INTERNATIONAL STANDARD

ISO 10432

First edition
1993-12-15

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

Industries du pétrole et du gaz naturel — Vannes de protection de fond de puits — Spécifications

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Reference number
ISO 10432:1993(E)

Foreword

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

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

International Standard ISO 10432 was prepared by the American Petroleum Institute (API) (as Spec 14A, 8th edition) and was adopted, under a special "fast-track procedure", by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum and natural gas industries*, in parallel with its approval by the ISO member bodies.

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Introduction

International Standard ISO 10432:1993 reproduces the content of API Spec 14A, 8th edition, 1994. ISO, in endorsing this API document, recognizes that in certain respects the latter does not comply with all current ISO rules on the presentation and content of an International Standard. Therefore, the relevant technical body, within ISO/TC 67, will review ISO 10432:1993 and reissue it, when practicable, in a form complying with these rules.

This standard is not intended to obviate the need for sound engineering judgement as to when and where this standard should be utilized and users of this standard should be aware that additional or differing requirements may be needed to meet the needs for the particular service intended.

Standards referenced herein may be replaced by other international or national standards that can be shown to meet or exceed the requirements of the referenced standards.

Appendices A, B and C form an integral part of this standard.

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

1 Scope

This International Standard provides the minimum acceptable requirements for subsurface safety valve equipment, and all components that establish tolerances and/or clearances which may affect performance or interchangeability of such equipment.

2 Requirements

Requirements are specified in:

"API Specification 14A (Spec 14A), Eighth Edition, January 1, 1994 — *Specification for Subsurface Safety Valve Equipment*",

which is adopted as ISO 10432.

For the purposes of international standardization, however, modifications shall apply to specific clauses and paragraphs of publication API Spec 14A. These modifications are outlined below.

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Information given in the POLICY is relevant to the API publication only.

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Subclause 1.4, Referenced standards

API standards referenced in table 1.1 and listed hereafter are available under the following ISO references:

API RP 14B as ISO 10417
API Spec 5CT as ISO 11960 (at present under study)
API Std 5B as ISO 10422

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Appendix A – Metric conversion

Throughout publication API Spec 14A, the conversion of English units shall be made in accordance with ISO 31. The content of Appendix A shall read as given below.

LENGTH	1 inch (in)	= 25,4 mm (exactly)
	1 foot (ft)	= 304,8 mm or 0,304 8 m (exactly)

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PRESSURE	1 pound-force per square inch (lbf/in^2) or psi NOTE 1 bar = 10^5 Pa	= 6,894 757 Pa
STRENGTH OR STRESS	1 pound-force per square inch (lbf/in^2)	= 6,894 757 Pa
IMPACT ENERGY	1 foot-pound force (ft·lbf)	= 1,355 818 J
TORQUE	1 foot-pound force (ft·lbf)	= 1,355 818 N·m
TEMPERATURE	The following formula was used to convert degrees Fahrenheit (°F) to degrees Celsius (°C): °C = 5/9 (°F − 32)	
MASS	1 pound (lb)	= 0,453 592 37 kg (exactly)
VOLUME	1 cubic foot (ft^3)	= 0,028 316 85 m^3 or 28,316 85 dm^3
FLOW RATE	1 cubic foot per minute (ft^3/min)	= 0,028 316 85 m^3/min or 40,776 192 m^3/day

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Appendix D – Test agency license criteria

Information given in Appendix D is relevant to the API publication only.

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Specification for Subsurface Safety Valve Equipment

API SPECIFICATION 14A (SPEC 14A)
EIGHTH EDITION, JANUARY 1, 1994

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Users of this publication should become familiar with its scope and content. This publication is intended to supplement rather than replace individual engineering judgment.

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FOREWORD

This standard was developed as an API specification under the jurisdiction of the API Exploration & Production Department Committee on Standardization of Offshore Safety and Anti-Pollution Equipment (OSAPE), and was prepared with the guidance of the API, the Offshore Operators Committee (OOC) and the Western States Petroleum Association (WSPA).

The API OSAPE Committee has the following scope:

API specifications and recommended practices for safety and anti-pollution equipment and systems used in offshore oil and gas production, giving emphasis when appropriate in such standards to manufacturing, equipment testing and systems analysis methods.

Other publications formulated by this committee are:

RP 14B, *Recommended Practice for Design, Installation, Repair and Operation of Subsurface Safety Valve Systems.*

RP 14C, *Recommended Practice for Analysis, Design, Installation and Testing of Basic Surface Safety Systems on Offshore Production Platforms.*

Spec. 14D, *Specification for Wellhead Surface Safety Valves and Underwater Safety Valves for Offshore Service.*

RP 14E, *Recommended Practice for Design and Installation of Offshore Production Platform Piping Systems.*

RP 14F, *Recommended Practice for Design and Installation of Electrical Systems for Offshore Production Platforms.*

RP 14G, *Recommended Practice for fire Prevention and Control on Open Type Offshore Production Platforms.*

RP 14H, *Recommended Practice for Use of Surface Safety Valves and Underwater Safety Valves Offshore.*

RP 14J, Recommended Practice for Design and Hazards Analysis for Offshore Production Facilities.

This is the Eighth Edition of this publication and supersedes all previous editions. It includes changes to the Seventh Edition approved by letter Ballot.

Request for interpretations of this specification, proposed revisions, or requests for permission to reproduce or translate all or any part of the material herein should be addressed to the Director, Exploration & Production Department, 1201 Main Street, Suite 2525, Dallas, TX 75202-3994.

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

API specifications usually include bar notations in the margins to indicate items that have been changed from the previous edition. These bar notations have not been included in this document due to the extensiveness of the changes made. Every section of this document includes changes from the previous edition.

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SECTION 1
SCOPE

1.1 PURPOSE

1.1.1 This specification was formulated to provide the minimum acceptable requirements for Subsurface Safety Valve (SSSV) Equipment.

1.1.2 To be qualified in accordance with this specification, SSSV Equipment shall meet all the applicable requirements of this specification.

1.2 COVERAGE. This specification 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.

1.3 CLASS OF SERVICE. SSSV Equipment manufactured in accordance with this specification 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 must 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 must 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 for chloride stress cracking service. Metallic materials, suitable for a 3S environment, shall be in accordance with NACE MR0175.

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 must meet the requirements for Class 1 or Class 2 and be manufactured from materials which are resistant to weight loss corrosion.

1.4 REFERENCED STANDARDS. This specification includes by reference, either in total or in part, other API, industry and government standards listed in Table 1.1. Where cited these requirements are mandatory. Referenced standards used by the Manufacturer may be either the applicable revision shown in Table 1.1 or the latest revision.

1.5 APPENDICES. Appendices are for information only.

1.6 ABBREVIATIONS AND DEFINITIONS. The following abbreviations and definitions are used in this specification:

AISI	— American Iron & Steel Institute
ANSI	— American National Standards Institute
API	— American Petroleum Institute
AQL	— Acceptance Quality Level
ASME	— American Society of Mechanical Engineers
ASTM	— American Society for Testing and Materials
BEAN	— The orifice or designed restriction causing the pressure drop in velocity type SSCSVs.
BS	— British Standards
CHLORIDE STRESS CORROSION CRACKING	— Cracking under the combined action of tensile stress and corrosion in the presence of chlorides and water.
END CONNECTION	— SSSV Equipment/Tubular connecting interface.
FAILURE	— Any condition of SSSV Equipment that prevents it from performing the design function.
FUNCTIONAL TEST	— Testing performed to confirm proper operation of SSSV Equipment.
MANUFACTURER	— The principal agent in the design, fabrication and furnishing of SSSV Equipment who chooses to comply with this specification.
MIL-STD	— Military Standard
MODEL	— SSSV Equipment with unique internal part(s) and operating characteristics which differentiate it from other SSSV Equipment of the same type. It may have any of a variety of end connections.
NACE	— National Association of Corrosion Engineers
NDE	— Nondestructive Examination
OPERATING MANUAL	— The publication issued by the Manufacturer which contains detailed data and instructions related to the design, installation, operation and maintenance of SSSV Equipment.

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OPERATOR — The user of SSSV Equipment.

SAE-AS — Society of Automotive Engineers, Inc. - Aerospace Standard

SCSSV — A Surface Controlled Subsurface Safety Valve is an SSSV controlled from the surface.

SNT — Society for Nondestructive Testing

SSCSV — A Subsurface Controlled Subsurface Safety Valve is an SSSV actuated by the characteristics of the well.

SSSV — A Subsurface Safety Valve is a device whose design function is to prevent uncontrolled well flow when closed. 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).

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.

STRESS CORROSION CRACKING — Cracking which results from a combination of corrosion and stress when susceptible materials are exposed to specific corrosive media.

SULFIDE STRESS CRACKING — Cracking under the combined action of tensile stress and corrosion in the presence of water and hydrogen sulfide.

SV LOCK — A Safety Valve Lock is a device attached to or a part of the SSSV that holds the SSSV in place.

SVLN — A Safety Valve Landing Nipple is a receptacle with internal sealing surfaces in which an SSSV may be installed. 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.

TEST AGENCY — Any independent third party which provides a test facility and administers a testing program that meets the Verification Test requirements of this specification.

TYPE — SSSV Equipment with unique characteristics which differentiate it from other SSSV Equipment. The SCSSV, the Velocity Type SSCSV and the Low Tubing Pressure Type SSCSV are examples of SSSV types.

VERIFICATION TEST — Testing performed to qualify a particular size, type and model of SSSV Equipment for a specific Class of Service.

WEIGHT LOSS CORROSION — Loss of metal in areas exposed to fluids which contain water or brine and carbon dioxide (CO_2), or hydrogen sulfide (H_2S), oxygen (O_2) or other corrosive agents.

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TABLE 1.1
REFERENCED STANDARDS

Applicable Revision At Publication*

1.	ASME SPPE-2	'91
2.	API RP 13B1	'90
3.	API RP 14B, 3rd ed	1/1/90
4.	API SPEC 5CT, 3rd ed	12/1/90
5.	API Std 5B, 13th (6/1/90 Supplement)	5/31/88
6.	ASME, B & PV, Sect. V (12/31/89 and 12/31/90 Supplements)	'89
7.	ASME, B & PV, Sect. VIII (12/31/89 and 12/31/90 Supplements)	'89
8.	ASME, B & PV, Sect. IX (12/31/89 and 12/31/90 Supplements)	'89
9.	ASTM A 370-90	'90
10.	ASTM A 388/A 388M-86	'86
11.	ASTM A 609/A 609M-86a	'86
12.	ASTM D 395-89	'89
13.	ASTM D 412-87	'87
14.	ASTM D 1414-78	Reapproved '87
15.	ASTM D 1415-88	'88
16.	ASTM D 2240-86	'86
17.	ASTM E 94	'84
18.	ASTM E 165-80	Reapproved '83
19.	ASTM E 186-84	Reapproved '89
20.	ASTM E 280-84	Reapproved '89
21.	ASTM E 428-71	Reapproved '85
22.	ASTM E 446-84	Reapproved '89
23.	ASTM E 709-80	Reapproved '85
24.	MIL-H-6875H	3/1/89
25.	MIL-STD-105E	'86
26.	MIL-STD-413C	'87
27.	MIL-STD-45662	'88
28.	NACE MR0175-92	'92
29.	SAE-AS-568A	'84
30.	SNT-TC-1A	'88
31.	API Manual of Petroleum Measurement Standards, Chapter 10.4	May '88
32.	MIL-HANDBOOK 5E CHANGE NOTICE 2 5/1/89	'87
33.	BS-M54:1982	'82
34.	API Manual Of Petroleum Measurement Standards, Chapter 15	Reapproved Aug. '87
35.	ISO/IEC Guide 25-1982	'82
36.	API SPEC Q1, 4TH ED.	'92
37.	API BUL S1, 17TH ED.	'92
38.	API Composite List Of Manufacturers Licensed For Use Of The API Monogram, 7TH ED.	'92

*Latest revision may be used.

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SECTION 2
DESIGN REQUIREMENTS

2.1 DESIGN REQUIREMENTS

2.1.1 Drawings, manufacturing specifications and the Verification Test results shall be retained by the Manufacturer for a period of ten years after SSSV's of that size, model and type are discontinued from the Manufacturer's product line. SSSV Equipment conforming to this specification shall be manufactured to drawings and specifications that are substantially the same as those of the SSSV Equipment that has passed the Verification Test.

2.1.2 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, API and other pertinent requirements upon which the design is based. Design documentation shall be clear, legible, reproducible, and retrievable.

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

2.1.4 Changes to the SSSV Equipment which may affect performance or interchangeability shall require requalification, except seals that have passed the applicable Verification Testing requirements of Section 5 are considered interchangeable among the SSSV Equipment of any one Manufacturer for a particular class of service.

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

2.3 DESIGN CONSIDERATIONS

2.3.1 Measurement Units shall be English units and SI units. Appendix A contains the formulas used for English to SI conversion in this document.

2.3.2 The Manufacturer shall establish rated working pressures of SSSV Equipment within the requirements of this specification. These rated working pressures are commonly: 3,000, 5,000, 6,000, 10,000 and 15,000 psi. (207, 345, 414, 690 and 1035 Bar). 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.

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

2.3.4 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 physical properties shall be in accordance with ASME Boiler and Pressure Vessel Code Section VIII or Military Handbook 5E.

2.3.5 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 with oil and gas production.

TABLE 2.1
STANDARD SAFETY VALVE LANDING NIPPLES

Nominal Nipple Size[1] Inches(mm)	Tubing or Casing Size[2] Inches(mm)	Sealing Surface ID Inches(mm)	Sealing Surface Tolerance[3] Inches(mm)
1 1/4 (31.8)	1.66 (42.2)	1.250 (31.75)	+.010 (+0.25) -.000 (-0.00)
1 1/2 (38.1)	1.90 (48.3)	1.500 (38.10)	+.010 (+0.25) -.000 (-0.00)
1 3/4 (44.5)	2.063(52.4)	1.625 (41.28)	+.010 (+0.25) -.000 (-0.00)
2 (50.8)	2 3/8 (60.3)	1.875 (47.63)	+.010 (+0.25) -.000 (-0.00)
2 1/2 (63.5)	2 7/8 (73.0)	2.312 (58.72)	+.010 (+0.25) -.000 (-0.00)
3 (76.2)	3 1/2 (88.9)	2.812 (71.42)	+.010 (+0.25) -.000 (-0.00)
3 1/2 (88.9)	4 (101.6)	3.313 (84.15)	+.010 (+0.25) -.000 (-0.00)
4 (101.6)	4 1/2 (114.3)	3.812 (96.82)	+.010 (+0.25) -.000 (-0.00)
4 1/2 (114.3)	5 (127.0)	4.125 (104.78)	+.010 (+0.25) -.000 (-0.00)
5 (127.0)	5 1/2 (139.7)	4.562 (115.87)	+.010 (+0.25) -.000 (-0.00)
6 (152.4)	7 (177.8)	5.963 (151.46)	+.010 (+0.25) -.000 (-0.00)

[1] *Only sealing surface ID is specified in this table, and only standard size landing nipple dimensions are shown.*

[2] *API Spec 5CT tubing or casing outside diameters on which the nipples are to be run.*

[3] *O-ring applications require reduced tolerance to +.005/-.000(+0.13/-0.00 mm).*

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2.3.6 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 improper interchangeability.

