INTERNATIONAL STANDARD

ISO 10432

Second edition
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Petroleum and natural gas industries — Downhole equipment — Subsurface safety valve equipment

Industries du pétrole et du gaz naturel — Équipement de forage vertical — Vannes de protection de fond de puits

Reference number
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Contents

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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.

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.

This International Standard was developed by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum and natural gas industries*, Subcommittee SC 4, *Drilling and production equipment*.

This second edition cancels and replaces the first edition (ISO 10432:1993) and includes the changes in API 14A, ninth edition, 1994, and its Supplement dated December 1997.

Annex B and Annex E form a normative part of this International Standard. Annexes A, C, D and F are for information only.

Introduction

This International Standard has been developed by users/purchasers and suppliers/manufacturers of subsurface safety valve equipment intended for use in the petroleum and natural gas industry worldwide. This International Standard is intended to give requirements and information to both parties in the selection, manufacture, testing and use of subsurface safety valve equipment. Further, this International Standard addresses requirements that set the minimum parameters with which the supplier/manufacturer must comply to claim conformity with this standard.

Users of this International Standard should be aware that further or differing requirements might be needed for individual applications. This International Standard is not intended to inhibit a supplier/manufacturer from offering, or the user/purchaser from accepting, alternative equipment or engineering solutions. This may be particularly applicable where there is innovative or developing technology. Where an alternative is offered, the supplier/manufacturer should identify any variations from this International Standard and provide details.

Upon publication of ISO 16070, *Petroleum and natural gas industries — Downhole equipment — Lock mandrels and landing nipples*, as an International Standard, the requirements for lock mandrels and landing nipples in this International Standard 10432 will be superseded.

Petroleum and natural gas industries — Downhole equipment — Subsurface safety valve equipment

1 Scope

This International Standard was formulated to provide the minimum acceptable requirements for subsurface safety valve (SSSV) equipment. It covers subsurface safety valves, safety valve locks, safety valve landing nipples and all components that establish tolerances and/or clearances which may affect performance or interchangeability of the SSSV equipment. Safety valve locks, safety valve landing nipples and SSSVs manufactured by different facilities or manufacturers may be supplied as separate items.

NOTE Limits: The subsurface safety valve is an emergency safety device, and is not intended or designed for operational activities, such as production/injection reduction, production stop, or as a backflow valve.

2 Normative references

The following normative documents contain provision which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

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

ISO 3601-1:1988, *Fluid systems — Sealing devices — O-rings — Part 1: Inside diameters, cross-sections, tolerances and size identification code.*

ISO 3601-3:—[1)], *Fluid power systems — O-rings — Part 3: Quality acceptance criteria.*

ISO 10417:1993, *Petroleum and natural gas industries — Subsurface safety valve systems — Design, installation, operation and repair.*

ISO 11960:—[2)], *Petroleum and natural gas industries — Steel pipes for use as casing or tubing for wells.*

ANSI/NCSL Z540-1:1994, *General requirements for calibration laboratories and measuring and test equipment.*

API Spec 5B:1996, *Threading, gauging, and thread inspection of casing, tubing, and line pipe threads.*

API RP 13B1:1990 (and 1993, 1996 supplements), *Standard procedure for field testing water-based drilling fluids.*

API Manual of Petroleum Measurement Standards, Chapter 10.4:1988 (reaffirmed 1993), *Determination of sediment and water in crude oil by the centrifuge method (field procedure).*

1) To be published. (Revision of ISO 3601-3:1987)

2) To be published. (Revision of ISO 11960:1996)

ASME Boiler and Pressure Vessel Code, Section II:1998, *Materials specification.*

ASME Boiler and Pressure Vessel Code, Section V:1998, *Nondestructive testing.*

ASME Boiler and Pressure Vessel Code, Section VIII:1998, *Pressure vessels.*

ASME Boiler and Pressure Vessel Code, Section IX:1998, *Welding and brazing qualifications.*

ASTM A 370:1997, *Standard test methods and definitions for mechanical testing of steel products.*

ASTM A 388/A 388M:1995, *Standard practice for ultrasonic examination of heavy steel forgings.*

ASTM A 609/A 609M:1991,*Standard practice for castings, carbon, low-alloy, and martensitic stainless steel, ultrasonic examination thereof.*

