

NORSOK Standard

M-710

Edition 3, September 2014

Qualification of non-metallic materials and manufacturers – Polymers

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M-710

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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 Subject to development and publication of international standards, the relevant NORSOK standard will be withdrawn.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 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 and Gas Association and the Federation of Norwegian Industries.

NORSOK standards are administered and published by Standards Norway.

Introduction

This edition 3 of NORSOK M-710 replaces edition 2 and is an update to include the following main changes:

- As a result of the joint industry effort to prepare ISO 23936-2 dealing with qualification of elastomers, this NORSOK standard refers to the requirements in ISO 23936-2 for elastomers.
- For thermoplastic materials, the qualification requirements are given directly in this NORSOK standard and aligned with requirements and format in ISO 23936-2.
- The ISO 23936-1: 2009 is considered as informative.

The intent of this NORSOK standard and the qualification process described herein is to ensure that the:

1. polymer material manufacturer and user have sufficient understanding and experience with the applicable materials to be reassured that they will give acceptable performance in the specified environment;
2. manufacturer has sufficient insight and experience in the manufacture of such materials and that they are supplied of a sufficiently consistent quality to meet given specifications.

The polymer materials covered by this NORSOK standard are elastomers and thermoplastics used for offshore oil and gas production.

It is intended that successful qualification of a manufacturer and a specific material be valid for other projects and different operators. The consideration of qualification is, however, at the discretion and determination of the user, normally on the basis of documentation provided by the manufacturer as required in this standard.

The user is responsible for ensuring, if necessary with external competence, that the manufacturer selected is qualified.

Materials previously approved to Revision 2 of this NORSOK standard do not need to be re-qualified as long as the requirements in this document are adhered to.

There does neither exist, nor are there currently plans to introduce, a NTS/NORSOK qualification or approval strategy or a public listing of qualified manufacturers in this regard.

In order for a material to be considered qualified in compliance with this standard, the qualification test data defined in this NORSOK standard shall be available to the purchaser, user and asset operator.

1 Scope

This NORSOK standard describes a methodology for establishing long term chemical compatibility for polymers based on an accelerated testing scheme for components wetted by production and injection hydrocarbon fluids. Further, for polymers (mainly elastomers) that can be exposed to sudden pressure drops in a gaseous environment, the standard describes a methodology for testing rapid gas decompression resistance.

The standard covers testing of material properties. Functional performance testing and low temperature properties are not covered by this standard.

The standard applies for downhole, subsea and workover systems. The standard also applies to topside valves up to and including choke valves in production systems and to high pressure gas injection systems.

This standard can be used for materials/components wetted by other fluids. Examples of such components are electrical isolation/sealing materials and sealing materials for hydraulic systems. In these cases, fluids and test scope needs to be specified by Purchaser.

This NORSOK standard supplements, but does not replace, the material requirements given in the appropriate design codes, standards and regulations.

This NORSOK standard is based on ISO 23936 -2: 2011. Additional requirements and clarifications stated in this document applies.

Annex A and B are normative.

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 and guidelines of the standards referenced below.

2.1 Normative references

ASTM 297, *Standard Test Methods for Rubber Products - Chemical Analysis*

ASTM D395, *Standard Test Methods for Rubber Property – Compression Set*

ASTM D412, *Standard test methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension*

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

ASTM D695, *Standard Test Method for Compressive Properties of Rigid Plastics*

ASTM D792, *Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement*

ASTM D1414, *Standard Test Methods of Testing Rubber O-rings*

ASTM D1415, *Standard Test Method for Rubber property – International hardness (IRHD)*

ASTM D1525, *Test Method for Vicat Softening Temperature of Plastics*

ASTM D2240, *Standard Test Method for Rubber Property – Durometer Hardness*

ASTM D2990, *Test methods for Tensile, Compressive and Flexural Creep and Creep-Rupture of Plastics*

EN 10204, *Metallic products – Types of inspection documents*

ISO 34-1, *Rubber, vulcanized or thermoplastic – Determination of tear strength – Part 1: trouser, angle and crescent test pieces*

ISO 37, *Rubber, vulcanized or thermoplastic – Determination of tensile stress-strain properties*

ISO 48, *Rubber, vulcanized or thermoplastic – Determination of hardness (hardness between 10 to 100 IRHD)*

