INTERNATIONAL STANDARD

ISO 13628-5

Second edition
2009-12-15

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

Part 5: Subsea umbilicals

Industries du pétrole et du gaz naturel — Conception et exploitation des systèmes de production immergés —
Partie 5: Faisceaux de câbles immergés

Reference number
ISO 13628-5:2009(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

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 13628-5 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*.

This second edition cancels and replaces the first edition (ISO 13628-5:2002), which has been technically revised.

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*

A Part 12, dealing with dynamic production risers, a Part 13, dealing with remotely operated tool and interfaces on subsea production systems, a Part 15, dealing with subsea structures and manifolds, a Part 16, dealing with specification for flexible pipe ancillary equipment, and a Part 17, dealing with recommended practice for flexible pipe ancillary equipment, are under development.

Introduction

This part of ISO 13628 is based on the first edition of ISO 13628-5, which was based on API Spec 17E, second edition and API RP 17I, first edition. The first edition of ISO 13628-5 was adopted by API as API Spec 17E, third edition. It is intended that API Spec 17E, fourth edition, will be identical to this International Standard.

It is important that users of this part of ISO 13628 be aware that further or differing requirements can 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 engineering solutions for the individual application. This can be particularly applicable if there is innovative or developing technology. If an alternative is offered, it is the responsibility of the vendor to identify any variations from this part of ISO 13628 and provide details.

In this part of ISO 13628, where practical, US Customary (USC) and other units are included in parentheses for information.

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

Part 5: Subsea umbilicals

1 Scope

This part of ISO 13628 specifies requirements and gives recommendations for the design, material selection, manufacture, design verification, testing, installation and operation of umbilicals and associated ancillary equipment for the petroleum and natural gas industries. Ancillary equipment does not include topside hardware. Topside hardware refers to any hardware that is not permanently attached to the umbilical, above the topside hang-off termination.

This part of ISO 13628 applies to umbilicals containing components, such as electrical cables, optical fibres, thermoplastic hoses and metallic tubes, either alone or in combination.

This part of ISO 13628 applies to umbilicals for static or dynamic service, with surface-surface, surface-subsea and subsea-subsea routings.

This part of ISO 13628 does not apply to the associated component connectors, unless they affect the performance of the umbilical or that of its ancillary equipment.

This part of ISO 13628 applies only to tubes with the following dimensions: wall thickness, $t < 6$ mm, internal diameter, ID < 50,8 mm (2 in). Tubular products greater than these dimensions can be regarded as pipe/linepipe and it is expected that they be designed and manufactured according to a recognised pipeline/linepipe standard.

This part of ISO 13628 does not apply to a tube or hose rated lower than 7 MPa (1 015 psi).

This part of ISO 13628 does not apply to electric cable voltage ratings above standard rated voltages $U_0/U(U_m) = 3{,}6/6(7{,}2)$ kV rms, where U_0, U and U_m are as defined in IEC 60502-1 and IEC 60502-2.

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 527 (all parts), *Plastics — Determination of tensile properties*

ISO 1402, *Rubber and plastics hoses and hose assemblies — Hydrostatic testing*

ISO 4080, *Rubber and plastics hoses and hose assemblies — Determination of permeability to gas*

ISO 4406, *Hydraulic fluid power — Fluids — Method for coding the level of contamination by solid particles*

ISO 4672:1997, *Rubber and plastics hoses — Sub-ambient temperature flexibility tests*

ISO 6801, *Rubber or plastics hoses — Determination of volumetric expansion*

ISO 6803:2008, *Rubber or plastics hoses and hose assemblies — Hydraulic-pressure impulse test without flexing*

ISO 7751, *Rubber and plastics hoses and hose assemblies — Ratios of proof and burst pressure to design working pressure*

ISO 13628-8, *Petroleum and natural gas industries — Design and operation of subsea production systems — Part 8: Remotely Operated Vehicle (ROV) interfaces on subsea production systems*