2.3.7 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.

2.3.8 Internal diameters and tolerances for standard size SVLN's are listed in Table 2.1. External diameters and tolerances for standard size Wireline Retrievable SSSV's are listed in Table 2.2. The Manufacturer may establish other dimensions and tolerances.

2.4 VERIFICATION TEST. SSSVs, SV Locks, SVLNs and seals shall pass the applicable Verification Test specified in Section 5.

TABLE 2.2
STANDARD OUTSIDE DIAMETERS
WIRELINE RETRIEVABLE SUBSURFACE SAFETY VALVES

Nominal SSSV Size		Standard Valve OD[1]	
Inches	(mm)	Inches	(mm)
1 1/4	(31.8)	1.240	(31.50)
1 1/2	(38.1)	1.490	(37.85)
1 3/4	(44.5)	1.615	(41.02)
2	(50.8)	1.865	(47.37)
2 1/2	(63.5)	2.302	(58.47)
3	(76.2)	2.802	(71.17)
3 1/2	(88.9)	3.303	(76.96)
4	(101.6)	3.802	(96.57)
4 1/2	(114.3)	4.115	(104.52)
5	(127.0)	4.552	(115.62)
6	(152.4)	5.953	(151.21)

[1] *OD tolerances shall be +.000/-.100(+0.00/-2.54 mm).*

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SECTION 3
MATERIALS

3.1 GENERAL. The manufacturer shall have written specifications for all material used in SSSV Equipment. The manufacturer shall select all material to be suitable for Class of Service designation 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 specification.

Seals that have passed the applicable Verification Test requirements of Section 5 are considered interchangeable among the SSSV Equipment of any one Manufacturer for a particular Class of Service.

3.2 METALS

3.2.1 The Manufacturer 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

3.2.2 The mechanical properties shall be verified by tests conducted on material samples from a heat treat or other appropriate heat treat batch lot basis for traceable metal components of SSSV Equipment. Material test reports provided by the material supplier or Manufacturer are acceptable.

3.2.3 Each traceable component subjected to processing that may change the properties subsequent to the lot test described in Section 3.2.2 shall be hardness tested after processing.

3.2.4 Each welded component shall be stress relieved 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.

3.3 NON-METALS

3.3.1 The Manufacturer shall have written procedures and documentation of testing for sealing materials to the limits for which SSSV Equipment is rated.

3.3.2 The Manufacturer's written specifications for elastomeric compounds shall define:

1. Compound type

2. Physical properties as a minimum;

a. Tensile strength

b. Elongation

c. Modulus

3. Compression set

4. Durometer

3.3.3 Manufacturer's written specifications shall include handling, storage, and labeling requirements including cure date, batch number, compound identification and shelf life appropriate for each compound.

3.4 TRACEABILITY

3.4.1 All components, weldments, subassemblies and assemblies of SSSV Equipment shall be traceable except:

a. Springs for SSCSV

b. Beans for SSCSV

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

3.4.2 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.

3.4.3 Traceability for SSSV Equipment, except SSSV's, is considered sufficient if it meets the requirements of this specification when it leaves the original Manufacturer's inventory.

3.4.4 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.

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SECTION 4
QUALITY CONTROL REQUIREMENTS

4.1 This section provides minimum quality control requirements to meet this specification. All quality control work shall be controlled by documented instruction which includes acceptance criteria.

4.2 DOCUMENTATION RETENTION. Required documentation for Quality Control work shall be retained for a minimum of five years from the date of origination.

4.3 PERSONNEL QUALIFICATIONS

4.3.1 Personnel performing NDE shall be qualified in accordance with ASNT: Recommended Practice SNT TC-1A, Level II minimum for evaluation and interpretation.

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

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

4.4 CALIBRATION SYSTEMS

4.4.1 Measuring and testing equipment used for acceptance shall be identified, controlled, calibrated and adjusted at specified intervals in accordance with written specifications, MIL-STD 45662 and this specification.

4.4.2 Pressure Measuring Devices shall:

a. Be readable to at least +/- 0.5% of full scale range.

b. Be calibrated to maintain +/- 2% accuracy of full scale range.

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

4.4.4 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.

4.4.5 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, degree of usage and documented calibration history.

4.5 ELASTOMERIC MATERIALS INSPECTION

4.5.1 Sampling procedures, and the basis for acceptance or rejection of a batch lot, shall be in accordance with MIL STD 105E, 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.

4.5.2 Visual Inspection of O-Rings shall be in accordance with MIL STD 413C. Other packing elements shall be visually inspected in accordance with the Manufacturer's documented specifications.

4.5.3 Dimensional tolerances of O-Rings shall be in accordance with SAE -AS- 568A or equivalent. Other packing elements shall meet dimensional tolerances of the Manufacturer's written specifications.

4.5.4 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.

4.6 DIMENSIONAL INSPECTION. All Traceable Components, except elastomeric seals must be dimensionally inspected to assure proper function and compliance with design specifications and drawings.

4.7 THREAD INSPECTION

4.7.1 All API tapered thread tolerances, inspection requirements, gaging, gaging practice, gage calibration and gage certification shall be in accordance with API STD 5B.

4.7.2 All other thread tolerances, inspection requirements, gage, gage practice, gage calibration and gage certification shall conform to written specifications.

4.8 WELDING AND BRAZING

4.8.1 Welding and Brazing Procedure and Personnel Qualification shall be in accordance with ASME Boiler and Pressure Vessel Code Section IX.

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

4.9 HEAT TREATING EQUIPMENT QUALIFICATION

4.9.1 Furnace Calibration

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

b. Each furnace shall be surveyed within one year prior to heat treating operations. When a furnace is repaired or rebuilt, a new survey shall be required before heat treating.

c. Batch type and continuous type heat treating furnaces shall be calibrated in accordance with one of the following procedures:

1. Procedures specified in MIL-H-6875H, Process for Heat Treatment of Steel, Section 3.

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2. Procedures specified in British Standard M54:1982, Specification for Temperature Control in the Heat Treatment of Metals, Section 5.

3. Manufacturer's written specifications including acceptance criteria which are not less stringent than the procedures identified above.

4.9.2 Instruments

a. Automatic controlling and recording instruments shall be used.

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

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

d. Temperature controlling and recording instruments shall be calibrated at least once every three (3) months until a documented calibration history can be established. Calibration intervals shall then be established based on repeatability, degree of usage and documented calibration history.

e. Equipment used to calibrate the production equipment shall possess an accuracy of +/- 0.25% of full scale range.

4.10 COATINGS AND OVERLAYS. Coatings and Overlays shall be controlled by documented instructions which include acceptance criteria.

4.11 MECHANICAL AND PHYSICAL PROPERTIES (Where required by this Specification)

4.11.1 Mechanical property and hardness test procedures and practices shall be in accordance with ASTM A370 for the metallic materials used for traceable components.

4.11.2 Physical Property and Hardness test procedures for Elastomeric compound types shall be in accordance with:

a. Tensile, Elongation, Modulus.

1. O-Rings — ASTM D1414
2. All others — ASTM D412

b. Compression Set

1. O-Rings — ASTM D1414
2. All others — ASTM D395

c. Durometer Hardness

1. O-Rings — ASTM D1415
2. All others — ASTM D2240

4.12 NDE REQUIREMENTS

4.12.1 All NDE instructions shall be approved by a Level III Examiner.

4.12.2 All Power Springs shall be Magnetic Particle or Liquid Penetrant inspected to verify conformance with the Manufacturers' written specifications.

4.12.3 All weldments shall be Magnetic Particle, Liquid Penetrant, Radiographic or Ultrasonic Inspected, to verify conformance with the Manufacturers' written specifications.

4.12.4 Castings and Forgings shall be Magnetic Particle, Liquid Penetrant, Radiographic or Ultrasonic Inspected to verify conformance with the Manufacturers' documented specifications. The Manufacturer may develop AQL Inspection Levels based on documented variation history.

4.12.5 NDE Methods and Acceptance Criteria.

a. Liquid penetrant

1. Method — ASTM E165
2. Acceptance Criteria — ASME Boiler and Pressure Vessel Code, Section VIII, Pressure Vessels, Division 1, Appendix 8.

b. Wet magnetic particle examination

1. Method — ASTM E709
2. Definitions:

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

b. Linear Indication — Any indication in which the length is equal to or greater than three times its width.

c. Rounded Indication — Any indication which is circular or elliptical with its length less than 3 times the width.

3. Acceptance Criteria —

a. Any relevant indication 3/16 in. or greater is unacceptable. No relevant linear indications are allowed for weldment.

b. No more than 10 relevant indications in any 6 sq. in. area.

c. Four (4) or more rounded relevant indications in a line separated by less than 1/16 in. are unacceptable.

c. Ultrasonic Inspection — Weldments

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

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2. Acceptance Criteria — ASME Boiler and Pressure Code, Section VIII, Pressure Vessel, Division 1, Appendix 12.

d. Ultrasonic Inspection — Castings

1. Method — ASTM E428: Standard Recommended Practice for Fabrication and Control of Steel Reference Blocks used in Ultrasonic Inspection.

ASTM A609: Standard Specification for Longitudinal-Beam Ultrasonic Inspection of Carbon and Low-Alloy Steel Castings.

2. Acceptance Criteria — ASTM A609: Standard Specification for Longitudinal-Beam Ultrasonic Inspection of Carbon and Low-Alloy Steel Castings. Ultrasonic Testing Quality Level 1, minimum.

e. Ultrasonic Inspection — Forgings and Wrought Products

1. Method — ASTM E428: Standard Recommended Practice for Fabrication and Control of Steel Reference Blocks used in Ultrasonic Inspection.

ASTM A388: Standard Recommended Practice for Ultrasonic Examination of Heavy Steel Forgings.

2. Calibration:

(a.) 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.

(b.) Flat Bottom Hole Technique — Distance Amplitude Curve (DAC) based on 1/8 in. (3.2 mm) flat bottom hole through 4 in. (101.6 mm) of metal and 1/4 in. (6.4 mm) flat bottom hole for metal distances exceeding 4 in. (101.6 mm).

(c.) Angle Beam Technique — Distance Amplitude Curve (DAC) shall be based on a notch of a depth equal to the lesser of 3/8 in. (9.5 mm) or 3% of the normal section thickness 3/8 in. maximum (9.5 mm), a length of approximately 1 in. (25.4 mm) and a width not greater than twice its depth.

3. Acceptance Criteria — The following forging or wrought product defects are rejectable.

(a.) Back Reflection Technique — Indications greater than 50% of the referenced back reflection accompanied by a complete loss of back reflection.

(b.) Flat Bottom Hole Technique — Indications equal to or larger than the indications observed from the calibration Flat Bottom Hole.

(c.) Angle Beam Technique — Amplitude of the discontinuities exceeding those of the reference notch.

f. Radiographic Inspection — Weldments

1. Method — ASTM E94: Standard Recommended Practice for Radiographic Testing.

2. Acceptance Criteria — ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, Pressure Vessel, UW-51.

g. Radiographic Inspection — Castings

1. Method — ASTM E94: Standard Recommended Practice for Radiographic Testing.

2. Acceptance Criteria —

(a.) ASTM E186: Standard Reference Radiographs for Heavy-Walled (2-4 1/2 in.) (51 mm to 114 mm) Steel Casting.

(b.) ASTM E280: Standard Reference Radiographs for Heavy-Walled (4 1/2 to 12 in.) (114 mm to 305 mm) Steel Castings.

(c.) ASTM E446: Standard Reference Radiographs for Steel Casting up to 2 in. (51 mm) thickness. Maximum defect classification as follows:

TYPE DEFECT	MAXIMUM DEFECT CLASS
A	3
B	2
C	2 (All Types)
D	None Acceptable
E	None Acceptable
F	None Acceptable
G	None Acceptable

h. Radiographic Inspection — Forgings

1. Method — ASTM E94: Standard Recommended Practice for Radiographic Testing.

2. Acceptance Criteria — The following defects are rejectable.

(a.) Any type of crack or lap

(b.) Any other elongated indication with length greater than:

1/4 inch (6.4 mm) for t up to 3/4 inch (19 mm) inclusive.

1/3 t from 3/4 inch (19 mm) up to 2 1/4 inch (57.2 mm).

3/4 inch (19 mm) for t over 2 1/4 inch (57.2 mm).

Where 't' is the pressure vessel wall thickness.

(c.) Any group of indications in a line that have an aggregate length greater than 't' in a length of 12t.

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SECTION 5
TESTING

5.1 GENERAL. The SSSVs, SV Locks and SVLNs produced in accordance with this specification shall be constructed of materials in compliance with this specification and pass the Verification and Functional Tests required by this section.

5.1.1 The API testing requirements are not represented as well conditions.

5.1.2 During Verification Testing of hydraulically operated SSSV's, control line fluid metering shall be used to provide a readable hydraulic control line pressure trace, unless otherwise specified. Refer to Figure 5.6 for a characteristic pressure versus time plot for opening and closing hydraulic control pressures with hydraulic fluid being applied at a metered rate.

5.1.3 All pressures are defined as gage unless otherwise specified.

5.1.4 All test conditions without a specified tolerance shall be considered minimum values. The maximum values shall not exceed 10% above the minimum value.

5.1.5 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.

5.1.6 With mutual consent between the Test Agency and the Manufacturer, higher flow rates may be applied and used for all flow tests.

5.1.7 The objectives of the testing requirements of this section 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 specification is:

a. 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.

b. Functional Testing for each SSSV.

c. Functional and Verification Testing for SVLN(s).

d. Functional and Verification Testing for SV Lock(s).

5.2 VERIFICATION TESTING

5.2.1 General

a. Verification Testing to qualify an SSSV for Class 1 or combined Class 1 and Class 2 service must be performed by a Test Agency.

b. Verification Testing for SV Locks, SVLNs and all seals shall be performed by the Manufacturer or a Test Agency.

