

Design and Operation of Subsea Production Systems—Subsea Wellhead and Tree Equipment

ANSI/API SPECIFICATION 17D
SECOND EDITION, MAY 2011

EFFECTIVE DATE: FEBRUARY 1, 2013
[for Valve and Actuator Design Validation (Test Requirements) Only]

EFFECTIVE DATE: NOVEMBER 1, 2011
[for All Other Requirements]

ERRATA, SEPTEMBER 2011
ERRATA 2, JANUARY 2012
ERRATA 3, JUNE 2013
ERRATA 4, JULY 2013
ERRATA 5, OCTOBER 2013
ERRATA 6, AUGUST 2015
ERRATA 7, OCTOBER 2015
ERRATA 8, SEPTEMBER 2019
ADDENDUM 1, SEPTEMBER 2015
ADDENDUM 2, SEPTEMBER 2019

**ISO 13628-4 (Identical), Design and operation of
subsea production systems—Part 4: Subsea
wellhead and tree equipment**



Design and Operation of Subsea Production Systems—Subsea Wellhead and Tree Equipment

Upstream Segment

ANSI/API SPECIFICATION 17D
SECOND EDITION, MAY 2011

EFFECTIVE DATE: FEBRUARY 1, 2013
[for Valve and Actuator Design Validation (Test Requirements) Only]

EFFECTIVE DATE: NOVEMBER 1, 2011
[for All Other Requirements]

ERRATA, SEPTEMBER 2011
ERRATA 2, JANUARY 2012
ERRATA 3, JUNE 2013
ERRATA 4, JULY 2013
ERRATA 5, OCTOBER 2013
ERRATA 6, AUGUST 2015
ERRATA 7, OCTOBER 2015
ERRATA 8, SEPTEMBER 2019
ADDENDUM 1, SEPTEMBER 2015
ADDENDUM 2, SEPTEMBER 2019

**ISO 13628-4 (Identical), Design and operation of
subsea production systems—Part 4: Subsea
wellhead and tree equipment**



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 for 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, translated, 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, NW, Washington, DC 20005.

Copyright © 2011 American Petroleum Institute

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.

Shall: As used in a standard, “shall” denotes a minimum requirement in order to conform to the specification.

Should: As used in a standard, “should” denotes a recommendation or that which is advised but not required in order to conform to the specification.

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, NW, Washington, DC 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) 682-8000. A catalog of API publications and materials is published annually by API, 1220 L Street, NW, Washington, DC 20005.

Suggested revisions are invited and should be submitted to the Standards Department, API, 1220 L Street, NW, Washington, DC 20005, standards@api.org.

Contents

Page

1	Scope	1
2	Normative references	3
3	Terms, definitions, abbreviated terms and symbols	4
3.1	Terms and definitions	4
3.2	Abbreviated terms and symbols	10
4	Service conditions and production specification levels	12
4.1	Service conditions	12
4.2	Product specification levels	13
5	Common system requirements	13
5.1	Design and performance requirements	13
5.2	Materials	24
5.3	Welding	25
5.4	Quality control	26
5.5	Equipment marking	29
5.6	Storing and shipping	30
6	General design requirements for subsea trees and tubing hangers	31
6.1	General	31
6.2	Tree valving	33
6.3	Testing of subsea tree assemblies	42
6.4	Marking	46
6.5	Storing and shipping	46
7	Specific requirements - Subsea-tree-related equipment and sub assemblies	46
7.1	Flanged end and outlet connections	46
7.2	ISO clamp hub-type connections	62
7.3	Threaded connections	62
7.4	Other end connectors	62
7.5	Studs, nuts and bolting	63
7.6	Ring gaskets	63
7.7	Completion guidebase	64
7.8	Tree connectors and tubing heads	65
7.9	Tree stab/seal subs for vertical tree	68
7.10	Valves, valve blocks and actuators	69
7.11	TFL wye spool and diverter	83
7.12	Re-entry interface	84
7.13	Subsea tree cap	85
7.14	Tree-cap running tool	88
7.15	Tree-guide frame	90
7.16	Tree running tool	94
7.17	Tree piping	96
7.18	Flowline connector systems	98
7.19	Ancillary equipment running tools	102
7.20	Tree-mounted hydraulic/electric/optical control interfaces	103
7.21	Subsea chokes and actuators	110
7.22	Miscellaneous equipment	118
8	Specific requirements — Subsea wellhead	122

