Specification for Subsurface Safety Valve Equipment

ISO 10432:1999, Petroleum and natural gas industries—Downhole equipment—Subsurface safety valve equipment

EFFECTIVE DATE: MAY 15, 2001
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API Foreword

This standard is under the jurisdiction of the API Standards Subcommittee on Valves and Wellhead Equipment (API C1/SC6). This API standard is identical with the English version of ISO 10432:1999. ISO 10432 was prepared by Technical Committee ISO/TC 67, Materials, equipment and offshore structures for petroleum and natural gas industries, SC 4, Drilling and production equipment.

For the purposes of this standard, the following editorial changes have been made:

- Deletion of ISO Foreword and Introduction from the international standard replaced by API Special Notes and Foreword;
- A national informative annex (Annex G – API Monogram and Test Agency Licensing) has been included giving guidance to users.

This standard shall become effective on the date printed on the cover but may be used voluntarily from the date of publication.

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Suggested revisions are invited and should be submitted to the Upstream Segment, API, 1220 L Street, NW, Washington, DC 20005.
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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 3601-3:—1), Fluid power systems — O-rings — Part 3: Quality acceptance criteria.


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.

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

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

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).*


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


### 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 SSSVs*

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 (CO₂), oxygen (O₂) 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 (3000 psi, 5000 psi, 6000 psi, 10000 psi and 15000 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 \( \pm 0.5\% \) of full-scale range;

b) be calibrated to maintain \( \pm 2\% \) 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.

6.8 Welding and brazing

6.8.1 Welding and brazing procedure and personnel qualification shall be in accordance with ASME Boiler and Pressure Vessel Code Section IX.

6.8.2 Material and practices not listed in ASME Boiler and Pressure Vessel Code Section IX shall be applied using welding procedures qualified in accordance with the methods of ASME Boiler and Pressure Vessel Code Section IX.

6.9 Qualification of heat treatment equipment

6.9.1 Furnace calibration

Heat treatment of production parts shall be performed with heat treatment equipment that has been calibrated and surveyed.

Each furnace shall be surveyed within one year prior to heat treatment operations. When a furnace is repaired or rebuilt, a new survey shall be carried out before heat treatment.

Batch-type and continuous-type heat treatment furnaces shall be calibrated in accordance with one of the following procedures:

a) the procedure specified in MIL-H-6875H, Section 5;
b) the procedure specified in BS 2M 54:1991, Section 7;
c) the manufacturer's written specifications, including acceptance criteria which are not less stringent than the procedures identified above.
6.9.2 Instruments

Automatic controlling and recording instruments shall be used.

Thermocouples shall be located in the furnace working zone(s) and protected from furnace atmospheres.

The controlling and recording instruments used for the heat treatment processes shall possess an accuracy of \( \pm 1 \% \) of their full-scale range.

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.

Equipment used to calibrate the production equipment shall possess an accuracy of \( \pm 0.25 \% \) of full-scale range.

6.10 Coatings and overlays

Coatings and overlays shall be controlled by documented instructions which include acceptance criteria.

6.11 Mechanical and physical properties (where required by this International Standard)

6.11.1 Mechanical-property test procedures and practices shall be in accordance with ASTM A 370 for the metallic materials used for traceable components. Hardness testing shall be in accordance with ASTM E 10 or E 18 (ASTM E 92 may be used when E 10 or E 18 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 NACE MR0175 for Class 3 equipment.

6.11.2 Mechanical-property test procedures for elastomeric compound types shall be in accordance with:

a) tensile-elongation modulus:

1) O-Rings — ASTM D 1414,
2) all others — ASTM D 412;

b) compression set:

1) O-Rings — ASTM D 1414,
2) all others — ASTM D 395;

c) durometer hardness:

1) O-Rings — ASTM D 1415,
2) all others — ASTM D 2240.

6.12 NDE requirements

6.12.1 All NDE instructions shall be approved by a Level III examiner.

6.12.2 All primary closure springs shall be magnetic-particle or liquid-penetrant inspected to verify conformance with the manufacturer's written specifications.

6.12.3 All pressure-containing welds shall be magnetic-particle or liquid-penetrant inspected for surface defects and shall be volumetrically inspected by radiographic or ultrasonic techniques to verify conformance with the manufacturer's written specifications.
6.12.4 All pressure-containing castings and forgings shall be magnetic-particle or liquid-penetrant inspected for surface defects and shall be volumetrically inspected by radiographic or ultrasonic techniques to verify conformance with the manufacturer's written specifications. The manufacturer may develop AQL inspection levels based on documented variation history.

6.12.5 NDE methods and acceptance criteria are as follows:

6.12.5.1 Liquid penetrant

a) Method — ASTM E 165.

b) Acceptance criteria — ASME Boiler and Pressure Vessel Code, Section VIII, Pressure Vessels, Division 1, Appendix 8.

6.12.5.2 Wet magnetic-particle examination

a) Method — ASTM E 709.

b) Definitions:

1) Relevant indication — only those indications with major dimensions greater than 1,6 mm (1/16 in) shall be considered relevant. Inherent indications not associated with a surface rupture (i.e. magnetic-permeability variations, non-metallic stringers, etc.) are considered non-relevant.

2) Linear indication — any indication in which the length is equal to or greater than three times its width.

3) Rounded indication — any indication which is circular or elliptical with its length less than three times the width.

c) Acceptance criteria:

1) Any relevant indication 4,8 mm (3/16 in) or greater is unacceptable. No relevant linear indications are allowed for weldments.

2) No more than ten relevant indications in any 39 cm² (6 in²) area.

3) Four or more rounded relevant indications in a line separated by less than 1,6 mm (1/16 in) are unacceptable.

6.12.5.3 Ultrasonic inspection — weldments

a) Method — ASME Boiler and Pressure Vessel Code, Section V, Nondestructive Examination, Article 5.

b) Acceptance criteria — ASME Boiler and Pressure Vessel Code, Section VIII, Pressure Vessel, Division 1, Appendix 12.

6.12.5.4 Ultrasonic inspection — castings

a) Method — ASTM E 428 and ASTM A 609.

b) Acceptance criteria — ASTM A 609 ultrasonic-testing quality level 1, minimum.

6.12.5.5 Ultrasonic inspection — forgings and wrought products

a) Method — ASTM E 428 and ASTM A 388.

b) Calibration:

1) Back-reflection technique — the instrument shall be set so that the first back-reflection is 75 % ± 5 % of screen height when the transducer is placed on an indication-free area of the forging or wrought product.
2) Flat-bottom hole technique — the distance-amplitude curve (DAC) shall be based on a 3,2 mm (1/8 in) flat-bottom hole through 101,6 mm (4 in) of metal and a 6,4 mm (1/4 in) flat-bottom hole for metal distances exceeding 101,6 mm (4 in).

3) Angle beam technique — the distance-amplitude curve (DAC) shall be based on a notch of depth equal to the lesser of 9,5 mm (3/8 in) or 3 % of the normal section thickness [9,5 mm (3/8 in) maximum], a length of approximately 25,4 mm (1 in) and a width not greater than twice its depth.

c) Acceptance criteria — the following forging or wrought-product defects are rejectable:

1) Back-reflection technique — indications greater than 50 % of the referenced back-reflection accompanied by a complete loss of back-reflection.

2) Flat-bottom hole technique — indications equal to or larger than the indications observed from the calibration flat-bottom hole.

3) Angle beam technique — amplitude of the discontinuities exceeding that of the reference notch.

6.12.5.6 Radiographic inspection — weldments

a) Method — ASTM E 94.

b) Acceptance criteria — ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, Pressure Vessel, UW-51.

6.12.5.7 Radiographic inspection — castings

a) Method — ASTM E 94.

b) Acceptance criteria:

1) ASTM E 186.

2) ASTM E 280.

3) ASTM E 446.

Maximum defect classification for 1), 2) and 3) above is as follows:

<table>
<thead>
<tr>
<th>Type of defect</th>
<th>Maximum defect classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3</td>
</tr>
<tr>
<td>B</td>
<td>2</td>
</tr>
<tr>
<td>C</td>
<td>2 (all types)</td>
</tr>
<tr>
<td>D</td>
<td>None acceptable</td>
</tr>
<tr>
<td>E</td>
<td>None acceptable</td>
</tr>
<tr>
<td>F</td>
<td>None acceptable</td>
</tr>
<tr>
<td>G</td>
<td>None acceptable</td>
</tr>
</tbody>
</table>

6.12.5.8 Radiographic inspection — forgings

a) Method — ASTM E 94.

b) Acceptance criteria — the following defects are rejectable:

1) Any type of crack or lap.
2) Any other elongated indication with length greater than:

- 6.4 mm (1/4 in) for \( t \) up to 19 mm (3/4 in) inclusive;
- \( 1/3t \) from \( t = 19 \) mm (3/4 in) up to \( t = 57.2 \) mm (2 1/4 in);
- 19 mm (3/4 in) for \( t \) over 57.2 mm (2 1/4 in).

**NOTE** \( t \) is the wall thickness.

3) Any group of indications in a line that have an aggregate length greater than \( t \) in a length of 12\( t \).

### 7 Testing

#### 7.1 General

7.1.1 The SSSVs, SV locks and SVLN(s) produced in accordance with this International Standard shall be constructed of materials in compliance with this International Standard and pass the verification and functional tests required by this clause.

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

7.1.3 During verification testing of hydraulically operated SSSVs, control line fluid metering shall be used to provide a readable hydraulic control line pressure trace, unless otherwise specified. Refer to Annex C, Figure C.6 for a characteristic pressure versus time plot for opening and closing hydraulic control pressures with hydraulic fluid being applied at a metered rate.

7.1.4 All pressures are defined as gauge unless otherwise specified and shall be recorded on time-based equipment.

7.1.5 All test conditions without a specified tolerance shall be considered minimum values. The maximum value shall not exceed the minimum value by more than 10%.

7.1.6 The drift bar used in the verification test shall be provided by the manufacturer. Drift bar dimensions and a unique identifier for the bar shall be provided by the manufacturer.

7.1.7 With mutual consent between the test agency and the manufacturer, higher flow rates may be applied and used for all flow tests.

7.1.8 The objectives of the testing requirements of this clause are to qualify SSSV equipment for specific classes of service and to verify proper operation of SSSV equipment. Testing required for SSSV equipment furnished to this International Standard is:

- verification testing to qualify each size, type and model of SSSV for a specific class of service, either Class 1 or combined Class 1 and Class 2;
- functional testing of each SSSV;
- functional and verification testing of SVLN(s);
- functional and verification testing of SV lock(s).
7.2 Verification testing

7.2.1 General

a) Verification testing to qualify an SSSV for Class 1 or combined Class 1 and Class 2 service shall be performed by a test agency.

b) Verification testing of SV locks, SVLNs and all seals shall be performed by a test agency.

7.2.2 Manufacturer requirements

The manufacturer shall submit an SSSV of most recent manufacture for verification testing. Such testing shall qualify SSSVs of the same size, type and model as the tested SSSV. Substantive changes to the verification test (specified herein) shall require requalification of a previously qualified SSSV within three years of the effective date of the change.

a) The test section shall completely enclose a wireline-retrievable SSSV. Tubing-retrievable SSSVs shall be an integral part of the test section. The test section shall be rated to at least the rated working pressure of the SSSV.

b) The test section ends, length and hydraulic control connections shall be compatible with the test agency's facility.

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 verification test.

7.2.3 Verification-testing requirements

a) The manufacturer shall declare that an SSSV is being submitted for the class of service and working pressure desired in the verification test by submitting an application to the test agency. The application form shall contain the minimum information shown in Annex B, Table B.1.

1) A manufacturer may submit an SSSV for Class 1 or for Class 1 and 2 testing. For combined testing, an SSSV passing both portions of the test shall be qualified for both Class 1 and Class 2 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.

2) 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.

3) The test agency shall conduct the test as specified on the manufacturer's test application. Any variation from the verification test requirements of this International Standard shall be recorded on the verification test data summary form (Table B.16) by the test agency.

b) The manufacturer shall provide the test agency with a functionally tested SSSV, one operating manual and associated documentation for each size, type and model to be tested.

c) If a particular size, type and model of SSSV fails the verification 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.

d) The test agency shall record the results of the verification test on documentation which as a minimum shall contain the data specified in the applicable example tables shown in Annex B. The content of the forms in Annex B is normative as a minimum data requirement for the documentation specified in this clause; however, the format of
the forms is informative. This documentation shall be retained by the manufacturer and by the test agency, and shall be available to the operator upon request to the manufacturer.

e) To pass the verification test, the SSSV shall successfully complete all steps of the verification-testing procedure within the limits specified and in the order shown. The basis for discontinuing the test, and any unusual conditions observed at or prior to the time of discontinuance, shall be noted on the test data form by the test agency. Verification testing shall be discontinued if the valve fails to perform within the limits specified for any step except when such failures are determined to be a result of actions by the test agency or a failure within the test facility. The manufacturer, not the test agency, shall be responsible for determining the cause of failure of the valve.

f) Pre-test and post-test dimensional verification shall be conducted and documented by the manufacturer.

g) The manufacturer shall maintain a verification test file on each verification 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. As a minimum, this file shall contain sufficient documentation to identify and permit retrieval of:

1) all drawings and specifications applicable at the time of manufacture;
2) all applications for verification tests or retests;
3) all design and/or material modifications, or other justification for retest, of SSSV equipment and seals which did not pass any verification test;
4) all test data specified in this clause;
5) the documentation required in clause 8.

