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

*Industries du pétrole et du gaz naturel — Équipement de forage et
de production — Équipement pour têtes de puits et arbre de Noël*



PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

This document is a preview generated by EVS



COPYRIGHT PROTECTED DOCUMENT

© ISO 2009

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

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	vi
Introduction	vii
1 Scope	1
1.1 Purpose	1
1.2 Applicability	1
1.3 Service conditions	2
1.4 Product specification levels	3
2 Normative references	6
3 Terms, definitions and abbreviated terms	8
3.1 Terms and definitions	8
3.2 Abbreviated terms	21
4 Design and performance — General requirements	21
4.1 Performance requirements — General	21
4.2 Service conditions	22
4.3 Design methods	25
4.4 Miscellaneous design information	29
4.5 Design documentation	30
4.6 Design review	30
4.7 Design validation	30
5 Materials — General requirements	30
5.1 General	30
5.2 Written specifications	31
5.3 Mandrel tubing hangers and casing hangers	31
5.4 Bodies, bonnets and end and outlet connections	35
5.5 Ring gaskets	42
5.6 Test coupons	43
5.7 Qualification test coupons	48
5.8 Heat-treating equipment qualification	50
5.9 Material qualification	50
5.10 Pressure-boundary penetrations	50
5.11 Wear bushings	51
5.12 Clamp hub-end connectors	51
6 Welding — General requirements	51
6.1 General	51
6.2 Non-pressure-containing weldments other than weld overlays — PSL 1 to PSL 3	51
6.3 Pressure-containing fabrication weldments for bodies, bonnets, end and outlet connections, bullplugs, valve-removal plugs and back-pressure valves	51
6.4 Pressure-containing repair weldments for bodies, bonnets, end and outlet connections, bullplugs, valve-removal plugs and back-pressure valves	57
6.5 Weld overlay for corrosion resistance and/or hard facing and other material surface property controls	59
7 Quality control	63
7.1 General	63
7.2 Measuring and testing equipment	63
7.3 Quality-control personnel qualifications	63
7.4 Quality control requirements	64
7.5 Quality control records requirements	104
8 Equipment marking	109

8.1	Marking requirements	109
8.2	Wellhead equipment	111
8.3	Connectors and fittings	111
8.4	Casing and tubing hangers	111
8.5	Valves and chokes	112
8.6	Loose connectors [flanged, threaded, other end connectors (OEC) and welded]	113
8.7	Other equipment	113
8.8	Studs and nuts	114
8.9	Christmas trees	114
8.10	Valve-removal plugs	115
8.11	Bullplugs	115
8.12	Back-pressure valves	115
9	Storing and shipping	115
9.1	Draining after testing	115
9.2	Rust prevention	115
9.3	Sealing-surface protection	115
9.4	Assembly and maintenance instructions	115
9.5	Ring gaskets	115
9.6	Age control of non-metallic materials	115
10	Equipment-specific requirements	116
10.1	Flanged end and outlet connections	116
10.2	Threaded end and outlet connections	152
10.3	Studs and nuts	158
10.4	Ring gaskets	160
10.5	Valves	168
10.6	Casing and tubing heads	181
10.7	Casing and tubing hangers	186
10.8	Tubing-head adapters	192
10.9	Chokes	194
10.10	Tees and crosses	197
10.11	Test and gauge connections for 103,5 MPa and 138,0 MPa (15 000 psi and 20 000 psi) equipment	202
10.12	Fluid sampling devices	204
10.13	Christmas trees	205
10.14	Cross-over connectors	205
10.15	Adapter and spacer spools	210
10.16	Actuators	211
10.17	Packing mechanisms for lock screws, alignment pins and retainer screws	216
10.18	Other end connectors	217
10.19	Top connectors	218
10.20	Surface and underwater safety valves and actuators	219
10.21	Bullplugs	225
10.22	Valve-removal plugs	228
10.23	Other pressure-boundary penetrations	229
10.24	Back-pressure valves	229
11	Repair and remanufacture	230
Annex A (informative)	Purchasing guidelines	231
Annex B (informative)	USC unit tables and data for this International Standard	250
Annex C (informative)	Method of calculating stud bolt lengths for type 6B and 6BX flanges	308
Annex D (informative)	Recommended flange bolt torque	310
Annex E (informative)	Recommended weld preparation design dimensions	314
Annex F (informative)	Design validation procedures	318
Annex G (informative)	Design and rating of equipment for use at elevated temperatures	353

