

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

The European Standard EN ISO 10432:2004 has the status of a
British Standard

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National foreword

This British Standard is the official English language version of EN ISO 10432:2004. It is identical with ISO 10432:2004. It supersedes BS EN ISO 10432:1999 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee PSE/17, Materials and equipment for petroleum, petrochemical and natural gas industries, to Subcommittee PSE/17/-/4, Drilling and production equipment, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

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Summary of pages

This document comprises a front cover, an inside front cover, the EN ISO title page, the EN ISO foreword page, the ISO title page, pages ii to v, a blank page, pages 1 to 77 and a back cover.

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**Petroleum and natural gas industries - Downhole equipment -
Subsurface safety valve equipment (ISO 10432:2004)**

Industries du pétrole et du gaz naturel - Equipement de
forage vertical - Vannes de protection de fond de puits (ISO
10432:2004)

This European Standard was approved by CEN on 10 December 2004.

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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

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Foreword

This document (EN ISO 10432:2004) has been prepared by Technical Committee ISO/TC 67 "Materials, equipment and offshore structures for petroleum and natural gas industries" in collaboration with Technical Committee CEN/TC 12 "Materials, equipment and offshore structures for petroleum 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 2005, and conflicting national standards shall be withdrawn at the latest by June 2005.

This document supersedes EN ISO 10432:1999.

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

Endorsement notice

The text of ISO 10432:2004 has been approved by CEN as EN ISO 10432:2004 without any modifications.

INTERNATIONAL STANDARD

ISO
10432

Third edition
2004-12-15

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*



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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.

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 10432 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 third edition cancels and replaces the second edition (ISO 10432:1999), which has been technically revised.

Introduction

This International Standard has been developed by users/purchasers and suppliers/manufacturers of subsurface safety valves 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 valves. Furthermore, this International Standard addresses the minimum requirements with which the supplier/manufacturer is to comply so as to claim conformity with this International Standard.

Users of this International Standard should be aware that requirements above those outlined in this International Standard may 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.

The requirements for lock mandrels and landing nipples previously contained in this International Standard are now included in ISO 16070.

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

1 Scope

This International Standard provides the minimum acceptable requirements for subsurface safety valves (SSSVs). It covers subsurface safety valves including all components that establish tolerances and/or clearances which may affect performance or interchangeability of the SSSVs. It includes repair operations and the interface connections to the flow control or other equipment, but does not cover the connections to the well conduit.

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.

Redress activities are beyond the scope of this International Standard, see Clause 8.

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 48, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD)*

ISO 527-1, *Plastics — Determination of tensile properties — Part 1: General principles*

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

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

ISO 3601-3, *Fluid systems — Sealing devices — O-rings — Part 3: Quality acceptance criteria*

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 (scales A, B, C, D, E, F, G, H, K, N, T)*

ISO 6892, *Metallic materials — Tensile testing at ambient temperature*

ISO 9000:2000, *Quality management systems — Fundamentals and vocabulary*

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 10417, *Petroleum and natural gas industries — Subsurface safety valve systems — Design, installation, operation and redress*

ISO 13628-3, *Petroleum and natural gas industries — Design and operation of subsea production systems — Part 3: Through flowline (TFL) systems*

ISO 13665, *Seamless and welded steel tubes for pressure purposes — Magnetic particle inspection of the tube body for the detection of surface imperfections*

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

ISO 16070, *Petroleum and natural gas industries — Downhole equipment — Lock mandrels and landing nipples*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

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

API Manual of Petroleum Measurement Standards, Chapter 10.4, *Determination of sediment and water in crude oil by the centrifuge method (field procedure)*²⁾

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

API Spec 14A, *Specification for subsurface safety valve equipment*

ASME Boiler and Pressure Vessel Code, Section II, *Materials specification*³⁾

ASME Boiler and Pressure Vessel Code, Section V, *Nondestructive examination*

ASME Boiler and Pressure Vessel Code, Section VIII:2001, *Pressure vessels*

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

ASTM A 388/A 388M, *Standard practice for ultrasonic examination of heavy steel forgings*⁴⁾

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

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

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

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

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

ASTM E 94, *Standard guide for radiographic examination*

ASTM E 140, *Standard hardness conversion tables for metals. (Relationship among Brinell hardness, Vickers hardness, Rockwell hardness, superficial hardness, Knoop hardness, and scleroscope hardness)*

1) NCSL International, 2995 Wilderness Place, Suite 107, Boulder, Colorado 80301-5404, USA.

