INTERNATIONAL STANDARD

ISO 10417

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

Industries du pétrole et du gaz naturel — Systèmes de vannes de protection de fond de puits — Étude, installation, fonctionnement et réparation

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 10417 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, Subcommittee SC 4, *Drilling and production equipment*.

This second edition cancels and replaces the first edition (ISO 10417:1993), which has been technically revised.

Introduction

This International Standard has been developed by users/purchasers and suppliers/manufacturers of subsurface safety valve (SSSV) equipment intended for use in the petroleum and natural gas industry worldwide. This International Standard is intended to give requirements and information to both parties on the design, operation, installation and testing of subsurface safety valve system equipment and also the storage/transport, maintenance, and redress of the SSSV equipment.

Users of this International Standard should be aware that further or differing requirements might be needed for individual installations, storage/transport and maintenance. This International Standard is not intended to inhibit the user/purchaser from accepting alternative engineering solutions. This may be particularly applicable where there is innovative or developing well-completion technology.

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

1 Scope

This International Standard establishes requirements and provides guidelines for configuration, installation, test, operation and documentation of subsurface safety valve (SSSV) systems. In addition, this International Standard establishes requirements and provides guidelines for selection, handling, redress and documentation of SSSV downhole production equipment.

This International Standard is not applicable to repair activities.

NOTE ISO 10432 provides requirements for SSSV equipment repair.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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

ISO 10432:—[1], *Petroleum and natural gas industries — Downhole equipment — Subsurface safety valve equipment*

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

ANSI/NCSL Z 540-1, *Calibration — Calibration Laboratories and Measuring and Test Equipment — General Requirements*

3 Terms and definitions

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

3.1
control line
conduit utilized to transmit control signals to SCSSVs

3.2
emergency shutdown system
system of stations which, when activated, initiate facility shutdown

3.3
equalizing feature
SSSV mechanism which permits the well pressure to bypass the SCSSV closure mechanism

1) To be published.

3.4
fail-safe device
device which, upon loss of the control medium, automatically shifts to a safe position

3.5
fail-safe setting depth
maximum true vertical depth at which an SCSSV can be set and closed under worst-case hydrostatic conditions

3.6
maintenance
service operations performed on SSSV system equipment as part of routine operations

3.7
manufacturer
principal agent in the design, fabrication and furnishing of original SSSV system equipment

3.8
operating manual
publication issued by the manufacturer, which contains detailed data and instructions related to the design, installation, operation and maintenance of SSSV system equipment

3.9
operator
user of SSSV system equipment

[ISO 10432]

3.10
orifice
designed restriction which causes the pressure drop in velocity-type SSCSVs

3.11
packaging
enclosure(s) of sufficient structural integrity to protect contents from damage or contamination, including impacts and environmental conditions encountered during the various phases of transport

3.12
qualified part
part manufactured under a recognized quality assurance programme and, in the case of replacement, produced to meet or exceed the performance of the original part produced by the original equipment manufacturer (OEM)

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

3.13
qualified personnel
personnel with characteristics or abilities, gained through training and/or experience as measured against established requirements, standards or tests, that enable the individual to perform a required function

3.14
redress
any activity involving the replacement of **qualified parts** (3.12) within the limits described in 5.3.3

3.15
repair
any activity beyond the scope of redress that includes disassembly, re-assembly and testing, with or without the replacement of qualified parts, and may include machining, welding, heat-treating or other manufacturing operations, that restores the equipment to its original performance

3.16
safety valve landing nipple
any receptacle containing a profile designed for the installation of an SSSV lock mandrel

NOTE It may be ported for communication to an outside source for SSSV operation.

3.17
safety valve lock mandrel
retention device used for SSSV equipment

3.18
self-equalizing feature
SCSSV mechanism which, on initiation of opening sequence of the SSSV, permits the well pressure to automatically bypass the SCSSV closure mechanism

3.19
storage
act of retaining SSSV system equipment without damage or contamination, after processing is completed and prior to or after field use, including the transport process

3.20
SSSV system equipment
components which include the **surface-control system** (3.2.4), **control line** (3.1), **SSSV** (3.23), **safety valve lock** (3.17), **safety valve landing nipple** (3.16), flow couplings and other downhole control components

3.21
surface-controlled subsurface safety valve
SCSSV
SSSV controlled from the surface by hydraulic, electrical, mechanical or other means

3.22
subsurface-controlled subsurface safety valve
SSCSV
SSSV actuated by the characteristics of the well itself

NOTE These devices are usually actuated by the differential pressure through the SSCSV (velocity type) or by tubing pressure at the SSCSV (high or low pressure type).

3.23
subsurface safety valve
SSSV
device whose design function is to prevent uncontrolled well flow when closed

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

[ISO 10432]

3.24
surface control system
surface equipment including manifolding, sensors, and power source to control the SCSSV

3.25
surface safety valve
SSV
automatic wellhead valve assembly which closes upon loss of power supply

NOTE Where used in this International Standard, the term is understood to include an SSV valve and SSV actuator.

[ISO 10423]

3.26
transport
actions required to ship SSSV system equipment from one geographic location to another

3.27
underwater safety valve
USV
automatic valve assembly (installed at an underwater wellhead location) which will close upon loss of power supply

NOTE Where used in this International Standard, the term is understood to include a USV valve and USV actuator.

[ISO 10423]

3.28
well test rate
stabilized rate at which the well is produced on a routine basis