5.2.2 Manufacturer Requirements

The Manufacturer shall submit a SSSV of most recent manufacture for Verification Testing. Such testing shall qualify SSSVs of the same size, type and model as the tested SSSV which are manufactured during the three year period subsequent to the date the Verification Test form is approved by the Test Agency.

a. The test section shall completely enclose the wireline retrievable SSSV. Tubing retrievable SSSV's 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.

5.2.3 Verification Testing Requirements

a. The Manufacturer must declare that a 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 Table 5.1.

1. A Manufacturer may submit a SSSV for Class 1 or Class 1 and 2 testing. For combined testing, a SSSV passing both portions of the test will be qualified for both Class 1 and Class 2 service. A SSSV passing the Class 1 portion, but failing the Class 2 portion of the combined test, will 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 specification, 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 specification.

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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 specification shall be recorded on the Verification Test Data Summary Form (Table 5.16) 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 must 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 contain the data specified in the applicable example tables shown in this section. 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 must 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 specified limits of 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 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 section.
5. Documentation required in Section 6 Identification, Documentation and Shipping.

5.2.4 Test Agency Requirements

a. The Agency must meet the criteria of API Spec 14A, Appendix D or ASME SPPE-2, Accreditation of Testing Laboratories for Safety and Pollution Prevention Equipment Used in Offshore Oil and Gas Operations. Test Agencies must be licensed by API or accredited in accordance with the requirements in ASME SPPE-2 in order to test SSSV equipment which is intended to be marked with the API Monogram or other Registered Mark, including the ASME SPPE OCS Symbol.

b. The Test Agency shall conform with the applicable portions of Section 4 — Quality Control Requirements.

c. The Test Agency shall conduct Verification Tests in accordance with this section.

d. The Test Agency shall be responsible for assuring itself, the Manufacturers and the Operators that the Test Facility, procedures and forms comply with this specification.

5.2.5 The Test Agency shall publish literature which includes as a minimum:

a. A description of the facility, including any limitation on the size, length, weight, type, pressure rating, temperature rating, and service class of SSSV that may be tested.

b. The test procedures and forms actually used at the facility for each type and service class of SSSV.

c. The procedures for maintenance and calibration of measuring equipment.

d. The basis for determining test scheduling priorities.

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TABLE 5.1
EXAMPLE APPLICATION FOR VERIFICATION TEST

Test Agency _____ Manufacturer _____

Address _____ Representative _____

_____ Address _____

_____ Telephone _____

_____ Date _____

Official Qualification Test _____ Retest _____ 3-Year Requalification _____

Requalification Date _____

Valve to be tested

Type SCSSV _____ SSCSV _____ Model _____ Serial Number _____

Rated Working Pressure _____ Nominal Tubing Size _____

Test Section Length _____ (inches)

For SCSSV:

Minimum specified ID _____

Maximum hydraulic control line pressure _____ psi greater than valve bore pressure

Maximum unequalized opening pressure _____ psi

For SSCSV:

Velocity:

Design Closing Rate _____ B/D _____ psi

Tubing Pressure: Design Closing Pressure _____ psi

Procedure Required:

API Spec 14A Procedure Section _____ Class 1 _____ Class 2 _____

Non-specified equipment or procedures required for testing _____

_____

_____

_____

TEST AGENCY USE ONLY

Testing Schedule _____ _____ _____
Month Day Year

Location _____

_____

_____

Applicant notified _____ _____ _____
Month Day Year

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e. The fees for testing each type and service class of SSSV.

f. The procedures for making application for tests, delivery of SSSVs, initial installation and checkout of SSSVs and other pertinent information.

g. Any limitations on accessibility of the facility. Such limitations shall not preclude reasonable access to the facility for inspection by Manufacturers or Operators.

h. Any limitation on receipt of proprietary information.

i. Any other information considered pertinent by the Test Agency.

j. The above literature shall be kept current and shall be furnished to Manufacturers or Operators upon written request.

5.3 FUNCTIONAL TESTING

5.3.1 SSSV Functional Testing shall be performed by the Manufacturer on each new SSSV manufactured in accordance with this Specification. The Manufacturer's test facility shall be equipped with instrumentation to display and record information required by the test procedure.

5.3.2 Each SSSV shall be serialized and results of Functional Tests delivered with the SSSV.

5.3.3 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.

5.3.4 Functional Test data shall be recorded, dated and signed by the personnel performing the tests. The required data is indicated in Table 5.24.

5.4 GENERAL REQUIREMENTS FOR SSSV VERIFICATION TEST FACILITY

5.4.1 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 verification tested. Typical Test Facility Schematics, the SSSV Gas Flow Facility, Liquid Test Facility, and Controlled Temperature Test Facility are shown in Figures 5.1, 5.2, and 5.4, respectively.

5.4.2 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 method for pressure relief to protect the system.

5.4.3 Nitrogen gas to conduct the required nitrogen leak test and a gas flow meter to indicate leakage rate.

5.4.4 A gas reservoir with a gas release device and instrumentation to measure test parameters.

5.4.5 The Liquid Test facility, as a minimum, shall consist of the items listed below:

a. The test facility piping shall be at least 2" (50.8 mm) nominal diameter.

b. Fresh water tank.

c. Sand slurry tank.

d. A Marsh Funnel Viscometer in accordance with API RP 13B1 with required timer and graduated beaker.

e. A centrifuge with BS&W (Basic Sediment & Water) sample flasks in accordance with API Manual of Petroleum Measurement Chapter 10.4.

f. Circulation pumps.

g. Flow rate measurement device.

h. Pressure measurement systems.

i. A time based recorder to simultaneously record the required pressure and flow data.

j. Back pressure regulator.

k. Propane system as shown in Figure 5.5.

l. A high pressure water pump and accumulator system.

5.5 SCSSV VERIFICATION TEST PROCEDURE

5.5.1 Verify that the model and serial numbers appearing on the test valve are in agreement with the Manufacturer's application before leaving the Test Agency.

5.5.2 Perform the SCSSV Gas Flow Test (Section 5.6).

5.5.3 Perform the Drift Test (Section 5.7).

5.5.4 Open the test valve. Record the full-open hydraulic control pressure on Table 5.5.

5.5.5 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.

5.5.6 Close the test valve. Record the full-closed hydraulic control pressure on Table 5.5.

5.5.7 Perform the Liquid Leakage Test (Section 5.8).

5.5.8 Perform the Unequalized Opening Test (Section 5.9).

5.5.9 Perform the Operating Pressure Test (Section 5.10).

5.5.10 Perform the Propane Test (Section 5.11).

5.5.11 Perform the Nitrogen Leakage Test (Section 5.12).

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5.5.12 Perform the Operating Pressure Test (Section 5.10).

5.5.13 Perform the SCSSV Class 1 Flow Test (Section 5.13).

5.5.14 Repeat 5.5.11 through 5.5.13 four additional times.

5.5.15 Perform the Liquid Leakage Test (Section 5.8).

5.5.16 Perform the Controlled Temperature Test (Section 5.14).

5.5.17 Cycle the test valve five times. Record the full-open and full-closed hydraulic control line pressures on Table 5.14. If the test valve is being qualified for Class 1 service only, proceed to 5.5.24.

Note: The full-open pressure and full-closed pressure shall be monitored for possible refinements of this specification but will not be a cause for failure of the Verification Test.

5.5.18 Perform the Nitrogen Leakage Test (Section 5.12).

5.5.19 Perform the Operating Pressure Test (Section 5.10).

5.5.20 Perform the Class 2 Flow Test (Section 5.15).

5.5.21 Repeat 5.5.18 through 5.5.20 six additional times. The slurry may be allowed to stagnate in the test section overnight with the test valve in the open position.

5.5.22 Perform the Liquid Leakage Test (Section 5.8).

5.5.23 Perform the Drift Test (Section 5.7).

5.5.24 If the test valve has performed within the limits specified, it has passed the Verification Test requirements.

5.5.25 Summarize the Verification Test data on Table 5.16 and attach the completed data forms. Calibration records shall be included with the Verification Test Report. Each data form must be signed and dated by the person(s) conducting the test. Table 5.16 must be signed and dated by the Test Agency's designated approval authority.

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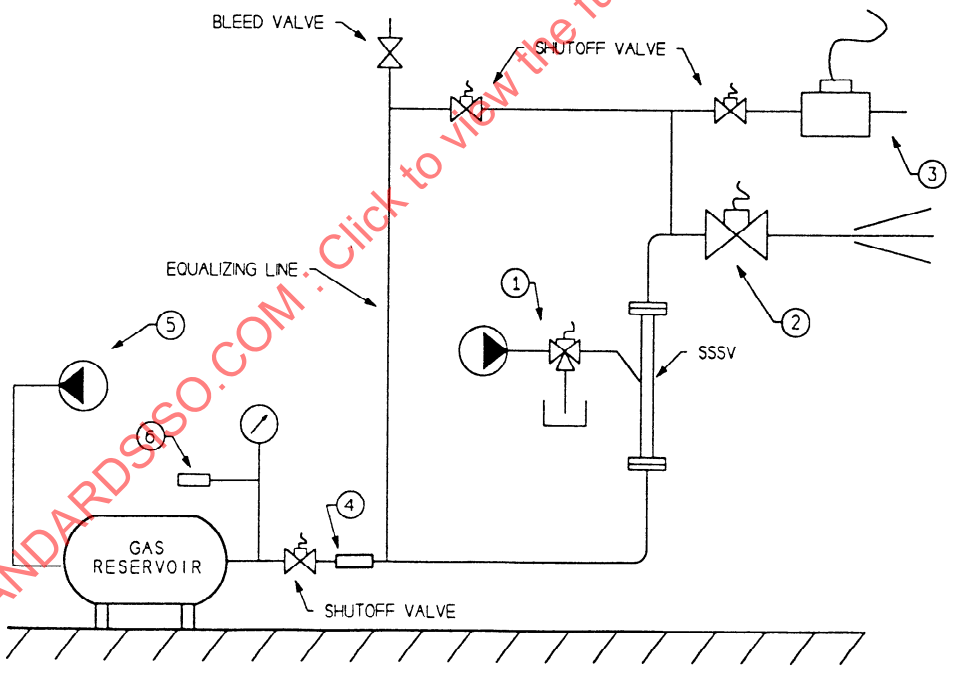

Equipment List

1. Hydraulic Pressure Source (For SCSSV Only)
2. Flow Control Valve
3. Leakage Flowmeter
4. Flow Measurement Device
5. Gas • Supply
6. Pressure Measurement Device

• Nitrogen or other suitable gas

FIGURE 5.1
EXAMPLE SCHEMATIC OF GAS FLOW FACILITY

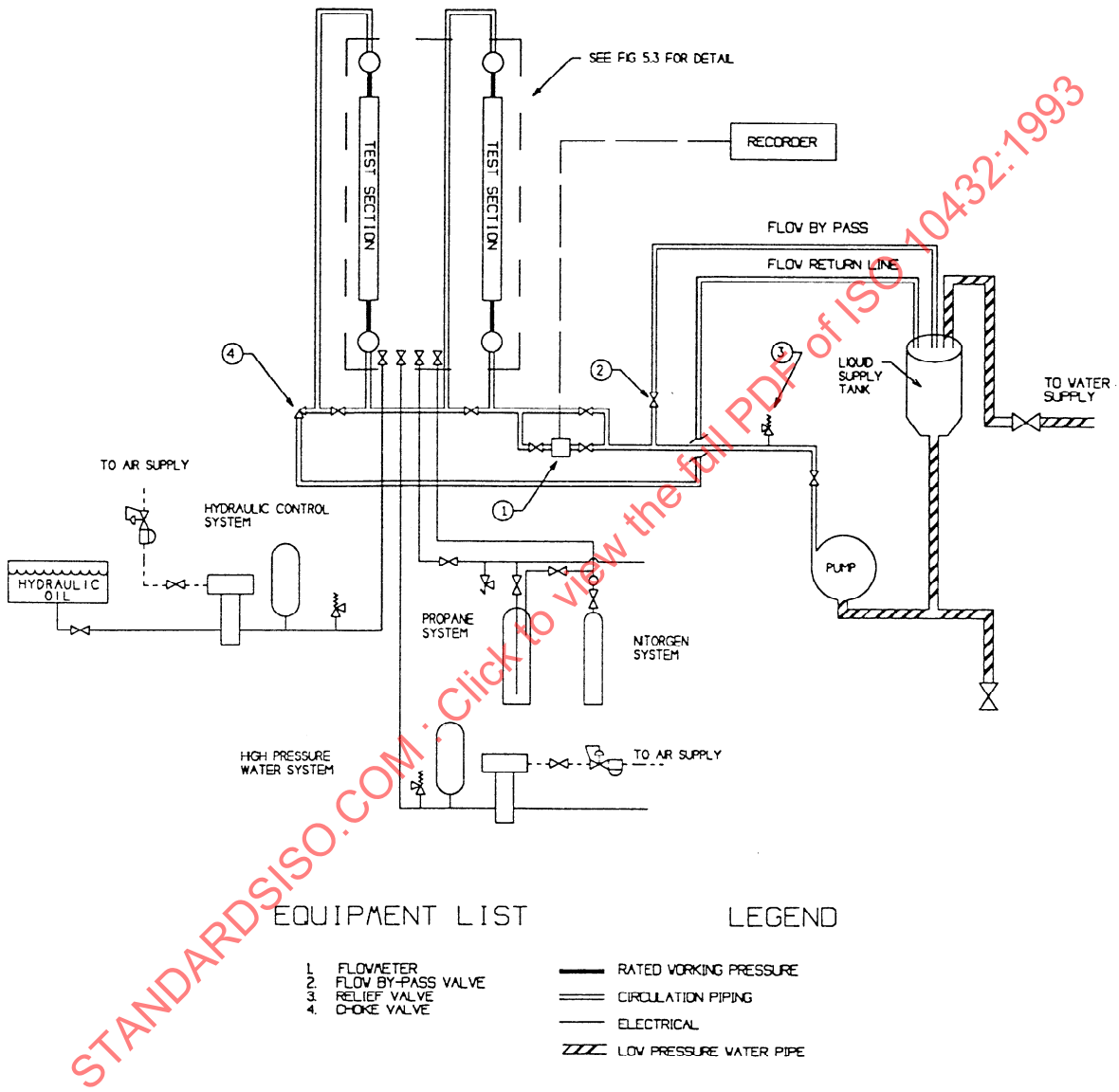

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FIGURE 5.2
EXAMPLE SCHEMATIC OF LIQUID TEST FACILITY
(Number of Test Sections is Optional)