2) American Petroleum Institute, 1220 L Street NW, Washington, DC 20005-4070, USA.

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

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

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

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

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

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

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

ASTM E 709, *Standard guide for magnetic particle examination*

BS 2M 54:1991, *Temperature control in the heat treatment of metals*⁵⁾

SAE-AMS-H-6875:1998, *Heat treatment of steel raw materials*⁶⁾

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 9000:2000 and the following apply.

3.1

bean orifice

designed restriction causing the pressure drop in velocity-type SSCSVs

3.2

design acceptance criteria

defined limits placed on characteristics of materials, products, or services established by the organization, customer, and/or applicable specifications to achieve conformity to the product design

[ISO/TS 29001:2003]

3.3

design validation

process of proving a design by testing to demonstrate conformity of the product to design requirements

[ISO/TS 29001:2003]

3.4

design verification

process of examining the result of a given design or development activity to determine conformity with specified requirements

[ISO/TS 29001:2003]

3.5

end connection

thread or other mechanism providing equipment-to-tubular interface

3.6

environment

set of conditions to which the product is exposed

5) BSI, Customer Services, 389 Chiswick High Road, London W4 4AL, UK.

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

3.7

failure

any equipment condition that prevents it from performing to the requirements of the functional specification

3.8

fit

geometric relationship between parts

NOTE This includes the tolerance criteria used during the design of a part and its mating parts, including seals.

3.9

form

essential shape of a product including all its component parts

3.10

function

operation of a product during service

3.11

functional test

test performed to confirm proper operation of equipment

3.12

heat treatment

heat treating

alternate steps of controlled heating and cooling of materials for the purpose of changing mechanical properties

3.13

interchangeable

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

3.14

manufacturer

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

3.15

manufacturing

process and action performed by an equipment supplier/manufacturer that are necessary to provide finished component(s), assembly(ies) and related documentation, that fulfil the requests of the user/purchaser and meet the standards of the supplier/manufacturer

NOTE Manufacturing begins when the supplier/manufacturer receives the order and is completed at the moment the component(s), assembly(ies) and related documentation are surrendered to a transportation provider.

[ISO 16070]

3.16

mass loss corrosion

weight loss corrosion (deprecated term)

loss of metal in areas exposed to fluids which contain water or brine and carbon dioxide (CO₂), oxygen (O₂) or other corrosive agents

NOTE The term "weight" is commonly incorrectly used to mean mass, but this practice is deprecated.

3.17**model**

SSSV equipment with unique components and operating characteristics which differentiate it from other SSSV equipment of the same type

NOTE The same model can have any of a variety of end connections.

3.18**operating manual**

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

3.19**profile**

feature that is designed for the reception of a locking mechanism

3.20**proof test**

test specified by the manufacturer which is performed to verify that the SSSV meets those requirements of the technical specification which are relevant to the validation testing performance

3.21**qualified part**

part manufactured under a recognized quality assurance programme and, in the case of replacement, produced to meet or exceed the performance of the original part produced by the original equipment manufacturer (OEM)

NOTE ISO 9001 is an example of a recognized quality assurance programme.

[ISO 10417]

3.22**redress**

any activity involving the replacement of qualified parts

cf. **repair** (3.23)

NOTE See Clause 8 for more information.

3.23**repair**

any activity beyond the scope of redress that includes disassembly, re-assembly, and testing with or without the replacement of parts and may include machining, welding, heat treating or other manufacturing operations, that restores the equipment to its original performance

cf. **redress** (3.22)

[ISO 10417]

NOTE See Clause 8 for more information.