4 Abbreviated terms

ESD emergency shut-down

FSSD fail-safe setting depth

NDE non-destructive examination

OEM original equipment manufacturer

SCSSV surface-controlled subsurface safety valve

SDV shutdown valve

SSCSV subsurface-controlled subsurface safety valve

SSSV subsurface safety valve

SSV surface safety valve

SVLN safety valve landing nipple

TFL through flow line

TRSV tubing-retrievable safety valve

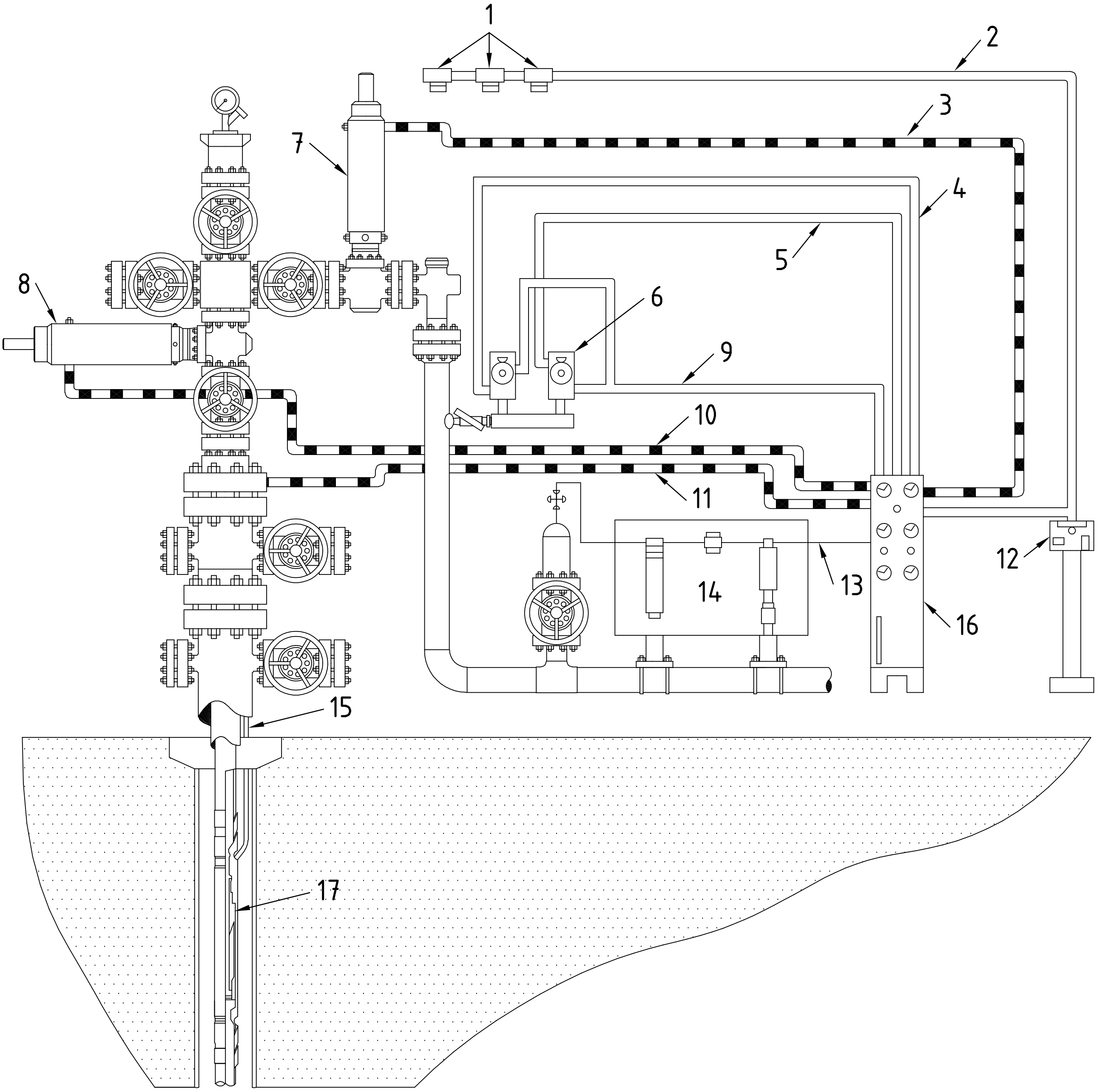
TR-SCSSV tubing-retrievable surface-controlled subsurface safety valve

USV underwater safety valve

5 System configuration

5.1 General

Subsurface safety valve systems are provided for the prevention of uncontrolled well flow when actuated. They include SCSSVs and SSCSVs, which are positioned below the wellhead and below ground level/mudline and are installed/retrieved by tubing, wireline, and TFL and their control systems (see Figure 1).



1	fusible plugs	10	hydraulic/pneumatic pressure to master valve
2	ESD pressure line [207 kPa to 345 kPa (30 psi to 50 psi)]	11	hydraulic pressure line to SCSSV
3	hydraulic/pneumatic pressure line to wing valve	12	manual remote emergency shutdown station
4	high pilot signal	13	supply line
5	low pilot signal	14	flowline scrubber assembly
6	pilot box	15	hydraulic pressure line to the SCSSV
7	wing SSV hydraulic or pneumatic actuator	16	hydraulic/pneumatic control panel
8	master SSV hydraulic or pneumatic actuator	17	surface-controlled subsurface safety valve (SCSSV)
9	supply to pilots [172 kPa (25 psi)]		

Figure 1 — Example: Surface-controlled subsurface safety valve system

5.2 System requirements

5.2.1 General

The user/purchaser, when developing the system configuration, shall consider all the pertinent elements and their compatibility. These elements shall include the following: control system, control line, wellhead/tubing hanger passages and connectors, control line protectors, control fluid (for SCSSV); SSSV; flow couplings; locking and sealing devices (for wireline safety valves); safety-valve landing nipples; related tools and exposed fluids.

5.2.2 Installation

5.2.2.1 General

The user/purchaser shall assure that installation and installation testing of the SSSV system is performed and approved by qualified personnel using documented procedures and acceptance criteria in accordance with the manufacturer's operating manual and operator's system integration manual. System configuration and installation testing results shall become a part of the well records (see 5.4).

5.2.2.2 Control system

The surface-control system shall include the elements necessary to sense abnormal conditions that may contribute to uncontrolled well flow and shall transmit the necessary signal to the SCSSV for closure.

All elements of the integrated system shall be analysed for potential hazards that may render the system vulnerable to failure or may preclude safe use. For example, automatic resets shall not be incorporated in the control system since this feature may cause the SCSSV to reopen when it should remain closed. Systems shall be designed and operated to address the potential hazards to safe use.

It is desirable to integrate the SCSSV surface-control system into the surface safety system to avoid duplication. Features shall be designed in the integrated system whereby routine production upsets do not result in closure of the SCSSV(s).

If hydraulic or pneumatic control systems are utilized, the test pressure of those systems shall be equal to or greater than the highest operating pressure of that system when installed. System components shall be verified capable of meeting all anticipated environmental conditions, including temperature.

For multiple-well installations, the control-system manifolding shall include provisions for individual well and SSSV isolation.

ESD controls should be installed in strategic locations in accordance with applicable regulations and sound engineering judgement. To avoid closure of the SCSSV under full well-flow conditions, a delay shall be incorporated between closure of the tree valves controlled by the ESD and the downhole SCSSV. The opening sequence should be reversed on returning production facilities to normal operations. This delay mechanism shall be carefully analysed and documented to verify that it does not create additional hazards that render the system vulnerable to failure.

For additional information, see ISO 13628-6.

5.2.2.3 Control line

Prior to installation, the control line shall be verified as filled with the specified control fluid of the specified cleanliness. During installation, care shall be taken to ensure that, when fully installed, the control line has no detrimental physical damage that can cause fluid flow restriction, stress risers or corrosion initiation sites. See 5.3.1.7 for control-line selection criteria.

5.2.2.4 Wellhead/tubing hanger passages and connectors

Passages/connectors shall have the following characteristics/considerations:

a) the verified pressure rating shall be equal to or greater than the highest anticipated control-system operating pressure;

b) specific consideration shall be given to minimum passages being equal to or greater than the control line;

c) materials shall be compatible with the production environment and other fluids that may come in contact;

d) specific consideration shall be given to seal material applications for working pressures equal to or greater than 68,9 MPa (10 000 psi);

e) the design and location of the wellhead outlet for the control line may include a valve for closure and isolation of the individual well from the control system. This valve shall be maintained in the open position during normal operations and it shall be readily identified when closed, since its closure will render the SCSSV inoperative.

5.2.2.5 Control-line protectors

Control-line protectors should be used to protect the control line from possible damage (abrasion, flattening, etc.) that could occur during running/pulling operations after connecting the control line. When used, at least one protector for each tubing joint is recommended. The cross-coupling types are recommended to prevent the protector from moving on the tubing joint. Protectors shall have dimensions compatible with the tubing size and connection, with the control-line size and type, and with the casing drift.