7.2.4 Test agency requirements

a) The test agency reporting and records shall conform with Annex E and the applicable portions of clause 6.

b) The test agency shall conduct verification tests in accordance with this clause.

c) The test agency shall be responsible for assuring itself, the manufacturers and the operators that the test facility, procedures and forms comply with this International Standard.

d) The test agency shall provide current documentation to manufacturers or operators on written request. This shall include, as a minimum:

1) a description of the facility, including any limitations on the size, length, mass, type, pressure rating, temperature rating, and service class of SSSV that may be tested;
2) the test procedures and forms actually used at the facility for each type and service class of SSSV;
3) the procedures for maintenance and calibration of measuring equipment;
4) the procedures for making applications for tests, the delivery of SSSVs, the initial installation and checkout of SSSVs and other pertinent information;
5) any limitations on the accessibility of the facility (such limitations shall not preclude reasonable access to the facility for inspection by manufacturers or operators);
6) any limitations on the receipt of proprietary information;
7) any other information considered pertinent by the test agency.
7.3 Functional testing

7.3.1 SSSV functional testing shall be performed by the manufacturer on each new SSSV manufactured in accordance with this International Standard. The manufacturer's test facility shall be equipped with instrumentation to display and record information required by the test procedure.

7.3.2 Each SSSV shall be serialized, and results of functional tests delivered with the SSSV.

7.3.3 Results of functional tests shall be retained by the manufacturer for a period of five years after the date of sale of a specific SSSV.

7.3.4 Functional-test data shall be recorded, dated and signed by the personnel performing the tests. The required data is indicated in Annex B, Table B.24.

7.4 General requirements for an SSSV verification test facility

7.4.1 The components of the test facility systems shall have a capacity and working pressure as required by the size and/or working pressure of the SSSV to be tested. Typical test facility schematics, the SSSV gas flow facility, the liquid test facility and the controlled-temperature test facility are shown in Annex C, Figure C.1, Figure C.2 and Figure C.4, respectively.

7.4.2 The control pressure system components shall, as a minimum, consist of the items listed below:

a) a hydraulic-fluid reservoir with a filtered vent;
b) an accumulator;
c) a hydraulic pump;
d) a control system to operate the pump;
e) a pressure relief facility to protect the system.

7.4.3 There shall be provision for the supply of nitrogen gas to conduct the required nitrogen leak test and a gas flow meter to indicate the leakage rate.

7.4.4 A gas reservoir with a gas release device and instrumentation to measure the test parameters shall be provided.

7.4.5 The liquid test facility shall, as a minimum, consist of the items listed below:

a) test facility piping, which shall be at least 50.8 mm (2 in) nominal diameter;
b) a fresh-water tank;
c) a sand slurry tank;
d) a Marsh funnel viscometer in accordance with API RP 13B1 with required timer and graduated beaker;
e) a centrifuge with basic sediment and water (BS&W) sample flasks in accordance with API Manual of Petroleum Measurement, Chapter 10.4;
f) circulation pumps;
g) a flow meter;
h) pressure measurement systems;
i) a time-based recorder to simultaneously record the required pressure and flow data;

j) a back-pressure regulator;

k) a propane system as shown in Annex C, Figure C.5;

l) a high-pressure water pump and accumulator system.

7.5 SCSSV verification test procedure

7.5.1 Verify that the model and serial numbers appearing on the test valve are in agreement with the manufacturer's application.

7.5.2 Perform the SCSSV gas flow test (see 7.6).

7.5.3 Perform the drift test (see 7.7).

7.5.4 Open the test valve. Record the full-open hydraulic control pressure as shown in Annex B, Table B.5.

7.5.5 Fill the test valve with water and circulate water to displace gas out of the test section. Once gas has been displaced from the test section, discontinue water circulation.

7.5.6 Close the test valve. Record the full-closed hydraulic control pressure as shown in Table B.5.

7.5.7 Perform the liquid leakage test (see 7.8).

7.5.8 Perform the unequalized opening test (see 7.9).

7.5.9 Perform the operating-pressure test (see 7.10).

7.5.10 Perform the propane test (see 7.11).

7.5.11 Perform the nitrogen leakage test (see 7.12).

7.5.12 Repeat the operating-pressure test (see 7.10).

7.5.13 Perform the SCSSV Class 1 flow test (see 7.13).

7.5.14 Repeat 7.5.11 to 7.5.13 four additional times.

7.5.15 Perform the liquid leakage test (see 7.8).

7.5.16 Perform the controlled-temperature test (see 7.14).

7.5.17 Cycle the test valve five times. Record the full-open and full-closed hydraulic control line pressures as specified in Annex B, Table B.14. If the test valve is being qualified for Class 1 service only, proceed to 7.5.24.

NOTE The full-open pressure and full-closed pressure shall be monitored for possible refinements of this International Standard, but will not be a cause for failure of the verification test.

7.5.18 Perform the nitrogen leakage test (see 7.12).

7.5.19 Perform the operating-pressure test (see 7.10).

7.5.20 Perform the Class 2 flow test (see 7.15).
7.5.21 Repeat 7.5.18 to 7.5.20 six additional times. The slurry may be allowed to stagnate in the test section overnight with the test valve in the open position.

7.5.22 Perform the liquid leakage test (see 7.8).

7.5.23 Perform the drift test (see 7.7).

7.5.24 If the test valve has performed within the limits specified, it has passed the verification test.

7.5.25 Summarize the verification test data as shown in Annex B, Table B.16, and attach the completed data forms. Calibration records shall be included with the verification test report. Each data form shall be signed and dated by the person(s) conducting the test. The form illustrated in Table B.16 shall be signed and dated by the test agency's designated approval authority.

7.6 SCSSV gas flow test (record results as per Annex B, Table B.2)

7.6.1 Install the test valve in the gas flow test stand. The test medium shall be air, nitrogen or any other suitable gas.

7.6.2 Set the control line resistance to the appropriate setting shown in Annex B, Table B.3.

a) The test flow rates specified in Table B.3 are based on a pressure of 13.8 MPa (2000 psi) and a velocity of 6.10 m/s (20 ft/s) in the tubing for valve closure test 1 and test 4, a velocity of 9.15 m/s (30 ft/s) for test 2, and a velocity of 3.05 m/s (10 ft/s) for test 3.

b) The test flow rates shall be maintained within −5 % and +15 % of the nominal value given in Table B.3 or between −0.01 × 10^6 m^3 and +0.04 × 10^6 m^3 per day (−0.5 × 10^6 scf and +1.5 × 10^6 scf per day), whichever is greater. The low control line resistance test shall be performed with a hydraulic control line having an inside diameter of at least 9.6 mm (0.38 in) and a maximum total length of 7.6 m (25 ft).

c) The configuration for the high control line resistance test shall consist of the control line used for the low-resistance configuration plus a square-edge orifice having an inside diameter of 0.5 mm ± 0.05 mm (0.020 in ± 0.002 in) and a length of 25.4 mm ± 2.5 mm (1.0 in ± 0.1 in).

d) Any manufacturer establishing SSSV sizes not covered by this International Standard may interpolate or extrapolate the values in Table B.3, assuming the flow rate depends on the square of the nominal size.

7.6.3 Open and close the test valve. Record the full-open and full-closed control pressures.

7.6.4 Close the gas release valve and bleed line valve (see Annex C, Figure C.1). Set the flow control device to provide a gas flow at a test rate in accordance with Table B.3.

7.6.5 Increase the gas pressure in the system to between 13.8 MPa (2000 psi) and 17.3 MPa (2500 psi).

7.6.6 Open the test valve. Record the full-open control pressure.

7.6.7 Establish and maintain the gas flow rate indicated in Table B.3, and then close the test valve while recording the control line pressure and gas flow rate.

7.6.8 The test valve shall shut off a minimum of 95 % of the specified flow in 5.0 s or less after the hydraulic control pressure reaches zero, or the test valve fails the test. Record the time required by the test valve to shut off the specified flow. If the test valve fails, discontinue testing.

7.6.9 Bleed the valve bore downstream pressure to zero. Adjust the test valve upstream bore pressure to 8.3 MPa ± 0.4 MPa (1200 psi ± 60 psi). Record the test valve bore upstream pressure and gas leakage rate. If leakage exceeds 0.14 m^3/min (5 scf/min) of gas, the test valve fails. If the test valve fails, discontinue testing.
7.6.10 Bleed all pressure to zero. Repeat step 7.6.2 to step 7.6.9 until all four closure tests specified in Table B.3 are successfully completed or until the test valve fails.

7.7 Drift test (record results as per Annex B, Table B.4)

7.7.1 If necessary, remove the end connections (hammer unions, etc.) from the test valve to allow the drift test to be completed.

7.7.2 Open and close the test valve, recording the full-open hydraulic control line pressure.

7.7.3 Position the test valve so that the valve is vertical, upside down and open before drifting the valve. The test valve may be opened prior to repositioning.

7.7.4 Record the drift bar dimensions and the unique identifier as supplied by the manufacturer. Record the minimum specified inside diameter of the test valve.

7.7.5 Pass the drift bar completely through the test valve in a manner that does not cause the test valve's closure mechanism to be opened. The drift bar shall be aided only by the force of gravity while being passed through the test valve. If the drift bar does not pass completely through the test valve, the test valve fails. If the test valve fails, discontinue testing.

7.7.6 Release the hydraulic control pressure to close the test valve, and reposition the valve. Open and close the test valve four additional times. Record the full-open and full-closed hydraulic control line pressures.

7.8 Liquid leakage test (record results as per Annex B, Table B.6)

7.8.1 Make certain that the test valve is in the closed position with only liquid above and below the valve.

7.8.2 Apply water pressure upstream of the test valve closure mechanism at \((100 \pm 0.5)\%\) of the rated working pressure of the valve. Record the test valve bore pressure and the time at which pressure was applied to the valve.

7.8.3 Wait for a minimum of 3 min after applying water pressure upstream of the test valve closure mechanism before beginning collection of water leakage from the downstream bleed valve. Continuously collect water leakage for a minimum of 5 min. Record the times at which water leakage collection began and ended and the amount of water collected during the collection period. Calculate and record the average leakage rate. If the average leakage rate exceeds \(10 \text{ cm}^3/\text{min}\) of water, or if external body leakage is detected (tubing-retrievable only), the test valve fails. If the test valve fails, discontinue testing.

7.9 Unequalized opening test (record results as per Annex B, Table B.7)

7.9.1 Establish water pressure upstream of the test valve closure mechanism at the maximum manufacturer-specified opening-pressure differential.

7.9.2 Open the test valve closure mechanism against pressure as recommended in the test valve operating manual. Record the equalizing pressure and the full-open hydraulic control pressure.

7.10 Operating-pressure test (record results as per Annex B, Table B.8)

7.10.1 Apply \(25 \pm 5\%\) of the rated working pressure of the test valve to the entire test section. Record the test valve bore pressure.

7.10.2 Close and open the test valve five times while recording the full-closed and full-open hydraulic control pressures. If the hydraulic control pressures do not repeat within \(\pm 10\%\) of their averages or \(\pm 0.7\text{ MPa (100 psi)}\), whichever is greater, or if any body joint leakage (tubing-retrievable only) is detected, the test valve fails. If the test valve fails, discontinue testing.
7.10.3 Repeat 7.10.1 and 7.10.2 at 75 % ± 5 % of the test valve's rated working pressure.

7.11 Propane test (record results as per Annex B, Table B.9)

7.11.1 Open the test valve. Displace liquid out of the test section with nitrogen at a downstream location and bleed the nitrogen pressure to zero.

7.11.2 Cycle the test valve closed and open three times. Leave the test valve open. Record the full-closed and full-open hydraulic control pressures. If the hydraulic control pressures do not repeat within ± 10 % of their averages or ± 0.7 MPa (100 psi), whichever is greater, the test valve fails. If the test valve fails, discontinue testing.

7.11.3 Transfer propane to the test section until the test section pressure reaches 2.8 MPa ± 0.14 MPa (400 psi ± 20 psi).

7.11.4 Open the downstream vent valve until liquid propane is expelled, close the propane vent valve, and adjust the pressure to 2.8 MPa ± 0.14 MPa (400 psi ± 20 psi). Record the test valve bore pressure.

7.11.5 Close and open the test valve three times, leaving the test valve in each position (opened or closed) for a minimum of 15 min. Record the full-open and full-closed hydraulic control pressures. If the hydraulic control pressures do not repeat within ± 10 % or ± 0.7 MPa (100 psi) of the averages, whichever is greater, or if any body joint leakage (tubing retrievable only) is detected, the test valve fails. If the test valve fails, discontinue testing.

7.11.6 Leave the test valve in the open position in propane for an additional 2 h, minimum. Record the start and completion times and the valve bore pressure at the end of the 2 h interval.

7.11.7 Bleed the section pressure to zero.

7.11.8 Purge the test section with nitrogen.

7.11.9 Close the test valve and record the full-closed hydraulic control pressure.

7.12 Nitrogen leakage test (record results as per Annex B, Table B.10)

7.12.1 Apply 1.4 MPa ± 0.07 MPa (200 psi ± 10 psi) nitrogen pressure upstream of the test valve. Wait a minimum of 1 min, then measure any nitrogen leakage through the closure mechanism. Record the test valve bore pressure, the leakage rate and the start and completion times of the waiting period. If the leakage rate is greater than 0.14 m³/min (5 scf/min), or if any body joint leakage (tubing-retrievable only) is detected, the test valve fails. If the test valve fails, discontinue testing.

7.12.2 Repeat 7.12.1 at 25 % ± 5 % of the rated working pressure of the test valve.

7.12.3 Bleed the pressure upstream of the test valve to zero.

7.12.4 Open the test valve. Record the full-open hydraulic control pressure.

7.13 SCSSV Class 1 flow test (record results as per Annex B, Table B.11)

7.13.1 Circulate fresh water through the system while bypassing the test valve until gas has been displaced from the system.

7.13.2 Adjust the water flow rate through the test valve to obtain a stable flow at the value specified in Annex B, Table B.12. Record the time at which flow is directed through the test valve. Pass water through the test valve at the specified rate for a minimum of 5 min.

7.13.3 Close the test valve against the flow. Record the full-closed hydraulic control pressure and the water flow rate through the test valve at the time closure was initiated. The test valve shall shut off a minimum of 95 % of the specified
flow at the first closure attempt in 15.0 s or less after the hydraulic control pressure reaches zero, or the test valve fails. Record the time required by the test valve to shut off the specified flow. If the test valve fails, discontinue testing.