ISO 8308, *Rubber and plastics hoses and tubing — Determination of transmission of liquids through hose and tubing walls*

IEC 60228, *Conductors of insulated cables*

IEC 60502-1, *Power cables with extruded insulation and their accessories for rated voltages from 1 kV (U_m = 1,2 kV) up to 30 kV (U_m = 36 kV) — Part 1: Cables for rated voltages of 1 kV (U_m = 1,2 kV) and 3 kV (U_m = 3,6 kV)*

IEC 60502-2, *Power cables with extruded insulation and their accessories for rated voltages from 1 kV (U_m = 1,2 kV) up to 30 kV (U_m = 36 kV) — Part 2: Cables for rated voltages from 6 kV (U_m = 7,2 kV) up to 30 kV (U_m = 36 kV)*

IEC 60793-1-1, *Optical fibres — Part 1-1: Measurement methods and test procedures — General and guidance*

IEC 60793-2, *Optical fibres — Part 2: Product specifications — General*

IEC 60794-1-1, *Optical fibre cables — Part 1-1: Generic specification — General*

IEC 60794-1-2, *Optical fibre cables — Part 1-2: Generic specification — Basic optical cable test procedures*

EN 10204:2004, *Metallic products — Types of inspection documents*

ASTM A240, *Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications*

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

ASTM A480, *Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip*

ASTM A789/A789M, *Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service*

ASTM A1016/A1016M-04A, *Standard Specification for General Requirements for Ferritic Alloy Steel, Austenitic Alloy Steel and Stainless Steel Tubes*

ASTM E8/E8M, *Standard Test Methods for Tension Testing of Metallic Materials*

ASTM E92, *Standard Test Method for Vickers Hardness of Metallic Materials*

ASTM E213, *Standard Practice for Ultrasonic Examination of Metal Pipe And Tubing*

ASTM E273, *Standard Practice for Ultrasonic Examination of the Weld Zone of Welded Pipe and Tubing*

ASTM E309, *Standard Practice for Eddy-Current Examination of Steel Tubular Products Using Magnetic Saturation*

ASTM E384, *Standard Test Method for Microindentation Hardness of Materials*

ASTM E426, *Standard Practice for Electromagnetic (Eddy-Current) Examination of Seamless and Welded Tubular Products, Austenitic Stainless Steel and Similar Alloys*

ASTM E562, *Standard Test Method for Determining Volume Fraction by Systematic Manual Point Count*

ASTM E1001, *Standard Practice for Detection and Evaluation of Discontinuities by the Immersed Pulse-Echo Ultrasonic Method Using Longitudinal Waves*

ASTM E1245, *Standard Practice for Determining the Inclusion or Second-Phase Constituent Content of Metals by Automatic Image Analysis*

ASTM G48-03, *Standard Test Methods for Pitting And Crevice Corrosion Resistance of Stainless Steels and Related Alloys by Use of Ferritic Chloride Solution*

BS 5099, *Electric cables. Voltage levels for spark testing*

ITU-T G.976, *Test methods applicable to optical fibre submarine cable systems*

3 Terms, abbreviated terms and definitions

3.1 Terms and definitions

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

3.1.1
allowable bend radius
minimum radius to which an umbilical, at a given tension, may be bent to without infringing design criteria or suffering loss of performance

See Figure 1.

NOTE 1 The bend radius is measured to the centreline of the umbilical.

NOTE 2 Allowable bend radius increases with increasing tensile load and varies depending on internal pressure and condition, i.e. safety level.

3.1.2
allowable tensile load
maximum tensile load that an umbilical, at a given bend radius, can be loaded to without infringing design criteria or suffering loss of performance

See Figure 1.

NOTE Allowable tensile load decreases with decreasing bend radius and will vary depending on internal pressure and condition, i.e. safety level.

3.1.3
ancillary equipment
accessory to the umbilical system that does not form part of the main functional purpose

EXAMPLES Weak link, buoyancy attachments, I-tube or J-tube seals, VIV strakes, centralizers, anchors external clamps.