TABLE 5.2 SCSSV GAS FLOW TEST
(Reference Section 5.6)

Test Report No._____

Test Start Date/Time: _____ Test Stop Date/Time: _____

Measurement	Test No. 1	Test No. 2	Test No. 3	Test No. 4
Hydraulic Opening Pressure at Zero Bore Pressure	____ PSI	____ PSI	____ PSI	____ PSI
Hydraulic Closing Pressure at Zero Bore Pressure	____ PSI	____ PSI	____ PSI	____ PSI
Hydraulic Opening Pressure at 2,000-2,500 PSI Bore Pressure	____ PSI	____ PSI	____ PSI	____ PSI
Closure Data:				
Gas Flow Rate	____ SCFD	____ SCFD	____ SCFD	____ SCFD
Full-Closed Hydraulic Control Pressure	____ PSI	____ PSI	____ PSI	____ PSI
Time To Close	____ S	____ S	____ S	____ S
Nitrogen Leakage Data:				
Test Pressure	____ PSI	____ PSI	____ PSI	____ PSI
Leakage Rate	____ SCFM	____ SCFM	____ SCFM	____ SCFM
Body Joint Leakage Detected (Tubing Retreivable Only)	Yes:__ No:__	Yes:__ No:__	Yes:__ No:__	Yes:__ No:__
Test Passed?	Yes:__ No:__	Yes:__ No:__	Yes:__ No:__	Yes:__ No:__

Conducted By:_____

Signature:_____ Date: _____

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TABLE 5.3 SCSSV GAS FLOW RATES[1]
(Reference Section 5.6)

Nominal Tubing or Casing Size inches (mm)	Gas Flow Rate and Control Line Resistances for Each Valve Closure Test			
	Low Resistance		High Resistance	
	Test No. 1 Flow Rate SCFD X 10^6 (M^3/d x 10^6)	Test No. 2 Flow Rate SCFD X 10^6 (M^3/d x 10^6)	Test No. 3 Flow Rate SCFD X 10^6 (M^3/d x 10^6)	Test No. 4 Flow Rate SCFD X 10^6 (M^3/d x 10^6)
2-3/8 (60.3)	5.1 (.14)	7.7 (.22)	2.6 (.07)	5.1 (.14)
2-7/8 (73.0)	8.0 (.23)	12.0 (.34)	4.0 (.11)	8.0 (.23)
3-1/2 (88.9)	11.5 (.33)	17.3 (.49)	5.8 (.16)	11.5 (.33)
4 (101.6)	15.7 (.44)	23.6 (.67)	7.9 (.22)	15.7 (.44)
4-1/2 (114.3)	20.5 (.58)	30.8 (.87)	10.3 (.29)	20.5 (.58)
5 (127.0)	25.9 (.73)	38.9 (1.10)	13.0 (.37)	25.9 (.73)
5-1/2 (139.7)	32.0 (.91)	48.0 (1.36)	16.0 (.45)	32.0 (.91)
6-1/2 (165.1)	46.1 (1.30)	69.2 (1.96)	23.1 (.65)	46.1 (1.30)
7 (177.8)	63.1 (1.79)	94.7 (2.68)	31.6 (.89)	63.1 (1.79)

[1] Based on a pressure of 2000 PSI (138 Bar) and a velocity of 20 feet (6.10 m) per second in the tubing for valve closure tests 1 and 4, a velocity of 30 feet (9.15 m) per second for test 2, and a velocity of 10 feet (3.05 m) per second for test 3.

NOTES:

A: The test medium shall be air, nitrogen or any other suitable gas.

B: Test flow rates shall be maintained within -5% and +15% of the nominal value given in Table 5.3 or $-0.5(10)^6$ and $+1.5(10)^6$ standard cubic feet of gas per day (- .01 x 10^6 and + .04 x 10^6 m^3/d), whichever is greater.

C: The low control line resistance test shall consist of a hydraulic control line having an inside diameter of at least 0.38 inches (9.6 mm) and a maximum total length of 25 feet (7.6 m). 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 0.020" +/- 0.002" (.5 mm +/- .05 mm) and a length of 1.0" +/- 0.1" (25.4 mm +/- 2.5 mm).

The manufacturer establishing sizes not covered by this specification may interpolate or extrapolate by a ratio of the square of the diameter versus the parameter involved.

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TABLE 5.4 DRIFT TEST
(Reference Section 5.7)

Test Report No.________

Internal Drift Information:

Minimum Inside Diameter of the Test Valve:_______ inches
Drift Outside Diameter:_______ inches
Drift Length:_______ inches
Drift Bar Unique Identifier:______________

	Step 5.5.3 (Class 1 Drift Test)	**Step 5.5.23 (Class 2 Drift Test)**
Date of Test	____________	____________
Full-Open Hydraulic Control Pressure	_________ PSI	_________ PSI
Full-Closed Hydraulic Control Pressure	_________ PSI	_________ PSI
Full-Open Hydraulic Control Pressure	_________ PSI	_________ PSI
Full-Closed Hydraulic Control Pressure	_________ PSI	_________ PSI
Full-Open Hydraulic Control Pressure	_________ PSI	_________ PSI
Full-Closed Hydraulic Control Pressure	_________ PSI	_________ PSI
Full-Open Hydraulic Control Pressure	_________ PSI	_________ PSI
Full-Closed Hydraulic Control Pressure	_________ PSI	_________ PSI
Full-Open Hydraulic Control Pressure	_________ PSI	_________ PSI
Full-Closed Hydraulic Control Pressure	_________ PSI	_________ PSI
Drift Pass?	Yes:___ No:___	Yes:___ No:___
Conducted By: Signature, Date:	____________	____________

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TABLE 5.5 INITIAL OPENING AND CLOSING TEST
(Reference Test Steps 5.5.4 and 5.5.6)

Test Report No. _____ Test Stand # _____

Date:_____ Test Start Time:_____ Test Stop Time:_____

Open and Close at Zero Valve Bore Pressure:

Full-Open Hydraulic Control Pressure:_____ PSI
Full-Closed Hydraulic Control Pressure:_____ PSI

Conducted By:

Signature:_____ Date: _____

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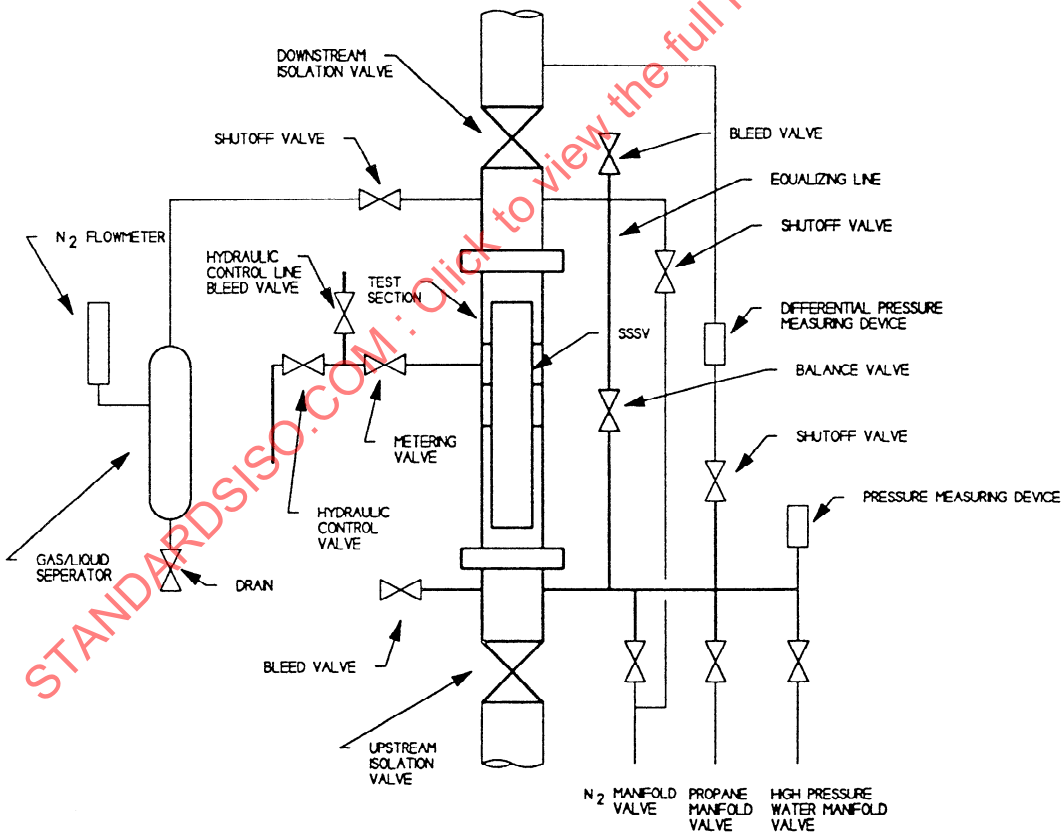

