – Specification
NS-EN ISO 12241	Thermal insulation for building equipment and industrial installations – Calculation rules (ISO 12241:1998)
NS-EN 13501-1	Fire classifications of construction products and building elements - Part 1: Classification using data from reaction to fire test
NS-EN ISO 13787	Thermal insulating products for building equipment and industrial installations-Determination of declared thermal conductivity
NS-EN 14706	Thermal insulating products for building equipment and industrial installations - Determination of maximum service temperature
Insulation Handbook,	Book 2 Sketches. Established by Statoil and Norsk Hydro, latest edition. www.statoil.com/tek/dvm/svg01757.nsf www.hydro.com/en/our_business/oil_energy/new_projects/index.html

2.2 Informative references

None

3 Terms, definitions and abbreviations

For the purposes of this NORSOK standard, the following terms, definitions and abbreviations apply.

3.1 Terms and definitions

3.1.1

can

verbal form used for statements of possibility and capability, whether material, physical or casual

3.1.2

Company

operating company

3.1.3

may

verbal form used to indicate a course of action permissible within the limits of this NORSOK standard

3.1.4

shall

verbal form used to indicate requirements strictly to be followed in order to conform to this NORSOK standard and from which no deviation is permitted, unless accepted by all involved parties

3.1.5

should

verbal form used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required

3.2 Abbreviations

AES	alkali earth silicate
AISI	American Iron and Steel Institute
ASTM	American Society for Testing and Materials
CG	cellular glass
CL	symbol of the declared level of soluble chlorides
c/c	center center
DN	diameter nominal
DNV	Det Norske Veritas
EN	European Standard
FEF	flexible elastomeric foam
HSE	health, safety and environment
HTAA	high temperature anti-abrasive coating
IACS	International Association of Classification Societies (e.g. DNV,)
IMO	International Maritime Organisation
IPS	insulation procedure specification
IPT	insulation procedure test
ISO	International Organization for Standardization
LTAA	low temperature anti-abrasive coating
NS	Norsk Standard
P&ID	piping & instrument diagram
PTIL	Petroleumstilsynet
prEN	Draft European Standard
QC	quality control
ST	service temperature
WL (p)	symbol of the declared level of long-term water absorption by partial immersion
WS	symbol of the declared level for short-term water absorption
pH	potential of hydrogen

3.3 Insulation classes

Heat conservation

Class 1

The purpose is to reduce heat losses and to maintain temperatures for the efficient operation of the process.

Cold medium conservation

Class 2

The purpose is to maintain low temperature and control heat input to the process.

Personnel protection

Class 3

Surfaces with temperatures below -10 °C or above 70 °C and which are confined to a distance of not more than 2,1 m vertically and 0,8 m horizontally away from walkways and normal working areas shall be guarded by screens. Insulation shall only be used where guards are not practical and for pipes with temperatures above 150 °C.

Frost protection

Class 4

Insulation with or without heat tracing, to prevent freezing, solidification and inside condensation.

Fire protection

Class 5

The purpose is to reduce the heat input and secure that the temperature on piping, vessels and equipment is below the specified critical temperature when exposed to the specified fire scenario for the actual area of installation. If no fire scenario or critical temperature is specified, the fire protection shall limit the temperature to 400 °C in a hydrocarbon fire situation lasting for 30 min according to ISO 834 (all parts).

Selected fire protection shall be documented based on relevant fire testing.

Acoustic insulation

Class 6, class 7 and class 8

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 as given in NORSOK S-002. Based on documented insertion loss, each project may select the applicable class and select materials or combinations of materials to cover the required insertion loss at actual frequencies. This selection shall not conflict with any other requirement of this NORSOK standard, and Company shall approve each combination.

The definition of the classes of acoustic insulation is as given in ISO 15665, Clause 4. The 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 is to 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 is to 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 is to be in accordance with the definition given in ISO 15665 for class C. Valves and flanges shall be insulated.

External condensation and icing protection Class 9

The purpose is to prevent outside condensation on piping and equipment with operation temperatures below 20 °C.

4 General requirements

4.1 Introduction

General requirements for all insulation classes and details are given in this clause.

Surface preparation prior to insulation on piping, equipment, vessels, tanks, valves, flanges, pipe penetration, etc. to be according to NORSOK M-501.

All materials, or combination of materials and thicknesses, for insulation class 5, class 6, class 7 and class 8 shall be subject to relevant testing prior to use, see 7.6 and 10.1.

The insulation thickness shall be calculated in accordance with NS-EN ISO 12241, and based upon project requirements for heat loss, energy input etc.

Qualification procedure is stated in 10.3.1. IPS shall be taken into consideration in design phase.

Alternative insulation system and materials may be used if the proposed materials and methods satisfy the functional requirements in this NORSOK standard, see Clause 13. Approval by Company is required.

Technical specifications and HSE data sheets for all materials shall be in Norwegian.

4.2 General design

Piping and equipment shall be insulated according to the insulation classes, operating temperature and insulation thickness defined in the P&ID, data sheets and IPS.

All insulation shall be covered with weather protection designed and installed to prevent ingress of water during normal operation throughout the project design life.

Insulation adjacent to flanges in piping and equipment shall be terminated to allow removal of bolts without damage to insulation. Minimum free space from the flange to the nearest part of the insulation shall be equal to the bolt length +25 mm. The termination of the weather protection shall be waterproof.

All design shall allow for necessary room for insulation and insulation jackets and preformed boxes. Particular care shall be taken in piping design to ensure sufficiently long straight pipe runs around e.g. branches, bends, valves and supports, to enable proper installation of insulation.

The insulation material shall be non-combustible according to NS-EN ISO 1182.

Insulation systems shall be non-toxic and watertight.