INTERNATIONAL STANDARD

**ISO 13628-7**

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# Petroleum and natural gas industries — Design and operation of subsea production systems —

## Part 7: Completion/workover riser systems



*Industries du pétrole et du gaz naturel — Conception et exploitation des systèmes de production immergés —*
*Partie 7: Systèmes de liaison surface/fond de mer pour complétion/reconditionnement*



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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 13628-7 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, Subcommittee SC 4, *Drilling and production equipment*.



ISO 13628 consists of the following parts, under the general title *Petroleum and natural gas industries — Design and operation of subsea production systems*:



— *Part 1: General requirements and recommendations*

— *Part 2: Unbonded flexible pipe systems for subsea and marine applications*

— *Part 3: Through flowline (TFL) systems*

— *Part 4: Subsea wellhead and tree equipment*

— *Part 5: Subsea umbilicals*

— *Part 6: Subsea production control systems*

— *Part 7: Completion/workover riser systems*

— *Part 8: Remotely Operated Vehicle (ROV) interfaces on subsea production systems*

— *Part 9: Remotely Operated Tool (ROT) intervention systems*

— *Part 10: Specification for bonded flexible pipe*

— *Part 11: Flexible pipe systems for subsea and marine applications*

# Introduction

This part of ISO 13628 has been prepared to provide general requirements, recommendations and overall guidance for the user to the various areas requiring consideration during development of subsea production system. The functional requirements defined in this part of ISO 13628 allow alternatives in order to suit specific field requirements.

This part of ISO 13628 constitutes the overall C/WO riser system standard. Functional requirements for components comprising the system and detailed requirements for riser pipe and connector design and analysis are included herein.

This part of ISO 13628 was developed on the basis of API RP 17G:1995, and other relevant documents on subsea production systems.

It is necessary that the users of this part of ISO 13628 be aware that further or different requirements might be needed for individual applications. This part of ISO 13628 is not intended to inhibit a vendor from offering, or the purchaser from accepting, alternative equipment or engineering solutions for the individual application.

This is probably particularly applicable where there is innovative or developing technology. Where an alternative is offered, it is the vendor's responsibility to identify any variations from this part of ISO 13628 and provide details.

# Petroleum and natural gas industries — Design and operation of subsea production systems —

# Part 7: Completion/workover riser systems

## 1 Scope

This part of ISO 13628 gives requirements and recommendations for the design, analysis, materials, fabrication, testing and operation of subsea completion/workover (C/WO) riser systems run from a floating vessel.

It is applicable to all new C/WO riser systems and may be applied to modifications, operation of existing systems and reuse at different locations and with different floating vessels.

This part of ISO 13628 is intended to serve as a common reference for designers, manufacturers and operators/users, thereby reducing the need for company specifications.



This part of ISO 13628 is limited to risers, manufactured from low alloy carbon steels. Risers fabricated from special materials such as titanium, composite materials and flexible pipes are beyond the scope of this part of ISO 13628.



Specific equipment covered by this part of ISO 13628 is listed as follows:

— riser joints;

— connectors;

— workover control systems;

— surface flow trees;

— surface tree tension frames;

— lower workover riser packages;

— lubricator valves;

— retainer valves;

— subsea test trees;

— shear subs;

— tubing hanger orientation systems;

— swivels;

— annulus circulation hoses;

— riser spiders;

— umbilical clamps;

— handling and test tools;

— tree cap running tools.

Associated equipment not covered by this part of ISO 13628 is listed below:

— tubing hangers;

— internal and external tree caps;

— tubing hanger running tools;

— surface coiled tubing units;

— surface wireline units;

— surface tree kill and production jumpers.

## 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, *Steel — Charpy impact test (V-notch)*



ISO 377, *Steel and steel products — Location and preparation of samples and test pieces for mechanical testing*

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

ISO 898-1, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs*

ISO 898-2, *Mechanical properties of fasteners — Part 2: Nuts with specified proof load values — Coarse thread*

ISO 1461, *Hot dip galvanized coatings on fabricated iron and steel articles — Specifications and test methods*

ISO 3183 (all parts), *Petroleum and natural gas industries — Steel pipe for pipelines — Technical delivery conditions*

ISO 2566-1, *Steel — Conversion of elongation values — Part 1: Carbon and low alloy steels*

ISO 4885, *Ferrous products — Heat treatment — Vocabulary*

ISO 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method*

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

ISO 9327-1, *Steel forgings and rolled or forged bars for pressure purposes — Technical delivery conditions — Part 1: General requirements*

ISO 9606-1, *Approval testing of welders — Fusion welding — Part 1: Steels*

ISO 9712, *Non-destructive testing — Qualification and certification of personnel*