7.13.4 Open the test valve. Record the full-open hydraulic control pressure.

7.13.5 Repeat 7.13.2 to 7.13.4 until the three fresh-water closure rates have been completed or the test valve fails.

7.14 Controlled-temperature test (record results as per Annex B, Table B.13)

7.14.1 Install the test valve in the controlled-temperature test stand. Temperature measurements shall be taken in the area of the control line entry port of the test valve.

7.14.2 Allow the test valve to reach a stable temperature of \(38^\circ C \pm 3^\circ C\) (100 \(^\circ F \pm 5^\circ F\)).

7.14.3 Apply nitrogen pressure at 25 % ± 5 % of the rated working pressure of the test valve. Allow the temperature at the test valve to stabilize. Record the test valve temperature and test valve bore pressure.

7.14.4 Cycle the test valve ten times while maintaining the specified test valve temperature and pressure. Record the full-open and full-closed hydraulic control pressures at each cycle and the test valve temperature and bore pressure. If the hydraulic control pressures do not repeat within ±10 % of their averages or ±0.7 MPa (100 psi), whichever is greater, or if body joint leakage (tubing-retrievable only) is detected, the test valve fails. If the test valve fails, discontinue testing.

7.14.5 Connect a tube from the test valve hydraulic control line port to a container filled with water. Position the tube so any gas bubbles from the hydraulic control line port can be observed.

7.14.6 With the test valve bore filled with nitrogen gas at the specified temperature and pressure, wait a minimum of 3 min and then observe the gas bubble leakage rate for a minimum of 5 min. Record the times at which the 3 min waiting period, preceding the leakage test, begins and ends and the times at which the 5 min gas bubble leakage observation period begins and ends. If continuous leakage from the control line is observed for at least 1 min during the observation period, or if body joint leakage (tubing-retrievable only) is detected, the test valve fails. If the test valve fails, discontinue testing.

7.14.7 Repeat 7.14.2 to 7.14.6 using a test valve bore pressure of 75 % ± 5 % of the rated working pressure of the test valve.

7.14.8 Bleed nitrogen pressure above the closure mechanism to zero. Adjust and stabilize the pressure below the closure mechanism to 75 % ± 5 % of the rated working pressure of the test valve. Wait a minimum of 1 min; then measure any nitrogen leakage. Record the test valve bore pressure below the closure mechanism, the leakage rate, and the start and completion times of the waiting period. If the leakage rate is greater than 0.14 m\(^3\)/min (5 scf/min), or if any body joint leakage (tubing-retrievable only) is detected, the test valve fails. If the test valve fails, discontinue testing.

7.14.9 Repeat 7.14.2 to 7.14.8 using a test temperature of \(82^\circ C \pm 3^\circ C\) (180 \(^\circ F \pm 5^\circ F\)).

7.14.10 Bleed all pressure to zero. Allow the test valve to cool. Remove the test valve from the controlled-temperature test stand.

7.15 SCSSV Class 2 flow test (record results as per Annex B, Table B.15)

7.15.1 Prepare a slurry consisting of sand and viscosified water.

7.15.2 Determine the sand content of the slurry in accordance with the API Manual of Petroleum Measurement Standards, Chapter 10.4. Adjust the sand content to 2 % ± 0.5 % by adding 180 \(\mu m\) to 150 \(\mu m\) (80 U.S. mesh to 100 U.S. mesh) sand or diluting the slurry with fresh water.
7.15.3 Determine the viscosity of the slurry sample with a Marsh funnel viscometer in accordance with API RP 13B1. Adjust the viscosity to 70 s ± 5 s by adding a viscosifier or diluting the slurry with fresh water.

7.15.4 The viscosity and sand content requirements specified above shall be met before proceeding.

7.15.5 Adjust the slurry circulation rate to the value specified in Table B.12. Record the slurry circulation rate, sand content and slurry viscosity. Record the time at which the slurry circulation begins.

7.15.6 Circulate the slurry through the test valve at the specified rate for a minimum of 1 h, and then close the test valve against the specified rate.

7.15.7 Record the full-closed hydraulic control pressure and the slurry flow rate through the test valve at the time closure is initiated. The test valve shall shut off a minimum of 95 % of the specified flow at the first closure attempt in 15.0 s or less after the hydraulic control pressure reaches zero or the test valve fails. Record the time required for the test valve to shut off the specified flow. If the test valve fails, discontinue testing.

7.15.8 At the completion of the flow period, measure and record the sand content of the slurry and the slurry viscosity.

7.16 SCSBV verification test procedure

7.16.1 Verify that the model and serial numbers appearing on the test valve assembly are in agreement with the manufacturer's application.

7.16.2 Perform the SCSBV gas closure test (7.17). For velocity-type SCSBVs, use the gas flow test stand to conduct the test.

7.16.3 Perform the initial liquid closure test (7.18) using water as the test medium.

7.16.4 Perform the liquid leakage test (7.8).

7.16.5 Perform the propane test (7.11), omitting 7.11.2 and 7.11.5. Replace 7.11.9 with: "Conduct the liquid closure test (7.18), using water as the test medium." Record the results as per Annex B, Table B.19. The closing flow rate for a velocity-type SCSBV or the closing pressure for a tubing-pressure-type SCSBV shall repeat within ±15 % of the closing flow rate or pressure of 7.16.3 or the test valve fails the test. If the test valve fails, discontinue testing.

7.16.6 Perform the nitrogen leakage test (7.12), omitting 7.12.4. Record the results as per Annex B, Table B.20.

7.16.7 Perform the SCSBV Class 1 flow test (7.19).

7.16.8 Repeat 7.16.6 and 7.16.7 fourteen additional times. The closing flow rate for velocity-type SCSBVs or the closing pressure for tubing-pressure-type SCSBVs shall repeat within ±15 % of the closing flow rate or pressure of 7.16.3 above, or the valve fails the test. If the test valve fails, discontinue testing.

7.16.9 Perform the liquid leakage test (7.8). If the test valve is being qualified for Class 1 service only, proceed to 7.16.14.

7.16.10 Perform the nitrogen leakage test (7.12), omitting 7.12.4.

7.16.11 Perform the Class 2 flow test (7.20).

7.16.12 Repeat 7.16.10 and 7.16.11 six additional times. The closing flow rate for a velocity-type SCSBV or the closing pressure for a tubing-pressure-type SCSBV shall repeat within ±15 % of the closing flow rate or pressure of 7.16.3, or the test valve fails the test. If the test valve fails, discontinue testing. The slurry may be allowed to stagnate in the test section overnight. Record the times at which each stagnation period begins and ends.

7.16.13 Perform the liquid leakage test (7.8).
7.16.14 If the test valve has performed within the limits specified, it has passed the verification test.

7.16.15 Summarize the verification test data as specified in Annex B, Table B.16, and attach the completed data forms. Calibration records shall be included with the verification test report. Each data form shall be signed and dated by the person(s) conducting the test. The form containing the data specified in Table B.16 shall be signed and dated by the test agency's designated approval authority.

7.17 SSCSV gas closure test (record results as per Annex B, Table B.17)

7.17.1 Increase gas pressure in the system to between 13.8 MPa (2000 psi) and 17.3 MPa (2500 psi).

7.17.2 Close the test valve as follows:

a) Velocity-type SSCSVs — Increase the gas flow rate through the test valve until the test valve closes. The test valve shall close at a flow rate of at least ±25 % of the design closing flow rate indicated in Table B.1 in 30 s or less from the time this flow rate is achieved, or the test valve fails the test. If the test valve fails, discontinue testing. Record the initial pressure upstream of the test valve, the differential pressure across the test valve closure mechanism, and the gas flow rate through the test valve at closure.

b) Tubing-pressure-type SSCSVs — Adjust the gas pressure downstream of the test valve to ensure the test valve is open. Decrease the downstream pressure until the test valve closes. The test valve shall close at a downstream pressure of at least 75 % of the design closing pressure indicated in Table B.1. The minimum allowable downstream pressure is 0.35 MPa (50 psi). The test valve shall close in 30 s or less from the time this minimum pressure is achieved, or the test valve fails the test. Record the initial pressure downstream of the test valve and the pressure downstream of the test valve at closure. If the test valve fails, discontinue testing.

7.17.3 Bleed the valve bore downstream pressure to zero. Adjust the test valve bore upstream pressure to 8.3 MPa (1200 psi) ± 5 %. Wait a minimum of 1 min, then measure any gas leakage through the closure mechanism. Record the test valve bore pressure, the leakage rate and the start and completion times of the waiting period. If the leakage rate is greater than 0.14 m³/min (5 scf/min), the test valve fails. If the test valve fails, discontinue testing.

7.17.4 Bleed all pressure to zero.

7.18 Liquid closure test (record results as per Annex B, Table B.18)

7.18.1 Circulate liquid through the system while bypassing the test valve until gas has been displaced from the system.

7.18.2 Adjust the circulation rate through the test valve to obtain a flow at the rate specified in Annex B, Table B.22.

7.18.3 Close the test valve as follows:

a) Velocity-type SSCSVs — Adjust the pressure downstream of the test valve to between 0.35 MPa and 0.38 MPa (50 psi and 55 psi). Increase the circulation rate through the valve until the valve closes. The circulation rate shall be increased such that the pressure downstream of the test valve can be maintained between 0.35 MPa and 0.38 MPa (50 psi and 55 psi). The test valve shall close at a flow rate of at least ±25 % of the design closing flow rate indicated in Table B.1 in 30 s or less from the time this flow rate is achieved, or the test valve fails the test. If the test valve fails, discontinue testing. Record the initial pressure upstream of the test valve, the differential pressure across the valve closure mechanism, and the flow rate through the valve at closure.

b) Tubing-pressure-type SSCSVs — Decrease the downstream pressure until the test valve closes. The test valve shall close at a downstream pressure of at least 75 % of the design closing pressure indicated in Table B.1. The minimum allowable downstream pressure shall be 0.35 MPa (50 psi). The test valve shall close in 30 s or less from the time this pressure minimum is achieved, or the valve fails the test. Record the initial pressure downstream of the test valve and the pressure downstream of the test valve at closure. If the test valve fails, discontinue testing.
7.19 SSCSV Class 1 flow test (record results as per Annex B, Table B.21)

7.19.1 Circulate water through the system while bypassing the test valve until gas has been displaced from the system.

7.19.2 Adjust the water circulation rate through the test valve to obtain a flow rate at the value specified in Table B.22. Record the time at which flow is directed through the test valve and the circulation rate. Circulate water through the test valve at the specified rate for a minimum of 1 h.

7.19.3 Close the test valve using the liquid closure test procedure (7.18), using water as the test medium and omitting 7.18.1 and 7.18.2.

7.20 SSCSV Class 2 flow test (record results as per Annex B, Table B.23)

7.20.1 Prepare a slurry consisting of 150 μm to 180 μm (80 U.S. mesh to 100 U.S. mesh) sand and viscosified water.

7.20.2 Determine the sand content of the slurry in accordance with the API Manual of Petroleum Measurement Standards, Chapter 10.4. Adjust the sand content to 2 % ± 0.5 % by adding 150 μm to 180 μm (80 U.S. mesh to 100 U.S. mesh) sand or diluting the slurry with water.

7.20.3 Determine the viscosity of the slurry sample with a Marsh funnel viscometer in accordance with API RP 13B1. Adjust the viscosity to 70 s ± 5 s by adding a viscosifier or diluting the slurry with water.

7.20.4 The viscosity and sand content requirements specified above shall be met before proceeding.

7.20.5 Adjust the slurry circulation rate to the value specified in Table B.22. Record the slurry circulation rate, sand content and slurry viscosity. Also, record the time at which the slurry circulation begins.

7.20.6 Circulate slurry through the test valve at the specified rate for a minimum of 1 h, and then close the test valve using the liquid closure test procedure (7.18), using slurry as the test medium and omitting 7.18.1 and 7.18.2.

7.20.7 At the completion of the circulation period, measure and record the sand content and the slurry viscosity.

7.21 SCSSSV functional testing

7.21.1 Test facility

A typical test facility is shown in Figure C.7 and includes:

a) a test section installed vertically;

b) test section and hydraulic control section pressure measurement devices;

c) a pressurized-gas source;

d) a hydraulic control pressure system;

e) flow meters;

f) a pressurized-water system;

g) a time-based recorder to simultaneously record the required data;

h) internal and external drifts.
7.21.2 SCSSV functional-testing procedure

All test section pressures shall be measured with calibrated devices and recorded.

a) Record the serial number.

b) Place the SCSSV in a fixture capable of retaining and sealing the valve in a vertical position.

c) Open the SCSSV with zero pressure in the test section. Adjust and stabilize the hydraulic control pressure to the manufacturer's recommended hold-open pressure. Isolate the hydraulic control pressure from the source. Monitor for a minimum of 5 min. If a loss greater than 5% of the applied pressure is detected after stabilization, the SCSSV fails the functional test.

d) Close and open the SCSSV five times with zero pressure in the test section. Record the full-closed and full-open hydraulic control pressures. Each control pressure shall repeat within ±5% of the average pressure of the five valve cycles as well as falling within the manufacturer's specified control pressure tolerance. If each pressure is not within these the limits, the SCSSV fails the functional test.

e) Fill the test section with water or another suitable liquid to displace air from the test section.

1) Wireline-retrievable SCSSVs — Close the SCSSV. Adjust and stabilize the pressure across the entire test section to 150% ± 5% of the rated working pressure of the SCSSV. Hold the pressure for a minimum of 5 min. Reduce the pressure in the test section to zero. Repeat the test once. The SCSSV fails the functional test if leakage is detected through the hydraulic control port(s).

