ERRATA
(AUGUST 1, 1994)

Specification for Wellhead Surface Safety Valves and Underwater Safety Valves for Offshore Services

API SPECIFICATION 14D (SPEC 14D)
NINTH EDITION, JUNE 1, 1994

STEP
Strategies for Today's Environmental Partnership

American Petroleum Institute
1220 L Street, Northwest
Washington, DC 20005

Issued by
AMERICAN PETROLEUM INSTITUTE
Production Department

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

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Front Cover of the Specification.

The effective date should be changed from June 1, 1994 to April 1, 1995.

Inside the front cover. *Add the following:*

Conformance to API's Environmental Mission and Guiding Principles.

This specification has been reviewed to determine if it conforms to API's Environmental Mission and Guiding Principles.[1] It has been determined that because this specification directly addresses safety and environmental issues, it does conform to API's Environmental Mission and Guiding Principles. The following guiding principles have been determined to be especially relevant to this specification:

- To recognize and to respond to community concerns about our raw materials, products, and operations.
- To operate our plants and facilities, and to handle our raw materials and products in a manner that protects the environment and the safety and health of our employees and the public.
- To make safety, health, and environmental considerations a priority in our planning and our development of new products and processes.
- To counsel customers, transporters, and others in the safe use, transportation, and disposal of our raw materials, products, and waste materials.
- To participate with government and others in creating responsible laws, regulations, and standards to safeguard the community, workplace, and environment.
- To promote these principles and practices by sharing experiences and offering assistance to others who produce, handle, use, transport, or dispose of similar raw materials, petroleum products, and wastes.

Add the following footnote to the bottom of the inside of the front cover:

[1]*Charter and Bylaws of the American Petroleum Institute,* American Petroleum Institute, Washington, D.C., April 3, 1991.

Page 7, Table 104.1, Referenced Standards. *Add:*

ASTM A703/A703M: Standard Methods and Definitions for Mechanical Testing of Steel Products.

Page 9, Section 200. *Add the following definition:*

Valve Bore Sealing Mechanism — Those internal valve parts which close off the flow through the valve bore, such as gates, balls, plugs, poppets, flappers, and their respective seats.

Page 14, Table 403.4, Adjustment Factors for Sub-Size Specimens. *Change the Adjustment Factor for Specimen Dimension* 10mm x 7.5mm *to:* 0.833

Page 15, Section 403.4c(2) Oil Quenching. *Delete this section and change* Section 403.4c(3) *to* Section 403.4c(2).

Page 16. *Add Section:*

404. Class 3S — Metals for Sulfide Stress Corrosion Cracking Service. SSV/USV materials for sulfide stress cracking service in direct fluid contact (as defined by NACE MR-01-75) shall comply with the requirements of NACE MR-01-75 and section 403.

Page 16, Section 404. *After adding new Section 404 as instructed above, renumber present* Section 404 *to* Section 405 *and renumber remaining Sections accordingly. New Section 405 should read:* **Class 3C — Metals for Chloride Stress Cracking Service.** *(PLEASE NOTE: While the sections of this section are renumbered, for simplicity, this errata will still refer to the old section numbers for other changes to this section.)*

Page 16, Section 410.2c Size Requirements. *Change the second paragraph to read:*

Forging — size not required to exceed 2½ inches (63mm) ER. Casting — size not required to exceed size shown in ASTM A 703.

Page 19, Section 502.3b. *Add the following sentence to the end of the section:*

A WPS for each base material, which is not listed in an ASME Section IX P-number grouping, shall be specifically qualified for the manufacturer's specified base material.

Page 19, Section 502.3f. *Insert the following after the first sentence:*

One set of three (3) test specimens each shall be removed at the ¼ thickness location of the test weldment for each of the weld metal and base material HAZ. The root of the notch shall be oriented normal to the surface of the test weldment and located as follows:

(a) Weld Metal Specimens (3 each) 100% weld metal.

(b) HAZ Specimens (3 each) include as much HAZ material as possible.

Page 19, Sections 502.4c and 502.4d. *Delete these sections.*

Page 23, Section 605.1. *Add the following table and renumber the present* Table 605.1 *to* 605.2.

TABLE 605.1
QUALITY CONTROL REQUIREMENTS FOR VALVE PARTS

	See Appropriate Section		
	Bodies Bonnets and Stems	Valve bore Sealing Mechanisms	Nonmetallic Seals
Tensile Testing	605.2a		
Impact Testing	605.2b		
Hardness Testing	605.2c		605.4c
Dimensional Verification	605.2d		605.4a
Traceability	605.2e		
Chemical Analysis	605.2f		
Visual Examination	605.2g		605.4b
Surface NDE	605.2h 605.2i		
Weld NDE — General	605.2j	605.2j	
— Examination Visual	605.2j(1)	605.2j(1)	
— NDE Surface	605.2j(2)	605.2j(2)	
— Repair Welds	605.2j(3)	605.2j(3)	
— NDE Volumetric	605.2j(4)		
Documentation			605.4d

PLEASE NOTE: Section numbers referenced in the table are the new Section numbers

Page 24, Section 605.2e Traceability. *Change the first sentence to read:*

Job lot traceability is required.

Page 25, Section 605.2j(2) Weld NDE — Surface. *In the first sentence change:* "$^{1}/_{18}$" *to* "$^{1}/_{8}$".