5.2.2.6 Control fluid

The requirements of 5.3.1.6 on control fluid selection apply.

5.2.2.7 SSSV

SSSVs shall be selected that have been verified as being compatible with the dimensions and configurations of: tubing and auxiliary conduit connections; tubing and casing drift diameters; related permanent well equipment and well-servicing tools; control or other fluids in contact with the equipment.

Well effluents and producing characteristics are principal factors in selection and design.

Scale, paraffin and hydrate deposition affect closure performance and should be carefully considered in determining the setting depth, especially for SSCSVs.

5.2.2.8 Flow couplings

Flow entrance effects can have an affect on SSSV performance. To reduce the resultant effects of turbulence during production, flow couplings should be considered an integral part of the tubing string, both upstream and downstream of the SSSV. Flow couplings should be compatible with the ID of the SSSV for an ample length prior to the SSSV entrance and at the exit. Typical industry practice has been to provide a minimum of 0,9 m (3 ft) in length provided it exceeds 8 to 10 times the ID of the tubing. In the case of TR-SCSSV installations, flow coupling length should take into account future insert valve installations.

5.2.2.9 Lock mandrels, safety valve landing nipples, sealing devices and related tools

Lock mandrels, safety valve landing nipples, sealing devices, running tools and related equipment shall be verified as compatible with the dimensions and configurations of related permanent well equipment and well-servicing tools. Installations and retrievals shall meet the requirements identified in the manufacturer's operating manual and, where applicable, the documented procedures of the user/purchaser as specified in ISO 16070.

5.2.2.10 Receiving inspection

SSSV system equipment shall be inspected when received.

Upon receipt of the SSSV equipment on location, documentation, e.g. receiving report, operations manual, data sheet, shall be checked to

a) verify that the part number and serial number on the SSSV equipment correspond to those recorded on the accompanying documents,

b) ensure that all visible sealing elements and threads are not damaged, and that all other visible features do not exhibit damage that may interfere with the SSSV equipment operation.

Prior to installation, the opening and closing hydraulic pressures (or operating loads) shall be verified according to the specific manufacturer's operating manual. Ensure that the SCSSV will function fail-safe at the planned setting depth before installation by calculation of FSSD in accordance with the manufacturer's operating manual.

It is recommended that SSSV system components be functionally tested prior to installation. Annex B offers guidelines for performing this process.

5.2.3 System test

5.2.3.1 General

When installed, the SSSV system equipment shall be tested by qualified personnel to ensure proper operation. System evaluation procedures shall include testing procedures, acceptance criteria, and documentation requirements.

5.2.3.2 Surface control system

To assure performance of the surface control system within the design limits, the manufacturer's/operator's prescribed operating procedures shall be followed. See Annex C for further recommendations and guidelines on operations.

The surface control system shall be tested at a maximum interval of every six months, with consideration given to no-flow conditions, unless local regulations, conditions and/or documented historical evidence indicate a different testing frequency.

To test the system, operate an ESD valve. The system tests successfully when all SCSSVs close after the prescribed delay.

5.2.3.3 SCSSV

The opening and closing hydraulic pressures, mechanical actuation, closure-mechanism integrity and other features shall be verified according to the manufacturer's operating manual prior to valve installation.

After installation of the SCSSV in the well, the SCSSV shall be closed under minimum or no-flow conditions by operation of the surface control system. Verification of closure operation may be accomplished by pressure build-up/in-flow test. The SCSSV can be tested for leakage by opening the surface valves to check for flow. The SCSSV is reopened following the procedures in the manufacturer's operating manual.

SCSSVs shall be tested by closure-mechanism operation to verify the rate of leakage through the closure mechanism at a maximum interval of every six months unless local regulations, conditions and/or documented historical data indicate a different testing frequency. Leakage rates exceeding 400 cm^3/min (13,5 oz/min) of liquid or 0,43 m^3/min (15 scfm) of test gas shall be cause for test rejection and corrective action shall be taken to meet the requirements of this International Standard. Methods other than volumetric determination of leakage may be used, provided they are verifiable and repeatable. Example procedures for testing of an *in situ* SCSSV are provided in Annex E, which confirm fail-safe operation.

More frequent operation of the SCSSV as dictated by field experience may serve to keep all moving parts free and functioning properly, and aid in early detection of failures.

5.2.3.4 SSCSV

Before installation, SSCSVs shall be tested by qualified personnel in accordance with the manufacturer's operating manual to verify mechanical actuation and closure-mechanism pressure integrity. A mechanical device may be used to test the actuation mechanism.

Guidance on sizing of subsurface-controller safety valves is provided in Annex D.

Testing of an SSCSV in the well is only recommended for those systems designed for *in situ* testing.

Installed (non-tubing conveyed) SSCSVs shall be retrieved, inspected, tested, and reset to current well conditions in accordance with the manufacturer's recommendations at intervals not to exceed 12 months. More frequent inspection as dictated by field experience may be necessary for early detection of service wear or fouling.

Pressure testing of the closure mechanism should be at 1,38 MPa ± 5 % (200 psi ± 5 %) pressure differential. Leakage rates exceeding 400 cm^3/min (13,5 oz/min) of liquid or 0,43 m^3/min (15 scfm) of test gas shall be cause for test rejection.

5.2.4 System quality

5.2.4.1 General

This subclause provides minimum quality control requirements to meet this International Standard. All quality control functions shall be controlled by documented instructions, which include acceptance criteria and test results.

5.2.4.2 Personnel qualifications

All personnel performing installation, redress, testing, and inspection for acceptance shall be qualified in accordance with documented requirements.

Personnel performing visual examinations shall have an annual eye examination, as applicable to the discipline to be performed, in accordance with ISO 9712.

Personnel performing NDE shall be qualified in accordance with ISO 9712, to at least Level II or equivalent.

NOTE For the purposes of these provisions, SNT-TC-1A is equivalent to ISO 9712.

5.2.4.3 Calibration systems

5.2.4.3.1 Measuring and testing equipment used for acceptance shall be identified, inspected, calibrated and adjusted at specific intervals in accordance with documented specifications, ANSI/NCSL Z 540-1 and this International Standard.

5.2.4.3.2 Pressure-measuring devices shall

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

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

5.2.4.3.3 Pressure-measuring devices shall be used only within the calibrated range.

5.2.4.3.4 Pressure-measuring devices shall be calibrated with a master pressure-measuring device or a deadweight tester. 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, degree of usage and documented calibration history.

5.3 Equipment requirements

5.3.1 Selection

5.3.1.1 Materials

The user/purchaser shall ensure that the materials used in SSSV system equipment are suitable for the intended environment, e.g. corrosion, stress-cracking (see ISO 10432 for SSSV class of service applications), pressure, flow rates, loads and temperature.

5.3.1.2 Interfaces

Equipment shall be selected that has been verified as being compatible with the dimensions and configurations of: tubing and auxiliary conduit connections; tubing and casing drift diameters; related permanent well equipment and well-servicing tools; and control or other fluids in contact with the equipment.