3.24**sealing device**

device preventing contact of liquid and/or gas across the interface between the lock mandrel and the landing nipple

3.25**size**

relevant dimensional characteristics of the equipment as defined by the manufacturer

3.26

sour service

exposure to oilfield environments that contain H₂S and can cause cracking of materials by the mechanisms addressed in ISO 15156

NOTE Adapted from ISO 15156-1:2001.

3.27

special feature

specific component or sub-assembly that provides a functional capability that is not validated during the validation test conducted in accordance with 6.5

3.28

subsurface safety valve

SSSV

device whose design function is to prevent uncontrolled well flow when closed

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

3.29

subsurface safety valve equipment

SSSV equipment

subsurface safety valve, and all components that establish tolerances and/or clearances which can affect its performance or interchangeability

3.30

stress corrosion cracking

SCC

cracking of metal involving anodic processes of localized corrosion and tensile stress (residual and/or applied) in the presence of water and H₂S

NOTE Chlorides and/or oxidants and elevated temperature can increase the susceptibility of metals to this mechanism of attack.

[ISO 15156-1]

3.31

stress cracking

stress corrosion cracking, or sulfide stress cracking, or both

NOTE Adapted from NACE MR0175: Jan 2003.

3.32

stress relief

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

3.33

sulfide stress cracking

SSC

cracking of metal involving corrosion and tensile stress (residual and/or applied) in the presence of water and H₂S

NOTE SSC is a form of hydrogen stress cracking (HSC) and involves embrittlement of the metal by atomic hydrogen that is produced by acid corrosion on the metal surface. Hydrogen uptake is promoted in the presence of sulfides. The atomic hydrogen can diffuse into the metal, reduce ductility and increase susceptibility to cracking. High strength metallic materials and hard weld zones are prone to SSC.

[ISO 15156-1]

3.34**test agency**

organization which provides a test facility and administers a test program that meets the validation test requirements of this International Standard

NOTE See Annex A for test agency requirements.

3.35**test pressure**

pressure at which the equipment is tested based upon all relevant design criteria

3.36**test section**

test apparatus which contains the SSSV and provides for connection to a test facility's validation test apparatus

3.37**type**

SSSV equipment with unique characteristics which differentiate it from other functionally similar SSSV equipment

EXAMPLES SCSSV, velocity-type SSCSV and low-tubing-pressure-type SSCSV are types of SSSV.

3.38**validation test**

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

NOTE See Annex B for details.

3.39**working pressure**

SSSV internal pressure rating, including the differential rating with the valve closed

4 Abbreviated terms

AQL	acceptance quality limit
NDE	non-destructive examination
TFL	through flowline
SCSSV	surface-controlled subsurface safety valve
SSCSV	subsurface controlled subsurface safety valve
SSSV	subsurface safety valve
TRSV	tubing-retrievable safety valve
WRSV	wireline-retrievable safety valve

5 Functional specification

5.1 General

5.1.1 Functional requirements

The user/purchaser shall prepare a functional specification for ordering products which conform with this International Standard and specify the following requirements and operating conditions, as appropriate, and/or identify the supplier's/manufacturer's specific product. These requirements and operating conditions may be conveyed by means of a dimensional drawing, data sheet or other suitable documentation.

5.1.2 Classes of service

SSSV equipment manufactured in accordance with this International Standard shall conform to one or more of the following classes of service. The user/purchaser shall specify the class(s), as applicable.

- **Class 1: standard service.** This class of SSSV equipment is intended for use in wells which are not expected to exhibit the detrimental effects defined by Classes 2, 3, or 4.
- **Class 2: sandy service.** This class of SSSV equipment is intended for use in wells where particulates such as sand could be expected to cause SSSV equipment failure.
- **Class 3: stress cracking service.** This class of SSSV equipment is intended for use in wells where water containing corrosive agents can cause stress cracking. Class 3 equipment shall meet the requirements for Class 1 or Class 2 service and be manufactured from metallic materials that are demonstrated as resistant to sulfide stress cracking and stress corrosion cracking.

The supplier/manufacturer shall ensure that the metallic materials used in Class 3 equipment meet the metallurgical requirements of ISO 15156 (all parts) for sour service and/or shall be suitable for service in non-sour-containing environments where stress corrosion cracking can occur.