ASTM D 395:1998, *Standard test methods for rubber property — Compression set.*

ASTM D 412:1998, *Standard test methods for vulcanized rubber and thermoplastic rubbers and thermoplastic elastomers — Tension.*

ASTM D 1414:1994, *Standard test methods for rubber O-rings.*

ASTM D 1415:1988, *Standard test methods for rubber property — International hardness.*

ASTM D 2240:1997, *Standard test methods for rubber property — Durometer hardness.*

ASTM E 10:1998, *Standard test method for Brinell hardness of metallic materials.*

ASTM E 18:1997, *Standard test methods for Rockwell hardness and Rockwell superficial hardness of metallic materials.*

ASTM E 92:1982, *Standard test method for Vickers hardness of metallic materials.*

ASTM E 94:1993, *Standard guide for radiographic testing.*

ASTM E 140:1997, *Standard hardness conversion tables for metals.*

ASTM E 165:1995, *Standard test method for liquid penetrant examination.*

ASTM E 186:1993, *Standard reference radiographs for heavy-walled [2 to 4 1/2-in. (51 to 114-mm)] steel castings.*

ASTM E 280:1993, *Standard reference radiographs for heavy-walled [4 1/2 to 12-in. (114 to 305-mm)] steel castings.*

ASTM E 428:1992, *Standard practice for fabrication and control of steel reference blocks used in ultrasonic inspection*

ASTM E 446:1993, *Standard reference radiographs for steel castings up to 2 in. (51 mm) in thickness.*

ASTM E 709:1995, *Standard guide for magnetic particle examination.*

MIL-H-6875H:1989, *Process for heat treatment of steel.*

NACE MR0175:1992, *Sulfide stress cracking resistant metallic materials for oilfield equipment.*

SNT-TC-1A:1988, *Personnel qualification and certification in nondestructive testing.*

BS 2M 54:1991, *Specification for temperature control in the heat treatment of metals.*

3 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply:

3.1
AQL
acceptance quality level

3.2
bean
the orifice or designed restriction causing the pressure drop in velocity-type SSCSVs

3.3
chloride stress corrosion cracking
cracking under the combined action of tensile stress and corrosion in the presence of chlorides and water

3.4
design acceptance criteria
defined limits placed on characteristics of materials, products,or services, established by the manufacturer to ensure conformance to the product design

3.5
end connection
SSSV equipment/tubular connecting interface

3.6
failure
any condition of SSSV equipment that prevents it from performing the design function

3.7
fit
the geometric relationship between parts

NOTE This would include the tolerance criteria used during the design of a part and its mating parts, including seals adjusted to or shaped for their purpose.

3.8
form
the essential shape of a product including all its component parts

3.9
function
the operation of a product during service

3.10
functional test
test performed to confirm proper operation of SSSV equipment

3.11
heat treatment
heat treating
alternate steps of controlled heating and cooling of materials for the purpose of changing physical or mechanical properties

3.12
interchangeable
conforming in every detail, within specified tolerances, to both fit and function of a safe design but not necessarily to the form

3.13
manufacturer
the principal agent in the design, fabrication and furnishing of SSSV equipment, who chooses to comply with this International Standard

3.14
model
SSSV equipment with unique internal part(s) and operating characteristics which differentiate it from other SSSV equipment of the same type

NOTE It may have any of a variety of end connections.

3.15
NDE
nondestructive examination

3.16
operating manual
a publication issued by the manufacturer which contains detailed data and instructions related to the design, installation, operation and maintenance of SSSV equipment

3.17
operator
a user of SSSV equipment

3.18
SCSSV
a surface-controlled subsurface safety valve

3.19
SSCSV
a subsurface-controlled subsurface safety valve

NOTE An SSCSV is actuated by the characteristics of the well.

3.20
SSSV
a subsurface safety valve (a device whose design function is to prevent uncontrolled well flow when closed)

NOTE These devices may be installed and retrieved by wireline or pump-down methods (wireline-retrievable) or be an integral part of the tubing string (tubing retrievable).