5.3.1.3 Pressures/temperatures/flow rates/loads

Equipment shall be selected that is verified as meeting or exceeding the anticipated pressure range, temperature range, maximum/minimum flow rates, and anticipated loading conditions.

5.3.1.4 SSSVs

5.3.1.4.1 Characteristics

The user/purchaser shall consider for selection the following functional characteristics: equalizing/self-equalizing/non-equalizing; selective/non-selective profiles; secondary communication; temporary/permanent lock-open. For a more extensive list of requirements, see the functional specification requirements given in ISO 10432.

5.3.1.4.2 Determination of SCSSV setting depth

The following shall be considered when determining the SCSSV setting depth:

a) maximum fail-safe setting depth according to the manufacturer's operating manual;

b) gradient and pressure of the annulus and control line fluids;

c) SSSV closing and opening pressure from the shipping report;

d) calculated maximum tubing pressure at the SCSSV;

e) required safety factors;

f) pour point, anticipated pressures and temperatures at valve depth (paraffin, hydrate deposition, permafrost, etc.).

5.3.1.5 Control system

5.3.1.5.1 Sensors

Each installation shall be analysed to determine applicable sensors. The sensor types used to signal the SCSSV may include heat sensors, pressure sensors, fluid level sensors and other sensors, as applicable.

A high/low level sensor may be placed on the supply tank of hydraulic systems to warn of abnormal operating conditions, e.g. well flowing through control line or a leaking control line. A low-pressure pilot can also be installed on the pump discharge.

5.3.1.5.2 Power

The system should be designed with sufficient excess capacity to operate with the minimum energy input.

In pneumatic and hydraulic systems, a relief valve should be incorporated to prevent overpressuring of the system.

In hydraulic systems, the hydraulic fluid reservoir shall be adequately vented to allow pressure relief for returned fluid upon closure of the SCSSV or in the event of back-flow from the well through the control conduit.

Pneumatic and hydraulic control systems shall meet the cleanliness standard recommendations of the equipment supplier/manufacturer.

5.3.1.6 Guidelines for selection of control fluid

The control fluid shall be in compliance with the equipment manufacturer's recommendations and the following shall be considered when selecting control fluids:

a) flammability;

b) flash point;

c) sealability;

d) lubricity;

e) physical/chemical compatibility: the fluid shall not degrade the sealing elements resulting in hardening, softening, swelling or shrinking;

f) fluid property stability over expected temperature/pressure ranges and service life;

g) fluid cleanliness (solids content);

h) foam inhibition;

i) toxicity (including environmental impacts);

j) low corrosiveness;

k) good oxidation stability;

l) viscosity at all operating temperatures.

5.3.1.7 Guidelines for selection of control line

The following should be considered when selecting the control line:

a) temperature at the SCSSV;

b) completion fluid (annulus);

c) maximum anticipated operating pressure;

d) working pressure of surface wellhead;

e) safety valve setting depth;

f) control line material, size, and thickness;

g) control line fluid;

h) control line connector design and material;

i) control line manufacturing technique;

j) continuous control line;

k) well environment;

l) control line encapsulation/protection.

5.3.2 Handling

5.3.2.1 General

SSSV equipment shall be transported and stored in such a manner as to preserve the integrity of the equipment prior to well installation.

5.3.2.2 Packaging

SSSV equipment shall be packaged in such a way as to prevent damage during transport and deterioration during storage. SSSV equipment which has exposed elastomeric seals shall be protected from direct sunlight or other UV light sources, and shall be prevented from contact with contaminants such as oils, vapours, solvents, etc.

5.3.2.3 Storage

SSSV equipment shall be stored in conditions (temperature, etc.) which meet the manufacturer's specifications in the operating manual. Equipment is typically stored vertically in an unstressed condition. Equipment shall be protected from the effects of abrasives and chemicals that can cause product damage.

SSSV equipment containing elastomeric materials shall not be stored in areas where ozone is produced by electrical devices or in the vicinity of radiation equipment. Storage of elastomeric materials shall take into account the effects of shelf life of that material.

5.3.2.4 Transport

Transportation regulations governing size, mass, hazardous materials, etc. as set forth by state, regional or national authorities, and supplier/manufacturer recommendations shall be observed when shipping/transporting SSSV system equipment.

5.3.3 Redress

5.3.3.1 General requirements

Redressed SSSV system equipment shall be verified as having equivalent performance to that of the equipment in its original condition. The redressed equipment shall, as a minimum, conform to the edition of the applicable International Standard or equivalent national standard in effect at the time of manufacture. Redressed equipment is equipment which has been redressed with qualified part(s) which have been installed by qualified person(s) (see 3.12), with proper testing and documentation.

5.3.3.2 SSSVs

The redress of tubing-retrievable subsurface safety valves shall be limited to the replacement of seals such as tubing-thread seal rings, end subs, and control-line fittings or adapters which do not involve the breaking of a body-joint connection. If any body-joint connection involving the hydraulic or operating sections of the valve is broken, the procedure then becomes a repair process and shall be performed in accordance with ISO 10432.

The redress of wireline/TFL-retrievable subsurface safety valves shall be limited to the replacement of elastomeric and non-elastomeric seals, seal back-ups, wiper rings, and common hardware components such as pins or screws within the requirements for redress as defined in the manufacturer’s operating manual. If any pressure-containing connection involving the hydraulic or operating sections of the valve is broken, the connection shall be tested at its rated working pressure. If any other action is performed, the procedure then becomes a repair process and shall be performed in accordance with ISO 10432.

5.3.3.3 Locks

The redress of SSSV locks shall be limited to the replacement of qualified parts and common hardware components within the requirements of the manufacturer’s operating manual.

5.3.3.4 Inspection and evaluation

All SSSV system equipment undergoing redress operations shall be inspected and evaluated for any deterioration in condition and functionality. Any equipment needing more than the redress within the limits described above shall be repaired under the requirements of the applicable International Standard or equivalent national standard in effect at the time of the equipment manufacture or the current edition.

5.3.3.5 Reassembly

Reassembly of redressed SSSV system equipment shall be performed in accordance with the original equipment manufacturer’s requirements and instructions, including the use of any specialized assembly equipment and tools.

5.3.3.6 Test

Before re-running, all redressed SSSV system equipment shall be tested for mechanical and/or hydraulic functionality in accordance with the OEM operating manual.

5.4 Documentation and data control

5.4.1 General

The user/purchaser shall establish and maintain documented procedures to control all SSSV system equipment documents and data that relate to the requirements of this International Standard. These documents and data shall be maintained to demonstrate conformance to specified requirements. All documents and data shall be legible and shall be sorted and retained in such a way that they are readily retrievable in facilities that provide a suitable environment to prevent damage or deterioration and to prevent loss. Documents and data may be in any type of media, such as hard copy or electronic files.

5.4.2 Retained documentation

The user/purchaser (operator) shall retain documentation that provides objective evidence of conformance to the system configuration requirements of this International Standard. As a minimum, this documentation shall include operating manuals; product data sheets; maintenance records; test reports (pre- and post-installation and system) and all product-specific quality records.

All documentation shall be retained and available for a minimum of one year past the date of decommissioning of the equipment.

