

# Specification for Unbonded Flexible Pipe

ANSI/API SPECIFICATION 17J  
THIRD EDITION, JULY 2008

EFFECTIVE DATE: JANUARY 1, 2009

CONTAINS API MONOGRAM ANNEX AS PART OF  
US NATIONAL ADOPTION

**ISO 13628-2:2006 (Identical), Petroleum and natural gas industries—Design and operation of subsea production systems—Part 2: Unbonded flexible pipe systems for subsea and marine application**



## Special Notes

API publications necessarily address problems of a general nature. With respect to particular circumstances, local, state, and federal laws and regulations should be reviewed.

Neither API nor any of API's employees, subcontractors, consultants, committees, or other assignees make any warranty or representation, either express or implied, with respect to the accuracy, completeness, or usefulness of the information contained herein, or assume any liability or responsibility for any use, or the results of such use, of any information or process disclosed in this publication. Neither API nor any of API's employees, subcontractors, consultants, or other assignees represent that use of this publication would not infringe upon privately owned rights.

API publications may be used by anyone desiring to do so. Every effort has been made by the Institute to assure the accuracy and reliability of the data contained in them; however, the Institute makes no representation, warranty, or guarantee in connection with this publication, and hereby expressly disclaims any liability or responsibility for loss or damage resulting from its use or from the violation of any authorities having jurisdiction with which this publication may conflict.

API publications are published to facilitate the broad availability of proven, sound engineering and operating practices. These publications are not intended to obviate the need for applying sound engineering judgment regarding when and where these publications should be utilized. The formulation and publication of API publications is not intended in any way to inhibit anyone from using any other practices.

Any manufacturer marking equipment or materials in conformance with the marking requirements of an API standard is solely responsible for complying with all the applicable requirements of that standard. API does not represent, warrant, or guarantee that such products do in fact conform to the applicable API standard.

Classified areas may vary depending on the location, conditions, equipment, and substances involved in any given situation. Users of this Specification should consult with the appropriate authorities having jurisdiction.

Users of this Specification should not rely exclusively on the information contained in this document. Sound business, scientific, engineering, and safety judgment should be used in employing the information contained herein.

All rights reserved. No part of this work may be reproduced, stored in a retrieval system, or transmitted by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission from the publisher. Contact the Publisher, API Publishing Services, 1220 L Street, N.W., Washington, D.C. 20005.

## API Foreword

Nothing contained in any API publication is to be construed as granting any right, by implication or otherwise, for the manufacture, sale, or use of any method, apparatus, or product covered by letters patent. Neither should anything contained in the publication be construed as insuring anyone against liability for infringement of letters patent.

This document was produced under API standardization procedures that ensure appropriate notification and participation in the developmental process and is designated as an API standard. Questions concerning the interpretation of the content of this publication or comments and questions concerning the procedures under which this publication was developed should be directed in writing to the Director of Standards, American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005. Requests for permission to reproduce or translate all or any part of the material published herein should also be addressed to the director.

Generally, API standards are reviewed and revised, reaffirmed, or withdrawn at least every five years. A one-time extension of up to two years may be added to this review cycle. Status of the publication can be ascertained from the API Standards Department, telephone (202) 682-2000. A catalog of API publications and materials is published annually and updated quarterly by API, 1220 L Street, N.W., Washington, D.C. 20005.

Suggested revisions are invited and should be submitted to the Standards and Publications Department, API, 1220 L Street, NW, Washington, DC 20005, [standards@api.org](mailto:standards@api.org).

This standard is under the jurisdiction of the API Standards Subcommittee on Subsea Production Systems (API SC17). This API standard is identical with the English version of ISO 13628-2:2006. ISO 13628-2 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*.

For the purposes of this standard, the following editorial change has been made:

- A national informative annex (Annex C - API Monogram) has been included giving guidance to users.

# Contents

Page

API Foreword .....	v
Foreword .....	v
Introduction.....	vi
1 Scope .....	1
2 Normative references .....	1
3 Terms and definitions .....	4
4 Symbols and abbreviated terms .....	9
5 Functional requirements.....	9
5.1 General .....	9
5.2 Overall requirements.....	10
5.3 General design parameters .....	10
5.4 Internal fluid parameters.....	10
5.5 External environment.....	12
5.6 System requirements .....	13
6 Design requirements.....	16
6.1 Loads and load effects.....	16
6.2 Pipe design methodology.....	17
6.3 Pipe structure design.....	20
6.4 System design requirements .....	25
7 Materials .....	28
7.1 Material requirements .....	28
7.2 Qualification requirements.....	32
7.3 Quality assurance requirements .....	39
8 Manufacturing requirements .....	41
8.1 Quality assurance requirements.....	41
8.2 Carcass.....	43
8.3 Polymer extrusions .....	43
8.4 Pressure and tensile armour layers .....	45
8.5 Anti-wear and insulation layers .....	45
8.6 End fittings .....	46
8.7 Special processes .....	47
8.8 Manufacturing tolerances.....	49
8.9 Repairs.....	49
9 Documentation.....	50
9.1 General .....	50
9.2 Design premise .....	50
9.3 Design load report.....	51
9.4 Design report .....	51
9.5 Manufacturing quality plan.....	52
9.6 Fabrication specification .....	52
9.7 As-built documentation .....	52
9.8 Operation manual .....	53

