# INTERNATIONAL STANDARD

# ISO 13624-1

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# Petroleum and natural gas industries — Drilling and production equipment —

## Part 1: Design and operation of marine drilling riser equipment

*Industries du pétrole et du gaz naturel — Équipement de forage et de production —*

*Partie 1: Conception et exploitation des tubes prolongateurs pour les forages en mer*



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## Foreword

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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 13624-1 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 13624 consists of the following parts, under the general title *Petroleum and natural gas industries — Drilling and production equipment*:



— *Part 1: Design and operation of marine drilling riser equipment*

— *Part 2: Deepwater drilling riser methodologies, operations, and integrity technical report* (Technical Report)

## Introduction

Since the first edition of API RP 16Q was first issued in November, 1993, hydrocarbon exploration in deep-water environments has increased significantly. As a consequence of this, the need has been identified to update that code of practice to address the issues of deep-water drilling risers in sufficient detail to supplement API RP 16Q for drilling in water depths up to 3 048 m (10 000 ft).

Under the auspices of the DeepStar programme, substantial work was commissioned during 1999 and 2000 by the DeepStar Drilling Committee 4502 and lead to the development by several contractors of *Deep-water Drilling Riser Methodologies, Operations, and Integrity Guidelines* in February 2001. These guidelines were intended to supplement the existing text of API RP 16Q (1993). In a subsequent Joint Industry Project funded by DeepStar 5500 and in collaboration with API, these guidelines were supplemented with other identified revisions to produce a draft update second edition of API RP 16Q and an associated API Technical Report 16TR1, designed to be read in conjunction with the revised API RP 16Q and to supplement its contents, by providing additional guidance on recommended riser analysis methodologies through detailed explanations, step-by-step procedures and worked examples.

API publications can be used by anyone desiring to do so. Every effort has been made to assure the accuracy and reliability of the data contained in them. It is the responsibility of the users of this part of ISO 13624 to ensure that its use does not result in any loss or damage or in the violation of any federal, state, or municipal regulation.



Annex A through Annex E are informative.



 

# Petroleum and natural gas industries — Drilling and production equipment —

# Part 1: Design and operation of marine drilling riser equipment

## 1 Scope

This part of ISO 13624 pertains to the design, selection, operation and maintenance of marine riser systems for floating drilling operations. Its purpose is to serve as a reference for designers, for those who select system components, and for those who use and maintain this equipment. It relies on basic engineering principles and the accumulated experience of offshore operators, contractors, and manufacturers.

NOTE Technology is advancing in this field and improved methods and equipment are continually evolving. Each owner and operator is encouraged to observe the recommendations outlined herein and to supplement them with other proven technology that can result in more cost effective, safer, and/or more reliable performance.



The marine drilling riser is best viewed as a system. It is necessary that designers, contractors, and operators realize that the individual components are recommended and selected in a manner suited to the overall performance of that system. For the purposes of this part of ISO 13624, a marine drilling riser system includes the tensioner system and all equipment between the top connection of the upper flex/ball joint and the bottom of wellhead conductor outer casing. It specifically excludes the diverter. Also, the applicability of this part of ISO 13624 is limited to operations with a subsea BOP stack deployed at the seafloor.

Clauses 1 through 7 of this part of ISO 13624 are directly applicable to most floating drilling operations. Special situations are addressed in 8.1 and 8.4 dealing with deep-water drilling and collapse. The special considerations required for guidelineless drilling are addressed in 8.2. In addition, 8.3 and 8.5 address operations in cold-weather conditions and $H_2S$ considerations.

It is important that all riser primary-load-path components addressed in this part of ISO 13624 be consistent with the load classifications specified in ISO 13625.

## 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 13625, *Petroleum and natural gas industries — Drilling and production equipment — Marine drilling riser couplings*

BS 7910, *Guide to methods for assessing the acceptability of flaws in metallic structures*

 

# 3 Terms, definitions, and abbreviations

## 3.1 Terms and definitions

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

**3.1.1**
**accumulator**
⟨BOP⟩ pressure vessel charged with gas (nitrogen) over liquid and used to store hydraulic fluid under pressure for operation of blowout preventers

**3.1.2**
**accumulator**
⟨riser tensioner⟩ pressure vessel charged with gas (generally nitrogen) over liquid that is pressurized on the gas side from the tensioner high-pressure gas supply bottles and supplies high-pressure hydraulic fluid to energize the riser tensioner cylinder

**3.1.3**
**actuator**
mechanism for the remote or automatic operation of a valve or choke

**3.1.4**
**air-can buoyancy**
tension applied to the riser string by the net buoyancy of an air chamber created by a closed top, open-bottom cylinder forming an air-filled annulus around the outside of the riser pipe



**3.1.5**
**annulus**
space between two pipes when one pipe is inside the other



**3.1.6**
**apparent weight**
**effective weight**
**submerged weight**
weight minus buoyancy

NOTE Apparent weight is commonly referred to as weight in water, wet weight, submerged weight, or effective weight.