ISO 10423:2003, *Petroleum and natural gas industries — Drilling and production equipment — Wellhead and christmas tree equipment*

ISO 10432, *Petroleum and natural gas industries — Downhole equipment — Subsurface safety valve equipment*

ISO 10474, *Steel and steel products — Inspection documents*

ISO 10945, *Hydraulic fluid power — Gas-loaded accumulators — Dimensions of gas ports*

ISO 11960:2001, *Petroleum and natural gas industries — Steel pipes for use as casing or tubing for wells*

ISO 11961, *Petroleum and natural gas industries — Steel pipes for use as drill pipe — Specification*

ISO 13533:2001, *Petroleum and natural gas industries — Drilling and production equipment — Drill-through equipment*

ISO 13535, *Petroleum and natural gas industries — Drilling and production equipment — Hoisting equipment*

ISO 13628-2, *Petroleum and natural gas industries — Design and operation of subsea production systems — Part 2: Unbonded flexible pipe systems for subsea and marine applications*

ISO 13628-4:1999, *Petroleum and natural gas industries — Design and operation of subsea production systems — Part 4: Subsea wellhead and tree equipment*



ISO 13628-5, *Petroleum and natural gas industries — Design and operation of subsea production systems — Part 5: Subsea umbilicals*

ISO 13628-6:2000, *Petroleum and natural gas industries — Design and operation of subsea production systems — Part 6: Subsea production control systems*



ISO 14693, *Petroleum and natural gas industries — Drilling and well-servicing equipment*

ISO 15156-1, *Petroleum and natural gas industries — Materials for use in $H_2S$-containing environments in oil and gas production — Part 1: General principles for selection of cracking-resistant materials*

ISO 15156-2:2003, *Petroleum and natural gas industries — Materials for use in $H_2S$-containing environments in oil and gas production — Part 2: Cracking-resistant carbon and low alloy steels, and the use of cast irons*

ISO 15156-3, *Petroleum and natural gas industries — Materials for use in $H_2S$-containing environments in oil and gas production — Part 3: Cracking-resistant CRAs (corrosion-resistant alloys) and other alloys*

ISO 17025, *General requirements for the competence of testing and calibration laboratories*

ISO 15579, *Metallic materials — Tensile testing at low temperature*

API [1)] Spec 7 [2)], *Rotary Drill Stem Elements*

API Spec 16C, *Specification for Choke and Kill Systems*

API RP 17B, *Recommended Practice for Flexible Pipe*

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1) American Petroleum Institute, 1220 L Street, North West Washington, DC 20005-4070, USA.

2) For the purposes of this part of ISO 13628, API Spec 7 will be replaced by ISO 10424-1 and ISO 10424-2 when they become publicly available.

ASME [3], *Boiler and pressure vessel code, Section VIII:2001, Rules for construction of pressure vessels, Division 1*

ASME, *Boiler and pressure vessel code, Section IX:2001, Welding and brazing qualification*

ASTM A193, *Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service*

ASTM A194, *Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service*

ASTM A320, *Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for Low-Temperature Service*

ASTM [4] A370, *Standard Test Methods and Definitions for Mechanical Testing of Steel Products*

ASTM A508, *Standard Specification for Quenched and Tempered Vacuum-Treated Carbon and Alloy Steel Forgings for Pressure Vessels*

BS [5] 7201, *Hydro-pneumatic accumulators for fluid power purposes — Part 1: Specification for seamless steel accumulator bodies above 0,5 l water capacity*

EN [6] 287-1, *Qualification test of welders — Fusion welding — Part 1: Steels*

EN 288 (all parts), *Specification and approval of welding procedures for metallic materials*

EN 1418, *Welding personnel — Approval testing of welding operators for fusion welding and resistance weld setters for fully mechanized and automatic welding of metallic materials*



IEC [7] 60089-0, *Electrical apparatus for explosive gas atmospheres — Part 0: General Requirements, Fourth Edition*



MSS [8] SP-25, *Standard Marking Systems for Valves, Fittings, Flanges and Unions*

SAE [9] AS 4059, *Aerospace fluid power — Cleanliness classification for hydraulic systems*

## 3 Terms, definitions, abbreviated terms and symbols

For the purposes of this document, the following terms, definitions, abbreviations and symbols apply.

### 3.1 Terms and definitions

**3.1.1**
**accidental load**
load(s) which are imposed on the C/WO riser system under abnormal and unplanned conditions

EXAMPLES Loss of vessel station-keeping and heave compensator lock-up.

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3) ASME International, Three Park Avenue, New York, NY 10016-5990, USA.

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

5) British Standards Institution, 389 Chiswick High Road, London W4 4AL, UK.