<b>10</b>	<b>Factory acceptance tests</b> .....	<b>54</b>
<b>10.1</b>	<b>General</b> .....	<b>54</b>
<b>10.2</b>	<b>Gauge test</b> .....	<b>54</b>
<b>10.3</b>	<b>Hydrostatic pressure test</b> .....	<b>54</b>
<b>10.4</b>	<b>Electrical continuity and resistance tests</b> .....	<b>55</b>
<b>10.5</b>	<b>Gas-venting system test</b> .....	<b>55</b>
<b>11</b>	<b>Marking and packaging</b> .....	<b>56</b>
<b>11.1</b>	<b>Marking</b> .....	<b>56</b>
<b>11.2</b>	<b>Packaging</b> .....	<b>56</b>
<b>Annex A (informative)</b>	<b>Purchasing guidelines</b> .....	<b>57</b>
<b>Annex B (informative)</b>	<b>Bend stiffeners and bend restrictors</b> .....	<b>64</b>
<b>Annex C (informative)</b>	<b>API Monogram</b> .....	<b>69</b>
<b>Bibliography</b>	.....	<b>72</b>

Currently in preview, click buy full version

## 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 Directive – 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 13628-2 was prepared by Technical Committee ISO/TC 67, *Machinery, 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 13628-2:2000), 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*

The following parts are under development:

- *Part 12 dealing with dynamic production risers*
- *Part 13 dealing with remotely operated tools and interfaces on subsea production systems*

## Introduction

This part of ISO 13628 is based on API Specification 17J, *Specification for unbonded flexible pipe*, Second edition, November 1999, and the Amendment issued June 2002. This part of ISO 13628 has been technically revised and updated to cater to the needs of the international oil and natural gas industries.

Users of this part of ISO 13628 should be aware that further or differing 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 may be particularly applicable where there is innovative or developing technology. Where an alternative is offered, the vendor should 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 2: Unbonded flexible pipe systems for subsea and marine applications

### 1 Scope

This part of ISO 13628 defines the technical requirements for safe, dimensionally and functionally interchangeable flexible pipes that are designed and manufactured to uniform standards and criteria. Minimum requirements are specified for the design, material selection, manufacture, testing, marking and packaging of flexible pipes, with reference to existing codes and standards where applicable. See ISO 13628-1 for guidelines on the use of flexible pipes and ancillary components.

This part of ISO 13628 applies to unbonded flexible pipe assemblies, consisting of segments of flexible pipe body with end fittings attached to both ends. This part of ISO 13628 does not cover flexible pipes of bonded structure. This part of ISO 13628 does not apply to flexible pipe ancillary components. Guidelines for bend stiffeners and bend restrictors are given in Annex B.

NOTE 1 Guidelines for other components are given in ISO 13628-1.

This part of ISO 13628 does not apply to flexible pipes that include non-metallic tensile armour wires. Pipes of such construction are considered as prototype products subject to qualification testing.

The applications addressed by this part of ISO 13628 are sweet and sour service production, including export and injection applications. Production products include oil, gas, water and injection chemicals. This part of ISO 13628 applies to both static and dynamic flexible pipes used as flowlines, risers and jumpers. This part of ISO 13628 does not apply to flexible pipes for use in choke-and-kill line applications.

NOTE 2 See API Specification 16C for choke-and-kill line applications.

NOTE 3 ISO 13628-10 provides guidelines for bonded flexible pipe.

