

Petroleum and natural gas industries - Design and operation of subsea production systems - Part 5: Subsea umbilicals

This document is a preview generated by EVS

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

Käesolev Eesti standard EVS-EN ISO 13628-5:2010 sisaldab Euroopa standardi EN ISO 13628-5:2009 ingliskeelset teksti.

Standard on kinnitatud Eesti Standardikeskuse 28.02.2010 käskkirjaga ja jõustub sellekohase teate avaldamisel EVS Teatajas.

Euroopa standardimisorganisatsioonide poolt rahvuslikele liikmetele Euroopa standardi teksti kättesaadavaks tegemise kuupäev on 15.12.2009.

Standard on kättesaadav Eesti standardiorganisatsioonist.

This Estonian standard EVS-EN ISO 13628-5:2010 consists of the English text of the European standard EN ISO 13628-5:2009.

This standard is ratified with the order of Estonian Centre for Standardisation dated 28.02.2010 and is endorsed with the notification published in the official bulletin of the Estonian national standardisation organisation.

Date of Availability of the European standard text 15.12.2009.

The standard is available from Estonian standardisation organisation.

ICS 75.180.10

Standardite reprodutseerimis- ja levitamiseõigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonilisse süsteemi või edastamine ükskõik millises vormis või millisel teel on keelatud ilma Eesti Standardikeskuse poolt antud kirjaliku loata.

Kui Teil on küsimusi standardite autorikaitse kohta, palun võtke ühendust Eesti Standardikeskusega:
Aru 10 Tallinn 10317 Eesti; www.evs.ee; Telefon: 605 5050; E-post: info@evs.ee

Right to reproduce and distribute Estonian Standards belongs to the Estonian Centre for Standardisation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without permission in writing from Estonian Centre for Standardisation.

If you have any questions about standards copyright, please contact Estonian Centre for Standardisation:
Aru str 10 Tallinn 10317 Estonia; www.evs.ee; Phone: +372 605 5050; E-mail: info@evs.ee

EUROPEAN STANDARD

EN ISO 13628-5

NORME EUROPÉENNE

EUROPÄISCHE NORM

December 2009

ICS 75.180.10

English Version

**Petroleum and natural gas industries - Design and operation of
subsea production systems - Part 5: Subsea umbilicals (ISO
13628-5:2009)**

Industries du pétrole et du gaz naturel - Conception et
exploitation des systèmes de production immergés - Partie
5: Faisceaux de câbles immergés (ISO 13628-5:2009)

Erdöl- und Erdgasindustrie - Konstruktion und Betrieb von
Unterwasser-Produktionssystemen - Teil 5: Unterwasser-
Versorgungskabel (ISO 13628-5:2009)

This European Standard was approved by CEN on 18 November 2009.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

Foreword

This document (EN ISO 13628-5:2009) has been prepared by Technical Committee ISO/TC 67 "Materials, equipment and offshore structures for petroleum, petrochemical 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 June 2010, and conflicting national standards shall be withdrawn at the latest by June 2010.

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

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

Endorsement notice

The text of ISO 13628-5:2009 has been approved by CEN as a EN ISO 13628-5:2009 without any modification.

Contents

Page

Foreword	vi
Introduction	vii
1 Scope	1
2 Normative references	1
3 Terms, abbreviated terms and definitions	3
3.1 Terms and definitions	3
3.2 Abbreviated terms	10
4 Functional requirements	11
4.1 General requirements	11
4.2 Project-specific requirements	12
5 Safety, design and testing philosophy	12
5.1 Application	12
5.2 Safety objective	12
5.3 Systematic review	12
5.4 Fundamental requirements	12
5.5 Design philosophy	13
5.6 Testing	14
6 Design requirements	16
6.1 General	16
6.2 Loads	16
6.3 Load effect analysis	20
6.4 Installation analysis	26
6.5 Fatigue life	27
7 Component design, manufacture and test	27
7.1 General	27
7.2 Electric cables	28
7.3 Hoses	38
7.4 Optical-fibre cable	49
7.5 Metallic tubes	54
8 Terminations and ancillary equipment design	71
8.1 Design principles	71
8.2 Design process	71
8.3 Armour terminations	71
8.4 Tube and hose terminations	72
8.5 Cable terminations	72
8.6 Pull-in head	73
8.7 Topside hang-off	73
8.8 Subsea termination interface	74
8.9 Subsea umbilical termination	74
8.10 Bend restrictors	74
8.11 Bend stiffeners	75
8.12 Ancillary equipment	75
9 Umbilical design	78
9.1 Temperature range	78
9.2 Maximum tensile load	78
9.3 Ultimate tensile load	78
9.4 Minimum bend radius	78