The user/purchaser shall ensure that the specific metallic materials contained within Class 3 equipment are suitable for the intended application.

Within Class 3, there are two sub-classes, as follows:

- 1) 3S for sulfide stress cracking service and stress corrosion cracking service in which chlorides are present in a sour environment. Metallic materials suitable for a 3S environment shall be in accordance with ISO 15156 (all parts).
- 2) 3C for stress corrosion cracking service in a non-sour environment. Metallic materials suitable for Class 3C non-sour service are dependent on specific well conditions; no national or international standards exist for the application of metallic materials for this class of service.

NOTE For the purposes of these provisions, NACE MR0175/ISO 15156-1-2-3, is equivalent to ISO 15156 (all parts).

- **Class 4: mass loss corrosion service** (see 3.16). This class of SSSV equipment is intended for use in wells where corrosive agents could be expected to cause mass loss corrosion. Class 4 equipment shall meet the requirements for Class 1 or Class 2 and be manufactured from materials which are resistant to mass loss corrosion. 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.

5.2 SSSV functional characteristics

The SSSV functional characteristics should include but are not limited to the following:

- a) type of SSSV control (surface-controlled, subsurface-controlled);
- b) type of SSSV retrieval (tubing-retrievable, WL-retrievable, coil-tubing-retrievable, TFL-retrievable, etc.);

- c) type of SSSV closing mechanism (ball, flapper, etc.);
- d) requirement for internal self-equalizing capability;
- e) requirement, if any, for holding the SCSSV open without the use of the primary operating source (temporary or permanent lock-open system);
- f) requirement, if any, for providing control fluid communication from the SCSSV to any other subsurface device (e.g. a through-tubing retrievable secondary valve);
- g) requirement, if any, for providing pump-through capability;
- h) requirement, if any, for a redundant/independent back-up operating system;
- i) requirements, if any, for minimal leakage (in accordance with 6.7.2) during functional testing.

5.3 Well parameters

The following characteristics shall be specified as applicable:

- a) well location (land, platform, subsea);
- b) size, mass, grade and material of the casing and tubing;
- c) setting depth (maximum required for application) and control system parameters (control fluid type/properties, supply pressure, supply line(s) and connection rating(s), etc.);
- d) casing and/or tubing architecture, trajectory, deviations, maximum dog leg severity;
- e) restrictions through which the SSSV shall pass and restrictions/profiles through which the SSSV service tools/accessories shall pass;
- f) requirement, if any, for passage of additional lines (electrical, hydraulic), between the valve OD and the casing ID, if applicable.

5.4 Operational parameters

5.4.1 SSSVs

The following operational parameters, as applicable, shall be specified for the SSSV:

- a) rated working pressure;
- b) rated temperature range;
- c) if applicable, maximum allowable pressure drop at maximum flow rate through SSSV;
- d) loading conditions, including combined loading (pressures, tension/compression, torque, bending) and the corresponding temperature extremes anticipated to be applied to the valve;
- e) well stimulation operations, including its parameters, such as acidizing (give the composition of the acid), the pressure, the temperature, the acid flow rate and the exposure time, as well as any other chemicals used during the stimulation;
- f) sand consolidation and fracturing operations, including sand/proppant description, fluid flow rate, proppant/fluid ratio or sand/fluid ratio, chemical composition, pressure and temperature;
- g) well-servicing activities through the safety valve: size, type and configuration of other devices to be run through the valve, if applicable.

5.4.2 SSCSVs

The conditions under which the SSCSV will operate (flow conditions) and the conditions under which the valve should close (see ISO 10417) shall be specified, such as

- a) at valve setting depth, the minimum, maximum and normal values of the production/injection pressures and temperatures at the anticipated flow rates;
- b) composition of the production fluid (gas/oil/water) and density of each component.

5.5 Environmental compatibility

The following shall be identified for the SSSV to ensure environmental compatibility:

- a) production/injection/annulus fluid chemical and physical composition, including solids (sand production, scale, etc.), to which the SSSV is exposed during its full life cycle;
- b) in cases where the user/purchaser has access to corrosion-property historical data and/or research which is applicable to the functional specification, the user/purchaser should state to the manufacturer which material(s) has the ability to perform as required within a similar corrosion environment.