Page 25, Section 605.2j. *Change reference from* Table 605.1 *to* 605.2.

Page 26, Section 605.3. *Add Section:*

605.3 Valve Bore Sealing Mechanism. Table 605.1 lists the quality control requirements for valve bore sealing mechanism.

Change present Section 605.3 *to* 605.4 *in all places.*

Page 27, Section 606.2b. *Add Section:*

606.2b Valve Bore Sealing Mechanism. Valve bore sealing mechanism records shall be required according to Section 605.3.

Renumber present 606.2b *to* 606.2c *and revise to read:*
Non-metallic Sealing Material. Non-metallic sealing material records shall be required according to Section 605.4.

Renumber Section 606.2c *to* 606.2d.

Page 33, Section 904.9. *Renumber to* Section 904.8b *and revise to read:*

The Test Agency must meet the criteria of API Spec 14D and applicable requirements of API Spec Q1 or the criteria of 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 of ASME SPPE-2, *Accreditation of Testing Laboratories for Safety and Pollution Prevention Equipment Used in Offshore Oil and Gas Operations,* in order to test SSV/USV equipment that is intended to be marked with the API Monogram or the ASME SPPE OCS Symbol. See Appendix D of this specification for API licensing procedures or contact ASME for SPPE-2 accreditation criteria.

Page 36, Section 905.7e, third line. *Change* "or" *to* "of".

Page 40, Section 908.1b, first sentence. *Revise to read:*

"Drift Test. The SSV/USV valve opening of each full bore SSV/USV valve shall be checked for proper bore alignment by passing a drift mandrel of the dimensions shown in API Spec 6A . . ."

Delete Table 908.2 from page 42.

Page 41, Table 908.1. *Revise as shown:*

I. SSV/USV Acutator Seal Test
V. Primary Seat Test
Secondary Seat Test
Tertiary Seat Test

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FOREWORD

The purpose of this specification is to provide requirements for wellhead surface safety valves and underwater safety valves. A wellhead surface safety valve (SSV) or an underwater safety valve (USV) is used as one means of assuring well stream shutoff.

API RP 14H: Recommended Practice for Installation, Maintenance, and Repair of Surface Safety Valves and Underwater Safety Valves Offshore, also provides guidelines for recommended installation, operation, maintenance, and testing procedures for SSVs/USVs.

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:

Spec 14A: Specification for Subsurface Safety Valve Equipment

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.

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.

Attention Users of This Publication: API Specifications usually include bar notations in the margin 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 revisions made in this edition. Every Section of this document includes revisions from the previous edition.

This is the Ninth Edition of this publication and supersedes all previous editions. It includes changes to the Eighth Edition, August 1991, as approved by letter ballot.

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

SECTION 100
SCOPE

101. PURPOSE. This Specification covers flanged valves, or valves with other industry accepted nonthreaded end connections, and multiple completion or block type valves used as wellhead surface safety valves (SSV). This Specification also covers underwater safety valves (USV) to be used on or near underwater wellheads.

102. CLASSES OF SERVICES. Included are minimum acceptable standards for materials, manufacturing, and testing of SSVs/USVs for four classes of service. To qualify, a SSV/USV valve must pass the verification test specified in Section 400. Also included are minimum acceptable standards for materials, manufacturing, and performance of lockopen devices. The four classes of service are as follows:

102a. Class 1. Standard Service. This class of SSV/USV is intended for use on oil or gas wells that do not exhibit the detrimental effects caused by corrosion (stress corrosion cracking or metal loss) or sand erosion or fouling.

102b. Class 2. Sandy Service. This class of SSV/USV is intended for use on oil or gas wells where a substance such as sand could be expected to cause a SSV/USV valve failure. This valve must also meet the requirements of Class 1 Service.

102c. Class 3. Stress Corrosion Cracking Service. This class of SSV/USV is intended for use on oil or gas wells where corrosive agents could be expected to cause stress corrosion cracking. This SSV/USV class must meet the requirements for a Class 1 or Class 2 SSV/USV, whichever is applicable, and be manufactured from materials that are resistant to stress corrosion cracking. Within this service class there are two subclasses: 3S for resistance to sulfide stress cracking, and 3C for resistance to chloride stress cracking.

102d. Class 4. Metal Loss Corrosion Service. This class of SSV/USV is intended for use on oil or gas wells where corrosion could be expected to cause a SSV/USV failure due to corrosive metal loss. This SSV/USV class must meet the requirements for a Class 1 or Class 2 SSV/USV, whichever is applicable. This class requires the use of materials that are resistant to metal loss corrosion.

103. VERIFICATION TESTING. The verification testing requirements in this Specification are not represented as duplicating actual well conditions.

104. REFERENCED STANDARDS.

104.1 GENERAL. This specification includes by reference, either in total or in part, other API, industry, and government standards listed in Table 104.1.

NOTE: *Only those standards listed in Table 104.1 are considered part of this Specification. Documents (subtier) that are referenced by those standards are not considered part of this Specification.*

When the latest edition is specified it may be used on issue and shall be mandatory six months from the date of revision. The replaced edition may be used up to six months from the date of the latest revision.

104.2 REQUIREMENTS. Requirements of other standards included by reference in this Specification are essential to the safety and interchangeability of the equipment produced.

For information on submitting Equivalent Standards for inclusion in this Specification, contact the API Exploration & Production Department, 700 North Pearl, Suite 1840 (LB-382), Dallas, Texas 75201-2845.