Annex H (normative) Design and manufacture of surface wellhead running, retrieving and testing tools, clean-out tools and wear bushings.....	357
Annex I (normative) Design validation procedures for surface safety valves and underwater safety valves	361
Annex J (normative) Repair and remanufacture requirements.....	369
Annex K (informative) Recommended specifications for top connectors for christmas trees	383
Annex L (normative) Specifications for valve-removal preparations, valve-removal plugs and handling tools	397
Annex M (informative) Qualification of heat-treating equipment.....	417
Annex N (informative) List of tables and list of figures	420
Bibliography.....	430

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 10423 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 fourth edition cancels and replaces the third edition (ISO 10423:2003), which has been technically revised.

Introduction

This International Standard, which has been technically revised, is based on API Spec 6A, nineteenth edition, July 2004 and its addendums and errata, and API Spec 6AV1, first edition, February 1996 and its errata, with the intent that the twentieth edition of API Spec 6A will be identical to this International Standard.

The International System of units (SI) is used in this International Standard. However, nominal sizes are shown as fractions in the inch system.

The fractions and their decimal equivalents are equal and interchangeable. Metric conversions and inch dimensions in this International Standard are based on the original fractional inch designs. Functional dimensions have been converted into the metric system to ensure interchangeability of products manufactured in metric or inch systems; see also Annex B.

Tables referenced in the main body of this International Standard that are marked with an asterisk (*) are repeated in Annex B in US Customary (USC) units with the same table number as in the main body but with the prefix B. In figures where dimensions are given only in inches, the values of surface roughness have been indicated in accordance with US draughting conventions.

It is necessary that users of this International Standard be aware that further or differing requirements can be needed for individual applications. This International Standard 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 International Standard and provide details.

This document is a preview generated by EVS

Petroleum and natural gas industries — Drilling and production equipment — Wellhead and christmas tree equipment

1 Scope

1.1 Purpose

This International Standard specifies requirements and gives recommendations for the performance, dimensional and functional interchangeability, design, materials, testing, inspection, welding, marking, handling, storing, shipment, purchasing, repair and remanufacture of wellhead and christmas tree equipment for use in the petroleum and natural gas industries.

This International Standard does not apply to field use, field testing or field repair of wellhead and christmas tree equipment.

1.2 Applicability

This International Standard is applicable to the following specific equipment:

a) wellhead equipment:

- casing-head housings,
- casing-head spools,
- tubing-head spools,
- cross-over spools,
- multi-stage head housings and spools;

b) connectors and fittings:

- cross-over connectors,
- tubing-head adapters,
- top connectors,
- tees and crosses,
- fluid-sampling devices,
- adapter and spacer spools;

c) casing and tubing hangers:

- mandrel hangers,
- slip hangers;

- d) valves and chokes:
- single valves,
 - multiple valves,
 - actuated valves,
 - valves prepared for actuators,
 - check valves,
 - chokes,
 - surface and underwater safety valves and actuators,
 - back-pressure valves;
- e) loose connectors [flanged, threaded, other end connectors (OEC), and welded]:
- weld neck connectors,
 - blind connectors,
 - threaded connectors,
 - adapter and spacer connectors,
 - bullplugs,
 - valve-removal plugs;
- f) other equipment:
- actuators,
 - clamp hubs,
 - pressure boundary penetrations,
 - ring gaskets,
 - running and testing tools (see Annex H),
 - wear bushings (see Annex H).

The nomenclature used in this International Standard for typical equipment is shown in Figures 1 and 2. All parts whose physical dimensions conform to the metric tables incorporated into the body of this International Standard or to the tables in USC units in Annex B are acceptable; see Introduction.

1.3 Service conditions

This International Standard defines service conditions, in terms of pressure, temperature and material class for the well-bore constituents, and operating conditions.

1.4 Product specification levels

This International Standard establishes requirements for five product specification levels (PSLs): PSL 1, 2, 3, 3G and 4. These five PSL designations define different levels of technical quality requirements. Annex A provides guidelines (not requirements) for selecting an acceptable PSL.