5.6 Compatibility with related well equipment

The following information, as applicable, shall additionally be specified to ensure the compatibility of the SSSV with the related well equipment:

- a) SSSV size, type, material, the configuration of the interface connections (these connections are not included in the evaluation of combined loading);
- b) internal receptacle profile(s), sealing bore dimension(s), outside diameter, inside diameter and their respective locations;
- c) requirement(s) for passage of conduits (electrical/hydraulic) between valve OD and casing ID.

6 Technical specification

6.1 Technical requirements

The supplier/manufacturer shall prepare and provide to the user/purchaser the technical specification that responds to the requirements defined in the functional specification.

6.2 Technical characteristics of SSSV

The following criteria shall be met:

- a) the SSSV shall be located and/or seal at the specified location and remain so until intentional intervention defines otherwise;
- b) while installed, the SSSV shall perform in accordance with the functional specification;
- c) where applicable, the SSSV shall not compromise well-intervention operations as specified in 5.4;
- d) while in service, the SSSV shall meet the requirements of the functional specification.

6.3 Design criteria

6.3.1 General

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

6.3.2 Design requirements

6.3.2.1 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, working and operating pressures, materials, environment (temperature limits, service class, chemicals) and other pertinent requirements upon which the design is based. Design documentation shall be reviewed and verified by a qualified individual other than the individual who created the original design.

6.3.2.2 SSSV equipment conforming to this International Standard shall be manufactured to drawings and specifications that are substantially the same as those of the size, type, and model SSSV equipment that has passed the validation test.

6.3.2.3 The manufacturer shall establish verified internal yield pressure, collapse pressure and minimum tensile strength, temperature limits, and rated working pressure, excluding end connections. The manufacturer shall identify the critically stressed components of the product and the mode of stress. The manufacturer shall calculate the critical stress level in the identified component(s) based upon the maximum loads in the design input requirements. The minimum acceptable material condition and minimum acceptable material yield shall be used in the calculations and the calculations shall include consideration of temperature limit effects and thermal cycles. Metal mechanical properties de-rating shall be in accordance with ASME Boiler and Pressure Vessel Code, Section II, Part D.

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.

6.3.2.4 Component and subassembly identification and interchangeability shall be required within each manufacturer's service class, size, type and model, including working pressure rating of SSSV equipment. Additive dimensional tolerances of components shall be such that proper operation of the SSSV equipment is assured. This requirement applies to manufacturer-assembled equipment and to replacement components or sub-assemblies.

6.3.2.5 TRSV profiles that interface with locks and sealing devices covered by ISO 16070 shall comply with the requirements of that International Standard.

6.3.3 Working pressure de-rating

6.3.3.1 Working pressure de-rating of SSSVs of the same nominal size, type and model is permitted by reference to a successfully validation-tested product (base design) when the requirements of this subclause and this International Standard are satisfied. The rated working pressure of a de-rated design may be less than that of the base design by a maximum of 50 %.

6.3.3.2 In establishing a de-rated design, the manufacturer shall identify the critically stressed components of the base design, establish the maximum stress factors within those components at the maximum rated conditions and the specific mode of that stress. All design considerations and stress factors applied to the base design and its components shall be applied to the de-rated design evaluation.

The manufacturer shall establish the maximum stress factors in the equivalent components within the de-rated design. The minimum acceptable material condition, minimum acceptable material yield strengths, and maximum and minimum temperature effects on material properties shall be used.

6.3.3.3 Evaluation of the de-rated design shall include comparison of the calculated maximum stress factors stated as a percentage of material yields of the components of the base design; these shall not exceed

the maximum stress factors of the components of the base design. The mode of stress and same method of calculation(s)/evaluation(s) shall be applied to the identified components of both product designs.

Adjustments to material thickness or yield strengths shall not negatively impact maximum stress factors. The de-rated product shall be evaluated by the manufacturer to ensure that it will meet the requirements of the validation test.