**3.1.7**
**auxiliary line**
conduit (excluding choke-and-kill lines) attached to the outside of the riser main tube

EXAMPLE Hydraulic supply line, buoyancy-control line, mud-boost line.

**3.1.8**
**back pressure**
pressure resulting from restriction of fluid flow downstream

**3.1.9**
**ball joint**
ball-and-socket assembly that has a central through-passage equal to or greater than the riser internal diameter and that may be positioned in the riser string to reduce local bending stresses

**3.1.10**
**blowout**
uncontrolled flow of well fluids from the wellbore

**3.1.11**
**blowout preventer**
**BOP**
device attached immediately above the casing, which can be closed to shut in the well

**3.1.12**
**blowout preventer**
⟨annular type⟩ remotely controlled device which can form a seal in the annular space around any object in the wellbore or upon itself

NOTE Compression of a reinforced elastomer packing element by hydraulic pressure effects the seal.

**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 Common usage of this term sometimes includes the lower marine riser package (LMRP).

**3.1.14**
**bottom-hole assembly**
**BHA**
assembly composed of the bit, stabilizers, reamers, drill collars, various types of subs, etc., that is connected to the bottom of a string of drillpipe

**3.1.15**
**box**
female member of a riser coupling, C&K line stab assembly or auxiliary line stab assembly



**3.1.16**
**breech-block coupling**
coupling that is engaged by rotation of one member into an interlock with another member by an angle of rotation of 90 ° or less

**3.1.17**
**buoyancy-control line**
auxiliary line dedicated to controlling, charging or discharging air-can buoyancy chambers

**3.1.18**
**buoyancy equipment**
devices added to riser joints to reduce their apparent weight, thereby reducing riser top tension requirements

NOTE The devices normally used for risers take the form of syntactic foam modules or open-bottom air chambers.

**3.1.19**
**choke-and-kill line**
**C&K line**
**kill line**
external conduit arranged laterally along the riser pipe and used for circulation of fluids into and out of the wellbore to control well pressure

**3.1.20**
**control pod**
assembly of subsea valves and regulators that, when activated from the surface, directs hydraulic fluid through special porting to operate BOP equipment

**3.1.21**
**coupling**
mechanical means for joining two sections of riser pipe in an end-to-end engagement

**3.1.22**
**diverter**
device attached to the wellhead or marine riser to close the vertical flow path and direct well flow away from the drill-floor and rig

**3.1.23**
**dog-type coupling**
coupling having wedges (dogs) that are mechanically driven between the box and pin for engagement

**3.1.24**
**drape hose**
flexible line connecting a choke, kill or auxiliary line terminal fitting on the telescopic joint to the appropriate piping on the rig structure

NOTE A U-shaped bend or "drape" in this line allows for relative movement between the inner barrel of the telescopic joint and the outer barrel of the telescopic joint as the vessel moves.

**3.1.25**
**drift-off**
unintended lateral move of a dynamically positioned vessel off of its intended location relative to the wellhead, generally caused by loss of stationkeeping control or propulsion

**3.1.26**
**drilling fluid**
**mud**
water- or oil-based fluid circulated down the drillpipe into the well and back up to the rig for purposes including containment of formation pressure, the removal of cuttings, bit lubrication and cooling, treating the wall of the well and providing a source for well data



**3.1.27**
**drive-off**
unintended move of a dynamically positioned vessel off location driven by the vessel's main propulsion or stationkeeping thrusters

**3.1.28**
**dynamic positioning**
**automatic stationkeeping**
computerized means of maintaining a vessel on location by selectively driving thrusters

**3.1.29**
**dynamic tension limit**
maximum allowable pressure multiplied by the effective hydraulic area, divided by the number of line parts

**3.1.30**
**effective hydraulic cylinder area**
net area of moving parts exposed to tensioner hydraulic pressure

**3.1.31**
**effective tension**
tension that controls the stability of risers

See 5.4.4.