6) European Committee for Standardization, 36 rue de Stassart, B-1050, Brussels, Belgium.

7) International Electrotechnical Commission, IEC Central Office, 3, rue de Varembé, P.O. Box 131, CH-1211 Geneva 20, Switzerland.

8) Manufactures Standardization Society of the Valve & Fitting Industry, 127 Park Street, N.E., Vienna, VA 22180, USA.

9) SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, USA.

 

**3.1.2**
**agreement**
unless otherwise indicated, “by agreement” means “by agreement between manufacturer and purchaser at the time of enquiry and order”

**3.1.3**
**apparent weight**
**weight in water**
**wet weight**
**net lift**
**submerged weight**
**effective weight**
submerged weight including content minus buoyancy

**3.1.4**
**attachment weld**
fillet or full penetration weld used for attachment of components to pipe or coupling

**3.1.5**
**auxiliary line**
conduit (excluding choke and kill lines) attached to the outside of the riser main pipe

EXAMPLES Hydraulic supply line and annulus circulation line.

**3.1.6**
**ball joint**

ball and socket assembly having a central through-passage equal to or greater than the riser internal diameter


NOTE This can be positioned in the riser string to reduce local bending stresses.



**3.1.7**
**barrier**
one or several barrier elements that are designed to prevent unintended flow of formation fluid

**3.1.8**
**barrier element**
device that, alone, cannot prevent flow from one side to the other side of itself

**3.1.9**
**bearing stress**
average normal stress on the contact surfaces of mating surfaces

**3.1.10**
**blow-out preventer**
**BOP**
device installed at the wellhead to contain well-bore pressure either in the annular space between the casing and the tubulars or in an open hole during drilling, completion, testing or workover

**3.1.11**
**BOP stack**
assembly of well control equipment including BOPs, spools, valves, hydraulic connectors, and nipples that connect to the subsea wellhead

NOTE As commonly used, this term sometimes includes the LMRP.

**3.1.12**
**BOP adapter joint**
**BOP spanner joint**
tubing hanger orientation joint
specialized C/WO riser joint used when the C/WO riser is deployed inside a drilling riser and subsea BOP to install and retrieve an orientated subsea tubing hanger

**3.1.13**
**BOP stack**
assembly of well control equipment including BOPs, spools, valves, hydraulic connectors and nipples that connects to the subsea wellhead

NOTE As commonly used, this term sometimes includes the LMRP.

**3.1.14**
**buoyancy module**
structure of low-mass material, usually foamed polymers strapped or clamped to the exterior of riser joints, to reduce the submerged mass of the riser

**3.1.15**
**calculation**
use of analytical-based formulas or numerical-based methods, e.g. finite element method or boundary element method, to investigate the structural safety of a component/system

**3.1.16**
**Charpy V-notch test**
test to indicate fracture toughness in terms of energy absorbed or lateral expansion or fracture appearance



**3.1.17**
**choke-and-kill line**
external conduits, arranged laterally along the riser pipe, and used to circulate fluids into and out of the wellbore to control well pressure



**3.1.18**
**connector**
mechanical device used to connect adjacent components in the riser system to create a structural joint resisting applied loads and preventing leakage

EXAMPLES Threaded types, including (i) one male fitting (pin), one female fitting (integral box) and seal ring(s), or (ii) two pins, a coupling and seal sea ring(s); flanged types, including two flanges, bolts and a gasket/seal ring; clamped hub types, including hubs, clamps, bolts and seal ring(s); dog-type connectors.

**3.1.19**
**control module**
assembly of subsea control equipment for piloted or sequential hydraulic or electrohydraulic operations from surface

NOTE Can be configured as a riser control module used for operation of landing strings in tubing hanger mode or as a workover control module in tree mode for operation of the lower workover package.

**3.1.20**
**completion riser**
temporary riser that is designed to run inside a BOP and drilling riser to allow for well completion

NOTE Completion operations are performed within the drilling riser. A completion riser can also be used for open-sea workover operations.

**3.1.21**
**completion/workover riser**
**C/WO riser**
temporary riser used for completion or workover operations

**3.1.22**
**component**
part of the pressure-containing equipment, which can be considered as an individual item for the calculation

NOTE Includes structural components like pipes, connectors, stress joints, tension joints, landing blocks, slick joints, tubing hanger orientation joints, adapter joints, etc.