6.3.3.4 Each de-rated product requires evaluation, justification and design documentation of the changes. Documentation shall be included in the product's design records.

6.3.4 Materials

6.3.4.1 General

- a) Materials, and/or the service, shall be stated by the supplier/manufacturer and shall be suitable for the class of service and the environment specified in the functional specification. The manufacturer shall have written specifications for all materials. All materials used shall comply with the manufacturer's written specifications.
- b) The user/purchaser may specify materials for the specific corrosion environment in the functional specification. Should the manufacturer propose to use another material, the manufacturer shall state that this material has performance characteristics suitable for all parameters specified in the well and production/injection parameters. This applies to metallic and non-metallic components.
- c) Material substitutions in qualified SSSV equipment are allowed without validation testing provided that the manufacturer's selection criteria are documented and meet all other requirements of this International Standard.

6.3.4.2 Metals

6.3.4.2.1 The manufacturer's specifications shall define the following:

- a) chemical-composition limits;
- b) heat treatment conditions;
- c) mechanical-property limits:
 - 1) tensile strength,
 - 2) yield strength,
 - 3) elongation,
 - 4) hardness.

6.3.4.2.2 The mechanical properties specified in 6.3.4.2.1 c) 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 6.3.4.2.1.c). 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.

6.3.4.2.3 Each welded component shall be stress-relieved as specified in 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 3S SSSV equipment shall be stress-relieved in accordance with ISO 15156 (all parts).

NOTE For the purposes of these provisions, NACE MR0175/ISO 15156-1-2-3, is equivalent to ISO 15156 (all parts).

6.3.4.3 Non-metals

6.3.4.3.1 The manufacturer shall have documented procedures, including acceptance criteria, for evaluations or testing of sealing materials or other non-metals to the limits for which the equipment is rated.

6.3.4.3.2 Evaluations (or tests) shall verify the material used is suitable for use in the specific configuration, environment and application. These evaluations shall include the combination of: pressure, temperature, geometric seal design and its application, and the fluids compatible with the intended application.

6.3.4.3.3 Sealing devices and materials previously qualified in accordance with prior editions of ISO 10432 or API Spec 14A for the relevant range of application shall be considered as meeting the design validation requirements of this International Standard.

6.3.4.3.4 The manufacturer's written specifications for non-metallic compounds shall include handling, storage and labelling requirements, including the cure date, batch number, compound identification and shelf life appropriate to each compound and shall define those characteristics critical to the performance of the material, such as the following:

- 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.

6.3.5 Performance data

6.3.5.1 Performance rating-SCSSV

The supplier/manufacturer shall state the pressure, temperature and axial load rating, as applicable for the specific product. This information may be provided in an operating performance envelope; an example is given in Annex E.

6.3.5.2 Performance rating-SSCSV

The supplier/manufacturer shall provide the following information, as applicable, to establish the closing conditions for the specific product:

- a) orifice size;
- b) setting spring;
- c) number of spacers to be used;
- d) pressure charge.

6.3.6 TFL equipment

For additional requirements for these products in TFL applications, see ISO 13628-3.

6.4 Design verification

Design verification shall be performed to ensure that each SSSV design meets the supplier's/manufacture's technical specifications. Design verification includes activities such as design reviews, design calculations, physical tests, comparison with similar designs and historical records of defined operating conditions.

6.5 Design validation

6.5.1 General

The SSSVs produced in accordance with this International Standard shall pass the validation test required by this subclause.

- a) SSSVs shall pass the applicable validation test specified in Annex B and shall be performed by a test agency.
- b) Seals shall meet the requirements of 6.3.4.3.

The validation testing requirements in this International Standard are not represented as well conditions.

The objectives of the validation testing requirements of this subclause are to qualify SSSV equipment for specific classes of service, either Class 1 or Class 2. SSSV equipment furnished to this International Standard requires validation testing to qualify each size, type and model of SSSV. Qualification for Class 2 service shall include testing for Class 1 service. An SSSV passing the Class 1 portion, but failing the Class 2 portion of the combined test, shall be qualified for Class 1 service only.