FIGURE 5.3
EXAMPLE LIQUID TEST SECTION DETAIL

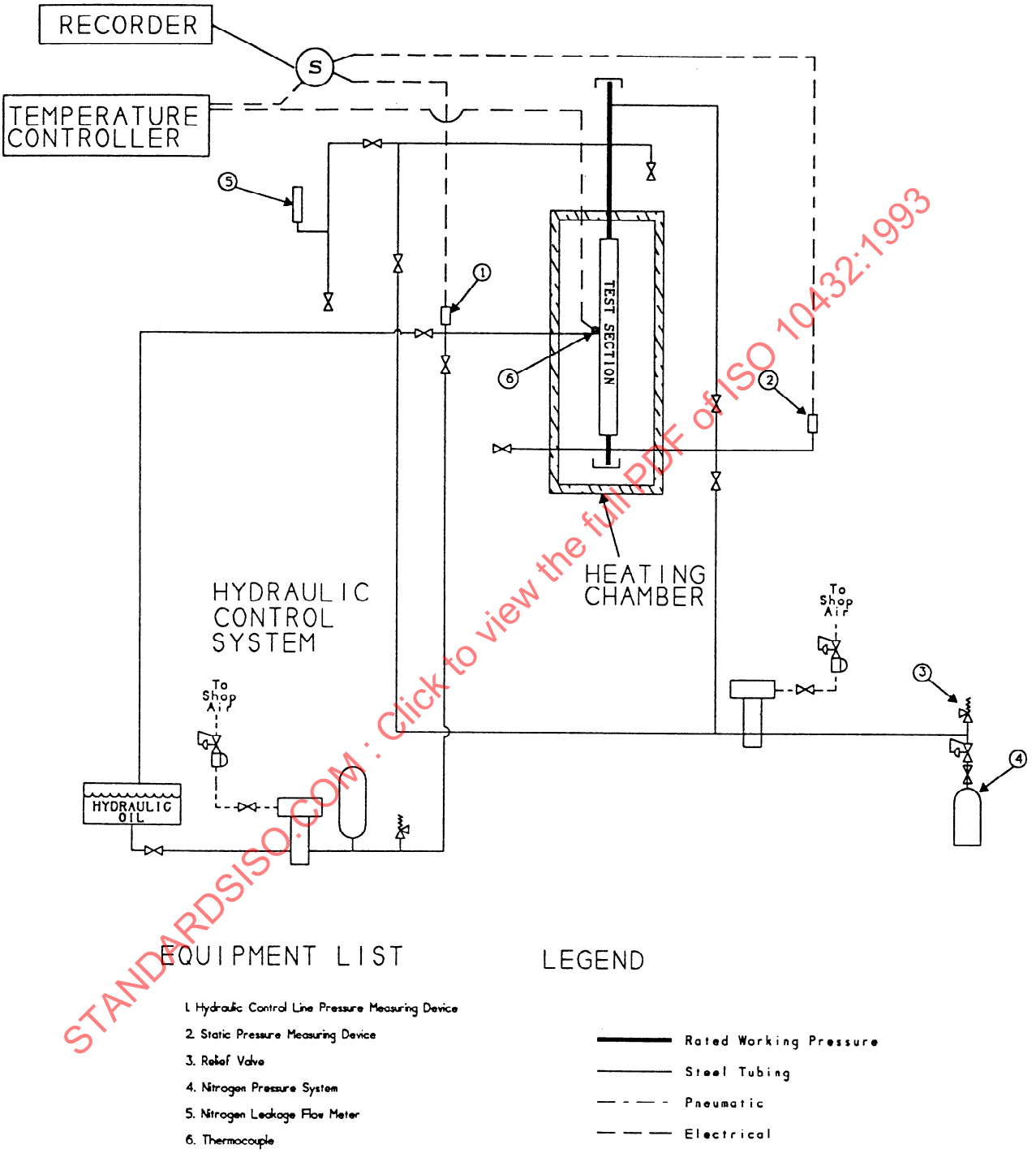

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FIGURE 5.4
EXAMPLE CONTROLLED TEMPERATURE TEST SECTION DETAIL

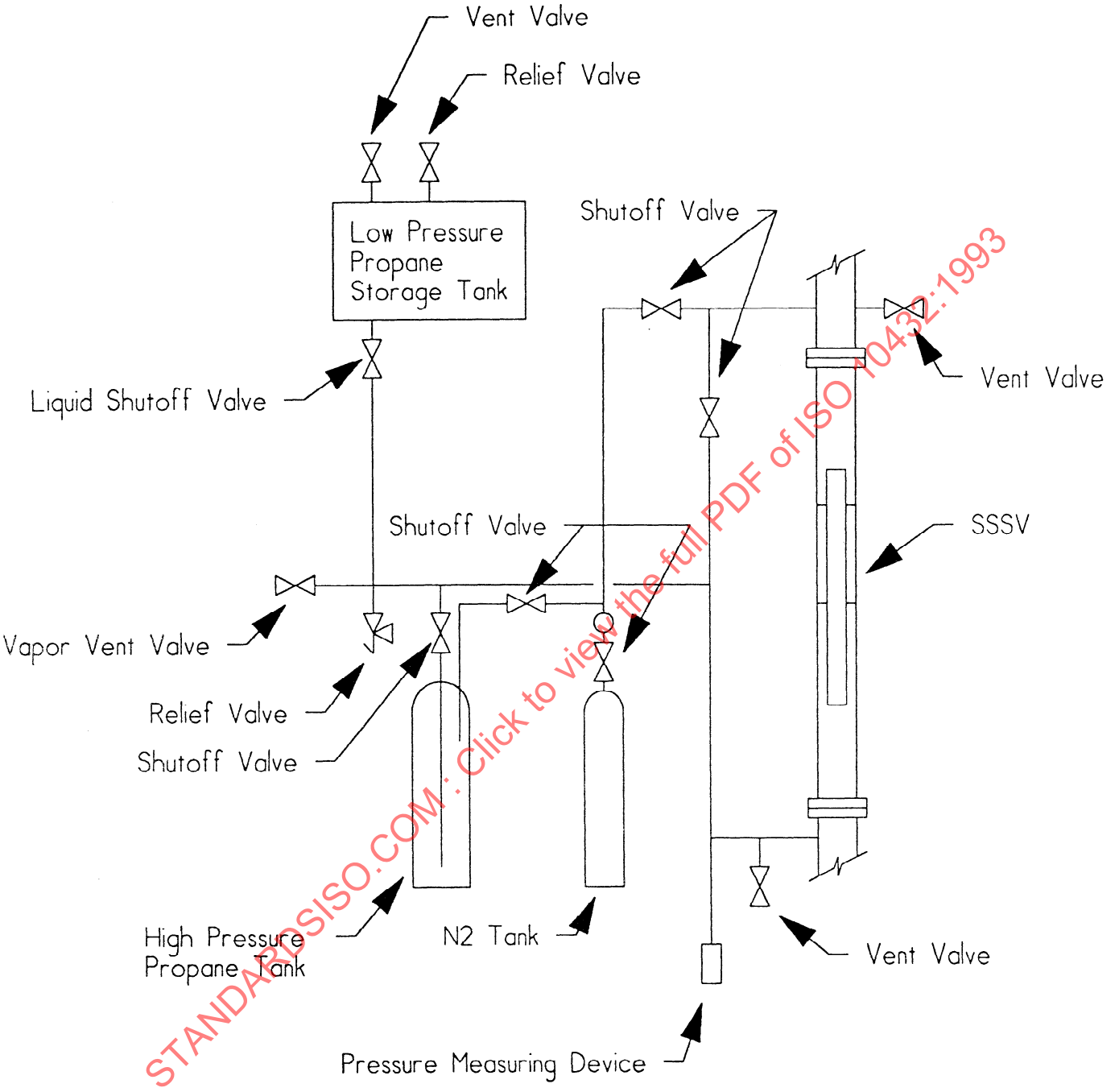

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FIGURE 5.5
EXAMPLE PROPANE SYSTEM SCHEMATIC

5.6 SCSSV GAS FLOW TEST (Enter results on Table 5.2.)

5.6.1 Install the test valve in the gas flow test stand.

5.6.2 Set the control line resistance to the appropriate setting shown in Table 5.3.

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

5.6.4 Close the gas release valve and bleed line valve (see Figure 5.1). Set the flow control device to provide gas flow at a test rate in accordance with Table 5.3.

5.6.5 Increase gas pressure in the system to between 2,000 (138 Bar) and 2,500 psi (173 Bar).

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

5.6.7 Establish and maintain the gas flow rate indicated in Table 5.3 and close the test valve, while recording control line pressure and gas flow rate.

5.6.8 The test valve must shut off a minimum of 95% of the specified flow in 5.0 seconds 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.

5.6.9 Bleed the valve bore downstream pressure to zero. Adjust the test valve upstream bore pressure to 1,200 psi +/- 60 psi (83 Bar +/- 4 Bar). Record the test valve bore upstream pressure and gas leakage rate. If leakage exceeds 5 standard cubic feet (.14m³) of gas per minute, the test valve fails. If the test valve fails, discontinue testing.

5.6.10 Bleed all pressure to zero. Repeat Steps 5.6.2 through 5.6.9 until tests 1 through 4 specified in Table 5.3 are successfully completed or until the test valve fails.

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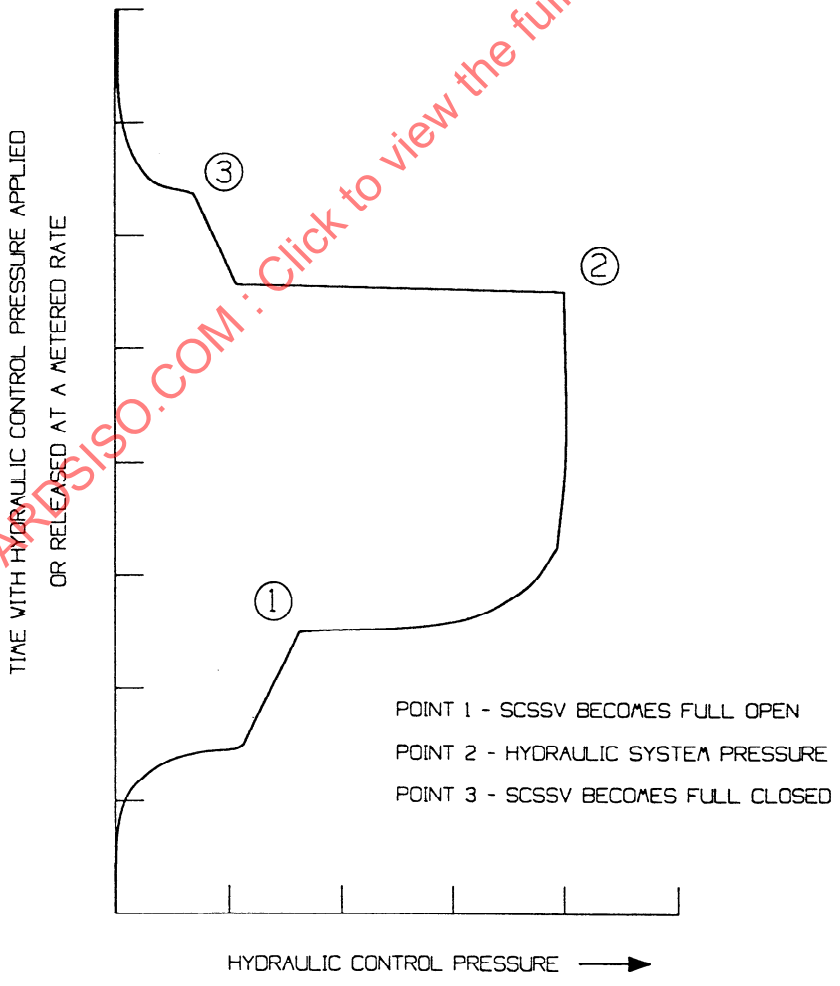

FIGURE 5.6
HYDRAULIC CONTROL PRESSURE CHARACTERISTICS FOR SCSSV
(For illustration)

5.7 DRIFT TEST (Enter results on Table 5.4.)

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

5.7.2 Open and close the test valve, record the full-open hydraulic control line pressure.

5.7.3 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.

5.7.4 Record the Drift Bar dimensions and the unique identifier as supplied by the Manufacturer. Record the minimum specified inside diameter of the test valve.

5.7.5 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.

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

5.8 LIQUID LEAKAGE TEST (Enter results on Table 5.6.)

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

5.8.2 Apply water pressure upstream of the test valve closure mechanism at 100% +0/-5% of the rated working pressure of the test valve. Record the test valve bore pressure and the time at which pressure is applied to the test valve.

5.8.3 Wait for a minimum of 3 minutes 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 minutes. Record the times at which water leakage collection begins and ends and the amount of water collected during the collection period. Calculate and record the average leakage rate. If the average leakage rate exceeds 10 cubic centimeters of water per minute, or if external body leakage is detected (tubing retrievable only), the test valve fails. If the test valve fails, discontinue testing.

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TABLE 5.6 LIQUID LEAKAGE TEST
(Reference Section 5.8)

Test Report No._____ Test Stand # _____

	Step 5.5.7 (Class 1)	Step 5.5.15 (Class 1)	Step 5.5.22 (Class 2)
Date of Test	_____	_____	_____
Valve Bore Test Pressure (Nominal 100% Rated Working Pressure)	_____ PSI	_____ PSI	_____ PSI
Time at Which Test Pressure Applied	_____	_____	_____
Time at Start of Leakage Test	_____	_____	_____
Time at End of Leakage Test	_____	_____	_____
Average Leakage Rate at Test Pressure (100% Rated Working Pressure)	_____ CC/M	_____ CC/M	_____ CC/M
Body Joint Leakage Detected? (Tubing Retrievable Only)	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___
Test Passed?	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___
Conducted By: Signature, Date:	_____	_____	_____

TABLE 5.7 UNEQUALIZED OPENING TEST
(Reference Section 5.9)

Test Report No._____ Test Stand #_____

Date:_____ Test Start Time:_____ Test Completion Time:_____

Rated Working Pressure of Test Valve:_____ PSI
Valve Bore Upstream Test Pressure (Manufacturer's Maximum Recommended Unequalized Opening Pressure):_____ PSI
Equalizing Test Pressure:_____ PSI
Full-Open Hydraulic Control Pressure:_____ PSI

Conducted By:

Signature:_____ Date: _____

5.9 UNEQUALIZED OPENING TEST (Enter results on Table 5.7.)

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

5.9.2 Open the test valve closure mechanism against pressure as recommended in the test valve Operating Manual. Record the equalizing pressure and full-open hydraulic control pressure.

5.10 OPERATING PRESSURE TEST (Enter results on Table 5.8.)

5.10.1 Apply 25% +/-5% of the rated working pressure of the test valve to the entire test section. Record the test valve bore pressure.

5.10.2 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 +/- 10% of their averages or +/- 100 psi (7 Bar), 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.

5.10.3 Repeat 5.10.1 and 5.10.2 at 75% +/-5% of the test valve rated working pressure.

5.11 PROPANE TEST (Enter results on Table 5.9.)

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

5.11.2 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 +/- 100 psi (7 Bar), whichever is greater, the test valve fails. If the test valve fails, discontinue testing.

5.11.3 Transfer propane to the test section until the test section pressure reaches 400 psi +/- 20 psi (28 Bar +/- 1.4 Bar).

5.11.4 Open the downstream vent valve until liquid propane is expelled, close the propane vent valve, and adjust the pressure to 400 psi +/-20 psi (28 Bar +/- 1.4 Bar). Record the test valve bore pressure.

5.11.5 Close and open the test valve three times, leaving the test valve in each position (opened or closed) for a minimum of 15 minutes. Record the full-open and full-closed hydraulic control pressures. If the hydraulic control pressures do not repeat within +/- 10% or +/- 100 psi (7 Bar) 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.

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

5.11.7 Bleed the section pressure to zero.

5.11.8 Purge the test section with nitrogen.

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

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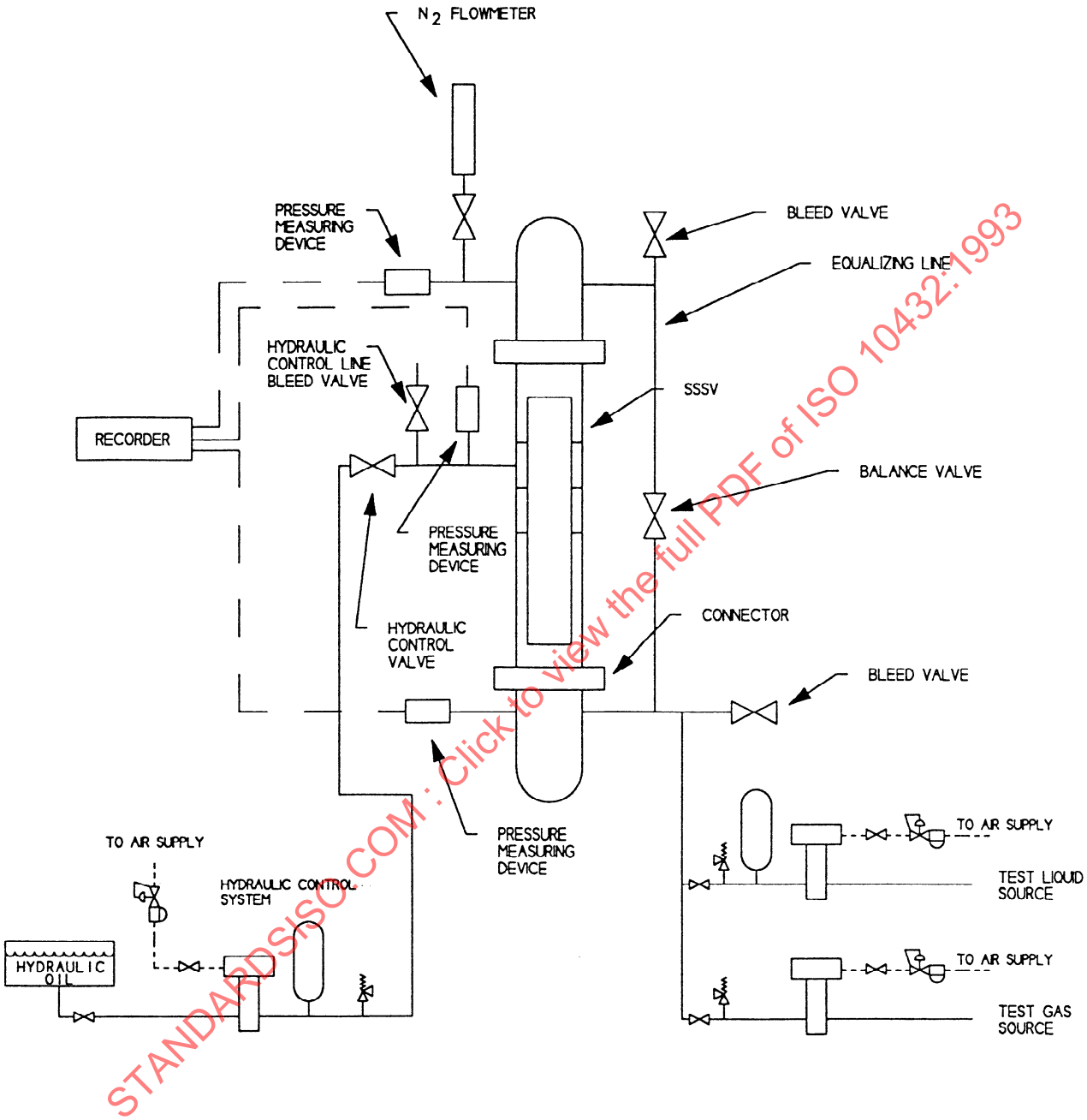

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FIGURE 5.7
EXAMPLE FUNCTIONAL TEST FACILITY FOR HYDRAULIC ACTUATED SSSV

TABLE 5.8 OPERATING PRESSURE TEST
(Reference Section 5.10)

Test Report No._____ Test Stand # _____

CHECK THE APPROPRIATE TEST CONDITION: _____ 20-30% of the Rated Working Pressure (RWP):_____ to _____ PSI
_____ 70-80% of the Rated Working Pressure (RWP):_____ to _____ PSI