All records shall be signed by qualified personnel and provide the following information, as a minimum:

— date;

— well identification;

— time summary and operations performed, including depth, pressures and equipment involved;

— all system equipment installed, removed, replaced and/or redressed;

— all equipment lost or left in the hole, and any restriction not previously reported;

— information required to complete failure-analysis reports.

5.4.3 SSSV redress documentation

To maintain traceability requirements of redressed SSSV equipment, documentation shall include SSSV equipment serial number, parts replaced, traceability of redress parts, personnel or company performing the redress and the date of redress. A redress report form, including the minimum data as specified in Annex A, shall be completed with each product redress.

5.4.4 Failure reporting documentation

Failure reporting shall be conducted in accordance with Annex F.

Annex A
(normative)

SSSV Redress report
(minimum data requirements)

A.1 General data

Equipment manufacturer: ______________________________

Redress facility identification: ______________________________

Equipment name: ______________________________

SSSV Catalog or Model No. ______________ Serial No. ______________ Size: ______________

Redress items[2)] ______________________________

____

____

____

____

Customer: ______________________________

Redress Purchase Order No. ______________________________

Internal work order number: ______________________________

Test date: ______________ Shipment date: ______________

A.2 Redress test summary

A.2.1 SCSSVs

1. Opening pressures: Maximum: ______________ Minimum: ______________
2. Closing pressures: Maximum: ______________ Minimum: ______________
3. Leakage rate: at 100 % working pressure: ______________ at low pressure gas: ______________
4. Performed by: ______________ Date: ______________

A.2.2 SSCSVs

1. Closing flow rates/pressure differentials/tubing pressures: ______________
2. Orifice (bean) size: ______________
3. Number and length of spacers: ______________ Spring rate: ______________
4. Leakage rate: at 100 % working pressure: ______________ at low pressure gas: ______________
5. Performed by: ______________ Date: ______________

2) Include, if appropriate, information on safety valve lock manufacturer, type and serial number.

Annex B
(informative)

Installation

B.1 General

The following recommended installation practices are intended as guides and are not all-inclusive, but cover the most common systems in use. They also provide information that may be utilized in other systems. A recommended SSSV test procedure is included in Annex E. Inspection of new valves before installation is covered in 5.2.2.10. Installation requirements for specific valves shall be covered in the operations manual for the product.

B.2 Surface-controlled subsurface safety valve

B.2.1 Control line — Single completion

Step 1. Run the production tubing until SCSSV position is reached. At this point, it is imperative that the well be fully under control, since it may be difficult to seal around both tubing and control line with standard blowout preventers. As an added safety precaution, a planned procedure for cutting the control line and closing in the well should be provided. Special care should be taken to avoid excessive use of thread compound.

Step 2. Install safety valve landing nipple or tubing-retrievable valve with flow couplings if applicable.

Step 3. Prior to connection, flush control line with the required fluid to the specified cleanliness. Connect control line(s) to safety valve landing nipple or tubing-retrievable SCSSV. A control line designed to withstand the maximum anticipated operating and environmental conditions is required (follow manufacturer's operating manual to purge the tubing-retrievable SCSSV operating systems of air).

Step 4. Test control line(s) and connections. Zero leakage should be attained. The control fluid is critical and should be selected as described in 5.3.1.6.

The following procedures are recommended.

a) Wireline-retrievable: install dummy or block off control ports, if control ports are exposed to well fluid, and test to the rated working pressure of the system.

b) Tubing-retrievable: test to maximum pressure differential as recommended by the valve manufacturer's operating manual.

Step 5. Run tubing and control line(s). When running a TR-SCSSV, hold valve open with pressure according to the manufacturer's operating manual.

Precautions should be taken

a) to prevent entry of well-bore contaminants into the control system,

b) to detect leaks while running, and

c) to prevent damage to the control line(s).

To aid in achieving these objectives, maintain pressure in the control line(s) when running according to the manufacturer's operating manual.

Step 6. Affix the control line(s) to the tubing with at least one fastener or control-line protector (see 5.2.2.5) for each joint.

Step 7. Run tubing to bottom and space out.

Step 8. Install tubing hanger and connect control line(s) to wellhead outlets. At this point special care should be taken to follow the manufacturer's written instructions for installing the wellhead assembly and assuring pressure continuity of the control-line system.

Step 9. Pressure-test control line(s) in accordance with step 4 a) or step 4 b).

Step 10. The following procedures are recommended.

a) For wireline-retrievable installations, where the control port(s) are exposed to the wellbore fluid: pull dummy or open control ports and circulate a minimum of one (1) control-line volume. Do not leave control-line port open for prolonged periods; either install safety valve, reinstall dummy, close mandrel ports, or continuously pump small volumes of hydraulic fluid to keep foreign materials out of the control line.

b) For tubing-retrievable installations: test valve for proper operation as recommended by manufacturer.

B.2.2 Control line — Multiple completions

Step 1. Run long string until subsurface safety valve location is reached, and hang off long string.

Step 2. Run short string(s) and latch into multiple packer.

Step 3. Install safety valve nipples and flow couplings, where used, in all strings. Run strings simultaneously from this point. This procedure is recommended to avoid possible damage to the small control line(s).

Remainder of procedure is a repetition of B.2.1, step 3 through step 10.

An alternative procedure may be used if it is desired to space out the short string from measurements of long string space-out. This will minimize movement of tubing strings during final landing.

AltStep 1. Run long string, including SCSSV landing nipple and flow couplings, where used, to packer and space out.

AltStep 2. Pull out the hole until SCSSV landing nipple is reached and hung off (utilize long-string measurement for space-out of short string).

AltStep 3. Run short strings and latch into multiple packer. Procedure from this point is the same as given in B.2.1, step 3 through step 10.

B.3 Surface control system

B.3.1 Installation of the surface control system should be made in accordance with ISO 10418 for surface safety systems, in accordance with ISO 13703 for piping systems and in accordance with API RP 14F for electrical systems.

B.3.2 The surface control system should be installed in such a fashion that it does not interfere with nor is subject to damage by the normal production operations performed on the facility. The location of the control unit, while not critical to its operation, should be chosen for convenience and safety. The control unit enclosure should be weatherproof.

B.3.3 All functions, hydraulic, pneumatic or electric, should be tested for proper operation prior to the system's connection to the SCSSV. Hydraulic and pneumatic systems should be tested in accordance with manufacturer's recommended testing and operating procedures.

B.4 Subsurface-controlled subsurface safety valves — Application to multiple and single completions

B.4.1 Run tubing with safety valve landing nipple and flow couplings, where used, positioned at designed SSCSV installation depth.

B.4.2 Additional safety valve landing nipples with flow couplings, where used, may be desirable to allow alternative SSCSV placement.

B.4.3 Install the SSCSV in accordance with the manufacturer's procedures.

Annex C
(informative)

Operations

C.1 General

The following recommended operation practices are intended as guidelines and are not all-inclusive, but cover the most common systems in use. They also provide information that may be utilized in other systems. Inspection of new valves before installation is covered in 5.2.2.10. Requirements for installation and operation of specific valves should be covered in the operations manual for that product.