3.21
SSSV equipment
the subsurface safety valve, safety valve lock, safety valve landing nipple and all components that establish tolerances and/or clearances which may affect performance or interchangeability of the SSSV equipment

3.22
stress corrosion cracking
cracking which results from a combination of corrosion and stress when susceptible materials are exposed to specific corrosive media

3.23
stress relief
controlled heating of material to a predetermined temperature for the purpose of reducing any residual stresses

3.24
sulfide stress cracking
cracking under the combined action of tensile stress and corrosion in the presence of water and hydrogen sulfide

3.25
SV lock
a device attached to or a part of the SSSV that holds the SSSV in place

3.26
SVLN
a receptacle with internal sealing surfaces in which an SSSV may be installed

NOTE It may include recesses for locking devices to hold the SSSV in place and may be ported for communication to an outside source for SSSV operation.

3.27
test agency
any party which provides a test facility and administers a test programme that meets the verification test requirements of this International Standard

3.28
type
SSSV equipment with unique characteristics which differentiate it from other SSSV equipment

NOTE The SCSSV, the velocity-type SSCSV and the low-tubing-pressure-type SSCSV are examples of SSSV types.

3.29
verification test
test performed to qualify a particular size, type and model of SSSV equipment for a specific class of service

3.30
weight loss corrosion
loss of metal in areas exposed to fluids which contain water or brine and carbon dioxide (CO_2), oxygen (O_2) or other corrosive agents

4 Requirements

4.1 General

The user shall provide to the manufacturer the information required to define the appropriate product. Annex F contains a checklist of suggested ordering information.

4.2 Design requirements

4.2.1 Drawings, manufacturing specifications and the verification test results shall be retained by the manufacturer for a period of ten years after SSSVs of that size, model and type are discontinued from the manufacturer's product line. SSSV equipment conforming to this International Standard shall be manufactured to drawings and specifications that are substantially the same as those of the SSSV equipment that has passed the verification test.

4.2.2 Documentation of designs shall include methods, assumptions, calculations and design requirements. Design requirements shall include but not be limited to those criteria for size, test and operating pressures, material, environmental and other pertinent requirements upon which the design is based. Design documentation shall be clear, legible, reproducible and retrievable.

4.2.3 Design documentation shall be reviewed and verified by a qualified individual other than the individual who created the original design.

4.2.4 Changes to the design acceptance criteria which may affect verification test performance or interchangeability of SSSV equipment shall require requalification, except that seals which have passed the applicable verification test requirements of clause 7 shall be considered interchangeable among the SSSV equipment of any one manufacturer for a particular class of service.

4.2.5 SSSV equipment manufactured in accordance with this International Standard shall conform to one or more of the following classes of service:

— **Class 1: standard service.** This class of SSSV equipment is intended for use in wells which do not exhibit the detrimental effects caused by sand or corrosive agents.

— **Class 2: sandy service.** This class of SSSV equipment is intended for use in wells where a substance such as sand could be expected to cause SSSV equipment failure. Class 2 SSSV equipment shall also meet the requirements for Class 1 service.

— **Class 3: stress corrosion cracking service.** This class of SSSV equipment is intended for use in wells where corrosive agents could be expected to cause stress corrosion cracking. Class 3 equipment shall meet the requirements for Class 1 or Class 2 and be manufactured from materials which are resistant to stress corrosion cracking. Within this service class, there are two divisions, 3S for sulfide stress cracking service and 3C (see note) for chloride stress cracking service. Metallic materials, suitable for a 3S environment, shall be in accordance with NACE MR0175.

NOTE Metallic materials suitable for Class 3C service are dependent on specific well conditions. No national or international standards exist for the application of metallic materials for this class of service.

— **Class 4: weight loss corrosion service.** This class of SSSV equipment is intended for use in wells where corrosive agents could be expected to cause weight loss corrosion. Class 4 equipment shall meet the requirements for Class 1 or Class 2 and be manufactured from materials which are resistant to weight loss corrosion (see note).

NOTE Metallic materials suitable for Class 4 service are dependent on specific well conditions. No national or international standards exist for the application of metallic materials for this class of service.

4.3 Functional considerations

SSSV design shall permit prediction and repeatability of rates, pressures or other conditions required for closure.