104.3 EQUIVALENT STANDARDS. Other nationally or internationally recognized standards shall be submitted to and approved by API for inclusion in this Specification prior to their use as Equivalent Standards.

105. UNITS OF MEASURE. A decimal/inch system is the standard for the dimensions shown in this Specification. Nominal sizes will continue to be shown as fractions. This change from previous editions of *API Spec 14D* reflects current widespread industry practice. It is not intended that this modify the fractional dimensions or tolerances from earlier editions. Table 304.1 gives fraction to decimal equivalence. For the purposes of this Specification, the fractions and their decimal equivalents are equal and interchangeable. Metric conversions are described in Appendix A.

106. APPENDICES. Appendices are for information only except where cited as requirements in the text.

SCOPE (continued)

TABLE 104.1
REFERENCED STANDARDS

Latest editions are applicable, unless otherwise so noted.
Refer to Section 104.1.

1. *ANSI B 1.1: Unified Standard Inch Screw Threads*
2. *ANSI B 18.2.2: Square and Hex Nuts*
3. *API Manual of Petroleum Measurement Standards,* Chapter 10, Section 10, Section 4: "Sediment and Water"
4. *API Manual of Petroleum Measurement Standards,* Chapter 15: "Guidelines for the Use of the International System of Units (SI)"
5. *API RP 13B: Standard Procedure for Field Testing Drilling Fluids*
6. *API RP 14H: Use of Surface Safety Valves and Underwater Safety Valves Offshore*
7. *API Spec 5CT: Casing and Tubing*
8. *API Spec 6A: Wellhead Equipment*
9. *API Std. 5B: Threading, Gaging, and Thread Inspection of Casing, Tubing, and Line Pipe Threads*
10. *API Spec 5L: Line Pipe*
11. *ASME Boiler and Pressure Vessel Code,* Sect. V, Nondestructive Testing, Article 5, "UT Examination Methods For Materials, and Fabrication" . . . Para. T522 & T542
12. *ASME Boiler and Pressure Vessel Code,* Section VIII, Division 1
    a) Part UG-101: "Proof Tests to Establish Maximum Allowable Working Pressure"
    b) Appendix 4: "Rounded Indication Charts Acceptance Standard for Radiographically Determined Rounded Indications in Welds"
13. ASME Section VIII, Division 2: "Pressure Vessels — Alternate Rules"
    a) Appendix 4: "Design Based on Stress Analysis"
    b) Appendix 6: "Experimental Stress Analysis"
14. *ASME Boiler and Pressure Vessel Code,* Section IX, "Welding and Brazing Qualifications"
15. *ASTM A 193: Alloy Steel and Stainless Steel Bolting Materials For High Temperature Service*
16. *ASTM A 194: Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service*
17. *ASTM A 307: Carbon Steel Externally Threaded Standard Fasteners*
18. *ASTM A 320: Alloy Steel Bolting Materials for Low Temperature Service*
19. *ASTM A 380: Practice for Cleaning and Descaling Stainless Steel Parts, Equipment, and Systems*
20. *ASTM A 370: Standard Methods and Definitions for Mechanical Testing of Steel Products*
21. *ASTM A 388: Recommended Practice for Ultrasonic Examination of Heavy Steel Forgings*
22. *ASTM A 453: Bolting Materials, High Temperature, 50 to 120 ksi Yield Strength, with Expansion Coefficients Comparable to Austenitic Steels*
23. *ASTM A 609: Practice for Castings, Carbon, Low-Alloy, and Martensitic Stainless Steel, Ultrasonic Examination Thereof*
24. *ASTM E 10: Standard Test Methods for Brinell Hardness of Metallic Materials*
25. *ASTM E 18: Standard Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials*
26. *ASTM E 92: Standard Test Method for Vickers Hardness of Metallic Materials*
27. *ASTM E 94: Standard Practice for Radiographic Testing*
28. *ASTM E 140: Standard Hardness Conversion Tables for Metals*
29. *ASTM E 165: Standard Practice for Liquid Penetrant Inspection*
30. *ASTM E 186: Reference Radiographs for Heavy-Walled 2 to 4½ in. (51 to 114 mm) Steel Castings*
31. *ASTM E 280: Reference Radiographs for Heavy-Walled 4½ to 12 in. (114 to 305 mm) Steel Castings*
32. *ASTM E 428: Standard Recommended Practice for Fabrication and Control of Steel Reference Blocks Used in Ultrasonic Inspection*
33. *ASTM E 446: Reference Radiographs for Steel Castings up to 2 in. (51 mm) in Thickness*
34. *ASTM E 709: Standard Recommended Practice For Magnetic Particle Examination*
35. *ASTM E 747: Standard Method for Controlling Quality of Radiographic Testing Using Wire Penetrameters*
36. *MSS SP-55: Quality Standard for Steel Castings for Valves, Flanges, and Fittings and Other Piping Components (Visual Method)*
37. *MIL-H-6875H: Heat Treatment of Steels Aircraft Practice Process,* Section 3
38. *MIL-STD-105D: Sampling Procedures and Tables for Inspection by Attributes*
39. *NACE Standard MR0175: Sulfide Stress Cracking Resistant Metallic Materials for Oilfield Equipment*
40. *SAE AS 568A: Aerospace Size Standard for O-Rings*
41. *ASTM D1418: Practice for Rubber and Rubber Latices*
42. *SNT-TC-1A: Personnel Qualification and Certification in Nondestructive Testing* — '84, or latest edition

NOTE: Other nationally or internationally recognized standards shall be submitted to and approved by API for inclusion in this Specification prior to their use as Equivalent Standards.