2) Tubing-retrievable SCSSVs — Close the SCSSV. Thoroughly dry the test valve exterior. Adjust and stabilize the pressure in the entire test section to 150% ± 5% of the rated working pressure of the SCSSV. Hold the pressure a minimum of 5 min. Reduce the pressure in the test section to zero. Repeat the test once. The SCSSV fails the functional test if leakage is detected on the exterior or through the hydraulic control line port(s).

f) Open and close the SCSSV with zero pressure in the test section and record the full-open and full-closed hydraulic control pressures. Open the SCSSV.

g) Adjust and stabilize the pressure in the entire test section to 50% ± 5% of the SCSSV's rated working pressure.

h) Close and open the SCSSV five times. Record the full-closed and full-open hydraulic control pressures and the test section pressure during each cycle. The hydraulic control pressure shall repeat within the greater of (1) 10% or 5% or (2) 0.7 MPa (100 psi) of the values specified by the manufacturer. Each hydraulic control pressure shall repeat within ±5% of the average pressure of the five cycles. If each of the control pressures is not within these limits, the SCSSV fails the functional test.

i) Adjust and stabilize the test section pressure to 100% ± 5% of the rated working pressure of the SCSSV. Close the SCSSV. Record the full-closed hydraulic control pressure. Bleed the hydraulic control pressure to zero.

j) Adjust and stabilize the test section pressure to 100% ± 5% of the rated working pressure of the SCSSV. Monitor for leakage at hydraulic control line port(s) for a minimum of 5 min. If any leakage is detected, the SCSSV fails the functional test.

k) Bleed the pressure above the SCSSV closure mechanism to zero. Adjust and stabilize the pressure below the closure mechanism to 100% ± 5% of the rated working pressure of the SCSSV. Measure liquid leakage for a minimum of 5 min. If the leakage rate exceeds 10 cm³/min, the SCSSV fails the functional test.

l) Remove the liquid from the test section.

m) Open the SCSSV. Record the full-open hydraulic control pressure.
n) Adjust and stabilize the pressure in the entire test section with gas to 1,4 MPa (200 psi) ± 5 %. Close the SCSSV. Record the full-closed hydraulic control pressure. Bleed the hydraulic control pressure to zero.

o) Adjust and stabilize the test section pressure with gas to 1,4 MPa (200 psi) ± 5 %. Monitor for gas leakage at the hydraulic control port(s) for a minimum of 5 min. If any leakage is detected, the SCSSV fails the functional test.

p) Bleed the pressure above the SCSSV's closure mechanism to zero. Adjust and stabilize the pressure below the SCSSV's closure mechanism to 1,4 MPa (200 psi) ± 5 % with gas. Measure the leakage rate for a minimum of 5 min. If the leakage rate exceeds 0,14 m³/min (5 scf/min), the SCSSV fails the functional test.

q) Repeat o) and p) with 8,3 MPa (1200 psi) ± 5 % gas.

r) Bleed all pressures to zero.

s) Open and close the SCSSV two times. Record the full-open and full-closed hydraulic control pressures.

t) Prepare the SCSSV for drift tests. Open the SCSSV.

1) Drift the interior of the SCSSV assembly with the manufacturer's specified drift bar. Pass the drift bar completely through the test valve.

2) Drift the exterior of wireline-retrievable SCSSVs with the manufacturer's specified drift sleeve. If the SCSSV fails the drift test, it fails the functional test.

3) Record the drift's unique identifiers and the nominal drift sizes.

u) Special features unique to a manufacturer's SCSSV shall be tested in accordance with the manufacturer's operating manual. Failure to meet the requirements of these tests fails the SCSSV. These tests can be incorporated in the existing sequence of functional tests. Such special-feature test procedures, the sequence and the results shall be fully described in the test report.

v) If the SCSSV performs within the limits of the functional test, it passes the functional test. Attach all recorded data to the manufacturer's test form. Certify the test with the appropriate manufacturer's approval signatures and dates.

7.22 SCSSV functional testing

7.22.1 Test facility

A typical test facility is shown in Figure C.8 and includes:

a) a test section installed vertically;

b) test section pressure measurement devices;

c) a pressurized-gas source;

d) flow meters;

e) a pressurized-water system;

f) a time-based recorder to record the required data simultaneously;

g) a drift sleeve.

7.22.2 Procedure for velocity-type SCSSVs

a) Record the serial number.
b) Place the SSCSV in a fixture capable of retaining and sealing the valve in a vertical position.

c) Initiate a flow against a minimum back-pressure of 0.35 MPa (50 psi).

d) Check the operation of the recorders for the flow rate, upstream pressure and downstream pressure.

e) Increase flow rate until the SSCSV closes.

f) Record the flow rate and the upstream and downstream pressures at the time of valve closure. If the closing rate and pressure differential are not within ±5 % of the manufacturer's specified values, the SSCSV fails the functional test.

g) Adjust and stabilize the pressure upstream of the SSCSV to 100 % ± 5 % of the rated working pressure.

h) Hold the upstream pressure for a minimum of 5 min and measure the leakage rate. If the leakage rate exceeds 10 cm³/min, the SSCSV fails the functional test.

i) Bleed the pressure from below the SSCSV to a value 0.7 MPa (100 psi) greater than the differential closing pressure.

j) Adjust the gas pressure to a value 1.4 MPa (200 psi) ± 5 % greater than the differential closing pressure.

k) Measure the gas leakage rate for 5 min. If the leakage rate exceeds 0.14 m³/min (5 scf/min), the SSCSV fails the functional test.

l) Bleed all pressures to zero.

m) Prepare the SSCSV for a drift test. Drift the exterior of a wireline-type SSCSV with the drift sleeve. If the SSCSV does not pass through the drift sleeve, it fails the functional test. Record the nominal size of the drift sleeve and the unique identifier.

n) If the SSCSV performs within the limits of the functional test, it has passed the functional test. Attach all recorded data to the manufacturer's test form. Certify the test with the appropriate manufacturer's approval signatures and dates.

7.22.3 Procedure for tubing-pressure-type SSCSVs

a) Record the serial number.

b) Place the SSCSV in a fixture capable of retaining and sealing the valve in a vertical position.

c) Adjust the flow rate in accordance with Table B.22.

d) Reduce the downstream pressure until the SSCSV closes.

e) Record the flow rate and downstream pressure at the time of valve closure. If the downstream pressure at closure is not within ±5 % of the manufacturer's specified pressure or 0.7 MPa (100 psi), whichever is larger, the SSCSV fails the functional test.

f) Bleed the downstream pressure to zero.

g) Adjust and stabilize the pressure upstream of the SSCSV to 100 % ± 5 % of the rated working pressure of the SSCSV.

h) Hold the upstream pressure for a minimum of 5 min and measure the leakage rate. If the leakage rate exceeds 10 cm³/min, the SSCSV fails the functional test.
i) Bleed the upstream pressure from the SSSV to a value 0,7 MPa (100 psi) greater than the closing pressure.

j) Adjust the upstream pressure with gas to a value 1,4 MPa (200 psi) ± 5 % greater than the closing pressure.

k) Measure the gas leakage rate for 5 min. If the leakage rate exceeds 0,14 m³/min (5 scf/min), the SSSV fails the functional test.

l) Bleed all pressures to zero.

m) Prepare the SSSV for a drift test. Drift the exterior of wireline-type SSSVs with a drift sleeve. If the SSSV does not pass through the drift sleeve, it fails the functional test.

n) If the SSSV performs within the limits of the functional test, it has passed the test. Attach all recorded data to the manufacturer's test form. Certify the test with the appropriate manufacturer's approval signatures and dates.

7.22.4 Functional testing of other types of SSSV

a) The apparatus and test procedure for a specific SSSV not included in previous subclauses shall be as specified by the manufacturer.

b) The manufacturer shall be responsible for assuring that the test procedures are not less stringent than those in this International Standard.

c) The manufacturer shall document the functional-test procedure and results.

7.23 Safety valve landing nipple (SVLN) testing

7.23.1 SVLN verification testing

a) The minimum test apparatus shall be a test facility capable of providing and recording pressures at the rated working pressure of the SVLN.

b) The manufacturer shall perform a body integrity pressure test on each size, type and model of SVLN at the rated working pressure of the SVLN in accordance with a documented test procedure.

c) Each SVLN that contains control fluid redirection feature(s) shall be bore pressure tested at the rated working pressure of the SVLN in each alternate position of the control fluid redirection feature(s). This may be performed on typical components provided the operating components tested are of the same design, dimensions and clearances as those of the production SVLN and made of equivalent material. During these bore pressure tests, the control line ports shall be monitored for leakage. If, during these tests, any leakage is detected from a control line port that is designated as isolated from the SVLN bore (as per the SVLN Operating Manual), the SVLN fails the test.

d) The manufacturer shall have on file drawings which show all the applicable dimensions and tolerances of parts contained in the verification-tested SVLN. Pre-test and post-test dimensional verification shall be conducted and documented by the manufacturer.

e) The manufacturer shall document the verification test procedures and results.

7.23.2 SVLN functional testing

a) Record the serial number.

b) Each SVLN shall be dimensionally inspected to ensure compliance with all design specifications and drawings.

c) Each SVLN that contains a control fluid redirection feature shall be functionally tested in accordance with the SVLN Operating Manual. As a minimum, this shall include a body integrity pressure test at the rated working pressure of the SVLN. Any leaks shall mean that the SVLN fails the test.
d) The manufacturer shall document the functional-test procedures and results.

7.24 Safety valve (SV) lock testing

7.24.1 SV lock verification testing

a) Each size, type and model of SV lock shall be installed in a landing nipple or test device and subjected to pressure from below equivalent to the rated working pressure of the SV lock.

b) The manufacturer shall have on file drawings which show all the applicable dimensions and tolerances of parts contained in the verification-tested SV lock. Pre-test and post-test dimensional verification shall be conducted and documented by the manufacturer.

c) The manufacturer shall document the verification test procedure and results.

7.24.2 SV lock functional testing

a) Record the serial number.

b) Each SV lock shall be dimensionally inspected to ensure compliance with all design specifications and drawings.

c) Each SV lock shall be installed in an SVLN or test device with the manufacturer’s specified running tool. Each SV lock shall be retrieved from the SVLN or test device using the manufacturer’s specified pulling tool. If the lock fails to set or retrieve, it fails the functional test.

d) The manufacturer shall document the functional-test procedure and results.

7.25 Verification test for seal materials

7.25.1 Test apparatus

a) Test mandrel:

1) O-rings — The test mandrel shall have an outside diameter no greater than the manufacturer’s minimum diameter of the equipment on which the O-ring will be used. The outside diameter of the O-ring groove shall be the minimum diameter specified. The mandrel shall be designed so that pressure can be applied between two O-rings.

2) Other packing — The test mandrel shall have an outside diameter equal to the manufacturer’s minimum diameter of the equipment on which the packing will be used. The mandrel shall be designed so that pressure can be applied between two sets of packing when the mandrel is placed inside the test nipple. The number of packing rings for each set tested shall be no greater than the number specified by the manufacturer for the equipment on which the packing will be used.

b) The test nipple shall have an inside diameter equal to the maximum diameter of the manufacturer’s equipment and a finish no finer than the manufacturer’s maximum specification for the equipment.

c) Test baths shall be designed to contain safely the fluids in which the seals are to be immersed and shall be capable of withstanding the test temperatures used.

7.25.2 Procedures

a) Pressure-differential test procedure:

1) Install the seals on the test mandrel and place in a test nipple, making sure the test bath fluid fills the void between the seals being tested.
2) Place mandrel and nipple in the test oil heated to the maximum temperature rating of the seals and leave for 3 h, maintaining the maximum temperature. The test oil used shall be a heat transfer oil or equivalent with an open-cup flash point of 260 °C (500 °F).

3) Apply pressure equal to 150 % of the maximum working pressure rating of the seals between the two sets of seals and hold for 10 min.

4) The maximum leakage shall be less than a pressure drop equal to 1 % of the test pressure in 10 min for each 500 cm³ of test chamber volume.

b) Growth test procedure:

1) Place four seals on the test mandrel and measure the outside diameter of the seals.

2) Immerse mandrel and seals in an appropriate test oil heated to the maximum rated temperature of the seals and leave for 2 h. The test oil for Class 1 and Class 2 service shall be No. 2 diesel oil with a closed-cup flash point of approximately 74 °C (165 °F). The test oil for Class 3S service shall be No. 2 diesel oil as above saturated with H₂S at 24 °C (75 °F) and 1,7 MPa (250 psi) (approximately 300 000 ppm H₂S).

3) Remove the test mandrel from the test bath and, immediately after removal, measure the outside diameter of the seals.

   i) The outside diameter of O-rings shall be limited to a 10 % increase in the cross-sectional diameter.

   ii) The outside diameter of other packings shall not exceed 2 % growth based on packing diameter per 38 °C (100 °F) above ambient temperature, and total growth shall not exceed 3,18 mm (0,125 in).

8 Identification, documentation and preparation for transport

8.1 Identification

SSSV equipment furnished to this International Standard shall be permanently identified as per the manufacturer’s written specifications. Identification shall include:

8.1.1 The manufacturer’s name or trademark.

8.1.2 The manufacturer’s size, type and model.

8.1.3 A unique identifying serial number.

8.1.4 The rated working pressure.

8.1.5 The date of original manufacture.

8.1.6 The class(es) of service designation.

Class of service designations listed below may be combined to indicate the complete class of service. For example, 234 indicates sandy, sulfide stress and chloride stress cracking and weight loss corrosion service.

1 — Standard service

2 — Sandy service

3 — Stress corrosion cracking service
3S — Sulfide stress cracking service.
3C — Chloride stress cracking service.
4 — Weight loss corrosion service.

8.1.7 Orifice beans for velocity-type SSSVs shall be identified by the orifice diameter.

8.2 Documentation

The content of the forms in Annex B is normative as a minimum data requirement for the documentation specified in this clause; however, the format of the forms is informative.

8.2.1 Supplied documentation

SSSVs, SV locks and multi-part SVLNs shall be delivered with a manufacturer’s shipping and receiving report and an operating manual. Table B.25 is a typical shipping and receiving report form for SSSVs. The manufacturer shall develop similar forms for SV locks and multi-part SVLNs.