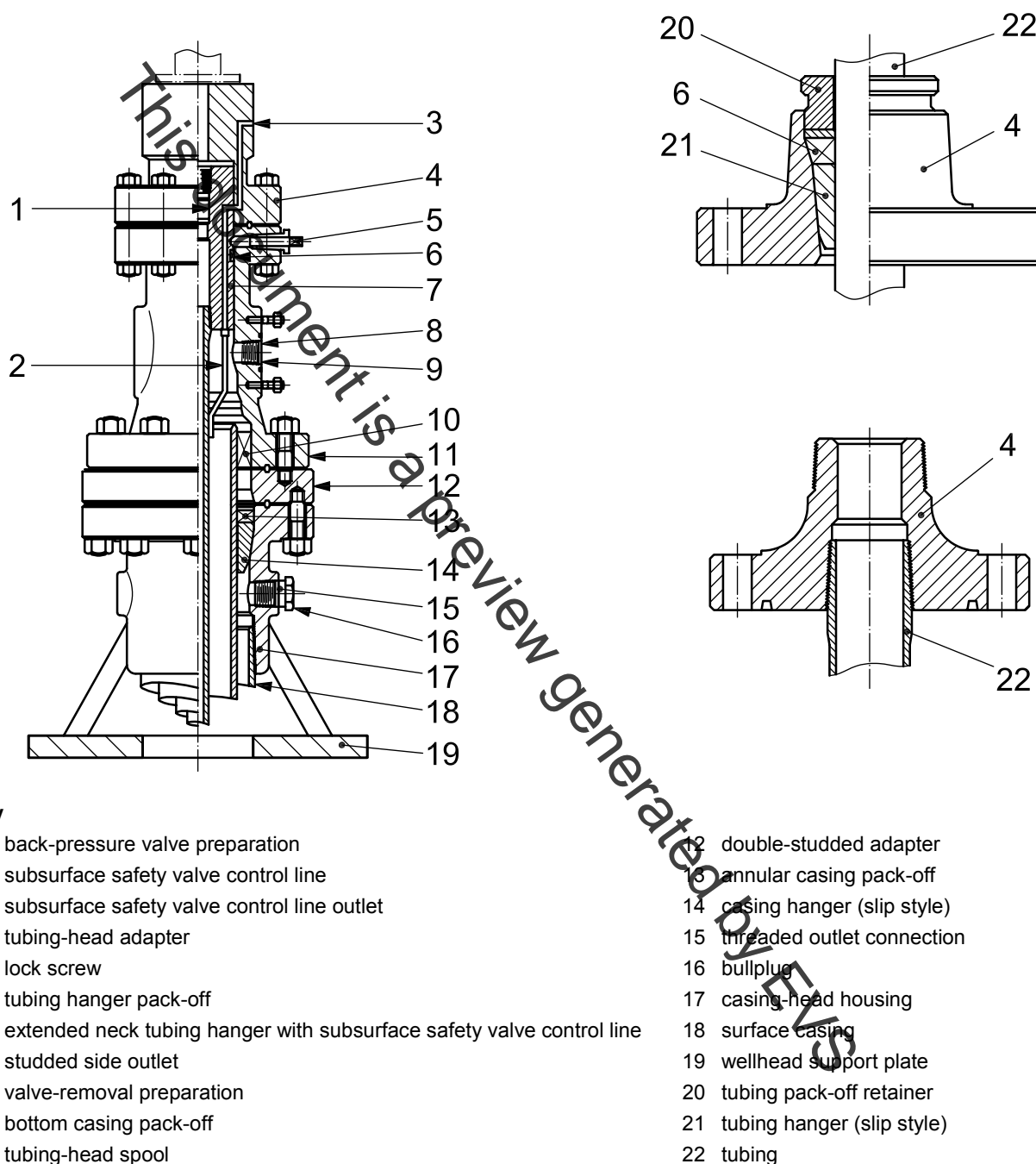
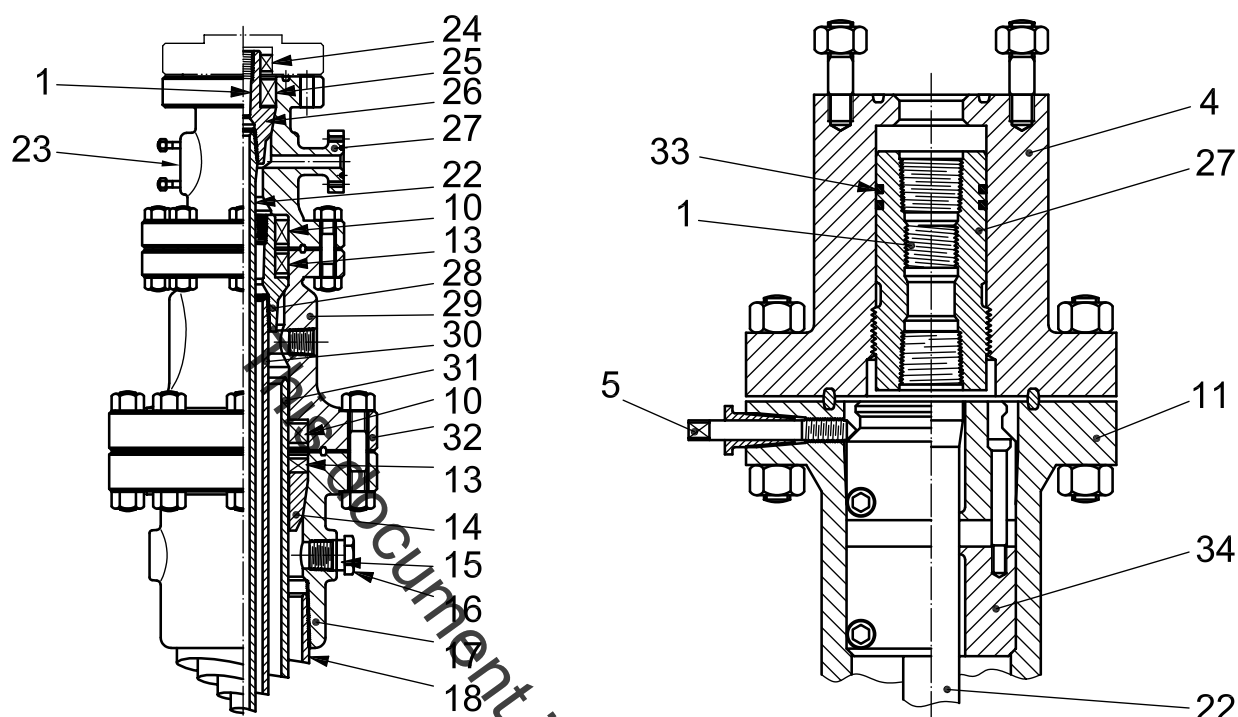