3.1.4
bend restrictor
device for limiting the bend radius of the umbilical by mechanical means

NOTE A bend restrictor typically is comprised of a series of interlocking metallic or moulded rings, applied over the umbilical. It is sometimes referred to as a bend strain reliever (BSR).

3.1.5
bend stiffener
device for providing a localized increase in bending stiffness, preserving the minimum bend radius of the umbilical under defined bending moment conditions

NOTE The stiffener is usually a moulded device, sometimes reinforced, depending on the required duty, applied over the umbilical. It is sometimes referred to as a bend strain reliever (BSR).

3.1.6
bird-caging
phenomenon whereby armour wires locally rearrange with an increase and/or decrease in pitch-circle diameter as a result of accumulated axial and radial stresses in the armour layer(s)

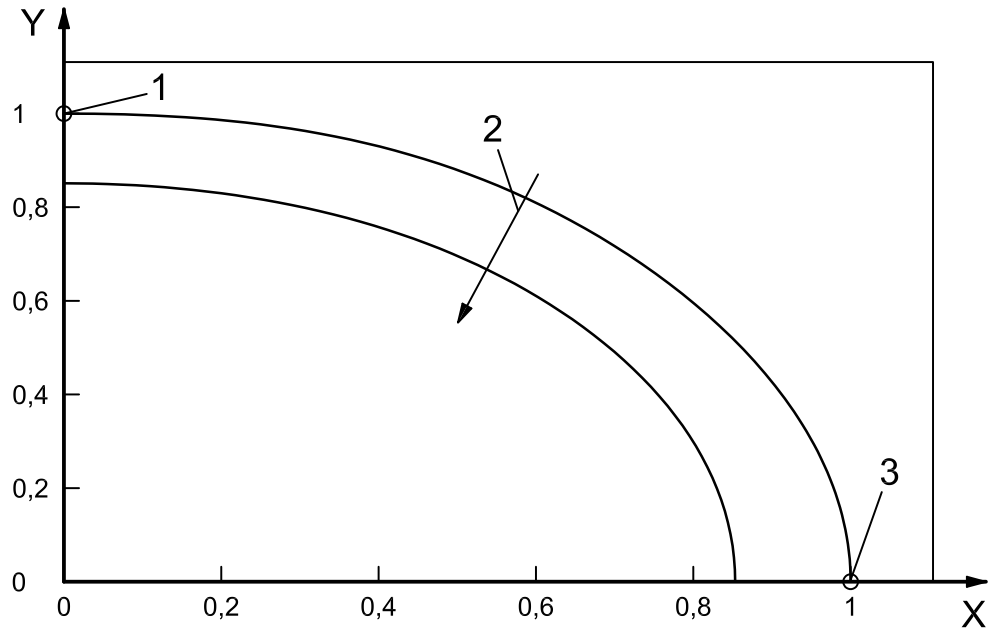
3.1.7
bundle
laid-up functional components and associated fillers in the umbilical prior to further processing

NOTE Typical functional components in a bundle include hoses, tubes, electric cables, optical fibre cables.

3.1.8
capacity curve
curve that defines the relationship between the allowable bend radius and allowable tension for an internal pressure condition

See Figure 1.

NOTE Curves can, therefore, differ for storage, testing, installation and operation scenarios.



Key

X inverse of the normalized bend radius, MBR per radius

Y normalized allowable tensile load, tension per MTL

1 maximum tensile load (MTL) with no bending

2 increasing pressure and/or increasing safety level

3 inverse of minimum bend radius (MBR) with no tension

NOTE 1 Increasing the level of safety generally increases the allowable bend radius and decreases the allowable tensile load, i.e. moves the capacity curves towards origin.

NOTE 2 Increasing the internal pressure generally increases the allowable bend radius and decreases the allowable tensile load, i.e. moves the capacity curves towards origin.