	Class 1						Class 2						
	Step 5.5.9 Cycle 1	**Step 5.5.12 Cycle 2**	**Step 5.5.14 Cycle 3**	**Step 5.5.14 Cycle 4**	**Step 5.5.14 Cycle 5**	**Step 5.5.14 Cycle 6**	**Step 5.5.19 Cycle 1**	**Step 5.5.21 Cycle 2**	**Step 5.5.21 Cycle 3**	**Step 5.5.21 Cycle 4**	**Step 5.5.21 Cycle 5**	**Step 5.5.21 Cycle 6**	**Step 5.5.21 Cycle 7**
Date of Test	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
Hyd. Ctrl. System Pressure	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI
Repetition 1													
Full-Closed Hyd. Ctrl. Pres.:	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI
Full-Open Hyd. Ctrl. Pres.:	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI
Repetition 2													
Full-Closed Hyd. Ctrl. Pres.:	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI
Full-Open Hyd. Ctrl. Pres.:	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI
Repetition 3													
Full-Closed Hyd. Ctrl. Pres.:	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI
Full-Open Hyd. Ctrl. Pres.:	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI
Repetition 4													
Full-Closed Hyd. Ctrl. Pres.:	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI
Full-Open Hyd. Ctrl. Pres.:	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI
Repetition 5													
Full-Closed Hyd. Ctrl. Pres.:	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI
Full-Open Hyd. Ctrl. Pres.:	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI
Average* Hyd. Ctrl. Pressure													
Full-Closed:	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI
	+10%:__	+10%:__	+10%:__	+10%:__	+10%:__	+10%:__	+10%:__	+10%:__	+10%:__	+10%:__	+10%:__	+10%:__	+10%:__
	-10%:__	-10%:__	-10%:__	-10%:__	-10%:__	-10%:__	-10%:__	-10%:__	-10%:__	-10%:__	-10%:__	-10%:__	-10%:__
Full-Open:	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI
	+10%:__	+10%:__	+10%:__	+10%:__	+10%:__	+10%:__	+10%:__	+10%:__	+10%:__	+10%:__	+10%:__	+10%:__	+10%:__
	-10%:__	-10%:__	-10%:__	-10%:__	-10%:__	-10%:__	-10%:__	-10%:__	-10%:__	-10%:__	-10%:__	-10%:__	-10%:__
Body Joint Leakage? (Tubing Retrievable Only)	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___
* The 5 individual closing and opening pressures must each repeat within +/-10% or +/-100 PSI of the average, whichever is greater.													
Test Passed	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___
Conducted By: Signature, Date:	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____

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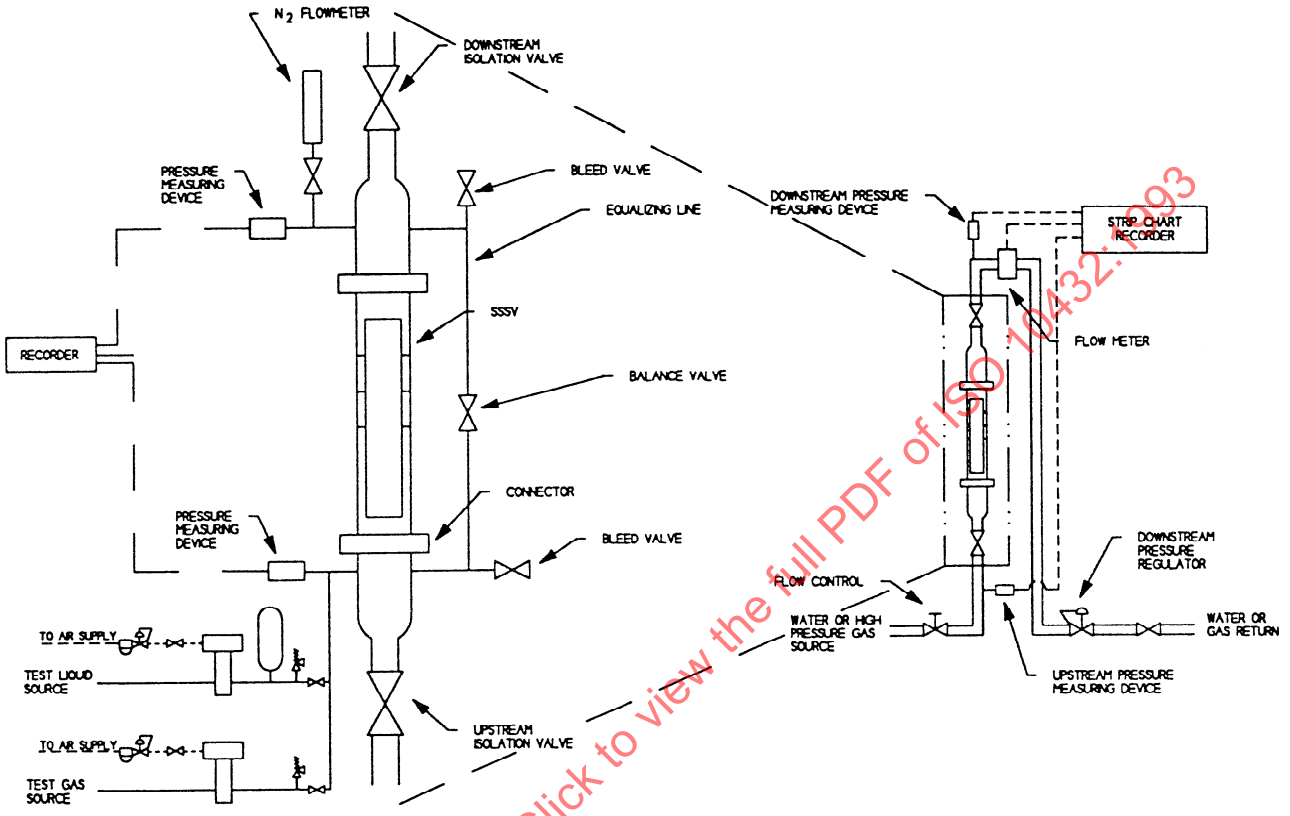

FIGURE 5.8
EXAMPLE FUNCTIONAL TEST FACILITY FOR VELOCITY AND TUBING PRESSURE SSSV

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TABLE 5.9 PROPANE TEST
(Reference Section 5.11)

Test Report No._____ Date: _____ Test Stand # _____

Open/Close Cycles at Zero psi Test Valve Bore Pressure:

Measurement	#	#	#
Full-Closed Hydraulic Control Pressure:	___ PSI	___ PSI	___ PSI
Full-Open Hydraulic Control Pressure:	___ PSI	___ PSI	___ PSI

Average Full-Closed Control Pressure for 3 Closures Just Completed:
_____ PSI +10% _____ PSI -10% _____ PSI

Open/Close Cycles at 400 psi Test Valve Nominal Bore Pressure:

Valve Bore Pressure at Start of Open/Close Cycling: _____ PSI

Measurement	#	#	#
Time at Valve Closure: Full-Closed Hydraulic Control Pressure:	_____ ___ PSI	_____ ___ PSI	_____ ___ PSI
Time at Valve Opening: Full-Open Hydraulic Control Pressure:	_____ ___ PSI	_____ ___ PSI	_____ ___ PSI

Average Full-Closed Control Pressure for 3 Closures Just Completed:
_____ PSI +10% _____ PSI -10% _____ PSI

Average Full-Open Control Pressure for 3 Openings Just Completed
_____ PSI +10% _____ PSI -10% _____ PSI

Propane Soak Period:

Time at Start of 2 Hour Soak Period: _____
Time at End of 2 Hour Soak Period: _____
Valve Bore Pressure at End of 2 Hour Soak Period: ____ PSI

Final Valve Closure During Propane Test:

Full-Closed Hydraulic Control Pressure After Last Closure: _____ PSI

Test Passed? Yes:____ No:____

*The 3 closings and openings must repeat within +/-10% or +/-100 PSI of the average, whichever is greater.

Conducted by:

Signature:_____ Date: _____

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TABLE 5.10 SCSSV NITROGEN LEAKAGE TEST
(Reference Section 5.12)

Test Report No._____ Test Stand # _____

Enter the Following Test Valve Parameter: 20-30% of the Rated Working Pressure (RWP): _____ to _____ PSI

	Class 1					Class 2						
	Step 5.5.11 Cycle 1	Step 5.5.14 Cycle 2	Step 5.5.14 Cycle 3	Step 5.5.14 Cycle 4	Step 5.5.14 Cycle 5	Step 5.5.18 Cycle 1	Step 5.5.21 Cycle 2	Step 5.5.21 Cycle 3	Step 5.5.21 Cycle 4	Step 5.5.21 Cycle 5	Step 5.5.21 Cycle 6	Step 5.5.21 Cycle 7
Date of Test	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
Valve Bore Test Pressure (190-210 PSI)	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI
Time at Start of Waiting Period	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
Time at Completion of Waiting Period	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
Measured Gas Leakage Rate (5 SCFM Max. Allowable)	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM
Body Joint Leakage? (Tubing Retrievable Only)	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___
Valve Bore Test Pressure (20-30% RWP)	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI	___PSI
Time at Start of Waiting Period	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
Time at Completion of Waiting Period	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
Measured Gas Leakage Rate (5 SCFM Max. Allowable)	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM
Body Joint Leakage? (Tubing Retrievable Only)	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___
Test Passed?	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___
Conducted By: Signature, Date:	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____

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TABLE 5.11 SCSSV CLASS 1 FLOW TEST
(Reference Section 5.13)

Test Report No._____ Test Stand # _____

	Step 5.5.13 Cycle 1	Step 5.5.14 Cycle 2	Step 5.5.14 Cycle 3	Step 5.5.14 Cycle 4	Step 5.5.14 Cycle 5
Date of Test	_____	_____	_____	_____	_____
Time at Start of Circulation of Test Rate No. 1 Through the Valve	_____	_____	_____	_____	_____
Time at Valve Closure (Against Test Rate No. 1)	_____	_____	_____	_____	_____
Closure Data for Test Rate No. 1:					
Water Flow Rate	____ B/D	____ B/D	____ B/D	____ B/D	____ B/D
Full-Closed Hydraulic Control Pressure	____ PSI	____ PSI	____ PSI	____ PSI	____ PSI
Time To Close	____ S	____ S	____ S	____ S	____ S
Full-Open Hydraulic Control Pressure	____ PSI	____ PSI	____ PSI	____ PSI	____ PSI
Time at Start of Circulation of Test Rate No. 2 Through the Valve	_____	_____	_____	_____	_____
Time at Valve Closure (Against Test Rate No. 2)	_____	_____	_____	_____	_____
Closure Data for Test Rate No. 2:					
Water Flow Rate	____ B/D	____ B/D	____ B/D	____ B/D	____ B/D
Full-Closed Hydraulic Control Pressure	____ PSI	____ PSI	____ PSI	____ PSI	____ PSI
Time To Close	____ S	____ S	____ S	____ S	____ S
Full-Open Hydraulic Control Pressure	____ PSI	____ PSI	____ PSI	____ PSI	____ PSI
Time at Start of Circulation of Test Rate No. 3 Through the Valve	_____	_____	_____	_____	_____
Time at Valve Closure (Against Test Rate No. 3)	_____	_____	_____	_____	_____
Closure Data for Test Rate No. 3:					
Water Flow Rate	____ B/D	____ B/D	____ B/D	____ B/D	____ B/D
Full-Closed Hydraulic Control Pressure	____ PSI	____ PSI	____ PSI	____ PSI	____ PSI
Time To Close	____ S	____ S	____ S	____ S	____ S
Full-Open Hydraulic Control Pressure	____ PSI	____ PSI	____ PSI	____ PSI	____ PSI
Test Passed?	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___
Conducted By: Signature, Date:	_____	_____	_____	_____	_____

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5.12 NITROGEN LEAKAGE TEST (Enter results on Table 5.10.)

5.12.1 Apply 200 psi +/- 10 psi (14 Bar +/- .7 Bar) nitrogen pressure upstream of the test valve. Wait a minimum of 1 minute; then measure any nitrogen leakage through the closure mechanism. Record the test valve bore pressure, the leakage rate and start and completion times of the waiting period. If the leakage rate is greater than 5 standard cubic feet (.14m^3) per minute, or if any body joint leakage (tubing retrievable only) is detected, the test valve fails. If the test valve fails, discontinue testing.

5.12.2 Repeat 5.12.1 at 25% +/- 5% of the rated working pressure of the test valve.

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

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

5.13 SCSSV CLASS 1 FLOW TEST (Enter results on Table 5.11.)

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

5.13.2 Adjust the water flow rate through the test valve to obtain a stable flow at the value specified in Table 5.12. Record the time at which flow is directed through the test valve. Flow water through the test valve at the specified rate for a minimum of 5 minutes.

5.13.3 Close the test valve against flow. Record the full-closed hydraulic control pressure and the water flow rate through the test valve at the time closure is initiated. The test valve must shut off a minimum of 95% of the specified flow at the first closure attempt in 15.0 seconds 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.

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

5.13.5 Repeat 5.13.2 through 5.13.4 until the three fresh water closure rates have been completed or the test valve fails.

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TABLE 5.12 SCSSV LIQUID FLOW RATES (+/-10%)
(Reference Sections 5.13 and 5.15)

Nominal Tubing or Casing Size inches (mm)	Circulation Rate B/D (m^3/d)			
	Class 1			Class 2
	Test No. 1	Test No. 2	Test No. 3	
2-3/8 (60.3)	500 (79)	1000 (159)	1500 (238)	500 (79)
2-7/8 (73.0)	780 (124)	1560 (248)	2340 (372)	780 (124)
3-1/2 (88.9)	1120 (178)	2240 (356)	3360 (534)	1120 (178)
4 (101.6)	1500 (238)	3000 (477)	4500 (715)	1500 (238)
4-1/2 (114.3)	1920 (305)	3840 (610)	5760 (915)	1920 (305)
5 (127.0)	2430 (386)	4860 (722)	7290 (1159)	2430 (386)
5-1/2 (139.7)	3000 (477)	6000 (954)	9000 (1431)	3000 (477)
6-1/2 (165.1)	4320 (686)	8640 (1373)	12960 (2060)	4320 (686)
7 (177.8)	5880 (935)	11760 (1869)	17640 (2804)	4700 (747)

The manufacturer establishing sizes not covered by this specification may interpolate or extrapolate by a ratio of the square of the diameter versus the parameter involved.