SECTION 200
ABBREVIATIONS AND DEFINITIONS

The following abbreviations are used in this Specification.

AISI	American Iron & Steel Institute
ANSI	American National Standards Institute
ASME SPPE	Refers to the program described in ASME SPPE 1 and 2
ASNT	American Society for Nondestructive Testing
API	American Petroleum Institute
AQL	Acceptance Quality Level
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
MIL-STD	Military Standard, USA
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry
NACE	National Association of Corrosion Engineers
NDE	Nondestructive Examination
OSAPE	API Exploration & Production Department Committee on Standardization of Offshore Safety and Anti-Pollution Equipment
QTC	Qualification Test Coupon

The definitions below are related specifically to surface safety valves and/or underwater safety valves and are presented to define the terminology used in this Specification.

Authorized Facility — A facility authorized under the applicable quality assurance program specified by the operator on the purchase order.

Authorized Quality Assurance Program — API or SPPE Quality Program.

Date of Manufacture — The date of manufacturer's final acceptance of finished equipment.

Chloride Stress Cracking — The stress corrosion cracking of ferrous based alloy steels, which may result when exposed to wellstreams containing water and chlorides under certain conditions of concentration and temperature. Other constituents present, such as oxygen, may contribute to chloride stress cracking.

Date of Repair/Remanufacture — The date of repairer's/remanufacturer's final acceptance of finished equipment.

Failure — Improper performance of a device or equipment item that prevents completion of its design function.

Heat Sensitive Lockopen Device — A device installed on an SSV actuator to maintain the SSV valve in a full open position until exposed to sufficient heat to cause the device to release and allow the SSV valve to close.

Manufacturer — The principal agent in the design, fabrication, and furnishing of SSV/USV actuator and or SSV/USV valve. The SSV/USV valve and SSV/USV actuator define functional entities and do not necessarily represent the units as supplied.

Metal Loss Corrosion — Loss of metal in areas exposed to well streams which contain water or brine and carbon dioxide (CO_2), hydrogen sulfide (H_2S), oxygen (O_2), or other corrosive agents.

Normally Closed Valve — A valve which will shift to the closed position upon loss of the power media.

Operating Manual — The publication issued by the manufacturer which contains detailed data and instructions related to the design, installation, operation, and maintenance of SSV/USV equipment.

Pressure Containing Parts — Those parts whose failure to function as intended would result in a release of pressurized fluid to the atmosphere. Includes only the SSV/USV valve body, bonnet, and stem; actuator piston, cylinder, and stem (shaft).

Pressure Controlling Parts — Those parts intended to control or regulate the movement of pressurized fluids. Includes only SSV/USV valve gate and seats.

Qualified Parts — A part manufactured under an authorized quality assurance program and, in the case of replacement, produced to meet or exceed the performance of the original part.

Rated Working Pressure — The maximum internal pressure that equipment is designed to contain and/or control. Working pressure is not to be confused with test pressure.

Remanufacture — An activity involving disassembly, reassembly, and testing of *API Spec 14D* equipment with or without the replacement of qualified parts where machining, welding, heat treating, or other manufacturing operations are employed. Remanufacture does not include the replacement of bodies.

Repair — An activity involving disassembly, reassembly, and testing of *API Spec 14D* equipment with or without the replacement of qualified parts. Repair does not include machining, welding, heat treating, other manufacturing operations or the replacement of bodies.

Repairer/Remanufacturer — A person or company who performs the repair/remanufacture in an authorized facility.

Manufacturing Operation — An activity involving, but not limited to, the machining, welding, heat treating, or other processes utilized to produce a finished product.

Stress Corrosion Cracking — The cracking which results from a combination of corrosion and stress.

Sulfide Stress Cracking — The stress corrosion cracking of susceptible materials which occurs when exposed to wellstreams containing hydrogen sulfide (H_2S) and water.

Surface Safety Valve (SSV) — An automatic wellhead valve assembly which will close upon loss of power supply. When used in this Specification it includes SSV valve and SSV actuator.

SSV/USV Actuator — The device which causes the SSV/USV valve to open when power is supplied and to automatically close when power is lost or released.

SSV/USV Valve — The portion of the SSV/USV which contains the wellstream and shuts off flow when closed.

Test Agency — Any independent third party which provides a test facility and administers a testing program which meets the Class 2 SSV/USV valve verification test requirements of this Specification.

Traceability, Job Lot — The ability for parts to be identified as originating from a job lot which identifies the included heat(s).

Underwater Safety Valve (USV) — An automatic valve assembly (installed at an underwater wellhead location) which will close upon loss of power supply. When used in this Specification, this includes the USV valve and USV actuator.

Valve, Gate — A valve designed to function in either a full open or full closed position in which the closure member (gate) is moved in a direction perpendicular to the flow direction.