Surface-controlled valves utilize valve elements that are normally closed. This fail-safe mode requires that the valve be opened by a signal, in most cases hydraulic control-line pressure. Loss of this pressure results in the closing of the valve by its power-spring system. The hydraulic pressure to the valve is supplied from a remote control panel, which is a part of the overall SSSV system and managed by a safeguarding ESD (emergency shutdown) system.

During normal operations, the SSSV should not be closed due to routine operational upset; it should only be closed in the event of an ESD. Closure of the SSSV under full-flow conditions should be avoided, and therefore a delay should be incorporated in the ESD system such that the surface safety valve (SSV) system closes before the downhole valve. The opening sequence should be reversed on returning production facilities to normal operations. This delay mechanism shall be carefully analysed to ensure that it does not create additional hazards that render the system more vulnerable to failure.

C.2 Operation and testing

Because failure of a safeguarding system may not be obvious until the system is needed, it is important to check the instruments and the surface control system at defined intervals. Operation of the surface control system serves to keep all moving parts free and functioning properly, and leads to early detection of failures. Additionally, more frequent checks should be made of all gauges and other displayed controls. It is recommended that testing of the complete safeguarding system be carried out every six months unless local regulations, conditions and/or documented historical data indicate a different testing frequency.

Checking and testing should be carried out during

— normal operations, using maintenance override switches; shutdown valves should not be actuated during normal operations,

— scheduled shutdowns, which could be initiated by actuating an individual shutdown device to test the system as a whole,

— unscheduled shutdowns initiated by any other cause.

C.3 Recommendations and required documentation

The following should be available:

— full system documentation including alarm and shutdown diagrams, loop diagrams, etc.;

— a comprehensive and updated testing procedure;

- all equipment should be correctly and clearly identified (tagged, labeled);
- all parties involved in the testing should be qualified personnel and be familiar with the testing procedure.

Records should be kept of all trips and test results (including spurious trips and failures to trip when required). The combination of above-mentioned checks should cover a complete ESD system including initiating devices, logic units and shutdown valves.

C.4 Review and responsibilities of ESD system testing

The procedure for testing of safeguarding systems should be reviewed to take into account testing results and to assess system reliability.

Reviews should involve personnel from engineering, operations, maintenance and safety.

The person responsible for testing the safeguarding system components should sign the test record to indicate that all shutdown sensors and devices were satisfactorily checked, placed back in operation after testing, and overrides withdrawn.

C.5 Important information on system shutdown

No shutdown sensor or device in the safeguarding system should be left in the blocked or bypass position while the system or equipment that is being protected is in operation, unless full-time attendance is provided for the individual item of equipment on which the shutdown sensor or device is located.

It is strongly recommended to re-pressurize the tubing to the shut-in tubing pressure before opening any SCSSV, even if it has equalizing feature(s).

Annex D
(informative)

Sizing of subsurface-controlled safety valves

D.1 General

The following recommended sizing practices are intended as guidelines and are not all-inclusive, but cover the most common products in use.

Two SSCSV-type designs are generally available (either velocity-type or low-tubing-pressure-type). Velocity-type SSCSVs are designed to close when high well-effluent velocity causes a pressure differential across a bean in the valve in excess of the design differential chosen by the installer. Low-tubing-pressure-type SSCSVs are designed to close when tubing pressure drops below a pre-set level referenced by a pneumatically charged container in the SSCSV. It is recommended that the valve manufacturer be consulted regarding the specific design of SSCSVs provided.

D.2 Velocity-type SSCSV

The following general procedure is recommended to size the velocity-type SSCSV.

Step 1. Obtain a representative well test rate. See Form D.1.

Step 2. Calculate or measure the flowing bottomhole pressure for the producing conditions of step 1. A suitable vertical flow correlation should be used in making the calculation. If an SSCSV was installed during the test, the pressure drop across the bean (orifice) shall be calculated to determine the correct flowing bottomhole pressure.

Step 3. Calculate the well inflow performance from data obtained in step 1 and step 2. For oil wells, a PI or a Vogel [13] IPR should be calculated. The backpressure equation developed by Rawlins [11] for open-flow potential can be used for gas wells. Two or more different rate tests may be useful in determining the well inflow performance more accurately. Once the well inflow performance has been determined, flowing bottomhole pressures for other producing rates can be calculated.

Step 4. Select a bean size or a desired pressure drop for a particular make, type, model and size of velocity-type SSCSV. The bean size shall be small enough in diameter to create a sufficient pressure differential to close the SSCSV. In addition, the bean size should be sufficiently large in diameter to prevent excessive pressure drop, in order to minimize erosion/corrosion of tubing. The manufacturer's recommended ranges of pressure differentials should be followed for each size and model of velocity-type SSCSV. Caution shall be exercised if the bean diameter exceeds 80 % of the flow tube diameter, since the pressure-drop calculations are less reliable. For gas wells, the calculated flow rate through the bean shall not exceed the critical flow rate. To make reliable gas orifice calculations, the pressure drop through the bean should not normally exceed 15 % of the value of the pressure immediately under the SSCSV. Appropriate orifice coefficient and pressure-drop correlations for the SSCSV and bean should be obtained from the manufacturer.

Step 5. Select a closure-rate condition. The closure rate should be no greater than 150 % but no less than 110 % of the well test rate. For oil wells producing less than 63,6 m^3/day [400 barrels of fluid per day (BFPD)], the SSCSV may be designed to close at a rate no greater than 31,8 m^3/day (200 BFPD) above the well test rate. To avoid frequent nuisance closures and valve throttling, the closure rate shall be greater than the well test rate.

Step 6. Calculate the following for closure-rate conditions:

a) the flowing bottomhole pressure (use the well inflow performance obtained in step 3 to calculate this value);

b) the pressure immediately under the SSCSV (use a suitable vertical flow correlation);

c) the pressure drop or the bean size (use the appropriate orifice correlation);

d) the flowing tubing wellhead pressure. Under closure-rate flow conditions, the surface tubing pressure should exceed 345 kPa (50 psi). If the calculated surface tubing pressure is less than 345 kPa (50 psi), select a reduced closure rate and recalculate.

Step 7. Calculate the required SSCSV closing force. The manufacturer will provide data, when applicable, to obtain the needed spring compression — normally by use of spacers. A spring with a particular spring-rate shall be selected and compression shall be applied which will keep the valve open under the well test rate but permit closure at the calculated closure rate. Ensure that all requirements of step 4, step 5 and step 6 are met. If not, return to step 4 and select a different bean size or pressure drop.

D.3 Low-tubing-pressure-type SSCSV

D.3.1 General

The SSCSV that is actuated by a decrease in the tubing pressure can be used in flowing oil and gas wells and in continuous gas-lift wells. Low-tubing-pressure-type SSCSVs are not suitable for intermittent gas-lift wells. As with the velocity-type SSCSV, the well test rate and closure-rate conditions shall be known to properly size the low-tubing-pressure-type SSCSV. Some wells may require the running of a pressure survey to determine more accurately the flowing pressure at the SSCSV. The low-tubing-pressure-type SSCSV can be sized using the following recommended procedure.

D.3.2 Flowing oil and gas wells

Step 1. Obtain the well test rate.

Step 2. Calculate or measure the flowing pressure at the SSCSV depth and the flowing bottomhole pressure. Use an appropriate vertical flow correlation when making the calculations.