**3.1.32**
**factory acceptance testing**
testing by a manufacturer of a particular product to validate its conformance to performance specifications and ratings

 

**3.1.33**
**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

**3.1.34**
**fillup line**
line through which fluid is added to the riser annulus

**3.1.35**
**flange-type coupling**
coupling having two flanges joined by bolts

**3.1.36**
**fleet angle**
angle between the vertical axis and a riser tensioner line at the point where the line connects to the telescopic joint

See Figure 1.

**3.1.37**
**flex joint**
steel and elastomer assembly that has a central through-passage equal to or greater in diameter than the riser bore and that may be positioned in the riser string to reduce local bending stresses

**3.1.38**
**gooseneck**
type of terminal fitting using a pipe section with a semicircular bend to achieve a nominal 180° change in flow direction



**3.1.39**
**guidelineless re-entry**
establishment of pressure-containing connection between the BOP stack and the subsea wellhead or between the LMRP and the BOP stack using a TV image and/or acoustic signals instead of guidelines to guide the orientation and alignment

**3.1.40**
**handling tool**
**running tool**
device that joins to the upper end of a riser joint to permit lifting and lowering of the joint and the assembled riser string in the derrick by the elevators

**3.1.41**
**heave**
vessel motion in the vertical direction

**3.1.42**
**hot spot stress**
**local peak stress**
highest stress in the region or component under consideration

NOTE The basic characteristic of a peak stress is that it causes no significant distortion and is principally objectionable as a possible initiation site for a fatigue crack. These stresses are highly localized and occur at geometric discontinuities.

**3.1.43**
**hydraulic connector**
mechanical connector that is activated hydraulically and connects the BOP stack to the wellhead or the LMRP to the BOP stack

**3.1.44**
**hydraulic supply line**
auxiliary line from the vessel to the subsea BOP stack that supplies control system operating fluid to the LMRP and BOP stack

**3.1.45**
**instrumented riser joint**
**IRJ**
riser joint equipped with sensors for monitoring parameters, such as tension in the riser pipe wall, riser angular offset, annulus fluid temperature and pressure, etc.

**3.1.46**
**jumper hose**
flexible section of choke, kill or auxiliary line that provides a continuous flow around a flex/ball joint while accommodating the angular motion at the flex/ball joint

**3.1.47**
**key-seating**
formation of a longitudinal slot in the bore of a riser system component caused by frictional wear of the rotating drillstring on the riser component

**3.1.48**
**landing joint**
riser joint temporarily attached above the telescopic joint used to land the BOP stack on the wellhead when the telescopic joint is collapsed and pinned



**3.1.49**
**landing shoulder**
**riser support shoulder**
shoulder or projection on the external surface of a riser coupling or other riser component for supporting the riser and BOP stack during deployment and retrieval



**3.1.50**
**lower marine riser package**
**LMRP**
upper section of a two-section subsea BOP stack consisting of a hydraulic connector, annular BOP, flex joint, riser adapter, jumper hoses for the choke, kill and auxiliary lines, and subsea control pods

NOTE This interfaces with the lower subsea BOP stack.

**3.1.51**
**made-up length**
actual length contributed to a riser string by a made-up riser component (overall component length minus box/pin engagement)

**3.1.52**
**make-up time**
**riser coupling**
time period beginning when the box and pin are stabbed and ending when the coupling is fully preloaded

**3.1.53**
**make-up tool**
**preload tool**
device used to engage and/or preload coupling members

**3.1.54**
**marine drilling riser**
tubular conduit serving as an extension of the wellbore from the equipment on the wellhead at the seafloor to a floating drilling rig

 

**3.1.55**
**maximum tensioner setting**
maximum setting that, when added with dynamic variations, is less than the **dynamic tension limit** (3.1.29)

**3.1.56**
**mud-boost line**
auxiliary line that provides supplementary drilling fluid from the surface and injects it into the riser at the top of the LMRP to assist in the circulation of drill cuttings up the marine riser, when required

**3.1.57**
**nipple up**
assemble a system of fluid handling components

**3.1.58**
**nominal stress**
stress calculated using the nominal pipe wall dimensions of the riser at the location of concern

**3.1.59**
**pin**
male member of a riser coupling or a choke, kill or auxiliary line stab assembly

**3.1.60**
**preload**
compressive bearing load developed between box and pin members at their interface

NOTE This is accomplished by elastic deformation during make-up of the coupling.