8.2.2 Minimum contents of manufacturer’s operating manual

8.2.2.1 Size, type and model.
8.2.2.2 Class(es) of service.
8.2.2.3 Operating data:
a) working pressure;
b) temperature range;
c) internal yield pressure;
d) collapse pressure (applies to tubing-retrievable SSSV equipment at maximum rated temperature);
e) tensile load strength (applies to tubing-retrievable SSSV equipment at maximum rated temperature).
8.2.2.4 Dimensional data, including dimensions of drift bar and drift sleeve, if applicable.
8.2.2.5 Calculations:
a) SCSSVs — Calculation procedures used to determine maximum fail-safe setting depths, where applicable.
b) SSCSVs — Orifice coefficients, spring force, optimum operating range of pressure differential for velocity-type valves, etc.
8.2.2.6 Drawings and illustrations.
8.2.2.7 Parts list with all necessary information for reordering, including manufacturer’s contact information.
8.2.2.8 Specific details of functional testing should be included if the test apparatus or procedures are significantly different than those included in this International Standard.
8.2.2.9 Running instructions.
8.2.2.10 Pulling instructions.
8.2.2.11 Inspection and testing procedures.
8.2.2.12 Installation and operating procedures.
8.2.2.13 Troubleshooting and maintenance procedures.
8.2.2.14 Repair procedures and limitations.
8.2.2.15 Assembly and disassembly instructions and limitations.
8.2.2.16 Operating requirements:
   a) SCSSVs:
      1) opening and closing procedures with opening and closing pressures;
      2) equalizing procedure including maximum allowable opening-pressure differential.
   b) SSCSVs:
      1) opening or equalization procedures;
      2) optimum conditions to avoid nuisance closures and throttling.
8.2.2.17 Storage recommendations.
8.2.3 Retained documentation
8.2.3.1 The verification test file for the SSSV equipment and seals shall be retained as per 7.2.3 g).
8.2.3.2 Quality control documentation shall be retained as per 6.2.
8.2.3.3 For a period of five years after the date of sale of the SSSV equipment, the manufacturer shall retain and have available for inspection by the operator the documentation listed below:
   a) one complete set of drawings and written specifications, standards and procedures;
   b) the manufacturing quality control reports;
   c) the operators' equipment failure reports and records of corrective action;
   d) the functional-test files;
   e) copies of mill and other test reports.
8.3 Preparation for transport
8.3.1 SSSV equipment shall be packaged to prevent damage due to vibration and shock while in transit.
8.3.2 Sealing surfaces and external exposed threads shall be protected. All control line ports shall be protected to prevent entry of foreign material.
8.3.3 Temporary plugs, seals and protectors shall be clearly identified.
9 Failure reporting and analysis

Manufacturers providing SSSV equipment in accordance with this International Standard shall make an analysis of failure reports submitted by operator(s) (see recommendation in Annex D). The manufacturer shall provide the operator(s) with a written report on progress of the analysis within six weeks of receipt of a written failure report. The manufacturer shall notify the operator(s) in writing of the final results of the failure analysis and of the corrective action taken. The manufacturer's final report shall include, as a minimum, the information contained in Table D.1. The manufacturer shall make necessary design changes that result from the failure analysis on all affected SSSV equipment. Design changes requiring equipment requalification and resulting from a failure history shall be communicated, within 30 days after the design change, by the manufacturer to the operator(s) having the failures of the SSSV equipment and all operator(s) having SSSV equipment with similar potential problems.
## Annex A
(informative)

### Informative tables

Table A.1 — Typical safety valve landing nipples (see 4.4.7)

<table>
<thead>
<tr>
<th>Nominal nipple size $^A$</th>
<th>Tubing or casing size $^B$</th>
<th>ID</th>
<th>Tolerance $^C$</th>
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<td>mm</td>
<td>in</td>
<td>mm</td>
<td>mm</td>
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<td>7</td>
</tr>
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</table>

$^A$ Only sealing-surface ID is specified in this table, and only typical-size landing-nipple dimensions are shown.

$^B$ ISO 11960 tubing or casing outside diameters on which the nipples are to be run.

$^C$ O-ring applications require reduced tolerance to $+0.13$ mm/$-0.00$ mm ($+0.005$ in/$-0.000$ in).
Table A.2 — Typical outside diameters of wireline-retrievable subsurface safety valves (see 4.4.7)

<table>
<thead>
<tr>
<th>Nominal SSSV size</th>
<th>Standard valve OD\textsuperscript{A}</th>
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<td>63.5</td>
<td>2 1/2</td>
</tr>
<tr>
<td>76.2</td>
<td>3</td>
</tr>
<tr>
<td>88.9</td>
<td>3 1/2</td>
</tr>
<tr>
<td>101.6</td>
<td>4</td>
</tr>
<tr>
<td>114.3</td>
<td>4 1/2</td>
</tr>
<tr>
<td>127.0</td>
<td>5</td>
</tr>
<tr>
<td>152.4</td>
<td>6</td>
</tr>
</tbody>
</table>

\textsuperscript{A} OD tolerances shall be +0.00 mm/−2.54 mm (+0.000 in/−0.100 in).
### Annex B
(normative)
**Documentation/reference tables**

#### Table B.1 — Verification test documentation (see 7.2.3)

<table>
<thead>
<tr>
<th>Test agency</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address</td>
<td>Representative</td>
</tr>
<tr>
<td>Address</td>
<td>Telephone</td>
</tr>
<tr>
<td>Date: Month Day Year</td>
<td>Official qualification test</td>
</tr>
<tr>
<td>Requalification date (month/day/year)</td>
<td></td>
</tr>
</tbody>
</table>

**Valve to be tested:**
- Type: SCSSV _____ SSCSV _____
- Model _____ Serial number _____
- Rated working pressure _____ Nominal tubing size _____
- Test section length _____
- For SCSSV:
  - Minimum specified ID _____
  - Maximum hydraulic control line pressure _____ greater than valve bore pressure
  - Maximum unequalized opening pressure _____

**For SSCSVs:**
- Velocity _____
- Design closing rate _____ Pressure _____
- Tubing pressure: Design closing pressure _____

**Procedure required:**
- ISO 10432 procedure clause _____ Class 1 _____ Class 2 _____
- Non-specified equipment or procedures required for testing _____

---

**TEST AGENCY USE ONLY**

Testing schedule _____ Location _____ month/day/year

Applicant notified _____ month/day/year
### Table B.2 — SCSSV gas flow test (see 7.6)

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Test No. 1</th>
<th>Test No. 2</th>
<th>Test No. 3</th>
<th>Test No. 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic opening pressure at zero bore pressure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydraulic closing pressure at zero bore pressure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydraulic opening pressure at 13.8 MPa to 17.3 MPa (2000 psi to 2500 psi) bore pressure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Closure data:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas flow rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full-closed hydraulic control pressure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time to close</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Nitrogen leakage data:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test pressure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leakage rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body joint leakage detected? (tubing-retrievable only)</td>
<td>Yes  No</td>
<td>Yes  No</td>
<td>Yes  No</td>
<td>Yes  No</td>
</tr>
<tr>
<td>Test passed?</td>
<td>Yes  No</td>
<td>Yes  No</td>
<td>Yes  No</td>
<td>Yes  No</td>
</tr>
</tbody>
</table>

Conducted by (signature) ____________________________________________ Date ____________________________

(month/day/year)
### Table B.3 — SCSSV gas flow rates (see 7.6)\(^a\)

<table>
<thead>
<tr>
<th>Nominal tubing or casing size</th>
<th>Gas flow rate and control line resistances for each valve closure test</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low resistance</td>
<td>High resistance</td>
</tr>
<tr>
<td></td>
<td>Test No. 1 Flow rate (\text{m}^3/\text{d} \times 10^6) (scf/d \times 10^6)</td>
<td>Test No. 2 Flow rate (\text{m}^3/\text{d} \times 10^6) (scf/d \times 10^6)</td>
</tr>
<tr>
<td>mm (in)</td>
<td>Flow rate (\text{m}^3/\text{d} \times 10^6)</td>
<td>Flow rate (\text{m}^3/\text{d} \times 10^6)</td>
</tr>
<tr>
<td>60.3 (2 3/8)</td>
<td>0.14 (5.1)</td>
<td>0.22 (7.7)</td>
</tr>
<tr>
<td>73.0 (2 7/8)</td>
<td>0.23 (8.0)</td>
<td>0.34 (12.0)</td>
</tr>
<tr>
<td>88.9 (3 1/2)</td>
<td>0.33 (11.5)</td>
<td>0.49 (17.3)</td>
</tr>
<tr>
<td>101.6 (4)</td>
<td>0.44 (15.7)</td>
<td>0.67 (23.6)</td>
</tr>
<tr>
<td>114.3 (4 1/2)</td>
<td>0.58 (20.5)</td>
<td>0.87 (30.8)</td>
</tr>
<tr>
<td>127.0 (5)</td>
<td>0.73 (25.9)</td>
<td>1.10 (38.9)</td>
</tr>
<tr>
<td>139.7 (5 1/2)</td>
<td>0.91 (32.0)</td>
<td>1.36 (48.0)</td>
</tr>
<tr>
<td>165.1 (6 1/2)</td>
<td>1.30 (46.1)</td>
<td>1.96 (69.2)</td>
</tr>
<tr>
<td>177.8 (7)</td>
<td>1.79 (63.1)</td>
<td>2.68 (94.7)</td>
</tr>
</tbody>
</table>

\(^a\) See 7.6.1 and 7.6.2 for information on the basis of this table, and requirements for its application.
Table B.4 — Drift test (see 7.7)

Test report No. __________

Internal drift information:
- Minimum inside diameter of test valve ______________
- Drift outside diameter ______________
- Drift length ______________
- Unique identifier of drift bar ______________

<table>
<thead>
<tr>
<th></th>
<th>Step 7.5.3 (Class 1 drift test)</th>
<th>Step 7.5.23 (Class 2 drift test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date of test</td>
<td>_______________________________</td>
<td>_______________________________</td>
</tr>
<tr>
<td>Full-open</td>
<td>_______________________________</td>
<td>_______________________________</td>
</tr>
<tr>
<td>hydraulic control</td>
<td>pressure</td>
<td>pressure</td>
</tr>
<tr>
<td>Full-closed</td>
<td>_______________________________</td>
<td>_______________________________</td>
</tr>
<tr>
<td>hydraulic control</td>
<td>pressure</td>
<td>pressure</td>
</tr>
<tr>
<td>Full-open</td>
<td>_______________________________</td>
<td>_______________________________</td>
</tr>
<tr>
<td>hydraulic control</td>
<td>pressure</td>
<td>pressure</td>
</tr>
<tr>
<td>Full-closed</td>
<td>_______________________________</td>
<td>_______________________________</td>
</tr>
<tr>
<td>hydraulic control</td>
<td>pressure</td>
<td>pressure</td>
</tr>
<tr>
<td>Drift pass?</td>
<td>Yes ___ No ___</td>
<td>Yes ___ No ___</td>
</tr>
<tr>
<td>Conducted by (signature)</td>
<td>_______________________________</td>
<td>Date ___________________</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(month/day/year)</td>
</tr>
<tr>
<td>Test report No.</td>
<td>Test stand No.</td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>---------------</td>
<td></td>
</tr>
<tr>
<td>Date (month/day/year)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test start time Test stop time

Open and close at zero valve bore pressure:

Full-open hydraulic control pressure

Full-closed hydraulic control pressure

Conducted by (signature) Date (month/day/year)
<table>
<thead>
<tr>
<th>Step 7.5.7 (Class 1)</th>
<th>Step 7.5.15 (Class 1)</th>
<th>Step 7.5.22 (Class 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date of test (month/day/year)</td>
<td>Date of test (month/day/year)</td>
<td>Date of test (month/day/year)</td>
</tr>
<tr>
<td>Valve bore test pressure (nominal 100 % rated working pressure)</td>
<td>Valve bore test pressure (nominal 100 % rated working pressure)</td>
<td>Valve bore test pressure (nominal 100 % rated working pressure)</td>
</tr>
<tr>
<td>Time at which test pressure applied</td>
<td>Time at which test pressure applied</td>
<td>Time at which test pressure applied</td>
</tr>
<tr>
<td>Time at start of leakage test</td>
<td>Time at start of leakage test</td>
<td>Time at start of leakage test</td>
</tr>
<tr>
<td>Time at end of leakage test</td>
<td>Time at end of leakage test</td>
<td>Time at end of leakage test</td>
</tr>
<tr>
<td>Average leakage rate at test pressure (100 % rated working pressure)</td>
<td>Average leakage rate at test pressure (100 % rated working pressure)</td>
<td>Average leakage rate at test pressure (100 % rated working pressure)</td>
</tr>
<tr>
<td>Body joint leakage detected? Yes ___ No ___</td>
<td>Body joint leakage detected? Yes ___ No ___</td>
<td>Body joint leakage detected? Yes ___ No ___</td>
</tr>
<tr>
<td>Test passed? Yes ___ No ___</td>
<td>Test passed? Yes ___ No ___</td>
<td>Test passed? Yes ___ No ___</td>
</tr>
<tr>
<td>Conducted by (signature) __________________________ Date __________________________ (month/day/year)</td>
<td>Conducted by (signature) __________________________ Date __________________________ (month/day/year)</td>
<td>Conducted by (signature) __________________________ Date __________________________ (month/day/year)</td>
</tr>
<tr>
<td>Test report No.</td>
<td>Test stand No.</td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>---------------</td>
<td></td>
</tr>
<tr>
<td>Date: Month</td>
<td>Day Year</td>
<td></td>
</tr>
<tr>
<td>Test start time</td>
<td>Test completion time</td>
<td></td>
</tr>
<tr>
<td>Rated working pressure of test valve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valve bore upstream test pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Manufacturer's maximum recommended unequalized opening pressure)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equalizing test pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full-open hydraulic control pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conducted by (signature)</td>
<td>Date (month/day/year)</td>
<td></td>
</tr>
</tbody>
</table>
Test report No. __________

CHECK APPROPRIATE TEST CONDITION

<table>
<thead>
<tr>
<th>Step</th>
<th>7.5.9</th>
<th>7.5.12</th>
<th>7.5.14</th>
<th>7.5.14</th>
<th>7.5.14</th>
<th>7.5.19</th>
<th>7.5.21</th>
<th>7.5.21</th>
<th>7.5.21</th>
<th>7.5.21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cycle 1</td>
<td></td>
<td></td>
<td></td>
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<td>Cycle 2</td>
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<tr>
<td>Cycle 3</td>
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<tr>
<td>Cycle 4</td>
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<td>Cycle 6</td>
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<tr>
<td>Cycle 2</td>
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<td></td>
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</tr>
<tr>
<td>Cycle 3</td>
<td></td>
<td></td>
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<td></td>
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<td>Cycle 4</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cycle 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Cycle 6</td>
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<td></td>
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</tr>
<tr>
<td>Cycle 7</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Date of test (month/day/year)

Hydraulic control system pressure

**Repetition 1**

Full-closed hydraulic control pressure

Full-open hydraulic control pressure

**Repetition 2**

Full-closed hydraulic control pressure

Full-open hydraulic control pressure

**Repetition 3**

Full-closed hydraulic control pressure

Full-open hydraulic control pressure

**Repetition 4**

Full-closed hydraulic control pressure

Full-open hydraulic control pressure

**Repetition 5**

Full-closed hydraulic control pressure

Full-open hydraulic control pressure

**Average* hydraulic control pressure**

Full-closed:

+ 10 %

− 10 %

Full-open:

+ 10 %

− 10 %

Body joint leakage? (Yes or No)

(Tubing-retrievable only)

* The five individual closing and opening pressures shall each repeat within ±10 % or ±0.7 MPa (100 psi) of the average, whichever is greater.