TABLE 5.13 CONTROLLED TEMPERATURE TEST
(Reference Section 5.14)

Test Report No._____ Date: _____ Test Stand # _____

CHECK THE APPROPRIATE TEST CONDITION:

___ 20-30% of the Rated Working Pressure (RWP):_____ to _____ PSI
___ 70-80% of the Rated Working Pressure (RWP):_____ to _____ PSI

CHECK THE APPROPRIATE TEST CONDITION:

___ 95-105°F
___ 175-185°F

Open/Close Cycles at the Specified Valve Temperature and Pressure:
Test Temperature: _____ °F Valve Bore Pressure: _____ PSI

Measurement	Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 5	Cycle 6	Cycle 7	Cycle 8	Cycle 9	Cycle 10
Full-Open Hydraulic Control Pressure	____ PSI	____ PSI	____ PSI	____ PSI	____ PSI	____ PSI	____ PSI	____ PSI	____ PSI	____ PSI
Full-Closed Hydraulic Control Pressure	____ PSI	____ PSI	____ PSI	____ PSI	____ PSI	____ PSI	____ PSI	____ PSI	____ PSI	____ PSI

Was Body Joint Leakage Detected (Tubing Retrievable Only) Yes: ____ No: ____
Average Full-Open Hydraulic Control Line Pressure for 10 Open/Close Valve Cycles: _____ PSI +10% _____ PSI -10% _____ PSI
Average Full-Closed Hydraulic Control Line Pressure for 10 Open/Close Valve Cycles: _____ PSI +10% _____ PSI -10% _____ PSI
Test Passed? Yes: ____ No: ____

Control Line Leakage Test at the Specified Valve Temperature and Pressure:
3 Minute Waiting Period Prior to the 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: ____
Test Passed? Yes: ____ No: ____

Closure Mechanism Leakage Test at the Specified Valve Temperature and Pressure Below the Closure Mechanism:
Test Temperature: _____ °F
Time at which Bore Pressure Above the Closure Mechanism Is Bled to Zero psi: _____
Valve Bore Pressure Below the Closure Mechanism: _____ PSI
1 Minute Waiting Period Prior to the Closure Mechanism Leakage Test: Time Start: _____ Time Stopped: _____
Leakage Rate: _____ SCFM
Test Passed? Yes: ____ No: ____

* The 10 individual opening and closing pressures must each repeat within +/-10% or +/-100 PSI of the average, whichever is greater.

Conducted by:

Signature:_____ Date: _____

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5.14 CONTROLLED TEMPERATURE TEST (Enter results on Table 5.13.)

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

5.14.2 Allow the test valve to reach a stable temperature of 100°F +/- 5°F (38°C +/- 3°C).

5.14.3 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 test valve temperature and test valve bore pressure.

5.14.4 Cycle the test valve 10 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 +/- 100 psi (7 Bar), whichever is greater, or if body joint leakage (tubing retrievable only) is detected, the test valve fails. If the test valve fails, discontinue testing.

5.14.5 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.

5.14.6 With the test valve bore filled with nitrogen gas at the specified temperature and pressure, wait a minimum of 3 minutes and then observe the gas bubble leakage rate for a minimum of 5 minutes. Record the times at which the 3 minute waiting period, preceding the leakage test, begins and ends and the times at which the 5 minute gas bubble leakage observation period begins and ends. If continuous leakage from the control line is observed for at least 1 minute 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.

5.14.7 Repeat 5.14.2 through 5.14.6 using a test valve bore pressure of 75% +/- 5% of the rated working pressure of the test valve.

5.14.8 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 minute; then measure any nitrogen leakage. Record the test valve bore pressure below the clo-

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TABLE 5.14 OPENING PRESSURE REPEATABILITY TEST
(Reference Test Steps 5.5.17)

Test Report No._____ Date: _____ Test Stand # _____

Hydraulic Control Pressures Measured During Test Step 5.5.17 of the Class 1 Test:

Full-Open Hydraulic Control Pressure:_____ PSI
Full-Closed Hydraulic Control Pressure:_____ PSI

Full-Open Hydraulic Control Pressure:_____ PSI
Full-Closed Hydraulic Control Pressure:_____ PSI

Full-Open Hydraulic Control Pressure:_____ PSI
Full-Closed Hydraulic Control Pressure:_____ PSI

Full-Open Hydraulic Control Pressure:_____ PSI
Full-Closed Hydraulic Control Pressure:_____ PSI

Full-Open Hydraulic Control Pressure:_____ PSI
Full-Closed Hydraulic Control Pressure:_____ PSI

Conducted by:

Signature:_____ Date: _____

sure mechanism, the leakage rate and start and completion times of the waiting period. If the leakage rate is greater than 5 standard cubic feet (.14m³) per minute, or if any body joint leakage (tubing retrievable only) is detected, the test valve fails. If the test valve fails, discontinue testing.

5.14.9 Repeat 5.14.2 through 5.14.8 using a test temperature of 180°F +/- 5°F (82°C +/- 3°C).

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

5.15 **SCSSV CLASS 2 FLOW TEST** (Enter results on Table 5.15.)

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

5.15.2 Determine the sand content of the slurry according to the API Manual of Petroleum Measurement Standards, Chapter 10.4. Adjust the sand content to 2% +/- 0.5% by adding 80 - 100 U.S. mesh (180-150 µm) sand or diluting the slurry with fresh water.

5.15.3 Determine the viscosity of the slurry sample with a Marsh funnel viscometer according to API RP 13B1. Adjust the viscosity to 70 seconds +/- 5 seconds by adding a viscosifier or diluting the slurry with fresh water.

5.15.4 The viscosity and sand content specified above, must be met before proceeding.

5.15.5 Adjust the slurry circulation rate to the value specified in Table 5.12. Record the slurry circulation rate, sand content, and slurry viscosity. Record the time at which the slurry circulation begins.

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

5.15.7 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 must shut off a minimum of 95% of the specified flow at the first closure attempt in 15.0 seconds 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.

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

5.16 **SSCSV VERIFICATION TEST PROCEDURE**

5.16.1 Verify that the model and serial numbers appearing on the test valve assembly are in agreement with the Manufacturer's application before leaving the Test Agency.

5.16.2 Perform the SSCSV Gas Closure Test (Section 5.17). For velocity type SSCSV, use the gas flow test stand to conduct the test.

5.16.3 Perform the initial Liquid Closure Test (Section 5.18) using water as the test medium.

5.16.4 Perform the Liquid Leakage Test (Section 5.8).

5.16.5 Perform the Propane Test (Section 5.11), omitting 5.11.2 and 5.11.5. Replace 5.11.9 with: Conduct the Liquid Closure Test (Section 5.18), using water as the test medium. The closing flow rate for velocity type SSCSV or the closing pressure for tubing pressure type SSCSV shall repeat within +/- 15% of the closing flow rate or pressure of 5.16.3 or the test valve fails the test. If the test valve fails, discontinue testing.

5.16.6 Perform the Nitrogen Leakage Test (Section 5.12), omitting 5.12.4.

5.16.7 Perform the SSCSV Class 1 Flow Test (Section 5.19).

5.16.8 Repeat 5.16.6 and 5.16.7 fourteen additional times. The closing flow rate for velocity type SSCSVs or the closing pressure for low tubing pressure type SSCSVs shall repeat within +/- 15% of the closing flow rate or pressure of 5.16.3 above, or the valve fails the test. If the test valve fails, discontinue testing.

5.16.9 Perform the Liquid Leakage Test (Section 5.8). If the test valve is being qualified for Class 1 service only, proceed to 5.16.14.

5.16.10 Perform the Nitrogen Leakage Test (Section 5.12), omitting 5.12.4.

5.16.11 Perform the Class 2 Flow Test (Section 5.20).

5.16.12 Repeat 5.16.10 and 5.16.11 six additional times. The closing flow rate for velocity type SSCSV or the closing pressure for tubing pressure type SSCSV shall repeat within +/- 15% of the closing flow rate or pressure of 5.16.3, 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.

5.16.13 Perform the Liquid Leakage Test (Section 5.8).

5.16.14 If the test valve has performed within the limits specified, it has passed the Verification Test requirements.

5.16.15 Summarize the Verification Test data on Table 5.16 and attach the completed data

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TABLE 5.15 SCSSV CLASS 2 FLOW TEST
(Reference Section 5.15)

Test Report No._____ Test Stand # _____

	Step 5.5.20 Cycle 1	Step 5.5.21 Cycle 2	Step 5.5.21 Cycle 3	Step 5.5.21 Cycle 4	Step 5.5.21 Cycle 5	Step 5.5.21 Cycle 6	Step 5.5.21 Cycle 7
Date of Test	_____	_____	_____	_____	_____	_____	_____
Time at Start of Slurry Circulation Through the Valve	_____	_____	_____	_____	_____	_____	_____
Flow Rate at Start of Circulation Period	____ B/D	____ B/D	____ B/D	____ B/D	____ B/D	____ B/D	____ B/D
Sand Concentration at Start of Circulation Period	_____ %	_____ %	_____ %	_____ %	_____ %	_____ %	_____ %
Slurry Viscosity at Start of Circulation Period	____ Marsh S	____ Marsh S	____ Marsh S	____ Marsh S	____ Marsh S	____ Marsh S	____ Marsh S
Time at Valve Closure (Against Slurry Flow)	_____	_____	_____	_____	_____	_____	_____
Closure Data:							
Slurry Flow Rate	_____ B/D	_____ B/D	_____ B/D	_____ B/D	_____ B/D	_____ B/D	_____ B/D
Full-Closed Hydraulic Control Pressure	_____ PSI	_____ PSI	_____ PSI	_____ PSI	_____ PSI	_____ PSI	_____ PSI
Time To Close	_____ S	_____ S	_____ S	_____ S	_____ S	_____ S	_____ S
Sand Concentration at Completion of Circulation Period	_____ %	_____ %	_____ %	_____ %	_____ %	_____ %	_____ %
Slurry Viscosity at Completion of Circulation Period	____ Marsh S	____ Marsh S	____ Marsh S	____ Marsh S	____ Marsh S	____ Marsh S	____ Marsh S
Test Passed?	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___
Conducted By: Signature, Date:	_____	_____	_____	_____	_____	_____	_____

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TABLE 5.16 VERIFICATION TEST SUMMARY

Test Agency:_____ Test Report No._____
Test Start Date:_____ Test Completion Date:_____
Manufacturer:_____
Model No.:_____ Serial Number:_____
Nominal Tubing Size:_____ inches Rated Working Pressure:_____ PSI

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 the valve manufacturer, unusual conditions observed during the test, etc.)

_____
_____
_____
_____
_____
_____
_____

Test Report Approved By: _____ Date: _____
(Test Agency Approval Authority)

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forms. Calibration records shall be included with the Verification Test Report. Each data form must be signed and dated by the person(s) conducting the test. Table 5.16 must be signed and dated by the Test Agency's designated approval authority.

5.17 SSCSV GAS CLOSURE TEST (Enter results on Table 5.17.)

5.17.1 Increase gas pressure in the system to between 2,000 (138 Bar) and 2,500 psi (173 Bar).

5.17.2 Close the test valve as follows:

a. Velocity Type SSCSV: Increase the gas flow rate through the test valve until the test valve closes. The test valve must close at a flow rate of at least +/- 25% of the design closing flow rate indicated in Table 5.1 in 30 seconds 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 SSCSV: 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 must close at a downstream pressure of at least 75% of the design closing pressure indicated in Table 5.1. The minimum allowable downstream pressure is 50 psi (3.5 Bar). The test valve must close in 30 seconds 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.

5.17.3 Bleed the valve bore downstream pressure to zero. Adjust the test valve bore upstream pressure to 1200 psi +/- 5% (83 Bar +/- 4 Bar). Wait a minimum of 1 minute; 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 5 standard

cubic feet (.14m³) per minute, the test valve fails. If the test valve fails, discontinue testing.

5.17.4 Bleed all pressure to zero.

5.18 LIQUID CLOSURE TEST (Enter results on Table 5.18.)

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

5.18.2 Adjust the circulation rate through the test valve to obtain a flow at the rate specified in Table 5.22.

5.18.3 Close the test valve as follows:

a. Velocity Type SSCSV: Adjust pressure downstream of the test valve to between 50 and 55 psi (3.5 and 3.8 Bar). 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 50 and 55 psi (3.5 and 3.8 Bar). The test valve must close at a flow rate of at least +/- 25% of the design closing flow rate indicated in Table 5.1 in 30 seconds 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 SSCSV: Decrease the downstream pressure until the test valve closes. The test valve must close at a downstream pressure of at least 75% of the design closing pressure indicated in Table 5.1. The minimum allowable downstream pressure shall be 50 psi (3.5 Bar). The valve must close in 30 seconds or less from the time this pressure minimum is achieved or the valve fails the

TABLE 5.17 SSCSV GAS CLOSURE TEST
(Reference Section 5.17)

Test Report No. _____

Test Start Time: _____ Test Completion Time: _____ Date: _____

For Velocity-Type SSCSV:

Initial Test Valve Upstream Pressure: _____ PSI
Closing Flow Rate (Gas): _____ SCFD
Differential Closing Pressure: _____ PSI
Design Closing Rate (gas): _____ SCFD
Maximum Closing Rate, Design Closing Rate (gas) +25%: _____ SCFD
Minimum Closing Rate, Design Closing Rate (gas) -25%: _____ SCFD

For Tubing-Pressure-Type SSCSV:

Initial Test Valve Downstream Pressure:_____ PSI
Downstream Closing Pressure:_____ PSI
Design Closing Pressure _____ PSI
Maximum Closing Rate, Design Closing Rate (gas) +25%: _____ PSI
Minimum Closing Rate, Design Closing Rate (gas) -25%: _____ PSI

Nitrogen Leakage Data:

Test Valve Bore Pressure:_____ PSI
Leakage Rate:_____ SCFM

Test Passed? Yes:___ No:___

Conducted By:

Signature:_____ Date: _____

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TABLE 5.18 INITIAL LIQUID CLOSURE TEST
(Test Procedure Step 5.16.3)

Test Report No._____

Date:_____ Test Start Time:_____ Test Completion Time:_____

For Velocity-Type SSCSV:

Initial Test Valve Downstream Pressure:_____ PSI
Closing Flow Rate (Water):_____ B/D
Differential Closing Pressure:_____ PSI
Design Closing Flow Rate (liquid): _____ B/D
Maximum Closing Rate, Design Closing Rate (liquid) +25%: _____ B/D
Minimum Closing Rate, Design Closing Rate (liquid) -25%: _____ B/D

For Low-Tubing-Pressure-Type SSCSV:

Initial Test Valve Downstream Pressure:_____ PSI
Downstream Closing Pressure:_____ PSI
Maximum Closing Rate, Design Closing Rate (liquid) +25%: _____ B/D
Minimum Closing Rate, Design Closing Rate (liquid) -25%: _____ B/D

Test Passed? Yes:___ No:___

Conducted By:

Signature:_____ Date: _____

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.