**3.1.61**
**protector, box**
**protector, pin**
cap or cover used to protect the box or pin from damage during storage and handling



**3.1.62**
**pup joint**
shorter than standard length riser joint

**3.1.63**
**rated load**
nominal applied loading condition used during riser design, analysis and testing based on maximum anticipated service loading

See API Spec 16F.

**3.1.64**
**response amplitude operator**
**RAO**
⟨regular waves⟩ ratio of a vessel's motion to the wave amplitude causing that motion and presented over a range of wave periods

**3.1.65**
**riser adapter**
crossover between riser and flex/ball joint

**3.1.66**
**riser annulus**
space around a pipe (drillpipe, casing or tubing) suspended in a riser

NOTE Its outer boundary is the internal surface of the riser pipe.

**3.1.67**
**riser connector**
**LMRP connector**
hydraulically operated connector that joins the LMRP to the top of the BOP stack

**3.1.68**
**riser disconnect**
operation of unlatching of the riser connector to separate the riser and LMRP from the BOP stack

**3.1.69**
**riser hang-off system**
means for supporting a disconnected deep-water riser from the drilling vessel during a storm without inducing excessive stresses in the riser

**3.1.70**
**riser hang-off tool**
tool used to latch onto an interior profile in the riser and connect it to the motion compensator

**3.1.71**
**riser joint**
section of riser main tube having the ends fitted with a box and pin and including choke, kill and (optional) auxiliary lines and their support brackets

**3.1.72**
**riser main tube**
**riser pipe**
seamless or electric-welded pipe that forms the principal conduit of the riser joint



NOTE The riser main tube is the conduit for guiding the drillstring and containing the return fluid flow from the well.



**3.1.73**
**riser recoil system**
means of limiting the upward acceleration of the riser when a disconnect is made at the riser connector

**3.1.74**
**riser spider**
device having retractable jaws or dogs used to support the riser string on the uppermost coupling support shoulder during deployment and retrieval of the riser

**3.1.75**
**riser string**
deployed assembly of riser joints

**3.1.76**
**riser tensioner**
means for providing and maintaining top tension on the deployed riser string to prevent buckling

**3.1.77**
**riser tensioner ring**
structural interface of the telescopic joint outer barrel and the riser tensioners

**3.1.78**
**rotary kelly bushing**
**RKB**
bushing that sits on top of the rotary table

NOTE It transmits torque from the rotary table to the kelly and is commonly used as a reference for vertical measurements from the drill-floor.

 

**3.1.79**
**stab**
mating box and pin assembly that provides a pressure-tight engagement of two pipe joints

NOTE An external mechanism is usually used to keep the box and pin engaged.

EXAMPLE Riser joint choke and kill stabs are retained in the stab mode by the make-up of the riser coupling.

**3.1.80**
**standard riser joint**
joint of typical length for a particular drilling vessel's riser storage racks, the derrick V-door size, riser-handling equipment capacity or a particular riser purchase

**3.1.81**
**storm disconnect**
riser disconnect to avoid excessive loading from vessel motions amplified by inclement weather conditions

**3.1.82**
**strakes**
helically wound appendages attached to the outside of the riser to suppress vortex induced vibrations

**3.1.83**
**stress amplification factor**
**SAF**
$F_{\text{SA}}$
value equal to the local peak alternating stress in a component (including welds) divided by the nominal alternating stress in the pipe wall at the location of the component



NOTE This factor is used to account for the increase in the stresses caused by geometric stress amplifiers that occur in riser components.



**3.1.84**
**thrust collar**
device for transmitting the buoyant force of a buoyancy module to the riser joint

**3.1.85**
**subsea fill-up valve**
special riser joint having a valve means to allow the riser annulus to be opened to the sea

NOTE To prevent riser pipe collapse, the valve can be opened by an automatic actuator controlled by a differential-pressure sensor.

**3.1.86**
**support bracket**
bracket positioned at intervals along a riser joint that provides intermediate radial and lateral support from the riser main tube to the choke, kill and auxiliary lines

**3.1.87**
**surge**
vessel motion along the fore/aft axis

**3.1.88**
**sway**
vessel motion along the port/starboard axis

**3.1.89**
**syntactic foam**
typically, a composite material of spherical fillers in a matrix or binder