Test passed? (Yes or No)

Conducted by (signature) __________________________ Date ________________ (month/day/year)

**Table B.8 — Operating-pressure test (see 7.10)**

44
Table B.9 — Propane test (see 7.11)

Test report No. _______ Date (month/day/year) ____________________________
Test stand No. _______

Open/close cycles at zero test valve bore pressure:

<table>
<thead>
<tr>
<th>No.</th>
<th>Full-closed hydraulic control pressure</th>
<th>Full-open hydraulic control pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Average full-closed control pressure for three closures just completed:

+10% ___________ -10% ___________

Average full-open control pressure for three openings just completed:

+10% ___________ -10% ___________

Open/close cycles at 2,8 MPa (400 psi) test valve nominal bore pressure:

Valve bore pressure at start of open/close cycling ______________________

<table>
<thead>
<tr>
<th>No.</th>
<th>Time at valve closure</th>
<th>Full-closed hydraulic control pressure</th>
<th>Time at valve opening</th>
<th>Full-open hydraulic control pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Average full-closed control pressure for 3 closures just completed:

+10% ___________ -10% ___________

Average full-open control pressure for 3 openings just completed:

+10% ___________ -10% ___________

Propane soak period:
Time at start of 2 h soak period ______________________
Time at end of 2 h soak period ______________________
Valve bore pressure at end of 2 h soak period _________

Final valve closure during propane test:
Full-closed hydraulic control pressure after last closure ______________________

Test passed? Yes ___ No____

* The three closings and openings shall repeat within ± 10 % or ± 0.7 MPa (100 psi) of the average, whichever is greater.
# Test report No. ______

## Test stand No. ______

<table>
<thead>
<tr>
<th>Step</th>
<th>Step</th>
<th>Step</th>
<th>Step</th>
<th>Step</th>
<th>Step</th>
<th>Step</th>
<th>Step</th>
<th>Step</th>
<th>Step</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.5.11</td>
<td>7.5.14</td>
<td>7.5.14</td>
<td>7.5.14</td>
<td>7.5.14</td>
<td>7.5.18</td>
<td>7.5.21</td>
<td>7.5.21</td>
<td>7.5.21</td>
<td>7.5.21</td>
</tr>
<tr>
<td>Cycle 1</td>
<td>Cycle 2</td>
<td>Cycle 3</td>
<td>Cycle 4</td>
<td>Cycle 5</td>
<td>Cycle 1</td>
<td>Cycle 2</td>
<td>Cycle 3</td>
<td>Cycle 4</td>
<td>Cycle 5</td>
</tr>
</tbody>
</table>

Enter the following test valve parameters:

- **Date of test (month/day/year)**
- **Valve bore test pressure**
  - 1.33 MPa to 1.47 MPa (190 psi to 210 psi)
- **Time at start of waiting period**
- **Time at completion of waiting period**
- **Measured gas leakage rate**
  - 0.14 m³/min (5 scf/min) max. allowable
  - Body joint leakage? (Yes or No)
  - (Tubing-retrievable only)

**Valve bore test pressure**

(20 % to 30 % RWP)

- **Time at start of waiting period**
- **Time at completion of waiting period**
- **Measured gas leakage rate**
  - 0.14 m³/min (5 scf/min) max. allowable
  - Body joint leakage? (Yes or No)
  - (Tubing-retrievable only)

- **Test passed? (Yes or No)**

Conducted by (signature) __________________________ Date __________________________ (month/day/year)

---

**Table B.10 — SCSSV nitrogen leakage test data summary (see 7.12)**
Table B.11 — SCSSV Class 1 flow test data summary (see 7.13)

<table>
<thead>
<tr>
<th>Test report No.</th>
<th>Test stand No.</th>
<th>Date of test (month/day/year)</th>
<th>Time at start of circulation through valve at test rate No. 1</th>
<th>Time at valve closure (against test rate No. 1)</th>
<th>Closure data for test rate No. 1:</th>
<th>Water flow rate</th>
<th>Full-closed hydraulic control pressure</th>
<th>Time to close</th>
<th>Full-open hydraulic control pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 7.5.13</td>
<td>Step 7.5.14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cycle 1</td>
<td>Cycle 2</td>
<td>Cycle 3</td>
<td>Cycle 4</td>
<td>Cycle 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time at start of circulation through valve at test rate No. 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time at valve closure (against test rate No. 2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Closure data for test rate No. 2:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water flow rate</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full-closed hydraulic control pressure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time to close</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full-open hydraulic control pressure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test passed? (Yes or No)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Conducted by (signature) ________________________________  Date ________________________________ (month/day/year)
Table B.12 — SCSSV liquid flow rates (see 7.13 and 7.15)

<table>
<thead>
<tr>
<th>Nominal tubing or casing size (mm (in))</th>
<th>Circulation rate m³/d (B/D) (± 10 %)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Class 1</td>
</tr>
<tr>
<td></td>
<td>Test rate No. 1</td>
</tr>
<tr>
<td>60.3 (2 3/8)</td>
<td>79 (500)</td>
</tr>
<tr>
<td>73.0 (2 7/8)</td>
<td>124 (780)</td>
</tr>
<tr>
<td>88.9 (3 1/2)</td>
<td>178 (1120)</td>
</tr>
<tr>
<td>101.6 (4)</td>
<td>238 (1500)</td>
</tr>
<tr>
<td>114.3 (4 1/2)</td>
<td>305 (1920)</td>
</tr>
<tr>
<td>127.0 (5)</td>
<td>386 (2430)</td>
</tr>
<tr>
<td>139.7 (5 1/2)</td>
<td>477 (3000)</td>
</tr>
<tr>
<td>165.1 (6 1/2)</td>
<td>686 (4320)</td>
</tr>
<tr>
<td>177.8 (7)</td>
<td>935 (5880)</td>
</tr>
</tbody>
</table>

The manufacturer establishing sizes not covered by this table may interpolate or extrapolate, assuming the circulation rate depends on the square of the nominal size.
Test report No. __________  Date (month/day/year) ____________________________  Test stand No. __________

CHECK APPROPRIATE TEST CONDITION:

______ 20 % to 30 % of rated working pressure (RWP): __________ to __________

______ 70 % to 80 % of rated working pressure (RWP): __________ to __________

CHECK APPROPRIATE TEST CONDITION:

______ 35 °C to 41 °C (95 °F to 105 °F)

______ 79 °C to 85 °C (175 °F to 185 °F)

Open/close cycles at specified valve temperature and pressure:

Test temperature ________  Valve bore pressure _______

<table>
<thead>
<tr>
<th>Cycle 1</th>
<th>Cycle 2</th>
<th>Cycle 3</th>
<th>Cycle 4</th>
<th>Cycle 5</th>
<th>Cycle 6</th>
<th>Cycle 7</th>
<th>Cycle 8</th>
<th>Cycle 9</th>
<th>Cycle 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>_______</td>
<td>_______</td>
<td>_______</td>
<td>_______</td>
<td>_______</td>
<td>_______</td>
<td>_______</td>
<td>_______</td>
<td>_______</td>
<td>_______</td>
</tr>
</tbody>
</table>

Full-open hydraulic control pressure

Full-closed hydraulic control pressure

Was body joint leakage detected (tubing-retrievable only)?  Yes ____  No ___

Average full-open hydraulic control line pressure for 10 open/close cycles: +10 % ______  −10 % ______

Average full-closed hydraulic control line pressure for 10 open/close cycles: +10 % ______  −10 % ______

Control line leakage test at specified valve temperature and pressure:

3 minute waiting period prior to control line leakage test:  Start time ______  Stop time ______

5 minute observation period for control line leakage test:  Start time ______  Stop time ______  Leak detected?:  Yes ____  No ___

Was body joint leakage detected (tubing-retrievable only)?  Yes ____  No ___

Closure mechanism leakage test at the specified valve temperature and pressure below closure mechanism:

Test temperature _______

Time at which bore pressure above the closure mechanism is bled to zero pressure: _______

Valve bore pressure below the closure mechanism: _______

1 minute waiting period prior to the closure mechanism leakage test:  Start time ______  Stop time ______  Leakage rate ______

Test passed?  Yes ____  No ___

* The individual opening and closing pressures shall each repeat within ± 10 % or ± 0.7 MPa (100 psi) of the average, whichever is greater.

Conducted by (signature) ________________________________  Date __________________________

(month/day/year)

Table B.13 — Controlled-temperature test (see 7.14)
Table B.14 — Opening-pressure repeatability test (see test step 7.5.17)

Test report No. _______  Date (month/day/year) ___________ ________________

Test stand No. _______

Hydraulic control pressures measured during test step 7.5.17 of Class 1 test:

<table>
<thead>
<tr>
<th>Test Step</th>
<th>Full-open Hydraulic Control Pressure</th>
<th>Full-closed Hydraulic Control Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.5.17</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Conducted by (signature) ____________________________  Date ____________________________

(month/day/year)
<table>
<thead>
<tr>
<th>Test report No.</th>
<th>Test stand No.</th>
<th>Step 7.5.20</th>
<th>Step 7.5.21</th>
<th>Step 7.5.21</th>
<th>Step 7.5.21</th>
<th>Step 7.5.21</th>
<th>Step 7.5.21</th>
<th>Step 7.5.21</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Cycle 1</td>
<td>Cycle 2</td>
<td>Cycle 3</td>
<td>Cycle 4</td>
<td>Cycle 5</td>
<td>Cycle 6</td>
<td>Cycle 7</td>
</tr>
<tr>
<td>Date of test (month/day/year)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time at start of slurry circulation through valve</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flow rate at start of circulation period</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand concentration at start of circulation period (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slurry viscosity at start of circulation period</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time at valve closure (against slurry flow)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Closure data:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slurry flow rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full-closed hydraulic control pressure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time to close</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand concentration at completion of circulation period (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slurry viscosity at completion of circulation period</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test passed? (Yes or No)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Conducted by (signature) ____________________________ Date ____________________________
(month/day/year)

Table B.15 — SCSSV Class 2 flow test data summary (see 7.15)
### Table B.16 — Verification test summary [see 7.2.3(a)(3) and 7.16.15]

<table>
<thead>
<tr>
<th>Test agency</th>
<th>Test report No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test start date (month/day/year)</td>
<td></td>
</tr>
<tr>
<td>Test completion date (month/day/year)</td>
<td></td>
</tr>
<tr>
<td>Date (month/day/year)</td>
<td></td>
</tr>
</tbody>
</table>

**Manufacturer**

**Model No.**

**Serial number**

**Nominal tubing size**

**Rated working pressure**

**SERVICE CLASS TESTED**

**CLASS PASSED**

1: ____ 2: ____

If valve failed the test:

**Step at which failure occurred**

**Reason for failure**

**Remarks** (describe any non-specified equipment or procedures requested by valve manufacturer, unusual conditions observed during test, etc.):

---

**Test report approved by**

(Test agency approval authority)  **Date** (month/day/year)
Table B.17 — SSSCV gas closure test (see 7.17)

<table>
<thead>
<tr>
<th>Test report No.</th>
<th>Test stand No.</th>
<th>Test start time</th>
<th>Test completion time</th>
<th>Date (month/day/year)</th>
</tr>
</thead>
</table>

For velocity-type SSSCVs:

- Initial test valve upstream pressure
- Closing flow rate (gas)
- Differential closing pressure
- Maximum closing rate: design closing rate (gas) + 25%
- Minimum closing rate: design closing rate (gas) – 25%

For tubing-pressure-type SSSCVs:

- Initial test valve downstream pressure
- Downstream closing pressure
- Design closing pressure
- Maximum closing rate: design closing rate (gas) + 25%
- Minimum closing rate: design closing rate (gas) – 25%

Nitrogen leakage data:

- Test valve bore pressure
- Leakage rate

Test passed? Yes ___ No ___

Conducted by (signature) ___________________ Date __________________ (month/day/year)
Table B.18 — Liquid closure test (see 7.18)

<table>
<thead>
<tr>
<th>Test report No.</th>
<th>Test stand No.</th>
<th>Test start time</th>
<th>Test completion time</th>
<th>Date (month/day/year)</th>
</tr>
</thead>
</table>

**For velocity-type SSCSVs:**

- Initial test valve downstream pressure
- Closing flow rate (water)
- Differential closing pressure
- Design closing flow rate (liquid)
- Maximum closing rate: design closing rate (liquid) + 25 %
- Minimum closing rate: design closing rate (liquid) – 25 %

**For low-tubing-pressure-type SSCSVs:**

- Initial test valve downstream pressure
- Downstream closing pressure
- Maximum closing rate: design closing rate (liquid) + 25 %
- Minimum closing rate: design closing rate (liquid) – 25 %

Test passed? Yes ___ No ___

Conducted by (signature) ___________________________ Date ___________________________ (month/day/year)
### Table B.19 — Propane SSCSV test (see 7.16.5)

