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Oil and gas industries including lower carbon energy - Non-metallic materials in contact with media related to oil and gas production - Part 4: Fiber-reinforced composite (ISO 23936-4:2024)

Táto norma obsahuje anglickú verziu európskej normy.  
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 11/24

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Oil and gas industries including lower carbon energy -  
Non-metallic materials in contact with media related to oil  
and gas production - Part 4: Fiber-reinforced composite  
(ISO 23936-4:2024)

Industries du pétrole et du gaz y compris les énergies à faible teneur en carbone - Matériaux non métalliques en contact avec les fluides relatifs à la production de pétrole et de gaz - Partie 4: Composites renforcés de fibres (ISO 23936-4:2024)

Öl- und Gasindustrie einschließlich kohlenstoffarmer Energieträger - Nichtmetallische Werkstoffe mit Medienkontakt bei der Öl- und Gasproduktion - Teil 4: Verbundwerkstoffe (ISO 23936-4:2024)

This European Standard was approved by CEN on 8 September 2024.

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CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

**EN ISO 23936-4:2024 (E)**

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## **European foreword**

This document (EN ISO 23936-4:2024) has been prepared by Technical Committee ISO/TC 67 "Oil and gas industries including lower carbon energy" in collaboration with Technical Committee CEN/TC 12 "Oil and gas industries including lower carbon energy" the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2025, and conflicting national standards shall be withdrawn at the latest by March 2025.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

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## **Endorsement notice**

The text of ISO 23936-4:2024 has been approved by CEN as EN ISO 23936-4:2024 without any modification.



# International Standard

**ISO 23936-4**

## **Oil and gas industries including lower carbon energy — Non- metallic materials in contact with media related to oil and gas production —**

### **Part 4: Fiber-reinforced composite materials**

*Industries du pétrole et du gaz y compris les énergies à faible teneur en carbone — Matériaux non métalliques en contact avec les fluides relatifs à la production de pétrole et de gaz —*

*Partie 4: Matériaux composites renforcés de fibres*

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### Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

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This document was prepared by Technical Committee ISO/TC 67, *Oil and gas industries including lower carbon energy*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 12, *Oil and gas industries including lower carbon energy*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

A list of all parts in the ISO 23936 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## ISO 23936-4:2024(en)

### Introduction

Non-metallic materials are used in the petroleum, petrochemical and natural gas industries for a wide range of components. The purpose of this document is to establish requirements and guidelines for systematic and effective planning, for non-metallic material selection to achieve cost effective technical solutions, taking into account possible constraints due to safety and/or environmental issues.

This document is of benefit to a broad industry group ranging from operators and suppliers to engineers and authorities. It covers relevant generic types of non-metallic material (e.g. thermoplastics, elastomers, thermosetting plastics) and includes the widest range of existing technical experience.

This information aids in material selection. It can be applied to help avoid costly degradation failures of the equipment itself, which can pose a risk to the health and safety of the public and personnel or the environment. This document complements the document for metallic materials in sour service (the ISO 15156 series). It differs in the form of guidance provided to the user related to the potential degradation of desired properties when used in equipment for oil and gas production environments. The ISO 15156 series provides application limits and qualification requirements for metallic materials in H<sub>2</sub>S-containing environments which are related solely to relevant environmentally assisted cracking mechanisms.

Mechanical properties and the environmental stability of composite materials depend on the properties and environmental stability of matrix resins, fibres and fibre/resin bonding interfaces. This document focuses on the overall composite properties and their environmental stability. To permit this assessment this document utilizes flat plates and/or tubular shapes made specifically for these tests.

The document recognizes that a wider range of compounds and parameters influence the degradation of non-metallic materials and thus provides guidance to permit selection of materials for oil and gas exploration and production applications based upon stability in appropriate test conditions.

# Oil and gas industries including lower carbon energy — Non-metallic materials in contact with media related to oil and gas production —

## Part 4: Fiber-reinforced composite materials

**CAUTION** — Non-metallic materials selected using the ISO 23936 series are resistant to the given environments in the petroleum and natural gas industries, but not necessarily immune under all service conditions. This document allocates responsibility for suitability for the intended service in all cases to the equipment user.

### 1 Scope

This document provides general principles, requirements and recommendations for the assessment of stability of fibre-reinforced composite materials for service in equipment used in oil and gas production environments.

This document describes the procedures for comparative testing of composite materials consisting of polymers (thermoplastics and thermosets) and re-enforcing materials e.g. glass, carbon, aramid and metals as continuous fibres or woven fabric used in equipment for oil and gas production.

Testing and characterization of neat resins and fibre products are beyond the scope of this document.

The equipment considered includes, but is not limited to, non-metallic pipelines, piping, liners and downhole tool components.

Blistering by rapid gas decompression, coatings and compounded particulate- and short fibre-reinforced composites are excluded from the scope of this document.

### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 175, *Plastics — Methods of test for the determination of the effects of immersion in liquid chemicals*

ISO 527-4, *Plastics — Determination of tensile properties — Part 4: Test conditions for isotropic and orthotropic fibre-reinforced plastic composites*

ISO 527-5, *Plastics — Determination of tensile properties — Part 5: Test conditions for unidirectional fibre-reinforced plastic composites*

ISO 1172, *Textile-glass-reinforced plastics — Prepregs, moulding compounds and laminates — Determination of the textile-glass and mineral-filler content using calcination methods*

ISO 1183-1, *Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pycnometer method and titration method*

ISO 1268-1, *Fibre-reinforced plastics — Methods of producing test plates — Part 1: General conditions*

ISO 1268-3, *Fibre-reinforced plastics — Methods of producing test plates — Part 3: Wet compression moulding*

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ISO 1268-4, *Fibre-reinforced plastics — Methods of producing test plates — Part 4: Moulding of prepregs*

ISO 1268-5, *Fibre-reinforced plastics — Methods of producing test plates — Part 5: Filament winding*

ISO 1268-7, *Fibre-reinforced plastics — Methods of producing test plates — Part 7: Resin transfer moulding*

ISO 1268-9, *Fibre-reinforced plastics — Methods of producing test plates — Part 9: Moulding of GMT/STC*

ISO 2781, *Rubber, vulcanized or thermoplastic — Determination of density*

ISO 6721-11, *Plastics — Determination of dynamic mechanical properties — Part 11: Glass transition temperature*

ISO 7822, *Textile glass reinforced plastics — Determination of void content — Loss on ignition, mechanical disintegration and statistical counting methods*

ISO 11357-2, *Plastics — Differential scanning calorimetry (DSC) — Part 2: Determination of glass transition temperature and step height*

ISO 14126, *Fibre-reinforced plastic composites — Determination of compressive properties in the in-plane direction*

ISO 14127, *Carbon-fibre-reinforced composites — Determination of the resin, fibre and void contents*

ISO 14129, *Fibre-reinforced plastic composites — Determination of the in-plane shear stress/shear strain response, including the in-plane shear modulus and strength, by the plus or minus 45 degree tension test method*

ISO 14130, *Fibre-reinforced plastic composites — Determination of apparent interlaminar shear strength by short-beam method*

ISO 15024, *Fibre-reinforced plastic composites — Determination of mode I interlaminar fracture toughness,  $G_{IC}$ , for unidirectionally reinforced materials*

ISO 15114, *Fibre-reinforced plastic composites — Determination of the mode II fracture resistance for unidirectionally reinforced materials using the calibrated end-loaded split (C-ELS) test and an effective crack length approach*

EN 2564, *Aerospace series – Carbon fibre laminates – Determination of the fibre, resin and void contents*

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

ASTM E1131, *Standard Test Method for Compositional Analysis by Thermogravimetry*

ASTM D2290, *Standard Test Method for Apparent Hoop Tensile Strength of Plastic or Reinforced Plastic Pipe*

ASTM D2344, *Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates*

ASTM D2412, *Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading*

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

ASTM D3171, *Standard Test Methods for Constituent Content of Composite Materials*

ASTM D3410, *Standard Test Method for Compressive Properties of Polymer Matrix Composite Materials with Unsupported Gage Section by Shear Loading*

ASTM D3418, *Standard Test Method for Transition Temperatures and Enthalpies of Fusion and Crystallization of Polymers by Differential Scanning Calorimetry*

ASTM D3518, *Standard Test Method for In-Plane Shear Response of Polymer Matrix Composite Materials by Tensile Test of a  $\pm 45^\circ$  Laminate*

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ASTM D5229, *Standard Test Method for Moisture Absorption Properties and Equilibrium Conditioning of Polymer Matrix Composite Materials*

ASTM D5379, *Standard Test Method for Shear Properties of Composite Materials by the V-Notched Beam Method*

ASTM D5448, *Standard Test Method for Inplane Shear Properties of Hoop Wound Polymer Matrix Composite Cylinders*

ASTM D5449, *Standard Test Method for Transverse Compressive Properties of Hoop Wound Polymer Matrix Composite Cylinders*

ASTM D5450, *Standard Test Method for Transverse Tensile Properties of Hoop Wound Polymer Matrix Composite Cylinders*

ASTM D5528, *Standard Test Method for Mode I Interlaminar Fracture Toughness of Unidirectional Fiber-Reinforced Polymer Matrix Composites*

ASTM D6641, *Standard Test Method for Compressive Properties of Polymer Matrix Composite Materials Using a Combined Loading Compression (CLC) Test Fixture*

ASTM D7028, *Standard Test Method for Glass Transition Temperature (DMA T<sub>g</sub>) of Polymer Matrix Composites by Dynamic Mechanical Analysis (DMA)*

ASTM D7078, *Standard Test Method for Shear Properties of Composite Materials by V-Notched Rail Shear Method*

ASTM D7905, *Standard Test Method for Shear Properties of Composite Materials by V-Notched Rail Shear Method*  
*Standard Test Method for Determination of the Mode II Interlaminar Fracture Toughness of Unidirectional Fiber-Reinforced Polymer Matrix Composites*

NPL (2020) Measurement Good Practice Guide No. 38, *Fibre Reinforced Plastic Composites – Machining of Composites and Specimen Preparation*; National Physical Laboratory (UK)<sup>1)</sup>

**koniec náhľadu – text ďalej pokračuje v platenej verzii STN**

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1) Available at [www.npl.co.uk](http://www.npl.co.uk).