### 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 12, *Plastics — Determination of water absorption*

ISO 75-1, *Plastics — Determination of temperature of deflection under load — Part 1: General test method*

ISO 75-2, *Plastics — Determination of temperature of deflection under load — Part 2: Plastics and ebonite*

ISO 178, *Plastics — Determination of flexural properties*

ISO 179 (all parts), *Plastics — Determination of Charpy impact properties*

ISO 180, *Plastics — Determination of Izod impact strength*

ISO 306, *Plastics — Thermoplastic materials — Determination of Vicat softening temperature (VST)*

- ISO 307, *Plastics — Polyamides — Determination of viscosity number*
- ISO 527-1, *Plastics — Determination of tensile properties — Part 1: General principles*
- ISO 527-2, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics*
- ISO 604, *Plastics — Determination of compressive properties*
- ISO 868, *Plastics and ebonite — Determination of indentation hardness by means of a durometer (Shore hardness)*
- ISO 899-1, *Plastics — Determination of creep behaviour — Part 1: Tensile creep*
- ISO 974, *Plastics — Determination of the brittleness temperature by impact*
- ISO 1183 (all parts), *Plastics — Methods for determining the density of non-cellular plastics*
- ISO 3384, *Rubber, vulcanized or thermoplastic — Determination of stress relaxation in compression at ambient and at elevated temperatures*
- ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method*
- ISO 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method*
- ISO 6508-1, *Metallic materials — Rockwell hardness test — Part 1: Test method (scale A, B, C, D, E, F, G, H, K, N, T)*
- ISO 8457-2, *Steel wire rod — Part 2: Quality requirements for unalloyed steel wire rods for conversion to wire*
- ISO 8692, *Water quality — Freshwater algal growth inhibition test with unicellular green algae*
- ISO 9352, *Plastics — Determination of resistance to wear by abrasive wheels*
- ISO 10423:2003, *Petroleum and natural gas industries — Drilling and production equipment — Wellhead and christmas tree equipment*
- ISO 10474:1991, *Steel and steel products — Inspection documents*
- ISO 11357-1, *Plastics — Differential scanning calorimetry (DSC) — Part 1: General principles*
- ISO 11357-4, *Plastics — Differential scanning calorimetry (DSC) — Part 4: Determination of specific heat capacity*
- ISO 11359-2, *Plastics — Thermomechanical analysis (TMA) — Part 2: Determination of coefficient of linear thermal expansion and glass transition temperature*
- ISO 13628-4, *Petroleum and natural gas industries — Design and operation of subsea production systems — Part 4: Subsea wellhead and tree equipment*
- ISO 13847, *Petroleum and natural gas industries — Pipeline transportation systems — Welding of pipelines*
- ISO 15156 (all parts), *Petroleum and natural gas industries — Materials for use in H<sub>2</sub>S-containing environments in oil and gas production*
- API <sup>1)</sup> Spec 16C, *Specification for Choke and Kill Systems*
- ASME <sup>2)</sup> Boiler and Pressure Vessel Code, Section IX, *“Welding and Brazing Qualifications”*
- ASTM <sup>3)</sup> A 29, *Standard Specification for Steel Bars, Carbon and Alloy, Hot-Wrought, General Requirements for*

1) American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005, USA

2) American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990, USA

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

ASTM A182, *Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service*

ASTM A388, *Standard Practice for Ultrasonic Examination of Heavy Steel Forgings*

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

ASTM A668, *Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use*

ASTM A751, *Standard Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products*

ASTM C177, *Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus*

ASTM C518, *Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus*

ASTM D695, *Standard Test Method for Compressive Properties of Rigid Plastics*

ASTM D789, *Standard Test Methods for Determination of Relative Viscosity of Polyamide (PA)*

ASTM D1238, *Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer*

ASTM D1418, *Standard Practice for Rubber and Rubber Latices — Nomenclature*

ASTM D1505, *Standard Test Method for Density of Plastics by the Density-Gradient Technique*

ASTM D1693, *Standard Test Method for Environmental Stress Cracking of Ethylene Plastics*

ASTM D5028, *Standard Test Method for Curing Properties of Extrusion Resins by Thermal Analysis*

ASTM D6869, *Standard Test Method for Coulometric and Volumetric Determination of Moisture in Plastics Using the Karl Fischer Reaction (the Reaction of Iodine with Water)*

ASTM E94, *Standard Guide for Radiographic Examination*

ASTM E165, *Standard Test Method for Liquid Penetrant Examination*

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

ASTM E428, *Standard Practice for Fabrication and Control of Steel Reference Blocks Used in Ultrasonic Examination*

ASTM E709, *Standard Guide for Magnetic Particle Examination*

ASTM E1356, *Standard Test Method for Assignment of the Glass Transition Temperatures by Differential Scanning Calorimetry*

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

DNV: Fire test, *DNV Classification Note 6.1 Test (Fire Test)*

EN 587-1, *Qualification test of welders — Fusion welding — Part 1: Steels*

EN 288-1, *Specification and approval of welding procedures for metallic materials Part 1: General rules for fusion welding*

4) Det Norske Veritas, Veritasveien 1, 1322 Høvik, Norway

5) European Committee for Standardization, CEN Management Centre, 36, rue de Stassart, B-1050, Brussels