9.5	Cross-sectional arrangement	78
9.6	Lay-up	79
9.7	Sub-bundles	79
9.8	Inner sheath.....	79
9.9	Armouring.....	79
9.10	Outer sheath.....	80
9.11	Length marking.....	80
10	Umbilical manufacture and test	80
10.1	Umbilical manufacture	80
10.2	Qualification and verification tests	83
11	Factory acceptance tests.....	84
11.1	General.....	84
11.2	Visual and dimensional inspection.....	84
11.3	Electrical continuity at the termination	84
11.4	Trial termination fit-up.....	84
11.5	Electric cable.....	84
11.6	Optical fibre cables.....	85
11.7	Hoses	85
11.8	Tubes	86
11.9	Terminations	86
11.10	Continuity check.....	86
12	Storage.....	86
12.1	General.....	86
12.2	Protection of unterminated umbilical components.....	86
12.3	Spare length	87
12.4	Repair kits.....	87
12.5	Handling for integration tests.....	87
13	Pre-installation activity	87
13.1	Umbilical information	87
13.2	Route information	88
13.3	Terminations and ancillary equipment information	88
13.4	Host facility information.....	89
13.5	Subsea structure information.....	89
13.6	Host facility visit	89
14	Load-out.....	90
14.1	General.....	90
14.2	Technical audit of load-out facilities.....	90
14.3	Load-out procedure	91
14.4	Pre-load-out meetings.....	91
14.5	Pre-load-out tests	91
14.6	Load-out operation	92
14.7	Stopping and starting the load-out.....	93
14.8	Handling of the umbilical	93
14.9	Load-out monitoring.....	94
14.10	Load-out on a reel or carousel	94
14.11	Post-load-out tests	95
15	Installation operations	95
15.1	General.....	95
15.2	Requirements for installation vessel and equipment	95
15.3	Pre-installation survey	96
15.4	I-tube or J-tube pull-in operations	97
15.5	Lay-down of subsea termination (first end).....	100
15.6	Lay route.....	100
15.7	Handling requirements for the main lay.....	100
15.8	Vessel positioning to achieve required touch-down	101
15.9	Control and monitoring of length laid	101
15.10	Integrity monitoring during lay.....	102

15.11	Burial operations	103
15.12	Approach to subsea termination position (second end).....	104
15.13	Lay-down of subsea termination	104
15.14	Pull-in of subsea termination	105
15.15	Pipeline crossings	105
15.16	Buoyancy attachments	106
15.17	Arming of the weak link	106
15.18	Post-lay survey	106
15.19	Post-burial survey	106
15.20	Post-pull-in test	107
15.21	Post-hook-up test	107
15.22	Retrieval of installation aids.....	108
15.23	Contingencies.....	108
15.24	Repairs.....	108
15.25	Post-installation survey.....	108
Annex A	(informative) Information that should be provided in a purchaser's functional specification.....	109
Annex B	(informative) Umbilical testing	116
Annex C	(informative) Hose and tube preferred sizes	120
Annex D	(normative) Characterization tests for hoses and umbilicals	121
Annex E	(informative) Fatigue testing	125
Annex F	(informative) Load-effect analysis.....	127
Annex G	(informative) Umbilical full-scale tests.....	139
Annex H	(informative) Tube material matrix.....	145
Annex I	(informative) Tube-wall thickness example calculation.....	157
Annex J	(informative) Buckling of metallic tubes.....	164
Bibliography	167

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 171, 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.