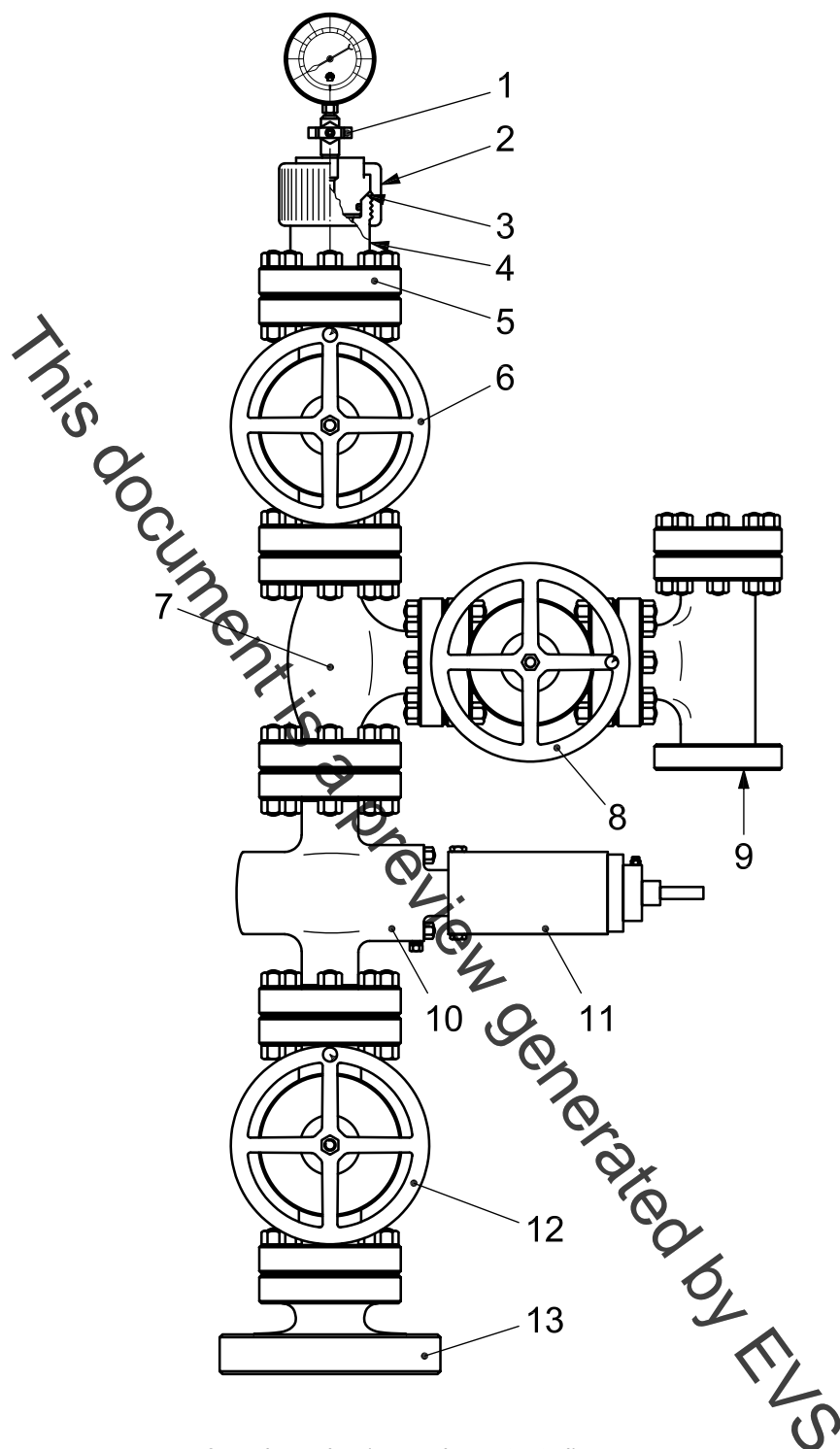
Figure 1 — Typical wellhead assembly nomenclature (continued)