Contents

	Page
8.1 General	122
8.2 Temporary guidebase	123
8.3 Permanent guidebase	124
8.4 Conductor housing	128
8.5 Wellhead housing	131
8.6 Casing hangers	134
8.7 Annulus seal assemblies	137
8.8 Casing hanger lockdown bushing	138
8.9 Bore protectors and wear bushings	139
8.10 Corrosion cap	141
8.11 Running, retrieving and testing tools	141
8.12 Trawl protective structure	141
8.13 Wellhead inclination and orientation	141
8.14 Submudline casing hanger and seal assemblies	142
9 Specific requirements - Subsea tubing hanger system	142
9.1 General	142
9.2 Design	143
9.3 Materials	145
9.4 Testing	145
10 Specific requirements - Mudline suspension equipment	146
10.1 General	146
10.2 Mudline suspension-landing/elevation ring	151
10.3 Casing hangers	151
10.4 Casing hanger running tools and tieback adapters	153
10.5 Abandonment caps	154
10.6 Mudline conversion equipment for subsea completions	154
10.7 Tubing hanger system - Mudline conversion equipment for subsea completions	155
11 Specific requirements - Drill-through mudline suspension equipment	155
11.1 General	155
11.2 External drill-through casing hangers (outside of the hybrid casing hanger housing)	155
11.3 Hybrid casing hanger housing	156
11.4 Internal drill-through mudline casing hangers	157
11.5 Annulus seal assemblies	159
11.6 Bore protectors and wear bushings	160
11.7 Tubing hanger system - Drill-through mudline equipment for subsea completions	161
11.8 Abandonment caps	161
11.9 Running, retrieving and testing tools	162

Contents

	Page
Annex A (informative) Vertical subsea trees	163
Annex B (informative) Horizontal subsea trees	167
Annex C (informative) Subsea wellhead	170
Annex D (informative) Subsea tubing hanger.	172
Annex E (normative) Mudline suspension and conversion systems.	176
Annex F (informative) Drill-through mudline suspension systems	183
Annex G (informative) Assembly guidelines of ISO (API) bolted flanged connections.	185
Annex H (informative) Design and testing of subsea wellhead running, retrieving and testing tools	195
Annex I (informative) Procedure for the application of a coating system.	197
Annex J (informative) Screening tests for material compatibility	200
Annex K (informative) Design and testing of pad eyes for lifting	205
Annex L (informative) Hyperbaric testing guidelines	220
Annex M (informative) Purchasing guidelines	222
Annex N (informative) Use of the API Monogram by Licensees.	244
Annex O (informative) Regional Annex	247
Bibliography	250

Date of Issue: September 2019

Affected Publication: ANSI/API Specification 17D/ISO 13628-4, *Design and Operation of Subsea Production Systems—Subsea Wellhead and Tree Equipment*, Second Edition, May 2011

Addendum 2

Section 2, Normative References:

The following reference shall be deleted:

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

Section 2, Normative References:

The following reference shall be added:

API Spec 6A, *Specification for Wellhead and Tree Equipment*, 20th Edition, October 2010

Section 3 through Annex O:

All references to “ISO 10423” shall be changed to “API 6A.”

Bibliography:

The following reference shall be added:

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

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 13628-4 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 13628-4:1999), 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 14, dealing with High Integrity Pressure Protections Systems (HIPPS), a part 15, dealing with subsea structures and manifolds, a part 16, dealing with specifications for flexible pipe ancillary equipment, and a part 17, dealing with recommended practice for flexible pipe ancillary equipment, are under development.

Introduction

This second edition of ISO 13628-4 has been updated by users and manufacturers of subsea wellheads and trees. Particular attention was paid to making it an auditable standard. It is intended for worldwide application in the petroleum industry. It is not intended to replace sound engineering judgement. It is necessary that users of this part of ISO 13628 be aware that additional or different requirements can better suit the demands of a particular service environment, the regulations of a jurisdictional authority or other scenarios not specifically addressed.