- ISO 179-1, *Plastics – Determination of Charpy impact properties – Part 1: Non-instrumented impact test*
- ISO 306, *Plastics – Thermoplastic materials – Determination of Vicat softening temperature (VST)*
- ISO 527-1, *Plastics – Determination of tensile properties – Part 1: General principles*
- ISO 527-2, *Plastics – Determination of tensile properties – Part 2: Test conditions for moulding and extrusion plastics*
- ISO 604, *Plastics – Determination of compressive properties*
- ISO 815-1, *Rubber, vulcanised or thermoplastic – Determination of compression set – Part 1: At ambient or elevated temperatures*
- ISO 868, *Plastics and ebonite – Determination of indentation hardness by means of a durometer (Shore hardness)*
- ISO 10423, *Petroleum and natural gas industries – Drilling and production equipment – Wellhead and christmas tree equipment*
- ISO 1183-1, *Plastics – Methods for determining the density of non-cellular plastics – Part 1: Immersion method, liquid pycnometer method and titration method*
- ISO 1183-2, *Plastics – Methods for determining the density of non-cellular plastics – Part 2: Density gradient column method*
- ISO 7619-1, *Rubber, vulcanized or thermoplastic – Determination of indentation hardness – Part 1: Durometer method (Shore hardness)*
- ISO 2039-1, *Plastics – Determination of hardness – Ball indentation method*
- ISO 2781 *Rubber, vulcanized or thermoplastic – Determination of density*
- ISO 2921, *Rubber vulcanized – Determination of low-temperature characteristics – Temperature retraction procedure (TR test)*
- ISO 23936-2, *Petroleum, petrochemical and natural gas industries – Non-metallic materials in contact with media related to oil and gas production – Part 2: Elastomers*

2.2 Informative references

ISO 23936-1:2009, *Petroleum, petrochemical and natural gas industries - Non-metallic materials in contact with media related to oil and gas production - Part 1: Thermoplastics*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

3.1.1

accelerated test

a test undertaken at conditions designed to speed material deterioration

NOTE This is usually accomplished by increasing temperature, to raise chemical reaction rates, but fluid concentration and stress are variables which can also be manipulated

3.1.2

asset operator

person who operates an asset, who has knowledge of operating parameters and who transmits this information to the user (3.1.20)

NOTE An asset can be a well, a production train, a plant, etc.

3.1.3

batch

discontinuously manufactured amount of polymer material before processing to semi-finished or finished shape

3.1.4

can

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

3.1.5

compression set, %

$100 \times [(Original\ sample\ height - Post-test\ height) / Interference]$

3.1.6

compound

semi-finished product or product made from polymers and additives

3.1.7

(compound) manufacturer

producer of the polymeric material or semi-finished products made from polymeric materials (thermoplastic or elastomer)

3.1.8

elastomer

rubber

amorphous material mechanically mixed with other constituents to form a rubber compound, which is then shaped by flow into articles by means of the manufacturing processes of moulding or extrusion, and then (invariably) chemically cured at elevated temperature to form an elastic insoluble material

3.1.9

fluid

a medium such as a gas, liquid, supercritical gas, or a mixture of these

3.1.10

interference

difference between the original sample height and the height of spacer bar, each measured in the same direction as the direction of compression

3.1.11

may

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

3.1.12

modulus

the ratio of the applied tensile stress to the increase in strain measured between two specified strain levels, i.e. representing the initial slope in the stress-strain curve. For rubber, modulus is the tensile stress at given elongation (strain), i.e. the stress required to extend a rubber to a stated percentage of its original length.

NOTE

In the rubber industry, the modulus at 50% elongation is often chosen.

3.1.13

polymer

high molecular weight molecule, natural or synthetic, whose chemical structure can be represented by repeated small units which collectively form molecular chains

NOTE

This material class has three main sub-groups: elastomers, thermoplastics and thermosets.

3.1.14

purchaser

a party responsible for procuring the elastomer material or component

3.1.15

rapid gas decompression

RGD

de-pressurization

explosive decompression (ED)

rapid pressure-drop in a high pressure gas-containing system disrupts the equilibrium between external gas pressure and the concentration of gas dissolved inside any polymer. Excess gas seeks to come out of solution at points throughout the material, causing expansion

NOTE If large enough and if the pressure-drop rate is faster than the natural gas diffusion rate, blistering or rupturing can occur.

3.1.16

room temperature

23 (+/- 2)°C

3.1.17

shall

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

3.1.18

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

3.1.19

thermoplastic

a material that is capable of being repeatedly softened by heating and hardened by cooling through a temperature range characteristic of the plastic and, in the softened state, of being repeatedly shaped by flow into articles by moulding, extrusion or forming

3.1.20

user

person responsible for the selection of suitable materials for a service operation based on information received from the asset operator (3.1.2)

3.1.21

wetted

exposed to the fluid. Includes primary and secondary sealing system, back-up materials and components

3.2 Abbreviations

ASTM	the American Society for Testing and Materials
DSC	differential scanning calorimetry
DMA	dynamic mechanical analysis
DMTA	dynamic mechanical thermal analysis
ISO	the International Organization for Standardization
MDSC	modulated differential scanning calorimetry
QC	quality control
RGD	rapid gas decompression (rapid gas depressurization)
PEEK	polyetheretherketone
PTFE	polytetrafluoroethylene
TMA	thermo mechanical analysis