Key

- | | | | |
|----|----------------------------------|----|-----------------------------|
| 23 | studded side-outlet connection | 29 | casing-head spool |
| 24 | extended neck tubing hanger seal | 30 | inner casing |
| 25 | annular tubing hanger seal | 31 | intermediate casing |
| 26 | tubing hanger mandrel | 32 | flanged end connection |
| 27 | flanged outlet connection | 33 | tubing hanger mandrel seals |
| 28 | casing hanger mandrel | 34 | wrap-around hanger pack-off |

Figure 1 — Typical wellhead assembly nomenclature



Key

- | | |
|-----------------------|-----------------------------------|
| 1 gauge valve | 8 wing valve (manual or actuated) |
| 2 bonnet nut | 9 choke |
| 3 blanking plug | 10 surface safety valve |
| 4 body | 11 actuator |
| 5 top connector | 12 master valve |
| 6 swab or crown valve | 13 tubing-head adapter |
| 7 tee | |

Figure 2 — Typical christmas tree nomenclature

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 31-0, *Quantities and units — Part 0: General principles*

ISO 148 (all parts), *Metallic materials — Charpy pendulum impact test*

ISO 2859-1:1999, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 6506 (all parts), *Metallic materials — Brinell hardness test*

ISO 6507 (all parts), *Metallic materials — Vickers hardness test*

ISO 6508 (all parts), *Metallic materials — Rockwell hardness test*

ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 9712, *Non-destructive testing — Qualification and certification of personnel*

ISO 10414-1, *Petroleum and natural gas industries — Field testing of drilling fluids — Part 1: Water-based fluids*

ISO 10424-1:2004, *Petroleum and natural gas industries — Rotary drilling equipment — Part 1: Rotary drill stem elements*

ISO 11960, *Petroleum and natural gas industries — Steel pipes for use as casing or tubing for wells*

ISO 13533, *Petroleum and natural gas industries — Drilling and production equipment — Drill-through equipment*

ISO 13628-4, *Petroleum and natural gas industries — Design and operation of subsea production systems — Part 4: Subsea wellhead and tree equipment*

ISO 13678, *Petroleum and natural gas industries — Evaluation and testing of thread compounds for use with casing, tubing, line pipe and drill stem elements*

ISO 15156 (all parts), *Petroleum and natural gas industries — Materials for use in H₂S-containing environments in oil and gas production*

NOTE In this International Standard, ISO 15156 (all parts) and NACE MR0175 provide the same technical result for a particular provision. In the running text the provision is written in the form "ISO 15156 (NACE MR0175; see Clause 2)".

ISO 18265, *Metallic materials — Conversion of hardness values*

API¹⁾ Spec 5B, *Specification for Threading, Gauging and Thread Inspection of Casing, Tubing, and Line Pipe Threads*

API Spec 6AV1, *Specification for Verification Test of Wellhead Surface Safety Valves and Underwater Safety Valves for Offshore Service*

API Spec 7:2001, *Specification for Rotary Drill Stem Elements*

1) American Petroleum Institute, 1220 L Street North West, Washington, DC 20005, USA.