<table>
<thead>
<tr>
<th>Test report No.</th>
<th>Test stand No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propane soak period:</td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td></td>
</tr>
<tr>
<td>2 h soak period: Start</td>
<td>Stop</td>
</tr>
<tr>
<td>Valve bore pressure at end of 2 h soak period</td>
<td></td>
</tr>
</tbody>
</table>

**Closure after propane soak:**

<table>
<thead>
<tr>
<th>Test start time</th>
<th>Test completion time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date (month/day/year)</td>
<td></td>
</tr>
</tbody>
</table>

**For velocity-type SSCSVs:**

- **Initial test valve downstream pressure**
- **Closing flow rate (water)**
  - + 15 % of Table B.18 “cycle value”
  - −15 % of Table B.18 “cycle value”
- **Differential closing pressure**

**For low-tubing-pressure-type SSCSVs:**

- **Initial test valve downstream pressure**
- **Downstream closing pressure**
  - + 15 % of Table B.18 “cycle value”
  - −15 % of Table B.18 “cycle value”

**Test passed?** Yes ___ No ___

Conducted by (signature) ___________________________ Date ___________________________ (month/day/year)
Enter the following test valve parameters:

<table>
<thead>
<tr>
<th>Date of test</th>
<th>___________________________________________________________________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>(month/day/year)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Valve bore test pressure</th>
<th>___________________________________________________________________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.3 bar to 14.7 bar (190 psi to 210 psi)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time at start of waiting period</th>
<th>___________________________________________________________________________</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Time at completion of waiting period</th>
<th>_______________________________________________________________________</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Measured gas leakage rate</th>
<th>___________________________________________________________________</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Valve bore test pressure (20 % to 30 % RWP)</th>
<th>__________________________________________________________________</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Time at start of waiting period</th>
<th>___________________________________________________________________</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Time at completion of waiting period</th>
<th>___________________________________________________________________</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Measured gas leakage rate</th>
<th>___________________________________________________________________</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Test passed? (Yes or No)</th>
<th>___________________________________________________________________</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Conducted by (signature)</th>
<th>___________________________________________________________________</th>
</tr>
</thead>
</table>

Table B.20 — SCSV nitrogen leakage test data summary (see 7.16)
Test report No. __________ Test stand No. __________

For velocity-type SCSVs: +15% __________, −15% __________ of closing flow rate from Table B.18

For low-tubing-pressure-type SCSVs: +15% __________, −15% __________ of closing pressure from Table B.18

<table>
<thead>
<tr>
<th>Step</th>
<th>Step</th>
<th>Step</th>
<th>Step</th>
<th>Step</th>
<th>Step</th>
<th>Step</th>
<th>Step</th>
<th>Step</th>
<th>Step</th>
<th>Step</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cycle 1</td>
<td>Cycle 2</td>
<td>Cycle 3</td>
<td>Cycle 4</td>
<td>Cycle 5</td>
<td>Cycle 6</td>
<td>Cycle 7</td>
<td>Cycle 8</td>
<td>Cycle 9</td>
<td>Cycle 10</td>
<td>Cycle 11</td>
</tr>
<tr>
<td>7.16.7</td>
<td>7.16.8</td>
<td>7.16.8</td>
<td>7.16.8</td>
<td>7.16.8</td>
<td>7.16.8</td>
<td>7.16.8</td>
<td>7.16.8</td>
<td>7.16.8</td>
<td>7.16.8</td>
<td>7.16.8</td>
</tr>
<tr>
<td>Cycle 12</td>
<td>Cycle 13</td>
<td>Cycle 14</td>
<td>Cycle 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.16.8</td>
<td>7.16.8</td>
<td>7.16.8</td>
<td>7.16.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Date of test (month/day/year) __________ __________ __________

Time at start of circulation through valve __________ __________ __________ __________ __________ __________ __________ __________

Flow rate at start of circulation period __________ __________ __________ __________ __________ __________ __________ __________

Time at valve closure __________ __________ __________ __________ __________ __________ __________ __________

For velocity-type SCSVs:

Initial downstream pressure __________ __________ __________ __________ __________ __________ __________

Water flow rate at closure __________ __________ __________ __________ __________ __________ __________

Differential pressure across valve at closure __________ __________ __________ __________ __________ __________ __________

For low-tubing-pressure-type SCSVs:

Initial downstream pressure __________ __________ __________ __________ __________ __________ __________

Downstream pressure at closure __________ __________ __________ __________ __________ __________ __________

Test passed? (Yes or No) __________

Conducted by (signature) __________ Date __________ (month/day/year)

Table B.21 — SCSV Class 1 flow test data summary (see 7.19)
<table>
<thead>
<tr>
<th>Nominal tubing or casing size</th>
<th>Circulation rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>m³/d (B/D)</td>
</tr>
<tr>
<td></td>
<td>(±10 %)</td>
</tr>
<tr>
<td></td>
<td>Class 1 and Class 2</td>
</tr>
<tr>
<td>mm (in)</td>
<td></td>
</tr>
<tr>
<td>60,3 (2 3/8)</td>
<td>79 (500)</td>
</tr>
<tr>
<td>73,0 (2 7/8)</td>
<td>124 (780)</td>
</tr>
<tr>
<td>88,9 (3 1/2)</td>
<td>178 (1120)</td>
</tr>
<tr>
<td>101,6 (4)</td>
<td>238 (1500)</td>
</tr>
<tr>
<td>114,3 (4 1/2)</td>
<td>305 (1920)</td>
</tr>
<tr>
<td>127,0 (5)</td>
<td>386 (2430)</td>
</tr>
<tr>
<td>139,7 (5 1/2)</td>
<td>477 (3000)</td>
</tr>
<tr>
<td>165,1 (6 1/2)</td>
<td>687 (4320)</td>
</tr>
<tr>
<td>177,8 (7)</td>
<td>935 (5880)</td>
</tr>
</tbody>
</table>

The manufacturer establishing sizes not covered by this specification may interpolate or extrapolate, assuming the circulation rate depends on the square of the nominal size.
<table>
<thead>
<tr>
<th>Test report No.</th>
<th>Test stand No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ 15% ____, - 15% _____ of closing flow rate from Table B.18</td>
<td></td>
</tr>
<tr>
<td>+ 15% ____, - 15% _____ of closing pressure from Table B.18</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 7.16.11</th>
<th>Step 7.16.12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cycle 1</td>
<td>Cycle 2</td>
</tr>
<tr>
<td>Step 7.16.12</td>
<td>Step 7.16.12</td>
</tr>
<tr>
<td>Cycle 3</td>
<td>Cycle 4</td>
</tr>
<tr>
<td>Step 7.16.12</td>
<td>Step 7.16.12</td>
</tr>
<tr>
<td>Cycle 5</td>
<td>Cycle 6</td>
</tr>
<tr>
<td>Step 7.16.12</td>
<td>Cycle 7</td>
</tr>
</tbody>
</table>

Date of test (month/day/year)  

Time at start of slurry circulation through valve  
Flow rate at start of circulation period  
Sand concentration at start of circulation period (%)  
Slurry viscosity at start of circulation period (Marsh seconds)  
Time at valve closure (against slurry flow)  

For velocity-type SCSVs:  
Initial downstream pressure  
Slurry flow rate at closure  
Differential pressure across valve at closure  

For low-tubing-pressure-type SCSVs:  
Initial downstream pressure  
Downstream pressure at closure  
Sand concentration at completion (%)  
Slurry viscosity at completion of circulation period  
Test passed? (Yes or No)  

Conducted by (signature)  
Date (month/day/year)  

Table B.23 — SCSV Class 2 flow test data summary (see 7.20)
Table B.24 — Functional test documentation [see 7.3.4, 7.21.2 (v), 7.22.2 (n), 7.22.3 (n)]

<table>
<thead>
<tr>
<th>Valve manufacturer</th>
<th>SSSV type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Equipment name</th>
<th>SSSV catalogue or model No.</th>
<th>Serial No.</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Safety valve lock</th>
<th>Serial No.</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Working-pressure rating</th>
<th>Temperature rating, min.</th>
<th>Temperature rating, max.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Tubing-retrievable only:</th>
<th>Internal yield pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tubing-retrievable only:</th>
<th>Collapse pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tubing-retrievable only:</th>
<th>Tensile load strength</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Verification test certification No.</th>
<th>Date (month/day/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Class of service</th>
<th>Test date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Attach functional test record.

Performed by (signature) | Date (month/day/year)
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(month/day/year)</td>
</tr>
</tbody>
</table>
## Table B.25 — Subsurface safety valve equipment — Typical shipping and receiving report
(minimum data requirement) (see 8.2)

### Manufacturer data:

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Equipment name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Catalogue or model No.</th>
<th>Equipment name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial No.</td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>Class of service</td>
</tr>
</tbody>
</table>

### SSSV data:

<table>
<thead>
<tr>
<th>Pressure rating</th>
<th>Temperature rating, max.</th>
<th>Temperature rating, min.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Verification test agency</th>
<th>Tested to standard ISO 10432, Edition</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Date of report</th>
<th>Test report No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(month/day/year)</td>
<td></td>
</tr>
</tbody>
</table>

### SSSV function test summary:

**A) SCSSV**

1. Opening pressure with "0" pressure in test section
2. Closing pressure with "0" pressure in test section
3. Performed by ________________  
   Date ______________________

**B) SSSCV (velocity type)**

1. Closing flow rates
2. Orifice (bean size)
3. Number and length of spacers
4. Spring rate
5. Performed by ________________  
   Date ______________________

**C) SSSCV (low-tubing-pressure type)**

1. Downstream pressure at closure
2. Performed by ________________  
   Date ______________________

**D) SSCSV (other type)**

1. Performed by ________________  
   Date ______________________

### Operator data:

<table>
<thead>
<tr>
<th>Date received</th>
<th>Company name</th>
<th>Organizational unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Field</th>
<th>Lease</th>
<th>Well</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Condition of SSSV prior to installation:

1. Connections tight?
2. Opening pressure*  
   Closing pressure*
3. General

*Actual pressure

<table>
<thead>
<tr>
<th>Inspected by</th>
<th>Date (month/day/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Annex C
(informative)

Reference test figures

Figure C.1 — Example schematic of gas flow facility
Figure C.2 — Example schematic of liquid test facility

Key

1  Hydraulic oil
2  Air supply
3  Hydraulic pressure source
4  Hydraulic control system
5  High-pressure water system
6  Nitrogen supply
7  Propane supply
8  Manifold valves
9  Choke valve
10 Test section
11 See Figure C.3
12 By-pass valve
13 Flow meter
14 Recorder
15 Relief valve
16 Pump
17 Drain valve
18 Water supply
19 Liquid supply tank
Key

1. Gas/liquid separator
2. Drain
3. Nitrogen flow meter
4. Shut-off valve
5. Test section
6. Hydraulic control line bleed valve
7. Metering valve
8. Hydraulic control valve
9. Bleed valve
10. Upstream isolation valve
11. SSSV
12. Downstream isolation valve
13. Balance valve
14. Differential pressure measuring device
15. Pressure-measuring device
16. High-pressure water manifold valve
17. Propane manifold valve
18. Nitrogen manifold valve

Figure C.3 — Example detail of liquid test facility
Figure C.4 — Example schematic of controlled-temperature test facility
Figure C.5 — Example schematic of propane test facility
Key
1 Hydraulic pressure increasing
2 Time with hydraulic control pressure applied or released at a metered rate
3 SCSSV becomes fully open
4 Hydraulic system pressure
5 SCSSV becomes fully closed

Figure C.6 — Example of characteristic hydraulic control pressure curve for SCSSVs
Figure C.7 — Example schematic of functional-test facility for hydraulically actuated SSSVs
Figure C.8 — Example schematic of functional-test facility for velocity- and tubing-pressure-activated SSSVs
Annex D
(informative)

Failure-reporting recommendations for operators

D.1 The operator of SSSV equipment manufactured to this International Standard should provide to the manufacturer a written report of equipment failure. This report should include, as a minimum, the information given in Table D.1.

D.2 The failure report should be submitted to the equipment manufacturer within 30 days of the discovery and identification of the failure. An investigation in the form of a failure analysis to define the cause of the failure should be performed and the results documented.

The operator's options for performing failure analysis on failed equipment should be as follows:

a) The operator removes the failed equipment from service and returns the equipment to the equipment manufacturer who, in cooperation with the operator, performs the failure analysis.

Or

b) The operator does not immediately remove the equipment from service. However, if the operator removes the equipment within five years of the date of the shipping report, the operator should return the equipment to the equipment manufacturer for failure analysis.

Or

c) The operator elects to perform an independent failure analysis.

The operator should notify the equipment manufacturer of the option selected for failure analysis as part of the initial failure report. If option (c) is selected, a copy of the analysis report should be sent to the equipment manufacturer within 45 days of completion of the analysis.