Step 3. Determine the well inflow performance. Use the same method given in step 3 for the velocity-type SSCSV.

Step 4. Determine the flowing temperature at the SSCSV. The temperature is required in order to properly size gas-pressure-charged-type SSCSVs. Normally a linear increase from the flowing surface temperature to the bottomhole static temperature is assumed.

Step 5. Select a closure-rate condition. The closure rate should be no greater than 150 % but no less than 110 % of the well test rate. For oil wells producing less than 63,6 m^3/day [400 barrels of fluid per day (BFPD)], the SSCSV may be designed to close at a rate no greater than 31,8 m^3/day (200 BFPD) above the well test rate. To avoid frequent nuisance closures and valve throttling, the closure rate shall be greater than the well test rate.

Step 6. Calculate the following for closure-rate conditions:

a) the flowing bottomhole pressure (use the well inflow performance obtained in step 3 to calculate this value);

b) the pressure at the SSCSV (use a suitable vertical flow correlation);

c) the flowing tubing wellhead pressure. The surface tubing pressure should exceed 345 kPa (50 psi) at closure-rate flow conditions. If the calculated flowing tubing wellhead pressure is less than 345 kPa (50 psi), select a reduced closure rate and recalculate.

Step 7. Set the low-tubing-pressure-type SSCSV to close at closure-rate condition. To avoid nuisance closures, the closure pressure should be at least 345 kPa (50 psi) less than the flowing pressure at valve depth.

D.3.3 Gas-lift oil wells

Step 1. Obtain the well test rate under gas-lifting producing conditions. Determine the injected gas volume and injection depths. Also, obtain a well test without gas injection. Form D.1 shows the required data.

Step 2. Determine the pressure at the SSCSV for the two well test rates obtained in step 1. Use a suitable vertical flow correlation when calculating the pressures. If the pressure at the SSCSV without gas injection is within 345 kPa (50 psi) or greater than the pressure for gas lifting conditions, the SSCSV is set too deep in the well or may not be suitable for use. Shallow settings of less than 305 m (1 000 ft) are frequently required.

Step 3. Size the low-tubing-pressure-type SSCSV to close at valve depth with a pressure (a) less than the well test rate pressure, and (b) greater than the producing rate pressure without gas injection (flowing). The closure pressure should be at least 345 kPa (50 psi) less than the normal operating pressure at the valve to prevent nuisance closures. A temperature adjustment as outlined in step 4 for flowing oil and gas wells is required for gas-pressure-charged valves.

Form D.1 — Sample sizing data form for subsurface-controlled subsurface safety valve

COMPANY ______________________________ DATE ______________________________

LOCATION ______________________________ LEASE AND WELL ______________________________

D.1 Well data — Oil wells

Oil production (gas-lift/flowing)	____________	m^3 OPD (BOPD)
Water production	____________	m^3 WPD (BWPD)
Gas/oil ratio	____________	m^3/m^3 (cf/bbl)
Separator pressure	____________	MPag (psig)
Flowing tubing head pressure	____________	MPag (psig)
Crude gravity	____________	API
Bubble point pressure	____________	MPag (psig)
Gas injection volume (gas-lift only)	____________	Mm^3/d (MMCF/D)
Depth of gas injection (gas-lift only)	____________	m (ft)

D.2 Well data — Gas wells

Gas production	____________	Mm^3/d (Bcf/d)
Condensate/gas ratio	____________	m^3/Mm^3 (bbl/Bcf)
Water/gas ratio	____________	m^3/Mm^3 (bbl/Bcf)
Flowing tubing head pressure	____________	MPag (psig)
Condensate gravity	____________	API
"*n*" Backpressure equation exponent	____________	

D.3 Completion and reservoir data

Depth of producing zone (TVD)	____________	m (ft)
Depth of SSSV (TVD)	____________	m (ft)
Tubing I.D.	____________	cm (in)
Static bottom hole pressure	____________	MPa (psi)
Flowing BHP	____________	MPa (psi)
Static bottom hole temperature	____________	°C (°F)
Flowing wellhead temperature	____________	°C (°F)

D.4 Standard assumptions: (oil/gas)

Separator gas gravity (0,7/0,6 w/Air = 1,0) ____________________

Water specific gravity (1,07/1,05) ____________________

Absolute pipe roughness (0,001 8/0,000 6) ____________________

Discharge coefficient of bean (0,85/0,90) ____________________

Standard pressure 0,101 325/0,101 325 (14.696/14.696) ____________________ MPa (psi)

Standard temperature 15,6/15,6 (60/60) ____________________ °C (°F)

D.5 Deviated hole data:

MD________ ,________, _______ ,_______ , _______ , ______ , _______ , _______ m (ft)

TVD _______ ,________, _______ ,_______ , _______ , ______ , _______ , _______ m (ft)

D.6 Existing SSSV data (where applicable)

Bean size ____________________ mm (in)

Valve code or flow tube I.D. ____________________

D.7 Sizing data

Valve code or valve type: (mfr. & description) ____

Bean size: (1) ________________ cm (in), (2)___________________ cm (in), (3) __________________ cm (in)

OR

Pressure differential: (1) _____________ MPa (psi), (2) _____________ MPa (psi), (3)_____________ MPa (psi)

Ratio of calculated closure rate to the tested production rate:

(1) ________________, (2) ______________ , (3) ______________ , (4) ______________ , (5) _____________

Annex E
(informative)

SSSV Testing

E.1 Procedure for testing installed surface-controlled subsurface safety valves — Standard depth

E.1.1 Record the control pressure.

E.1.2 Isolate the control system from the well to be tested.

E.1.3 Shut the well in at the wellhead.

E.1.4 Wait a minimum of 5 min. Check the control line for loss of pressure, which may indicate a leak in the system.

E.1.5 Bleed the control line pressure to zero to shut in the SCSSV. Close the control line system and observe for pressure buildup, which may indicate a faulty SCSSV system.

E.1.6 Bleed the pressure off the wellhead to the lowest practical pressure and then shut in the well at the wing or flow-line valve. When possible, bleed flow-line header pressure down to or below wellhead pressure and observe the flow-line and wellhead for a change in pressure, which would indicate a faulty surface valve. Any leaks through the wing or flow-line valve shall be repaired before proceeding with the test.

E.1.7 Conduct leakage test and document results. For gas wells, flow rates can be computed from pressure build-up by the following formulae.

$$q = 17\ 07 \left(\Delta \frac{p}{Z} \right) \left(\frac{1}{t} \right) \left(\frac{V}{T} \right) \qquad \text{(SI units)}$$

$$q = 2\ 122 \left(\Delta \frac{p}{Z} \right) \left(\frac{1}{t} \right) \left(\frac{V}{T} \right) \qquad \text{(USC units)}$$

where

$\left(\Delta \frac{p}{Z} \right)$ is the final pressure p_f divided by final Z_f minus initial pressure p_i divided by initial Z_i;

p is the pressure, in MPa (psi);

q is the leakage rate, m^3/h (SCF/hr);

t is the build-up time, in min, to reach a stabilized pressure;

V is the volume of the tubing string above the SSSV, in m^3 (ft^3);

T is the absolute temperature at the SSSV, ^{o}C + 273 (°F + 460);

Z is the compressibility factor.

