
Petroleum and natural gas industries - Pipeline transportation systems - Test procedures for mechanical connectors (ISO 21329:2004)

Petroleum and natural gas industries - Pipeline transportation systems - Test procedures for mechanical connectors (ISO 21329:2004)

Erdöl- und Erdgasindustrie - Rohrleitungstransportsysteme - Prüfverfahren für mechanische Verbindungen (ISO 21329:2004)

Industries du pétrole et du gaz naturel - Systèmes de transport par conduites - Modes opératoires d'essai des connecteurs métalliques (ISO 21329:2004)

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Petroleum products and
 natural gas handling
 equipment

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transport par conduites - Modes opératoires d'essai des
connecteurs métalliques (ISO 21329:2004)

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- Prüfverfahren für mechanische Verbindungen (ISO
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This European Standard was approved by CEN on 23 September 2004.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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EN ISO 21329:2004 (E)**Foreword**

This document (EN ISO 21329:2004) has been prepared by Technical Committee ISO/TC 67 "Materials, equipment and offshore structures for petroleum and natural gas industries" in collaboration with Technical Committee CEN/TC 12 "Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries", the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by April 2005, and conflicting national standards shall be withdrawn at the latest by April 2005.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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The text of ISO 21329:2004 has been approved by CEN as EN ISO 21329:2004 without any modifications.

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Petroleum and natural gas industries — Pipeline transportation systems — Test procedures for mechanical connectors

*Industries du pétrole et du gaz naturel — Systèmes de transport par
conduites — Modes opératoires d'essai des connecteurs mécaniques*

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 21329 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, Subcommittee SC 2, *Pipeline transportation systems*.

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Introduction

In some circumstances mechanical connectors provide a lower cost and/or enabling advantage to welded connectors usually used for pipelines. However, use of mechanical connectors has raised concerns about pipeline integrity due to the potential for leak paths and absence of a direct method of inspection. In the past, reassurance of the integrity of mechanical pipeline connectors has relied upon design information provided by the manufacturer, the results of finite element analysis and past experience.

This International Standard is primarily applicable to connectors to be used in a large number, and hence there is a significant burden in the number of connectors that need to be tested. However, it is recognized that the test burden can be reduced in project-specific cases, for example if there is no concern about fatigue, if the connector will not be subjected to fully restrained forces and/or if the connector design is less sensitive to accuracy of tolerance matching of components at assembly.

The tests specified in this International Standard provide a physical demonstration of the integrity of the pipeline connector. This International Standard has been developed from three main sources.

The first is the *Low cost pipeline connector systems joint industry project (JIP)*, (1995-1997)^[14], which defined the load envelopes for pipelines, identified the practical issues of installation, and conducted demonstration physical tests on three types of mechanical connectors.

The second source is ISO 13679, which has a parallel function for downhole connections.

The third is the *Connection testing specification JIP*, (1999-2000)^[15]. The JIP was sponsored by oil companies, connector suppliers, pipeline construction contractors and design consultants.

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Petroleum and natural gas industries — Pipeline transportation systems — Test procedures for mechanical connectors

1 Scope

This International Standard specifies requirements and provides guidance for the testing of mechanical connectors for use in pipeline transportation systems for the petroleum and natural gas industries as defined in ISO 13623.

The tests specified in this International Standard are intended to form part of the design verification process for connectors. They provide objective evidence that connectors conform to a defined performance envelope.

This International Standard does not cover the use of design procedures as part of the qualification process for mechanical connectors, nor does it address fabrication and quality control. However, it can be used as input to a qualification procedure.

Although its principles can be applied, this International Standard does not address

- a) connectors that are designed to rotate in use,
- b) manifolds,
- c) topsides pipework or piping,
- d) flanges,
- e) connectors used in pipelines installed by reeling or J-tube pulls,
- f) factory acceptance testing,
- g) statistical bases for risk analysis.

2 Normative references

The following referenced documents are indispensable for the application 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 148-1, *Metallic materials — Charpy pendulum impact test — Part 1: Test method*

ISO 783:1999, *Metallic materials — Tensile testing at elevated temperature*

ISO 3183-1, *Petroleum and natural gas industries — Steel pipe for pipelines — Technical delivery conditions — Part 1: Pipes of requirement class A*

ISO 3183-2, *Petroleum and natural gas industries — Steel pipe for pipelines — Technical delivery conditions — Part 2: Pipes of requirement class B*

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ISO 3183-3, *Petroleum and natural gas industries — Steel pipe for pipelines — Technical delivery conditions — Part 3: Pipes of requirement class C*

ISO 6892:1998, *Metallic materials — Tensile testing at ambient temperature*

ISO 9327, *Steel forgings and rolled or forged bars for pressure purposes — Technical delivery conditions*

ISO 13623, *Petroleum and natural gas industries — Pipeline transportation systems*

ISO 13679:2002, *Petroleum and natural gas industries — Procedures for testing casing and tubing connections*

EN 10213, *Technical delivery conditions for steel castings for pressure purposes*

EN 10222-1, *Steel forgings for pressure purposes – Part 1: General requirements for open die forgings*

ASTM A 370¹⁾, *Standard Test Methods and Definitions for Mechanical Testing of Steel Products*

ASTM A 487/A 487M, *Standard Specification for Steel Castings Suitable for Pressure Service*

ASTM A 694/A 694M, *Standard Specification for Carbon and Alloy Steel Forgings for Pipe Flanges, Fittings, Valves, and Parts for High-Pressure Transmission Service*

3 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply.