**3.1.23**
**corrosion allowance**
amount of wall thickness added to the pipe or component to allow for corrosion, scaling, abrasion, erosion, wear and all forms of material loss

**3.1.24**
**crack tip opening displacement**
**CTOD**
measure of crack severity that can be compared against a critical value at the onset of crack propagation

**3.1.25**
**design basis**
set of project-specific design data and functional requirements that are not specified or are left open in the general standard



**3.1.26**
**design check**
assessment of a component for a load case by means of an application rule



**3.1.27**
**design criteria**
quantitative formulations which describe each failure mode the conditions shall fulfil

**3.1.28**
**design factor**
factor (usage factor) used in working stress design

**3.1.29**
**design life**
period for which a riser can be used for its intended purpose with anticipated maintenance but without substantial repair or replacement being necessary including storage and working periods

NOTE The design life includes the entire period from start of manufacture to condemnation of the C/WO riser system or part of the system.

**3.1.30**
**design load**
combination of load effects

**3.1.31**
**design material strength**
stress used for structural strength calculation

**3.1.32**
**design pressure**
maximum difference between internal pressure and external pressure that is unlikely to be exceeded during the life of the riser, referred to a specified reference height

NOTE Design pressure is often named maximum allowable pressure or rated working pressure or maximum allowable.

EXAMPLE Design pressure is the maximum pressure considering shut-in pressure at the wellhead (seabed) or at the top of the riser with subsea valves open, maximum well fracturing pressure, maximum well injection pressure, maximum surge pressure or maximum well kill pressure.

**3.1.33**
**designer**
individual or organization that takes the responsibility for the design of C/WO riser systems conforming with requirements of this part of ISO 13628

**3.1.34**
**drift**
cylindrical mandrel for verifying drift diameter of individual and assembled equipment

**3.1.35**
**meter**
minimum diameter that allows for the passage of the drift

**3.1.36**
**drift-off**
unintended lateral movement of a dynamically positioned vessel off its intended location relative to the wellhead, generally caused by loss of station-keeping control or propulsion

**3.1.37**
**drill pipe riser**
single string of drill pipe with an attached hydraulic control umbilical and annulus umbilical



**3.1.38**
**drilling riser**
system used with floating drilling vessel for guiding the drill string and circulating fluids between the drilling vessel and the subsea BOP



**3.1.39**
**drive-off**
unintended movement of a dynamically positioned vessel off location driven by the vessel's main propulsion or station-keeping thrusters

**3.1.40**
**dynamic positioning**
computerized means of maintaining a vessel on location by selectively activating thrusters

**3.1.41**
**effective tension**
axial tension calculated at any point along a riser by considering only the top tension and the apparent weight of the riser and its contents (tension positive)

NOTE Global buckling and geometric stiffness is governed by the effective tension.

**3.1.42**
**emergency disconnect package**
subsea equipment package that typically forms part of the lower workover riser package and provides a disconnection point between the riser and subsea equipment

NOTE This equipment is used when it is required to disconnect the riser from the well, typically in case of a vessel drift-off or other emergency that could move the vessel away from the well location.

**3.1.43**
**emergency quick-disconnect**
automatic activation of an emergency shutdown followed by an automatic disconnect of the riser

**3.1.44**
**emergency shutdown**
controlled sequence of events that ensures that the well is secured against accidental release of hydrocarbons into the environment, i.e. closing of barrier elements

**3.1.45**
**environmental loads**
loads due to the environment

EXAMPLES Waves, current and wind.

**3.1.46**
**environmental seal**
outermost pressure-containing seal at a connector interface

NOTE This seal normally separates a pressurized medium from the surrounding environment.

**3.1.47**
**fabricator**
individual or organization that takes the responsibility for the fabrication of C/WO riser systems conforming with the requirements of this part of ISO 13628



**3.1.48**
**factory acceptance test**
**FAT**
test conducted by the manufacturer to verify that the manufacture of a specific assembly meets all intended functional and operational requirements



**3.1.49**
**fail-safe**
term applied to equipment or a system so designed that, in the event of failure or malfunction of any part of the system, devices are automatically activated to stabilize or secure the safety of the operation

**3.1.50**
**failure**
event causing an undesirable condition, e.g. loss of component or system function, or deterioration of functional capability to such an extent that the safety of the unit, personnel or environment is significantly reduced

EXAMPLE Structural failure (excessive yielding, buckling, rupture, leakage) or operational limitations (slick joint protection length, clearance).

**3.1.51**
**false rotary**
component that sits on the drilling rotary and provides a slip profile for single, dual or triple tubing strings

NOTE This allows the workover control system umbilical to feed into the drilling riser without interfering with the slips.

**3.1.52**
**fatigue analysis**
conventional stress-life fatigue analysis using material S-N curves and specified fatigue design factors

**3.1.53**
**fatigue crack growth analysis**
analysis of crack growth from assumed initial defect size under the action of cyclic loading

NOTE Used to determine fabrication inspection requirements and in-service inspection plans.