For low-pressure applications, this formula may be simplified as follows:

$$q = \frac{5{,}81(\Delta p)V}{t} \quad \text{(SI units)}$$

$$q = \frac{4(\Delta p)V}{t} \quad \text{(USC units)}$$

E.1.8 For oil wells, the pressure build-up depends on the static fluid level and the amount of gas in the oil. If the fluid level is below the SCSSV, the formulae for gas wells (E.1.7) can be used. If the fluid level is above the SCSSV, the leakage rate should be measured.

E.1.9 If the SCSSV failed to close or if the leakage rate exceeds 0,43 m^3/min (15 SCF/min) gas, or 400 cm^3/min (13,5 oz/min) liquid, corrective action shall be taken.

E.1.10 After the SCSSV tests successfully, use the following recommended reopening procedures.

a) SCSSVs with equalizing features

1) with external pressure source.

Pressurize the tubing above the valve until the pump-through feature of the SCSSV functions to indicate the pressures are equalized. When equalized, slowly increase control-line pressure to the value recorded in step 1 or to the pressure established for normal operations.

2) without external pressure source.

With the well shut in, increase control pressure slowly until the tubing pressure begins to increase. Close the manifold control valve and record the opening pressure. When the tubing pressure stabilizes, pressurize the control system to open the SCSSV. Increase the hydraulic control-line pressure to the value recorded in step 1, or to at least 3,45 MPa (500 psi) greater than the opening pressure.

b) SCSSVs without equalizing features

An external pressure source should be used to equalize the pressure across the SCSSV before opening. When equalized, slowly increase control-line pressure to the value recorded in step 1 or to the pressure established for normal operations.

E.1.11 When the SCSSV has been determined to operate properly and is opened, reconnect the control line to the control system and place the well back on production. Check the well test rate. A significant reduction in the well test rate could be the result of the SCSSV not reopening fully.

E.2 Test procedure for installed surface-controlled subsurface safety valves — Deepwater installations

An alternative method for leak-off tests uses a fluid-packed chemical injection line as a sensor to transmit pressure change information from the tree to the host platform. Deepwater applications do not always yield conclusive results with the test duration commonly used; the subsea completion approach utilizing a direct hydraulic control system is the most effective means of accomplishing this task.

Flow in the line is controlled by an actuated valve at the tree (there are no check valves in the line downstream of the pressure recorder on the host platform). To test the USV, the valves on the tree are manipulated to create a test chamber between the USV and the other valve on the tree. For the SCSSV test, the chamber is formed between the wing valve (USV) and the SCSSV.

The procedure follows the methodology listed below.

a) USV test:

   1) close boarding valve (SDV) at host platform and allow flow line to pack;

   2) close USV (wing valve);

   3) close master valve;

   4) close SSSV;

   5) bleed 20 % or 3,45 MPa (500 psi), whichever is less, from the flow line to establish a differential across the USV;

   6) open the chemical injection control valve at the tree;

   7) monitor the test chamber between USV (wing valve) and master valve for pressure decay, i.e. USV allowing a leak from test chamber into flow line.

b) SCSSV test (immediately follows USV test):

   1) open USV;

   2) open master valve;

   3) close USV;

   4) monitor the test chamber between USV (wing valve) and the intermediate valve for pressure buildup; this allows a leak into the test chamber from below.

Using a liquid-packed line to monitor pressure changes in these chambers yields a conclusive result within 30 min, based on the formulae cited in E.1.7.

E.3 Test procedure for installed subsurface-controlled subsurface safety valves

E.3.1 Close the SSCSV using the method specified by the manufacturer in the appropriate operating manual.

E.3.2 Isolate the well from the flow line by shutting in at or near the wellhead.

E.3.3 Bleed any remaining pressure off the wellhead to the lowest practical pressure and then shut in the well at the wing or flow line valve. When possible, bleed flow line header pressure down to or below wellhead pressure and observe the flow line and wellhead for a change in pressure which would indicate a faulty surface valve. Any leaks through the wing or flow line valve must be repaired before proceeding with the test.

E.3.4 Conduct leakage test and document results. For gas wells, flow rates can be computed from pressure build-up by the formulae given in E.1.7.

E.3.5 For oil wells, the pressure build-up depends on the static fluid level and the amount of gas in the oil. If the fluid level is below the SSCSV, the formulae for gas wells (see E.1.7) can be used. If the fluid level is above the SSCSV, the liquid leakage rate should be measured.

E.3.6 If the SSCSV failed to close or if the leakage rate exceeds 0,43 m^3/min (15 SCF/min) gas, or 400 cm^3/min (13,5 oz/min), corrective action shall be taken.

E.3.7 After the SSCSV tests successfully, open the SSCSV using the procedure specified by the manufacturer in the appropriate operating manual. The well is now ready to be put back on production.

Annex F
(normative)

Failure reporting

F.1 Failure reporting

The operator of SSSV equipment manufactured to this International Standard shall provide to the manufacturer a written report of equipment failure. The failure report shall 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 shall be performed and the results documented.

The operator's options for performing failure analysis on failed equipment shall 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/receiving report, the operator shall return the equipment to the equipment manufacturer for the failure analysis;

or

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

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

The manufacturer shall respond in accordance with the failure reporting requirements of ISO 10432.

F.2 Minimum information

The failure report should include, as a minimum, the information included in Table F.1.

Table F.1 — Failure report — Subsurface safety valve equipment (minimum data)

Operator data	**Manufacturer data** (completed on receipt of equipment)
I Identification – Operator — Operator — Date — Field and/or area — Lease name and well number	I. Failed equipment condition — Condition as received — Failed components — Damaged components

II. SSSV equipment identification
— SSSV ______; SSV landing nipple ______ ; SSSV lock _______
  — Equipment mfr.
  — Model
  — Tubing retrievable ___________
  — Wireline retrievable __________
  — SCSSV retrievable __________
  — SSCSV retrievable __________
— Serial number
— Working pressure
— Nominal size
— Service class
  — Class 1 only
  — Class 1 and class 2
  — Class 3
  — Class 4
— Redress history records
	II. Test results
	— Furnished by operator and/or conducted by manufacturer
	— Failure mode
	— Leakage rate
	— Control fluid
	— Operational data (opening and closing pressures, etc.)
	
	III. Cause of failure
	— Probable cause
	— Secondary cause

III. Well data
— Well test rate
— Environmental conditions
  — Percent sand
  — H_2S
  — CO_2
— Pressures and temperatures
  — Surface
  — Bottom hole
— SSSV equipment setting depth
— SSSV equipment installation date
— Time equipment in service
— Unusual operating conditions
	IV. Repair and maintenance
	— Parts replaced
	— Other maintenance or repair
	
	V. Corrective action to prevent recurrence
	— Operator procedures
	  — Design/material change
	  — Proper equipment application

IV. Description of failure — Nature of failure — Observed conditions which could have caused failure	VI. Additional information — Facility location where failed valve was originally manufactured — Date of manufacture
V. Operator's signature and date	VII. Manufacturer's signature and date — Completed report to be transmitted to operator with copy retained

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