SECTION 300
GENERAL

301. PERFORMANCE REQUIREMENTS.

301.1 GENERAL. Surface Safety Valves (SSV) and Underwater Safety Valves (USV) designed and manufactured in accordance with this Specification shall be constructed of materials in compliance with Section 400 of this Specification and shall perform satisfactorily in the tests required by Section 900 of this Specification. The SSV/USV shall be of a normally closed design. The SSV/USV shall be designed to operate, without damage to the SSV/USV valve or SSV/USV actuator, when SSV/USV actuator energy is instantaneously applied or lost under any condition of SSV/USV valve body pressure within its pressure rating. Design criteria for USV's shall also include the maximum water depth.

301.2 RELATED SPECIFICATIONS. In addition to the requirements of this section, a SSV/USV valve must comply with the applicable dimensional requirements of *API Spec 6A*.

301.3 SSV VALVE DESIGN. This Specification covers flanged valves, or valves with other industry accepted non-threaded end connections, and multiple completion or block type valves used as wellhead surface safety valves. A multiple completion or block type valve will qualify as a wellhead SSV for Class 2 service, without verification testing, if it is of the same internal design as an SSV valve within the manufacturer's product line, which has passed the verification test in Section 900 of this Specification. Such valves must be manufactured and supplied in accordance with all other requirements of this Specification.

301.4 USV VALVE DESIGN. USV valve designs must meet the requirements for SSV valve design with the following exceptions: (1) USV valves may use any standard or other industry accepted end connections. (2) USVs may be of nonstandard bores and/or end-to-end lengths. End connections which are not specified in *API Spec 6A* shall meet all other requirements of this Specification.

301.5 SSV/USV ACTUATOR DESIGN. The manufacturer shall provide an SSV/USV actuator design which has the following features:

301.5a Internal components shall be resistant to environmental corrosion, the operating media, and the wellstream fluid, if exposed under normal operating conditions.

301.5b SSV/USV actuator closing force must be sufficient to close the SSV/USV valve when the SSV/USV valve is at the most severe design closing condition as specified by the valve manufacturer.

301.5c In pneumatically operated SSV/USV actuators, a relief device will be provided to relieve at no higher than the rated working pressure of the SSV/USV actuator.

301.5d SSV/USV actuators must be designed to prevent pressure buildup in the SSV/USV actuator case due to leakage from the SSV/USV valve.

301.5e Permanently attached lockopen features are not permitted on SSV actuators.

301.6 HEAT SENSITIVE LOCKOPEN DEVICE DESIGN. The SSV actuator manufacturer shall make available, as an accessory, a heat sensitive lockopen device. Each type of heat sensitive lockopen device shall maintain the SSV valve in the fully open position, at atmospheric temperatures up to 150 degrees Fahrenheit (66° Celsius) with the SSV valve body pressurized to its rated working pressure and the SSV actuator cylinder bled to atmospheric conditions.

301.6a The following temperature actuation conditions must be met:

301.6a(1) The lockopen device shall allow the SSV valve to automatically close from SSV actuator forces alone (i.e., no pressure in the SSV valve body or energy supply to the SSV actuator cylinder) within six minutes after being subjected to, and maintained in, a controlled environmental temperature of 1,000 degrees Fahrenheit ±25 degrees Fahrenheit (538° Celsius ±14°). Tests to confirm this design feature shall be done in an air environment with air velocity past the SSV actuator due to natural air convection only.

301.6a(2) Eutectic materials used shall meet the manufacturer's design specifications for fusing within a degree Fahrenheit temperature range of ±10%. The heat sensitive device shall be designed to actuate at maximum sustained temperature of 400 degrees Fahrenheit (204° Celsius).

301.6b The lockopen device shall be designed such that any component part released upon actuation of the device shall not present itself as a potential hazard to personnel.

302. SERVICE CONDITIONS.

302.1 PRESSURE RATINGS.

302.1a General. Valves shall be designed to operate in the following rated working pressures: 2,000 psi (13,8 MPa); 3,000 psi (20,7 MPa); 5,000 psi (34,5 MPa); 10,000 psi (69,0 MPa); 15,000 psi (103,4 MPa); 20,000 psi (138,0 MPa)

302.1b Design Considerations. The design shall take into account the effects of pressure containment and other pressure-induced loads.

302.1c SSV/USV Valve Pressure Considerations. The rated working pressure of SSV/USV valve shall be the lowest rated working pressure of any part.

302.2 TEMPERATURE RATINGS.

302.2a General. Equipment shall be designed to operate in one or more of the specified temperature ratings with minimum and maximum temperatures as shown in Table 302.2.

Minimum temperature is the lowest ambient temperature to which the equipment may be subjected. Maximum temperature is the highest temperature of the fluid that will directly contact the equipment.

TABLE 302.2
TEMPERATURE RATINGS

Temperature Classification	Operating Range Degree Fahrenheit			Degree Celsius		
	Min.		Max.	Min.		Max.
K	-75	to	180	-60	to	82
L	-50	to	180	-46	to	82
P	-20	to	180	-29	to	82
S	0	to	150	-18	to	65
T	0	to	180	-18	to	82
U	0	to	250	-18	to	121

302.3 SERVICE CLASSES. SSVs/USVs are classified as to the service to which they will be subjected, as outlined in Section 102: Class 1 — Standard Service; Class 2 — Sandy Service; Class 3 — Stress Corrosion Cracking Service; Class 4 — Metal Loss Corrosion. SSV/USV valves designed to meet the requirements for combinations of these classes of service may be furnished to this Specification. They must be identified as specified in Section 700.