Successful completion of the validation testing process shall qualify SSSVs of the same size, type and model as the tested SSSV.

Substantive changes to the validation test (specified herein) shall require requalification of a previously qualified SSSV within three years of the effective date of the change.

With mutual consent between the test agency and the manufacturer, higher flow rates than those stipulated in Annex B may be applied and used for all flow tests.

6.5.2 Manufacturer requirements

- a) The SSSV shall be proof tested to ensure the valve meets the requirements of the technical specification with the manufacturer's specified safety factors. The manufacturer shall provide the test agency with an SSSV of most recent manufacture, one operating manual, records of proof testing, and associated documentation for each size, type and model for the class of service and working pressure desired in the validation test.
- b) The manufacturer shall maintain a validation test file on each validation test including any retests that may have been required to qualify SSSV equipment and seals. This file shall be retained by the manufacturer for a period of ten years after such SSSV equipment and seals are discontinued from the manufacturer's product line.
- c) The manufacturer shall furnish any equipment not normally furnished by the test agency to accommodate installation of a particular SSSV in the test facility or to accomplish the validation test.
- d) The manufacturer shall submit a validation test application for each SSSV to be validation tested to the test agency that shall contain the manufacturer's test application as required in A.1.

- e) In the event that a particular SSSV has design or operational features which are incompatible with the test facility and test procedures required by this International Standard, the manufacturer shall advise the test agency as to the nature of the incompatibility and shall request and fully describe on the test application, or attachments thereto, any equipment or procedures required to test the SSSV. Responsibility for furnishing, installing and testing this equipment shall be by agreement between the test agency and the manufacturer. The manufacturer shall be responsible for assuring that such equipment or procedures are not less stringent than this International Standard.
- f) In the case of validation test non-conformance, the manufacturer shall be responsible for determining the cause of the non-conformance. The test agency shall cooperate with the manufacturer to determine whether the non-conformance was product or test agency related. If the nonconformance is determined to be valve-related, the nonconformance becomes a test failure; if the nonconformance is determined to be test agency related, the manufacturer and test agency shall determine a course of action on the validation test process for the specific valve that is not less stringent than the validation testing requirements of this International Standard. The test agency shall document the testing non-conformance on the test data forms.
- g) If a particular size, type and model of SSSV fails the validation test, that SSSV and any other SSSV of the same basic design and materials of construction shall not be submitted for retest until the manufacturer has determined and documented the justification for retest. The manufacturer shall conduct this analysis and document the results, including any corrective action taken. Such information need not be submitted to the test agency, but shall be placed in the manufacturer's test file for that SSSV before the SSSV is submitted for retest.
- h) Pre-test and post-test dimensional verification of functionally critical dimensions defined by the manufacturer shall be conducted and documented by the manufacturer. Dimensions shall be within established criteria.

6.5.3 Test agency requirements

Test agency requirements are provided in Annex A.

6.5.4 Special feature validation

The manufacturer shall identify, in design documentation, all special features included in the product design that are not validated by design validation testing per this International Standard. Special features shall be validated by test to their rated limits. Special feature validation testing may be performed by the manufacturer.

The manufacturer shall identify those special features that shall be included in the functional testing.

The manufacturer's design validation documentation shall include the design requirements, test procedures and test results of special features.

6.6 Design changes

Changes to the design acceptance criteria of the SSSV design which may affect validation test performance or interchangeability shall require requalification of the SSSV design. Seals that meet the requirements of 6.3.4.3 shall be considered interchangeable among the SSSV equipment of any one manufacturer.

The manufacturer/supplier shall, as a minimum, consider the following when making design changes: stress levels of the modified or changed components; material changes; and functional changes. All design changes and modifications shall be identified, documented, reviewed and approved before their implementation. Design changes and changes to design documents shall require the same control features as the design which has passed the applicable validation test requirements of this International Standard.

6.7 Functional test

6.7.1 Each SSSV shall be tested in accordance with Annex C.

6.7.2 Optional minimal leakage requirements are given in Annex D.

7 Supplier/manufacture requirements

7.1 General

Clause 7 contains the detailed requirements to verify that each product manufactured under this International Standard meets the requirements of the functional and technical specifications.