A major effort in developing this second edition was a study of the risks and benefits of penetrations in subsea wellheads. All previous editions of both this part of ISO 13628 and its parallel API document Specification for Subsea Wellhead and Christmas Tree Equipment (Specification 17D) prohibited wellhead penetrations. However, that prohibition was axiomatic. In developing this second edition, the workgroup used qualitative risk analysis techniques and found that the original insight was correct: subsea wellheads with penetrations are more than twice as likely to develop leaks over their life as those without penetrations.

The catalyst for examining this portion of the original editions of the API and ISO standards was the phenomenon of casing pressure and its monitoring in subsea wells. The report generated by the aforementioned risk analysis has become API 17 TR3 and API RP 90. The workgroup encourages the use of these documents when developing designs and operating practices for subsea wells.

Care has also been taken to address the evolving issue of using external hydrostatic pressure in design. The original versions of both API 17D and ISO 13628-4 were adopted at a time when the effects of that parameter were relatively small. The industry's move into greater water depths has prompted a consideration of that aspect in this version of this part of ISO 13628. The high-level view is that it is not appropriate to use external hydrostatic pressure to augment the applications for which a component can be used. For example, this part of ISO 13628 does not allow the use of a subsea tree rated for 69 MPa (10 000 psi) installed in 2 438 m (8 000 ft) of water on a well that has a shut-in tubing pressure greater than 69 MPa (10 000 psi). See 5.1.2.1.1 for further guidance.

The design considerations involved in using external hydrostatic pressure are only currently becoming fully understood. If a user or fabricator desires to explore these possibilities, it is recommended that a thorough review of the forthcoming American Petroleum Institute technical bulletin on the topic be carefully studied.

The overall objective of this part of ISO 13628 is to define clear and unambiguous requirements that facilitate international standardization in order to enable safe and economic development of offshore oil and gas fields by the use of subsea wellhead and tree equipment. It is written in a manner that allows the use of a wide variety of technology, from well established to state-of-the-art. The contributors to this update do not wish to restrict or deter the development of new technology. However, the user of this part of ISO 13628 is encouraged to closely examine standard interfaces and the reuse of intervention systems and tools in the interests of minimizing life-cycle costs and increasing reliability through the use of proven interfaces.

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 or engineering solutions for the individual application. This can be particularly applicable where there is innovative or developing technology. Where an alternative is offered, it is the responsibility of the vendor 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 4: Subsea wellhead and tree equipment

1 Scope

This part of ISO 13628 provides specifications for subsea wellheads, mudline wellheads, drill-through mudline wellheads and both vertical and horizontal subsea trees. It specifies the associated tooling necessary to handle, test and install the equipment. It also specifies the areas of design, material, welding, quality control (including factory acceptance testing), marking, storing and shipping for both individual sub-assemblies (used to build complete subsea tree assemblies) and **complete** subsea tree assemblies.

The user is responsible for ensuring subsea equipment meets any additional requirements of governmental regulations for the country in which it is installed. This is outside the scope of this part of ISO 13628.

Where applicable, this part of ISO 13628 can also be used for equipment on satellite, cluster arrangements and multiple well template applications.

Equipment that is within the scope of this part of ISO 13628 is listed as follows:

a) subsea trees:

- tree connectors and tubing hangers,
- valves, valve blocks, and valve actuators,
- chokes and choke actuators,
- bleed, test and isolation valves,
- TFL wye spool,
- re-entry interface,
- tree cap,
- tree piping,
- tree guide frames,
- tree running tools,
- tree cap running tools,
- tree mounted flowline/umbilical connector,
- tubing heads and tubing head connectors,
- flowline bases and running/retrieval tools,
- tree mounted controls interfaces (instrumentation, sensors, hydraulic tubing/piping and fittings, electrical controls cable and fittings);

b) subsea wellheads:

- conductor housings,
- wellhead housings,
- casing hangers,
- seal assemblies,