302.3a Requirements for Service Class. The parts of an SSV/USV valve exposed to well fluids shall be resistant to the effects of the service for which the SSV/USV valve is classed (e.g., erosion, corrosion).

302.4 SSV/USV ACTUATOR.

302.4a Temperature Ratings. Equipment shall be designed to operate in one or more of the specified temperature ratings with minimum and maximum temperatures as shown in Table 302.2.

Minimum temperature is the lowest ambient temperature for which the equipment is designed to operate. Maximum temperature is the highest temperature of the fluid that the equipment is designed to contain.

302.4b Low Temperature. For temperature ratings at -20 degrees Fahrenheit (-6° Celsius) and below, metallic pressure containing parts shall be fabricated from materials which demonstrate material toughness. Refer to Tables 403.3 and 403.4.

302.4c Pressure Ratings. An SSV/USV actuator covered by this Specification shall be designed by the manufacturer for a pressure rating not greater than 20,000 psi (138,0 MPa). The pressure ratings shall be applicable to pressure containing parts at the rated temperature.

303. DESIGN METHODS.

303.1 FLANGES. API flanges have been designed in accordance with design criteria and methods developed by the API Committee on Standardization of Valves and Wellhead Equipment (Committee 6).

303.2 BODIES AND BONNETS. Bodies and bonnets shall be designed in accordance with one or more of the following methods:

NOTE: *In the event stress levels calculated by these methods exceed the allowable stresses, other methods identified by the manufacturer shall be used to justify these stresses. Fatigue analysis and localized bearing stress values are beyond the scope of this Specification.*

303.2a ASME. The design methodology as described in the *ASME Boiler and Pressure Vessel Code,* Section VIII, Division 2, Appendix 4, may be used for design calculations for pressure containing equipment. Design allowable stresses shall be limited by the following criteria:

$$S_T = 0.83S_Y \text{ and } S_M = \frac{2\,S_Y}{3}$$

where:

S_M = design stress intensity at rated working pressure, psi.

S_T = maximum allowable general primary membrane stress intensity at hydrostatic test pressure, psi.

S_Y = material minimum specified yield strength, psi.

303.2b Distortion Energy Theory. The distortion energy theory method may be used for design calculations for pressure containing equipment. The basic pressure vessel wall thickness may be sized by combining triaxial stresses based on hydrostatic test pressure and limited by the following criteria:

$$S_E = S_Y$$

where:

S_E = maximum allowable equivalent stress computed by the Distortion Energy Theory method, psi.

S_Y = material minimum specified yield strength, psi.

303.2c Experimental Stress Analysis. Experimental stress analysis as described in the *ASME Boiler and Pressure Vessel Code,* Section VIII, Division 2, Appendix 6.

303.2d Proof Test Analysis. Proof testing as described in the *ASME Boiler and Pressure Vessel Code,* Section VIII, Division 1, Part UG-101.

303.3 CLOSURE BOLTING. The maximum allowable tensile stress for closure bolting shall be determined, considering initial boltup, rated working pressure, and hydrostatic test pressure conditions. Bolting stresses, based on the root area of the thread, shall not exceed the following limits:

$$S_A = 0.83S_Y$$

where:

S_A = maximum allowable tensile stress, psi.

S_Y = bolting material specified minimum yield strength, psi.

Bolting stresses shall be determined considering all loading on the closure including pressure acting over the seal area, gasket loads, and any additive mechanical and thermal loads.

303.4 OTHER PARTS. All other pressure containing parts shall be designed to satisfy the manufacturer's documented performance characteristics and the service conditions in this Specification. The manufacturer shall specify methods to be used in design which are consistent with accepted engineering practices.

304. MISCELLANEOUS DESIGN INFORMATION.

304.1 GENERAL. End and outlet connections shall be an integral part of the body or attached by welding which meets requirements of this Specification.

304.2 DIMENSIONAL REQUIREMENTS. Dimensional tolerance of components or subassemblies shall be such that additive tolerances will not preclude proper operation of the SSV/USV. All components must be dimensionally inspected to the extent necessary to assure proper operation and compliance with design specifications and drawings.

304.3 BOLTING.

304.3a End and Outlet Bolting.

304.3a(1) Hole Alignment. End and outlet bolt holes shall be equally spaced and shall straddle common center lines.

304.2a(2) Stud Thread Engagement. Stud thread engagement length into the body shall be a minimum of one times the outside diameter of the stud.

304.3b Other Bolting. The stud thread anchoring means shall be designed to sustain a tensile load equivalent to the load which can be transferred to the stud through a fully engaged nut.

304.3c Bonnet Bolting. Bonnet bolting material for Class 4 valves shall meet the requirements of *API Spec 6A.*

304.4 TEST, VENT, INJECTION, AND GAGE CONNECTIONS. Test, vent, injection, and gage connections shall conform to all design and equipment requirements of *API Spec 6A.*

304.5 OPERATING ORIENTATION. The SSV/USV shall be designed to be fully operative in all possible positions of installation when installed and maintained in accordance with manufacturer's operating manual.

304.6 REDUCED OPENING SSV/USV VALVE PORTS. Reduced opening SSV/USV valves are customarily made in regular and venturi types, both of which can have ports of circular or substantially rectangular cross-section through the plug or gate.

These SSV/USV valves have no drift test requirement; however, the bore through the gate or plug shall align with the bore through the SSV/USV valve body to permit a smooth flow pattern when in the fully open position.