API RP 14F, *Design, Installation, and Maintenance of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class 1, Division 1 and Division 2 Locations*

ASME²⁾ B1.1, *Unified Inch Screw Threads (UN and UNR Thread Form)*

ASME B1.2, *Gages and Gaging for Unified Inch Screw Threads*

ASME B1.3, *Screw Thread Gaging Systems for Acceptability: Inch and Metric Screw Threads (UN, UNR, UNJ, M, and MJ)*

ASME B1.5, *ACME Screw Threads*

ASME B1.20.1, *Pipe Threads, General Purpose (Inch)*

ASME Boiler and Pressure Vessel Code:2004 with 2005 and 2006 addenda, Section V, *Nondestructive Examination*

ASME Boiler and Pressure Vessel Code:2004 with 2005 and 2006 addenda, Section VIII, Division 1, *Rules for Construction of Pressure Vessels*

ASME Boiler and Pressure Vessel Code:2004 with 2005 and 2006 addenda, Section VIII, Division 2, *Alternative Rules*

ASME Boiler and Pressure Vessel Code:2004 with 2005 and 2006 addenda, Section IX, *Welding and Brazing Qualifications*

ASNT³⁾ SNT-TC-1A, *Non-Destructive Testing*

ASTM⁴⁾ A193/A193M, *Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications*

ASTM A194/A194M, *Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both*

ASTM A320/A320M, *Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for Low-Temperature Service*

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

ASTM A388/A388M, *Standard Practice for Ultrasonic Examination of Heavy Steel Forgings*

ASTM A453/A453M, *Standard Specification for High-Temperature Bolting Materials, with Expansion Coefficients Comparable to Austenitic Stainless Steels*

ASTM A703/A703M-08a, *Standard Specification for Steel Castings, General Requirements, for Pressure-Containing Parts*

ASTM D395, *Standard Test Methods for Rubber Property — Compression Set*

ASTM D412, *Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers — Tension*

ASTM D471, *Standard Test Method for Rubber Property — Effect of Liquids*

ASTM D1414, *Standard Test Methods for Rubber O-Rings*

2) ASME International, 345 East 47th Street, New York, NY 10017-2392, USA.

3) American Society for Nondestructive Testing, 4153 Arlingate Plaza, Columbus, OH 43228-0518, USA.

4) American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA.

ASTM D1415, *Standard Test Method for Rubber Property — International Hardness*

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

ASTM D2240, *Standard Test Method for Rubber Property — Durometer Hardness*

ASTM E10, *Standard Test Method for Brinell Hardness of Metallic Materials*

ASTM E18, *Standard Test Methods for Rockwell Hardness of Metallic Materials*

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

ASTM E94, *Standard Guide for Radiographic Examination*

ASTM E140, *Standard Hardness Conversion Tables for Metals — Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness and Scleroscope Hardness*

ASTM E165, *Standard Practice for Liquid Penetrant Examination for General Industry*

ASTM E428, *Standard Practice for Fabrication and Control of Metal, Other than Aluminum, Reference Blocks Used in Ultrasonic Testing*

ASTM E709, *Standard Guide for Magnetic Particle Testing*

ASTM E747, *Standard Practice for Design, Manufacture and Material Grouping Classification of Wire Image Quality Indicators (IQI) Used for Radiology*

EN⁵⁾ 473, *Non-destructive testing — Qualification and certification of NDT personnel — General principles*

MSS⁶⁾ SP-55, *Quality Standard for Steel Castings for Valves, Flanges and Fittings and Other Piping Components — Visual Method for Evaluation of Surface Irregularities*

SAE⁷⁾ AMS-H-6875, *Heat treatment of steel raw materials*

SAE AS 568A:1974, *Aerospace size standard for O-rings*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

3.1.1

acceptance criteria

defined limits placed on characteristics of materials, products or services

3.1.2

accessible wetted surface

wetted surface for purposes of non-destructive examination that can be viewed by direct line of sight

NOTE This excludes test ports, control line ports, lockdown screw holes and other penetrations of these types.

5) European Committee for Standardization, rue de Stassart 36, Brussels B-1050, Belgium.

6) Manufacturers Standardization Society of the Valve & Fittings Industry, 127 Park Street, N.E., Vienna, VA 22180, USA.

7) SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, USA.