7.2 Raw material

7.2.1 Certification

Raw material used in the manufacture of components shall require the following:

- a) certificate of conformance stating that the raw material meets the manufacturer's documented specifications;
- b) material test report so that the manufacturer can verify that the raw material meets their documented specifications.

7.2.2 Mechanical and physical properties

7.2.2.1 Metals

Tensile testing shall be in accordance with ISO 6892 for the metallic materials used for traceable components. Hardness testing shall be in accordance with ISO 6506-1 or ISO 6508-1; ISO 6507-1 may be used if ISO 6506-1 or ISO 6508-1 cannot be applied due to size, accessibility, or other limitations. Hardness conversion to other measurement units shall be in accordance with ASTM E 140, with the exceptions noted in ISO 15156 (all parts) for materials that are intended for use in wells where corrosive agents can possibly be expected to cause stress-corrosion cracking.

NOTE For the purposes of these provisions, NACE MR0175/ISO 15156-1-2-3 is equivalent to ISO 15156 (all parts).

7.2.2.2 Non-metals

Non-metals shall be tested to determine their mechanical properties as follows:

- a) tensile, elongation, modulus:
 - 1) O-rings in accordance with ASTM D 1414,
 - 2) other elastomers in accordance with ASTM D 412 (alternative ISO or ASTM methods may be used, where applicable),
 - 3) non-elastomers in accordance with ISO 527-1;

NOTE For the purposes of these provisions, ASTM D 638 is equivalent to ISO 527-1.

- b) compression set (homogeneous elastomeric compounds only):

- 1) O-rings in accordance with ASTM D 1414,
- 2) all others in accordance with ASTM D 395;

- c) durometer hardness:

- 1) O-rings in accordance with ISO 48 or ASTM D 2240 with Shore M,

NOTE For the purposes of these provisions, ASTM D 1415 is equivalent to ISO 48.

- 2) other elastomers in accordance with ASTM D 2240 (plastics and other materials may be tested using the Rockwell method, where applicable).

7.3 Heat-treating-equipment qualification

7.3.1 Furnace calibration

Furnaces for heat treatment of production parts shall require the following.

- a) Heat treatment of production parts shall be performed with heat treating equipment that has been calibrated and surveyed.
- b) Each furnace shall have been surveyed within one year prior to heat treating operations. When a furnace is repaired or rebuilt, a new inspection shall be required before heat treating.
- c) Batch-type and continuous-type heat treating furnaces shall be calibrated in accordance with one of the following procedures:
 - 1) procedures specified in SAE-AMS-H-6875:1998, Section 5;
 - 2) procedures specified in BS 2M 54:1991, Section 7;
 - 3) manufacturer's written specifications including acceptance criteria which are not less stringent than the procedures identified above.

7.3.2 Furnace instrumentation

The requirements for furnace instrumentation are as follows.

- a) Automatic controlling and recording instruments shall be used.
- b) Thermocouples shall be located in the furnace working zone(s) and protected from furnace atmospheres.
- c) Controlling and recording instruments used for the heat treatment processes shall possess an accuracy of ± 1 % of their full-scale range.
- d) Temperature-controlling and -recording instruments shall be calibrated at least once every three months until a documented calibration history can be established; calibration intervals shall then be established based on repeatability, degree of usage and documented calibration history.
- e) Equipment used to calibrate the production equipment shall possess an accuracy of $\pm 0,25$ % of full-scale range.

7.4 Traceability

7.4.1 All components, weldments, subassemblies and assemblies of SSSV equipment shall be traceable except the following:

- a) setting springs used to establish closure parameters for SSCSVs;
- b) beans for SSCSVs;
- c) common hardware items such as nuts, bolts, set screws and spacers.

7.4.2 Traceability shall be in accordance with the manufacturer's documented procedures. All assemblies, components (including seals), weldments and subassemblies of equipment supplied shall be traceable to a job lot and a material test report. Components and weldments shall also have their included heat(s) or batch