Reduced opening USV flow ports should be sized after consideration of Through Flow-Line (TFL) operations.

304.7 GREASE OR SEALANT FITTING. If grease or sealant is required in the SSV/USV valve body or stem area, provisions shall be made for injecting the grease or sealant without reducing the pressure in the SSV/USV valve.

305. DESIGN DOCUMENTATION. Documentation of designs shall include methods, assumptions, calculations, and, design requirements. Design requirements shall include, but not be limited to, those criteria for size, test, and operating pressures, material environmental and API Specification requirements, and other pertinent requirements upon which the design is to be based. Design documentation media shall be clear, legible, reproducible, and retrievable. Design documentation shall be retained for five (5) years after the last unit of that design is manufactured.

306. DESIGN REVIEW.

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

306.2 DESIGN CHANGES FROM FAILURE REPORTS — MANUFACTURER'S RESPONSIBILITY. The manufacturer providing SSVs/USVs in accordance with this Specification shall make an analysis of failures submitted in accordance with Appendix C. In the event the Failure Reports show repetitive failure of any component part or subassembly, the manufacturer shall make necessary design changes on all future affected models, types, and sizes of SSVs/USVs. The manufacturer shall notify purchasers of equipment affected by such design changes.

307. DESIGN VERIFICATION.

307.1 GENERAL. The manufacturer shall conduct and document the verification test as described in Section 900.

307.2 MANUFACTURE. All SSVs/USVs conforming to this Specification shall be manufactured in accordance with drawings and written standards, specifications, and procedures prepared by the manufacturer. In addition, Class 2 SSV/USV valves shall be manufactured to drawings and written specifications that are neither less stringent nor significantly different from those of the Class 2 SSV or USV valve that qualified in the verification test. Qualification of an SSV qualifies a USV with the same SSV valve bore sealing mechanisms and vice versa.

307.3 DESIGN OR MATERIAL CHANGES OF CLASS 2 SSV/USV VALVES. Changes in design or material, which affect the valve bore sealing mechanism of the Class 2 SSV/USV valve, shall require requalification by verification test.

SECTION 400
MATERIAL REQUIREMENTS

401. GENERAL. This section describes the material performance, processing, and composition requirements for pressure containing and pressure controlling metallic and non-metallic parts.

402. WRITTEN SPECIFICATIONS. All metallic and non-metallic pressure containing or pressure controlling parts for SSV/USV valves shall require a written material specification.

402.1 METALLIC REQUIREMENTS. The manufacturer's written specified requirements for metallic materials shall define the following along with accept/reject criteria:

1. Mechanical property requirements.
2. Material qualification.
3. Allowable melting practice(s).
4. Forming practice(s) including hot working & cold working.
5. Heat treatment procedure including cycle time and temperature with tolerances, heat treating equipment, and cooling media.
6. Material composition with tolerance.
7. NDE requirements.

402.2 NON-METALLIC REQUIREMENTS. Non-metallic pressure containing seals shall have written material specifications. The manufacturer's written specified requirements for non-metallic materials shall define the following:

1. Generic base polymer(s).
2. Physical property requirements.
3. Service class material compatibility.
4. Storage and age control requirements.

403. CLASS 1 AND CLASS 2 — MATERIALS FOR STANDARD AND SANDY SERVICE.

SSV/USV materials for standard and sandy service in direct contact with retained fluids shall comply with the manufacturer's written specification and Section 403.1 through 403.5.

403.1 VALVE MATERIAL PERFORMANCE BASES FOR PRESSURE CONTAINING PARTS.

403.1a Property Requirements. All bodies, bonnets, and flanges shall be fabricated from materials which meet the applicable property requirements shown in Table 403.1 and Table 403.2.

403.1b Impact Requirements. Impact testing shall conform to the requirements of Table 403.3. When subsize specimens are used, the Charpy V-Notch impact requirements shall be equal to that of the 10mm X 10mm specimens multiplied by the appropriate adjustment factor listed in Table 403.4.

403.2 MATERIAL QUALIFICATION TESTING.

403.2a When minimum impact and/or tensile properties are required in order for a material to be qualified for service, the required tests shall be performed on specimens from an acceptable Qualification Test Coupon (QTC) as described in Section 411.

403.2b Tensile Testing.

403.2b(1) Test Specimens. Tensile test specimens shall be removed from a QTC as described in Section 410.4a. This QTC shall be used to qualify a heat and the bodies, bonnets, and flanges produced from that heat.

403.2b(2) Methods. Tensile tests shall be performed at room temperature in accordance with the procedures specified in *ASTM A370*. A minimum of one tensile test shall be performed. The results of the tensile test(s) shall satisfy the applicable requirements of Table 403.1. If the results of the tensile test(s) do not satisfy the applicable requirements, two additional tensile tests may be performed in an effort to qualify the material. The results of each of these tests shall satisfy the applicable requirements.