Figure 1 — Capacity curves

3.1.9
carousel
storage container that can be rotated by a drive about a vertical axis

3.1.10
caterpillar
device that holds the umbilical between belts or pads and which transfers axial linear motive power to the umbilical

NOTE A caterpillar is also known as an in-line cable engine, or haul off, or tensioner.

3.1.11
characterization data
data relating to a component or an umbilical giving an indication of performance but not giving specific acceptance/rejection criteria

3.1.12
chinese finger
type of gripper used to hold the umbilical via its outer diameter, comprised of a number of spirally interwoven wires or synthetic rope attached to a built-in anchorage arrangement

3.1.13
core
generic term used to describe an individual electrically insulated conductor

3.1.14
crab lay
installation deployment activity whereby the installation vessel moves sideways along, or at the end of, the installation route

3.1.15
crushing load
load that acts in the radial direction that might not be evenly distributed along the circumference and that is limited in length along the umbilical

NOTE A crushing load is typically induced during installation.

3.1.16
deep water
water depth generally ranging from 610 m (2 000 ft) to 1 830 m (6 000 ft)

3.1.17
design life
service life multiplied by an appropriate factor that is equal to, or greater than, one

3.1.18
design working pressure
DWP
maximum working pressure at which a hose or tube is rated for continuous operation

3.1.19
design tensile load
maximum tensile load multiplied by an appropriate factor that is equal to, or less than, one

3.1.20
end termination
mechanical fitting that is attached to the end of an umbilical and that provides a means of transferring installation and operating loads, fluid and electrical services to a mating assembly mounted on the subsea facility or surface facility

3.1.21
factory acceptance test
series of tests carried out on the completed umbilical component or complete umbilical to demonstrate the integrity of the item under test

3.1.22
filler
item wholly or partially filling the voids between the **functional components** (3.1.23) with the purpose(s) of maintaining the relative location of the components, maintaining the shape of the cross-section, influencing the weight-to-diameter ratio, separating components for wear considerations, or providing a certain radial stiffness

3.1.23
functional component
hoses, tubes, electric/optical fibre cables included within an umbilical which are required to fulfil the operational service needs

3.1.24
functional specification
document that specifies the totality of needs expressed by features, characteristics, process conditions, boundaries and exclusions defining the performance of a product or service including quality assurance requirements

3.1.25
host facility
fixed or floating facility to which the umbilical is mechanically and functionally connected and that provides the functions and services transmitted through the umbilical

EXAMPLES Platform, buoy, floating production system.

3.1.26
hydrogen scavenger
gel material applied inside the tube (metal or polymer) holding the optical fibre to absorb hydrogen ions that prevent fibre from "darkening" and from reducing transmission capabilities

3.1.27
independent verification agent
party or group independent from the manufacturer and the purchaser

3.1.28
lay-up
operation of helically assembling (SZ where appropriate) electrical cores or optical fibres into a cable, or hoses, tubes, electric cables, optical fibre cables into a bundle or sub-bundle

NOTE Sometimes referred to as "cabling".

3.1.29
lay angle
angle between the axis of a spiral-wound element (e.g. armour wires) and a line parallel to the longitudinal axis of the umbilical

3.1.30
load-out
transfer of an umbilical or umbilical system from a storage facility onto an installation/shipping vessel, either by transfer spooling or by lifting the product stored on its installation/shipping reel

3.1.31
manufacturer's written specification
specification for the umbilical, the umbilical components and their manufacture, generated by the manufacturer in compliance with requirements specified by the purchaser and this part of ISO 13628

NOTE The specification may be comprised of a multiplicity of documents (design plan, inspection and test plan, test procedures, etc.).

3.1.32
maximum tensile load
maximum tensile load that an umbilical, with zero curvature, can withstand without infringing the stress criterion or suffering loss of performance

See Figure 1, and 3.1.8.

3.1.33
messenger wire
device installed or pre-fitted into an I-tube or J-tube for transferring the primary pulling device, usually a wire rope, into the tube to provide means of pulling an umbilical through the tube