4.4 Design considerations

4.4.1 The manufacturer shall establish rated working pressures of SSSV equipment within the requirements of this International Standard. These rated working pressures are commonly 20,7 MPa, 34,5 MPa, 41,4 MPa, 69,0 MPa and 103,5 MPa (3 000 psi, 5 000 psi, 6 000 psi, 10 000 psi and 15 000 psi). Temperature effects on all the materials used in the manufacture of SSSV equipment shall be considered in establishing the rated working pressure. The design shall take into account the effects of pressure containment and pressure-induced loads. Specialized conditions shall also be considered such as pressure testing with temporary test plugs.

4.4.2 The manufacturer shall establish internal yield pressure, collapse pressure and minimum tensile strength ratings, excluding end connections.

4.4.3 SSSV equipment design shall take into consideration the effects of temperature gradients and thermal cycles on all components. The upper temperature limit shall be the lowest high-temperature rating of any component of the SSSV. The lower temperature limit shall be the highest low-temperature rating of any component of the SSSV. Derating of metal mechanical properties shall be in accordance with ASME Boiler and Pressure Vessel Code Section II, Part D, *Material Properties*.

4.4.4 SSSV equipment design shall take into account the effects of retained fluid(s) on all components. SSSV equipment design shall consider the effects of sand, chlorides, corrosion inhibitors and other chemicals routinely encountered in oil and gas production.

4.4.5 Component and subassembly interchangeability shall be required within each manufacturer's service class, size, type and model, including pressure rating of SSSV equipment. This shall extend to all facilities of the manufacturer. Components shall be designed or identified to avoid the use of non-interchangeable parts.

4.4.6 Additive dimensional tolerance shall be such that proper operation of the SSSV equipment is assured. This requirement applies to factory-assembled equipment and to replacement components.

4.4.7 Internal diameters and tolerances for typical-size SVLNs are listed in Annex A, Table A.1. External diameters and tolerances for typical-size wireline-retrievable SSSVs are listed in Annex A, Table A.2. The manufacturer may establish other dimensions and tolerances.

4.5 Verification test

SSSVs, SV locks, SVLNs and seals shall pass the applicable verification test specified in clause 7.

5 Materials

5.1 General

The manufacturer shall have written specifications for all materials used in SSSV equipment. The manufacturer shall select all materials to be suitable for a particular class of service and shall document the selection criteria. All materials shall comply with the manufacturer's written specifications.

Material substitutions, except seals, in qualified SSSV equipment are allowed without verification testing provided that the manufacturer's selection criteria are documented and meet all other requirements of this International Standard.

Seals that have passed the verification test requirements of 7.25 are considered interchangeable among the SSSV equipment of any one manufacturer for a particular class of service.

5.2 Metals

5.2.1 The manufacturer's specifications shall define:

a) chemical-composition limits;

b) heat treatment conditions;

c) mechanical-property limits:

   1) tensile strength,

   2) yield strength,

   3) elongation,

   4) hardness.

5.2.2 The mechanical properties specified in 5.2.1 for traceable metal components shall be verified by tests conducted on a material sample produced from the same heat of material. The material sample shall experience the same heat treatment process as the component it qualifies. Material subsequently heat-treated from the same heat of material shall be hardness-tested after processing to confirm compliance with the hardness requirements of the manufacturer's specifications. The hardness results shall verify through documented correlation that the mechanical properties of the material tested meet the properties specified in 5.2.1. The heat treatment process parameters shall be defined in the heat treatment procedure. Hardness testing is the only mechanical-property test required after stress relieving. Material test reports provided by the material supplier or the manufacturer are acceptable documentation.

5.2.3 Each welded component shall be stress-relieved as per the manufacturer's written specifications and, where applicable, in accordance with Paragraphs UCS-56 and UHA-32, Section VIII, Division 1, Subsection C, ASME Boiler and Pressure Vessel Code. In addition, carbon and low-alloy steel weldments on Class 3 SSSV equipment shall be stress-relieved in accordance with NACE MR0175.

5.3 Non-metals

5.3.1 The manufacturer shall have written procedures, and documentation of test results, for testing sealing materials to the limits for which the SSSV equipment is rated.