3.1
actual yield strength
yield strength of material determined from specimens directly related to components used in construction of the test samples

3.2
application level
service loading envelope encompassing a group of pipeline and riser applications

3.3
batch
group of items manufactured or machined under controlled conditions to ensure consistent chemical composition, processing and heat treatment such that the group can be considered as a single population

3.4
by agreement
unless otherwise indicated, agreement between the manufacturer and purchaser at the time of enquiry and order

NOTE Adapted from ISO 3183-2:1996.

3.5
connector
mechanical device used to connect adjacent components in the pipeline

1) American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA

3.6**galling**

localized damage to material surfaces resulting from contact conditions

NOTE Galling can be caused by cold welding of contacting material surfaces followed by tearing of the weld during further sliding or rotation.

3.7**heat**, noun

batch of steel prepared in one steel-making operation

[ISO 15590-1:2001]

3.8**liner**

internal layer of a material different to that of the pipe body

NOTE The liner material may be, for example, plastic or non-ferrous.

3.9**load envelope**

limit of loads (axial, pressure, torsion, bending, fatigue and temperature) within which a connector operates during service or is tested

3.10**manufacturer**

organization responsible for the design and manufacture of the equipment

NOTE 1 The manufacturer is not necessarily the vendor.

NOTE 2 Adapted from ISO 13707:2000. [SIST EN ISO 21329:2005](https://standards.iteh.ai/catalog/standards/sist/1f91d656-2928-469e-b689-1cad6593be92/sist-en-iso-21329-2005)

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3.11**operational restrained test**

simulation of the loads due to operational cycling on a section of pipeline that is fully axially constrained

3.12**operational unrestrained test**

simulation of the loads due to operational cycling on a section of pipeline or riser that is not axially constrained and may have axial tension due to self-weight or externally applied tension

3.13**pipeline**

those facilities through which fluids are conveyed, including pipe, pig traps, components and appurtenances up to and including the isolating valves

[ISO 13623:2000]

3.14**purchaser**

individual or organization that issues the order and specification to the vendor

NOTE The purchaser may be the owner or the owner's agent.

[ISO 13707:2000]

3.15**reverse torque**

Z

torque applied during tests to simulate loads that might cause the connector to rotate or unscrew, if applicable

ISO 21329:2004(E)**3.16****riser**

that part of an offshore pipeline, including subsea spool pieces, which extends from the seabed to the pipeline termination on an offshore installation

[ISO 13623:2000]

3.17**seal**

barrier that resists the passage of fluids

[ISO 13678:2000]

3.18**multiple seals**

sealing system that consists of more than one independent barrier and of which each barrier forms a seal itself

3.19**specified minimum yield strength**

minimum yield strength required by the specification or standard under which the material is purchased

[ISO 13623:2000]

3.20**test sample**

assembly of a connector and two pieces of pipe specifically for testing

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4 Symbols and abbreviated terms [SIST EN ISO 21329:2005](#)

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4.1 Symbols

$A_{F,un}$	operational unrestrained axial factor
A_s	specified cross-sectional area of pipe
$B_{F,hy}$	bending factor for hydrostatic pressure test
$B_{F,in}$	bending factor for installation
$B_{F,un}$	bending factor for unrestrained operation tests
D_i	specified pipe inside diameter
D_o	specified pipe outside diameter
E_p	Young's modulus of pipe
F_{re}	axial force for restrained operation
F_{un}	axial force for unrestrained operation
f_{VM}	von Mises' factor
H_r	depth rating
K	load multiplication factor

K_F	torque factor
K_{cc}	ratio of actual to specified minimum yield stress of the critical connector component material
K_p	ratio of actual to specified minimum yield stress of the pipe body material
K_{SCF}	stress concentration factor
L	length of test sample between inner supports
L_g	grip length of pipe
L_p	unsupported pipe length for test sample
L_s	length between scribe mark and coupling on test sample
M_{in}	bending moment for installation
M_{hy}	bending moment for hydrostatic pressure test
M_{un}	bending moment for unrestrained operation
N_c	total number of cycles
p_d	design pressure
p_{ex}	external hydrostatic pressure
p_H	internal pressure value to be used for testing
p_{op}	operating pressure based on MAOP at the connector
p_r	manufacturer's rated pressure
p_t	hydrostatic test pressure
S_L	lowest fatigue stress range
S_M	middle fatigue stress range
S_H	highest fatigue stress range
$S-N$	stress versus number of cycles in fatigue curve
$\sigma_{ax, re}$	restrained axial stress
σ_{ayc}	actual yield stress of the connector critical component
σ_{ayp}	actual yield stress of the pipe body material
σ_{sysc}	specified minimum yield stress of the connector critical component
σ_{sysp}	specified minimum yield stress of the pipe body material
$T_{d, max}$	maximum design temperature
$T_{d, min}$	minimum design temperature
T_{HT}	maximum test temperature