D.3 The manufacturer shall respond in accordance with clause 9.
Table D.1 — Failure report on subsurface safety valve equipment (minimum data) (see clause 9)

<table>
<thead>
<tr>
<th>Operator data</th>
<th>Manufacturer data (completed on receipt of equipment)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I. Identification — Operator</strong></td>
<td><strong>I. Condition of failed equipment</strong></td>
</tr>
<tr>
<td>— Operator</td>
<td>— Condition as received</td>
</tr>
<tr>
<td>— Date</td>
<td>— Failed components</td>
</tr>
<tr>
<td>— Field and/or area</td>
<td>— Damaged components</td>
</tr>
<tr>
<td>— Lease name and well number</td>
<td></td>
</tr>
<tr>
<td><strong>II. SSSV equipment identification</strong></td>
<td><strong>II. Test results</strong></td>
</tr>
<tr>
<td>— SSSV ____; SV landing nipple ____; SV lock _____</td>
<td>— Furnished by operator and/or by manufacturer</td>
</tr>
<tr>
<td>— Make</td>
<td>— Failure mode</td>
</tr>
<tr>
<td>— Model</td>
<td>— Leakage rate</td>
</tr>
<tr>
<td>— Tubing-retrievable ____</td>
<td>— Control fluid</td>
</tr>
<tr>
<td>— Wireline-retrievable ____</td>
<td>— Operational data (opening and closing pressures, etc.)</td>
</tr>
<tr>
<td>— SCSSSV ____</td>
<td></td>
</tr>
<tr>
<td>— SSCSV ____</td>
<td></td>
</tr>
<tr>
<td>— Serial number</td>
<td></td>
</tr>
<tr>
<td>— Working pressure</td>
<td></td>
</tr>
<tr>
<td>— Nominal size</td>
<td></td>
</tr>
<tr>
<td>— Service class</td>
<td></td>
</tr>
<tr>
<td><strong>III. Well data</strong></td>
<td><strong>III. Cause of failure</strong></td>
</tr>
<tr>
<td>— Well test rate</td>
<td>— Probable cause</td>
</tr>
<tr>
<td>— Environmental conditions</td>
<td>— Secondary cause</td>
</tr>
<tr>
<td>— Percent sand</td>
<td></td>
</tr>
<tr>
<td>— H₂S</td>
<td></td>
</tr>
<tr>
<td>— CO₂</td>
<td></td>
</tr>
<tr>
<td>— Pressure and temperatures</td>
<td></td>
</tr>
<tr>
<td>— Surface</td>
<td></td>
</tr>
<tr>
<td>— Bottom hole</td>
<td></td>
</tr>
<tr>
<td>— SSSV equipment setting depth</td>
<td></td>
</tr>
<tr>
<td>— SSSV equipment installation date</td>
<td></td>
</tr>
<tr>
<td>— Time equipment in service</td>
<td></td>
</tr>
<tr>
<td>— Unusual operating conditions</td>
<td></td>
</tr>
<tr>
<td><strong>IV. Description of failure</strong></td>
<td><strong>IV. Repair and maintenance</strong></td>
</tr>
<tr>
<td>— Nature of failure</td>
<td>— Parts replaced</td>
</tr>
<tr>
<td>— Observed conditions which could have caused failure</td>
<td>— Other maintenance</td>
</tr>
<tr>
<td><strong>V. Operator’s signature and date</strong></td>
<td></td>
</tr>
<tr>
<td><strong>VI. Additional information</strong></td>
<td><strong>VII. Manufacturer’s signature and date</strong></td>
</tr>
<tr>
<td>— Facility location where failed valve originally manufactured</td>
<td>— Completed report to be transmitted to operator with a copy retained</td>
</tr>
<tr>
<td>— Date of manufacture</td>
<td></td>
</tr>
</tbody>
</table>
Annex E
(normative)

Test agency reporting and records (see 7.2.4)

E.1 Test reports completed by a test agency conforming to this International Standard shall be traceable to the equipment tested and shall include the following:

a) general information (date, location, manufacturer, model, serial number, size, rating, etc.);
b) summary of test results (quantities and characteristics);
c) description of the characteristics of equipment under test;
d) observed data (including calculations and details of test personnel);
e) test conditions (limits required by the standard);
f) identification of test methods and procedures;
g) supporting data (log sheets, calibration records);
h) graphical presentation (curves);
i) identification of instruments involved in the testing;
j) certificate of compliance.

E.2 Unless otherwise specified in the appropriate referenced standard(s), the test agency shall keep the following records for five years from completion of all tests on all equipment tested:

a) test data and test reports;
b) calibration data;
c) non-conformance reports;
d) audit and corrective-action records;
e) personnel qualification records;
f) test procedures;
g) data on any special testing.
Annex F
(informative)

Checklist of suggested ordering information for SSSV equipment

F.1 General

When placing inquiries or orders for SSSV equipment in accordance with this International Standard, the user/purchaser should provide the following information to the supplier/manufacturer.

F.2 Requirements (applicable to all SSSV types)

a) Applicable specification(s), standards(s) and their edition(s).
b) Type of system (surface-controlled, subsurface-controlled).
c) Type of SSSV (tubing-retrievable, WL-retrievable, coil-tubing-retrievable, TFL-retrievable, etc.).
d) Rated working pressure (maximum requirement for application).
e) Rated working temperature (maximum requirement for application).
f) Model name (if known).
g) Class of service (see 4.2.5 of this International Standard).
h) Size (see Annex A of this International Standard).
i) Quantity of each piece of equipment.
j) Required delivery date(s).
k) Material requirements, such as:
   1) specific corrosion/chemical-resistance characteristics;
   2) specific NDE methods/techniques required by purchaser.
l) Applicable quality system (if desired).
m) Setting depth (minimum required for application) and control system parameters (supply pressure, supply line(s) and connection rating(s), etc.).
n) Minimum internal diameter.
o) If applicable, maximum allowable pressure drop at maximum flow rate through SCSSV.
p) The requirement(s), if any, for holding the SCSSV open without the use of the primary operating source (temporary or permanent lock-open system).
q) The requirement(s), if any, for providing control fluid communication from the SCSSV to any other subsurface device (e.g. a through-tubing retrievable backup valve).

r) If applicable, specific performance/acceptance criteria for features specified but not previously verified.

s) Type and characteristics of control fluid to be used, if applicable.

F.2.1 TR-SCSSVs

a) Type of tubular top and bottom connection(s) and the material and dimensions of the tubular products which are connected to the valve (these connections are not included in the evaluation of combined loading).

b) The loading conditions, including combined loading (pressure, tension/compression, torque) and the corresponding temperature extremes anticipated to be applied to the valve.

c) The receptacle profile(s) and sealing-bore dimension(s) and location(s), if applicable.

d) Dimensions of casing and tubing, including any requirement for passage of lines (electrical/hydraulic) between valve OD and casing ID.

F.2.2 WR-SCSSVs

a) The dimensions of the connection between the valve and the mechanism securing the valve in the tubing, or the type and make of mechanism securing the valve in the tubing.

b) The required dimensions of and tolerances on the tubular products in which the SCSSV is positioned when installed in the well.

c) The material of the mounting device interface to which the valve is connected and the tubular product(s) in which the SCSSV is positioned when installed in the well.

F.2.3 SSCSVs

a) Orifice size, if applicable.

b) Setting spring, if applicable.

c) Number of spacers to be used, if applicable.

d) Pressure charge, if applicable.

e) If the details above are not known, describe the conditions under which the valve will operate (flow conditions) and the conditions under which the valve should close (see ISO 10417).

F.3 Well and production/injection parameters

Include parameters such as:

a) the density, chemical/physical composition and condition of the produced/injected fluid or its components, solids (e.g. sand, scale, etc.), liquid or gaseous, to which the SCSSV is exposed during its full life cycle;

b) the minimum, maximum and normal values of the production/injection pressures, temperatures and expected flow rates;

c) the dimensions and the material of the casing and tubing;
d) the well trajectory, if it deviates more than 10° from the vertical at the setting position of the SCSSV.

F.4 Examples of operations to be allowed for

a) Well stimulation, 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.

b) Sand consolidation and fracturing, including sand/proppant description, fluid flow rate, proppant/fluid ratio or sand/fluid ratio, chemical composition, pressure and temperature.

c) Well-servicing activities through the safety valve: size, type and configuration of other devices to be run through the valve, if applicable.
Annex G
(informative)

API Monogram and Test Agency Licensing

G.0 Introduction

The API Monogram Program allows a licensee to apply the API Monogram to products. Products stamped with the API Monogram provide observable evidence that they were produced in accordance with a verified quality system and in accordance with an API-recognized, international oil and gas industry product specification. The API Monogram Program delivers significant value to the international oil and gas industry by linking the verification of a supplier’s quality system with the demonstrated ability to meet specific product specification requirements.

When used in conjunction with the requirements of the API License Agreement, API Specification Q1 Parts One and Two define the program for voluntary licensing of suppliers who wish to provide oil and gas industry products in accordance with an API-recognized international oil and gas industry product specification.

API Monogram Program Licenses are issued only after an on-site audit has verified that the licensee conforms with both the quality system requirements described in API Specification Q1 Part One and the requirements of an API-recognized international oil and gas industry product specification.

For information on becoming an API Monogram Licensee, please contact API at 1220 L Street, N. W., Washington, DC 20005 or call 202-682-8000.

G.1 Scope

This Annex sets forth the API Monogram Program requirements necessary for a supplier to consistently produce products in accordance with API specified requirements.

G.2 References

In addition to the referenced standards listed in Section 2, this Annex references the following standards:

- API Specification Q1
- The API Composite List
- ISO/IEC Guide 25

For Licensees under the Monogram Program, where cited these requirements are mandatory. Referenced standards used by the Manufacturer may be either the applicable revision shown in Section 2 and herein, or the latest revision.

G.3 API Monogram Program: Licensee Responsibilities

G.3.1 The requirements for all suppliers desiring to acquire and maintain a license to use the API Monogram shall include:

a. The quality system requirements of API Specification Q1, Part One.
b. The API Monogram Program requirements of API Specification Q1, Part Two.

c. The requirements contained in API recognized product specifications.

d. The requirements contained in the API License Agreement.

G.3.2 When a licensed supplier is providing monogrammed product, Parts One and Two of API Specification Q1 are mandatory.

G.3.3 Each Licensee shall control the application of the monogram in accordance with the following:

a. The Licensee shall apply the monogram, license number, and date of manufacture to monogrammed products in accordance with a marking procedure as specified by the applicable API product specification. Where there are no API product specification marking requirements, the licensee shall define the location(s) where this information is applied.

b. The monogram may be applied at any time appropriate to the manufacturing process but shall be removed if the product is subsequently found to be in nonconformance with API specified requirements. Products determined to be nonconforming to API specified requirements shall not bear the API monogram.

c. Only an API Licensee may apply its monogram.

d. The monogram shall be applied at the licensed facility.

e. The authority responsible for applying and removing the API monogram shall be defined.

G.3.4 Records required by API product specifications shall be retained for the period of time specified therein. Records specified to demonstrate achievement of the effective operation of the quality system shall be maintained for a minimum of 5 years.

G.4 Marking Requirements

These marking requirements apply only to those API licensees wishing to mark their products with the API Monogram.

There are no specific marking requirements for the API Monogram on API 14A SSSV equipment. Application of the API Monogram shall be per the manufacturers procedures as specified in API Specification Q1.

G.5 API Monogram Program: API Responsibilities

The API shall maintain, without references to licensees or users, records of reported problems encountered with API monogrammed products produced in accordance with API Specification Q1 and API product standards.

G.6 API Monogram Program: User Responsibilities

The effectiveness of the API monogram program can be strengthened by user reporting problems encountered with API monogrammed products to the API. API solicits information on both new product nonconformance with API specified requirements and field failures (or malfunctions) which are judged to be caused by either specification deficiencies or nonconformance with API specified requirements. Users are requested to report to API problems encountered with API monogrammed products.
G.7 Test Agency License Criteria

G.7.1 The Test Agency performing verification testing must meet the requirements of clause 7.2.4 and Annex E. In addition, for compliance with these API Monogram Program requirements, the Test Agency must be an Independent Third Party, and must be licensed by API in order to test SSSVs which are intended to be marked with the API Monogram.

G.7.2 Laboratories desiring license under this Annex shall have a functional quality program in accordance with the ISO/IEC Guide 25-1982, "General Requirements for the Technical Competence of Testing Laboratories," and the following sections of API Spec Q1: Scope and Field of Application, References, Definitions, Quality System Requirements except requirements related to design, manufacturing and field nonconformance. API shall maintain a list of licensed laboratories, which shall appear in the API Composite List of Manufacturers Licensed for use of the API Monogram. Laboratories desiring licensing under this Annex shall make application and pay fees as follows:

Initial License Fee. The applicant will be assessed an initial license fee for the first Specification included in the application, and a separate fee for each additional Specification included in the application.

Annual License Fee. In addition to the initial license fee, laboratories will be assessed an annual renewal fee for each specification under which they are listed.

G.7.3 The Laboratory shall submit a controlled copy of their Quality Manual to API. The manual will be reviewed by API Staff for conformance to the requirements of Section G.7.2 of this Annex and specific test methods identified in this or other API Specifications. Upon acceptance of the manual, API shall arrange a survey, as follows:

Initial and Renewal Surveys. First-time applicants and current licensed laboratories on every third year renewal of licensing shall be surveyed by qualified surveyors. The parameters of these surveys shall be the appropriate API Specifications and the laboratory's API approved quality manual. The surveys will be performed to gather objective evidence for API's use in verifying that the laboratory is in conformance with the provision of the Laboratory Quality Program as applicable to this API specification and the requirements of G.7.2 of this Annex. The laboratory will be invoiced for the cost of these surveys.

Periodic Surveys. Existing laboratories will be periodically surveyed by an approved API surveyor on a nondiscriminatory basis to determine whether or not they continue to qualify as a licensed laboratory. The frequency of the periodic surveys will be at the discretion of the staff of the Institute. The costs of periodic surveys will be paid by the Institute.

G.7.4 Removal of Laboratory from Licensed List shall occur due to the following:

a. Failure to meet the requirements of the survey

b. Failure to pay annual renewal fee

G.7.5 Reinstatement of License Rights

Laboratories who have been cancelled may request reinstatement at any time. If a request for reinstatement is made within sixty (60) days after cancellation, and if the reason for cancellation has been corrected, no new application is necessary. A resurvey of the laboratory's facilities will be made by an approved Institute surveyor prior to a decision to reinstate license rights. The laboratory will be invoiced for this resurvey regardless of the Institute's decision on reinstatement. If the result of the resurvey indicates to the API staff that the laboratory is qualified, the license list will be updated.

Request for reinstatement made more than sixty (60) days after cancellation shall be treated as a new application unless circumstances dictate and extension of this time period as agreed upon by the API staff.
G.7.6 Appeals

An interested party may appeal a decision by the Institute to withhold license rights. Appeals shall be directed to the API general manager, Upstream Segment and handled by the Upstream Segment Committee with a further right of appeal to the API Management Committee. Competing suppliers of the service to which the standard applies or might apply may not be involved in appeals. The Upstream Segment Committee and the Management Committee may convene appeals boards to hear and act on appeals.

G.7.7 Any changes to a Licensed Laboratory’s approved Quality Assurance Manual must be approved by API in writing prior to implementation.