5.3.2 The manufacturer's written specifications for non-metallic compounds shall define those characteristics critical to the performance of the material, such as:

a) compound type;

b) mechanical properties, as a minimum:

   1) tensile strength (at break),

   2) elongation (at break),

   3) tensile modulus (at 50 % or 100 %, as applicable);

c) compression set;

d) durometer hardness.

5.3.3 The manufacturer's written specifications shall include handling, storage and labelling requirements, including the cure date, batch number, compound identification and shelf life appropriate to each compound.

5.4 Traceability

5.4.1 All components, weldments, subassemblies and assemblies of SSSV equipment shall be traceable except:

a) setting springs used to establish closure parameters for SSCSVs;

b) beans for SSCSVs;

c) common hardware items such as nuts, bolts, set screws, shear pins, spacers, tube fittings, tubing and shear screws.

5.4.2 Component traceability is considered sufficient when it can be traced to a job lot, which identifies the included heat or batch lot(s) and a material test report. All components in a multiheat job lot are rejectable if any heat lot does not comply with the manufacturer's written specification.

5.4.3 Traceability identification shall be sufficient to identify significant problems and permit proper corrective action and shall include assembly, subassembly and component traceability to a heat or other appropriate batch lot.

5.4.4 Traceability for SSSV equipment is considered sufficient if the equipment meets the requirements of this International Standard when it leaves the manufacturer's inventory.

6 Quality control requirements

6.1 General

This clause provides minimum quality control requirements to meet this International Standard. All quality control work shall be controlled by documented instructions which include acceptance criteria.

6.2 Documentation retention

Required documentation for quality control work shall be retained for a minimum of five years from the date of origination.

6.3 Personnel qualifications

6.3.1 Personnel performing NDE shall be qualified in accordance with at least SNT TC-1A, Level II, for evaluation and interpretation.

6.3.2 Personnel performing visual examinations shall have an annual eye examination in accordance with SNT-TC-1A, as applicable to the discipline to be performed.

6.3.3 All other personnel performing inspection for acceptance shall be qualified in accordance with documented requirements.

6.4 Calibration systems

6.4.1 Measuring and testing equipment used for acceptance shall be identified, controlled, calibrated and adjusted at specified intervals in accordance with written specifications, ANSI/NCSL Z540-1 and this International Standard.

6.4.2 Pressure-measuring devices shall:

a) be readable to at least ±0,5 % of full-scale range;

b) be calibrated to maintain ±2 % accuracy of full-scale range.

6.4.3 If a pressure gauge is utilized, pressure measurements shall be made at not less than 25 % nor more than 75 % of the full span of the pressure gauge.

6.4.4 Pressure-measuring devices shall be periodically calibrated with a master pressure-measuring device or a dead-weight tester at 25 %, 50 % and 75 % of full scale.

6.4.5 Calibration intervals for pressure-measuring devices shall be a maximum of three months until documented calibration history can be established. Calibration intervals shall then be established based on repeatability, amount of usage and documented calibration history.

6.5 Inspection of elastomeric materials

6.5.1 Sampling procedures, and the basis for acceptance or rejection of a batch lot, shall be in accordance with ISO 2859-1 general inspection level II at a 2,5 AQL for O-rings and a 1,5 AQL for other packing elements until a documented variation history can be established. Sampling procedures shall then be established based on the documented variation history.

6.5.2 Visual inspection of O-rings shall be in accordance with ISO 3601-3. Other packing elements shall be visually inspected in accordance with the manufacturer's documented specifications.

6.5.3 Dimensional tolerances of O-rings shall be in accordance with ISO 3601-1 or equivalent. Other packing elements shall meet dimensional tolerances of the manufacturer's written specifications.

6.5.4 The durometer hardness of O-rings or other elastomeric packing elements shall be determined in accordance with ASTM D 2240 or D 1415. A test specimen manufactured from each batch may be used.

6.6 Dimensional inspection

All traceable components, except elastomeric seals, shall be dimensionally inspected to assure proper function and compliance with design specifications and drawings.

6.7 Thread inspection

6.7.1 All API tapered-thread tolerances, inspection requirements, gauging, gauging practice, gauge calibration and gauge certification shall be in accordance with API Spec 5B.

6.7.2 All other thread tolerances, inspection requirements, gauging, gauging practice, gauge calibration and gauge certification shall conform to the specified thread manufacturer’s written specifications.