5.19 SSCSV CLASS 1 FLOW TEST (Enter results on Table 5.21.)

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

5.19.2 Adjust the water circulation rate through the test valve to obtain a flow rate at the value specified in Table 5.22. 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 hour.

5.19.3 Close the test valve using the Liquid Closure Test Procedure (Section 5.18), using water as the test medium and omitting 5.18.1 and 5.18.2.

5.20 SSCSV CLASS 2 FLOW TEST (Enter results on Table 5.23.)

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

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

5.20.3 Determine the viscosity of the slurry sample with a Marsh funnel viscometer according to API RP 13B1. Adjust the viscosity to 70 seconds +/- 5 seconds by adding a viscosifier or diluting the slurry with water.

5.20.4 The viscosity and sand content specified above, must be met before proceeding.

5.20.5 Adjust the slurry circulation rate to the value specified in Table 5.22. Record the slurry circulation rate, sand content, and slurry viscosity. Also, record the time at which the slurry circulation begins.

5.20.6 Circulate slurry through the test valve at the specified rate for a minimum of 1 hour, and then close the test valve using the Liquid Closure Test Procedure (Section 5.18), using slurry as the test medium and omitting 5.18.1 and 5.18.2.

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

5.21 SCSSV FUNCTIONAL TESTING

5.21.1 A typical Manufacturer's test facility is shown in Figure 5.7 and includes:

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TABLE 5.19 PROPANE SSCSV TEST
(Reference Section 5.16.5)

Propane Soak Period:

Date:_____
2 Hour Soak Period: Start: _____ Stop: _____
Valve Bore Pressure at End of 2 Hour Soak Period: ____ PSI

Closure After Propane Soak

Test Start Time: _____ Test Completion Time: _____ Date: _____

For Velocity-Type SSCSV:

Initial Test Valve Downstream Pressure:_____ PSI
Closing Flow Rate (Water):_____ B/D
+15% of Table 5.18 Cycle Value:_____ B/D
-15% of Table 5.18 Cycle Value:_____ B/D
Differential Closing Pressure:_____ PSI

For Low-Tubing-Pressure-Type SSCSV:

Initial Test Valve Downstream Pressure:_____ PSI
Downstream Closing Pressure:_____ PSI
+15% of Table 5.18 Cycle Value:_____ PSI
-15% of Table 5.18 Cycle Value:_____ PSI

Test Passed? Yes:____ No:____

Conducted By:

Signature:_____ Date: _____

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a. Test section installed vertically.

b. Test section and hydraulic control section pressure measurement devices.

c. Pressurized gas source.

d. Hydraulic control pressure system.

e. Flow rate measurement devices.

f. Pressurized water system.

g. A time based recorder to simultaneously record the required data.

h. Internal and external drifts.

5.21.2 SCSSV Functional Testing Procedure

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

a. Record serial number.

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

c. Open 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 minutes. 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 must 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.

TABLE 5.20 SSCSV NITROGEN LEAKAGE TEST
(Reference Section 5.16.6)

Test Report No._____ Test Section # _____
Enter the Following Test Valve Parameter: 20-30% of the Rated Working Pressure (RWP):_____ to _____ PSI

	Class 1														
	Step 5.16.6 Cycle 1	**Step 5.16.8 Cycle 2**	**Step 5.16.8 Cycle 3**	**Step 5.16.8 Cycle 4**	**Step 5.16.8 Cycle 5**	**Step 5.16.8 Cycle 6**	**Step 5.16.8 Cycle 7**	**Step 5.16.8 Cycle 8**	**Step 5.16.8 Cycle 9**	**Step 5.16.8 Cycle 10**	**Step 5.16.8 Cycle 11**	**Step 5.16.8 Cycle 12**	**Step 5.16.8 Cycle 13**	**Step 5.16.8 Cycle 14**	**Step 5.16.8 Cycle 15**
Date of Test	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
Valve Bore Test Pressure (190-210 PSI)	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI
Time at Start of Waiting Period	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
Time at Completion of Waiting Period	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
Measured Gas Leakage Rate	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM
Valve Bore Test Pressure (20-30% RWP)	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI
Time at Start of Waiting Period	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
Time at Completion of Waiting Period	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
Measured Gas Leakage Rate	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM	__SCFM
Test Passed?	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___
Conducted By: Signature, Date:	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____

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TABLE 5.21 SSCSV CLASS 1 FLOW TEST
(Reference Section 5.19)

Test Report No._____ Test Stand # _____

For Velocity-Type SSCSVs: +15% _____B/D -15% _____ B/D of Closing Flow Rate: From Table 5.18
For Low-Tubing-Pressure-Type SSCSVs: +15% _____PSI -15% _____ PSI of Closing Pressure: From Table 5.18

	Step 5.16.7 Cycle 1	Step 5.16.8 Cycle 2	Step 5.16.8 Cycle 3	Step 5.16.8 Cycle 4	Step 5.16.8 Cycle 5	Step 5.16.8 Cycle 6	Step 5.16.8 Cycle 7	Step 5.16.8 Cycle 8	Step 5.16.8 Cycle 9	Step 5.16.8 Cycle 10	Step 5.16.8 Cycle 11	Step 5.16.8 Cycle 12	Step 5.16.8 Cycle 13	Step 5.16.8 Cycle 14	Step 5.16.8 Cycle 15
Date of Test															
Time at Start of Circulation Through the Valve															
Flow Rate at Start of Circulation Period	___ B/D	___ B/D	___ B/D	___ B/D	___ B/D	___ B/D	___ B/D	___ B/D	___ B/D	___ B/D	___ B/D	___ B/D	___ B/D	___ B/D	___ B/D
Time at Valve Closure															
For Velocity-Type SSCSVs:															
• Initial Downstream Pressure	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI
• Water Flow Rate at Closure	___ B/D	___ B/D	___ B/D	___ B/D	___ B/D	___ B/D	___ B/D	___ B/D	___ B/D	___ B/D	___ B/D	___ B/D	___ B/D	___ B/D	___ B/D
• Differential Pressure Across Valve at Closure	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI
For Low-Tubing-Pressure-Type SSCSVs:															
• Initial Downstream Pressure	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI
• Downstream Pressure at Closure	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI	___ PSI
	Yes:___	Yes:___	Yes:___	Yes:___	Yes:___	Yes:___	Yes:___	Yes:___	Yes:___	Yes:___	Yes:___	Yes:___	Yes:___	Yes:___	Yes:___
Test Passed?	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___
Conducted By: Signature, Date:															

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

Wireline Retrievable SCSSV: Close the SCSSV. Adjust and stabilize pressure across the entire test section to 150% +/- 5% of the rated working pressure of the SCSSV. Hold the pressure for a minimum of five minutes. Reduce pressure in the test section to zero. Repeat test once. The SCSSV fails the Functional Test if leakage is detected through the hydraulic control port(s).

Tubing Retrievable SCSSV: Close the SCSSV. Thoroughly dry the test valves 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 five minutes. Reduce pressure in the test section to zero. Repeat 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 SCSSV with zero pressure in test section and record full-open and full-closed hydraulic control pressures. Open the SCSSV.

g. Adjust and stabilize the pressure in 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. Hydraulic control pressure must repeat within the greater of (1) +10% or -5% or (2) 100 psi (7 Bar) of the values specified by the Manufacturer. Each hydraulic control pressure must 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 hydraulic control pressure to zero.

j. Adjust and stabilize the test section pressure to 100% +/- 5% of rated working pressure of the SCSSV. Monitor for leakage at hydraulic control line port(s) for a minimum of five minutes. 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 five minutes. If the leakage rate exceeds 10 cc/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 200 psi (14 Bar) +/- 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 200 psi (14 Bar) +/- 5%. Monitor for gas leakage at the hydraulic control port(s) for a minimum of five minutes. 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 200 psi (14 Bar) +/- 5% with gas. Measure the leakage rate for a minimum of five minutes. If the leakage rate exceeds 5 standard cubic feet (.14m^3) per minute the SCSSV fails the Functional Test.

q. Repeat Steps o and p with 1200 psi (83 Bar) +/- 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.

Drift interior of SCSSV assembly with Manufacturer's specified drift bar. 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.

Drift exterior of wireline retrievable SCSSV with Manufacturer's specified drift sleeve. If the SCSSV fails the drift test, the SCSSV fails the Functional Test.

Record the drift's unique identifiers and 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 installed into the existing

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sequence of the Functional Test. Such special feature testing procedures, sequence and results shall be fully described in the test report.

v. If the SCSSV performed within the limits of the Functional Test, it has passed the Functional Test. Attach recorded data to the Manufacturer's test form. Certify the test with the appropriate Manufacturer's approval signatures and dates.

TABLE 5.22
SSCSV LIQUID FLOW RATES (+/-10%)
(Reference Sections 5.18, 5.19, and 5.20)

Normal Tubing or Casing Size inches (mm)	Circulation Rate B/D (m^3d)
	Class 1 & 2
2-3/8 (60.3)	500 (79)
2-7/8 (73.0)	780 (124)
3-1/2 (88.9)	1120 (178)
4 (101.6)	1500 (238)
4-1/2 (114.3)	1920 (305)
5 (127.0)	2430 (386)
5-1/2 (139.7)	3000 (477)
6-1/2 (165.1)	4320 (687)
7 (177.8)	5880 (935)

The manufacturer establishing sizes not covered by this specification may interpolate or extrapolate by a ratio of the square of the diameter versus the parameter involved.

5.22 SSCSV FUNCTIONAL TESTING

5.22.1 A typical Manufacturer's test facility is shown in Figure 5.8 and includes:

a. Test section installed vertically.

b. Test section pressure measurement devices.

c. Pressurized gas source.

d. Flow rate measurement devices.

e. Pressurized water system.

f. A time based recorder to simultaneously record the required data.

g. Drift sleeve.

5.22.2 SSCSV Functional Testing Procedure — Velocity Type.

a. Record serial number.

b. Place 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 50 psi (3.5 Bar).

d. Check operation of recorders for flowrate, 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 time of valve closure. If 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 pressure upstream of SSCSV to 100% +/- 5% of the rated working pressure of the SCSSV.

h. Hold the upstream pressure for a minimum of five minutes and measure leakage rate. If the leakage rate exceeds 10 cc/min, the SSCSV fails the Functional Test.

i. Bleed pressure from below the SSCSV to a pressure 100 psi (7 Bar) greater than the closing differential pressure.

j. Adjust gas pressure to 200 psi (14 Bar) +/- 5% greater than the closing pressure differential.

k. Measure gas leakage rate for five minutes. If the leakage rate exceeds 5 standard cubic feet (.14m^3) per minute, the SSCSV fails the Functional Test.

l. Bleed all pressures to zero.

m. Prepare SSCSV for drift test. Drift exterior of SSCSV with drift sleeve. If SSCSV does not pass through the drift sleeve, it fails the Functional Test. Record the drift sleeve nominal size and the unique identifier.

n. If the SSCSV performed within the limits of the Functional Test, it has passed the Functional Test. Attach recorded data to the Manufacturer's test form. Certify the test with the appropriate Manufacturer's approval signatures and dates.

5.22.3 SSCSV Functional Testing Procedure — Tubing Pressure Type.

a. Record serial number.

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

c. Adjust flow rate in accordance with Table 5.22.

d. Reduce downstream pressure until the SSCSV closes.

e. Record the flow rate and downstream pressure at the time of valve closure. If downstream pressure at closure is not within +/- 5% of the Manufacturer's specified pressure or 10 psi (7 Bar) whichever

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TABLE 5.23 SSCSV CLASS 2 FLOW TEST
(Reference Section 5.20)

Test Report No._____ Test Stand # _____

For Velocity-Type SSCSVs: +15% _____B/D -15% _____ B/D of Closing Flow Rate: From Table 5.18
For Low-Tubing-Pressure-Type SSCSVs: +15% _____PSI -15% _____ PSI of Closing Pressure: From Table 5.18

	Step 5.16.11 Cycle 1	Step 5.16.12 Cycle 2	Step 5.16.12 Cycle 3	Step 5.16.12 Cycle 4	Step 5.16.12 Cycle 5	Step 5.16.12 Cycle 6	Step 5.16.12 Cycle 7
Date of Test	_____	_____	_____	_____	_____	_____	_____
Time at Start of Slurry Circulation Through the Valve	_____	_____	_____	_____	_____	_____	_____
Flow Rate at Start of Circulation Period	_____ B/D	_____ B/D	_____ B/D	_____ B/D	_____ B/D	_____ B/D	_____ B/D
Sand Concentration at Start of Circulation Period	_____ %	_____ %	_____ %	_____ %	_____ %	_____ %	_____ %
Slurry Viscosity at Start of Circulation Period	___ Marsh S	___ Marsh S	___ Marsh S	___ Marsh S	___ Marsh S	___ Marsh S	___ Marsh S
Time at Valve Closure (Against Slurry Flow)	_____	_____	_____	_____	_____	_____	_____
For Velocity-Type SSCSVs:							
• Initial Downstream Pressure	_____ PSI	_____ PSI	_____ PSI	_____ PSI	_____ PSI	_____ PSI	_____ PSI
• Slurry Flow Rate at Closure	_____ B/D	_____ B/D	_____ B/D	_____ B/D	_____ B/D	_____ B/D	_____ B/D
• Differential Pressure Across Valve at Closure	_____ PSI	_____ PSI	_____ PSI	_____ PSI	_____ PSI	_____ PSI	_____ PSI
For Low-Tubing-Pressure-Type SSCSVs:							
• Initial Downstream Pressure	_____ PSI	_____ PSI	_____ PSI	_____ PSI	_____ PSI	_____ PSI	_____ PSI
• Downstream Pressure at Closure	_____ PSI	_____ PSI	_____ PSI	_____ PSI	_____ PSI	_____ PSI	_____ PSI
Sand Concentration at Completion of Circulation Period	_____ %	_____ %	_____ %	_____ %	_____ %	_____ %	_____ %
Slurry Viscosity at Completion of Circulation Period	___ Marsh S	___ Marsh S	___ Marsh S	___ Marsh S	___ Marsh S	___ Marsh S	___ Marsh S
Test Passed?	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___	Yes:___ No:___
Conducted By: Signature, Date:	_____	_____	_____	_____	_____	_____	_____

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