TABLE 403.1
API MATERIAL PROPERTY REQUIREMENTS
BODIES, BONNETS, AND FLANGES

API Material Designation	.2% Yield Strength, minimum (psi)	Tensile Strength, minimum (psi)	Elongation in 2 in. (50mm), minimum (%)	Reduction in Area, minimum (%)
36K	36,000 (248 MPa)	70,000 (483 MPa)	21	No requirement
45K	45,000 (310 MPa)	70,000 (483 MPa)	19	32
60K	60,000 (414 MPa)	85,000 (586 MPa)	18	35
75K	75,000 (483 MPa)	95,000 (655 MPa)	17	35

TABLE 403.2
API MATERIAL APPLICATIONS FOR BODIES, BONNETS, AND FLANGES

Part	Pressure Ratings (psi)					
	2000 (13,8 MPa)	3000 (20,7 MPa)	5000 (34,5 MPa)	10,000 (69,0 MPa)	15,000 (103,4 MPa)	20,000 (138,0 MPa)
Body, Bonnet	36K,45K 60K,75K	36K,45K 60K,75K	36K,45K 60K,75K	36K,45K 60K,75K	45K,60K 75K	60K,75K
Flanges	60K,75K	60K,75K	60K,75K	60K,75K	75K	75K

TABLE 403.3
CHARPY V NOTCH IMPACT REQUIREMENTS (10mm x 10mm)

Temperature Classification	Test Temperature (°F)	Minimum Average Impact Value (ft-lbs)
K	-75 (-60°C)	15 (20 Joules)
L	-50 (-46°C)	15 (20 Joules)
P	-20 (-29°C)	15 (20 Joules)
S	0 (-18°C)	--
T	0 (-18°C)	--
U	0 (-18°C)	--

TABLE 403.4
ADJUSTMENT FACTORS FOR SUB-SIZE SPECIMENS

Specimen Dimension	Adjustment Factor
10mm x 7.5mm	0.838
10mm x 5.0mm	0.667
10mm x 2.5mm	0.333

TABLE 403.5
STEEL COMPOSITION LIMITS FOR BODY, BONNET, AND FLANGE MATERIAL (wt%)

Alloying Element	Carbon and Low Alloy Steels Composition Limits	Martensitic** Stainless Steels Composition Limits
Carbon	0.45 max	0.15 max
Manganese	1.80 max	1.00 max
Silicon	1.00 max	1.50 max
Phosphorus	0.040 max	0.040 max
Sulfur	0.040 max	0.040 max
Nickel	1.00 max	4.50 max
Chromium	2.75 max	11.0-14.0
Molybdenum	1.50 max	1.00 max
Vanadium	0.30 max	N/A

**Other alloy systems are not required to conform to this table.

403.2c Impact Testing.

403.2c(1) Sampling. Impact tests shall be performed on a heat of material when a body, bonnet, or flange produced from that heat requires testing as shown in Table 403.3.

403.2c(2) Test Specimens. Impact test specimens shall be removed from a QTC as described in Section 410.4a. This QTC shall be used to qualify a heat and the bodies, bonnets, and flanges produced from that heat.

403.2c(3) Methods. Impact tests shall be performed in accordance with the procedures specified in *ASTM A370* using the Charpy V-Notch technique. In order to qualify material for an API temperature rating, the impact tests shall be performed at or below the lowest temperature of that classification range.

A minimum of three impact specimens shall be tested to qualify a heat of material. Impact properties as determined from these tests shall satisfy the applicable requirements of Table 403.3. In no case shall an individual impact value fall below two-thirds of that required as a minimum average. Similarly, no more than one of the three test results may be below the required minimum average.

403.2c(4) If a test fails, then a retest of three additional specimens (removed from the same general location within the same QTC with no additional treatment) shall be made, each of which shall exhibit an impact value equal to or exceeding the required minimum average.

403.2c(5) Specimen Orientation. The values listed in Table 403.3 are the minimum acceptable values for forgings and wrought products tested in the transverse direction and for castings and weld qualifications. Forgings and wrought products may be tested in the longitudinal direction instead of the transverse direction and then shall exhibit 20 ft-lbs (27 Joules) minimum average value.

403.3 PROCESSING.

403.3a Casting Practices. The materials manufacturer shall document foundry practices which establish limits for sand control, core making, rigging, and melting to ensure repeatability in producing castings that meet the requirements of this Specification.

403.3b Hot Working Practices. The materials manufacturer shall document hot working practices.

403.3c Melting Practices. The manufacturer shall select and specify the melting practices for all body, bonnet, and flange material.

403.4 HEAT TREATING.

403.4a Equipment Qualification. All heat treatment operations shall be performed utilizing equipment qualified in accordance with Section 607.

403.4b Temperatures. Time at temperature and temperature level for heat treatment cycles shall be determined in accordance with the manufacturer's specification.

403.4c Quenching. (Applies to those materials that are quenched and tempered.)

403.4c(1) Water Quenching. The temperature of the water or quench media used to approximate the cooling rate of water shall not exceed 100 degrees Fahrenheit (37° Celsius) at the start of the quench. For bath type quenching the temperature of the water or quench media shall not exceed 120 degrees Fahrenheit (48° Celsius) at the completion of the quench.

403.4c(2) Oil Quenching. The temperature of any oil quenching medium shall be greater than 100 degrees Fahrenheit (37° Celsius) at the start of the quench.

403.4c(3) Other Quenching Media. The temperature range of other quenching media shall meet the manufacturer's written specification.

403.5 CHEMICAL COMPOSITIONS.

403.5a General. Body, bonnet, and flange material shall conform to the manufacturer's written specification and the requirements of this Section.

403.5a(1) The manufacturer shall specify the nominal chemical composition including composition tolerances of material.

403.5a(2) Material composition shall be determined on a heat basis (or a remelt ingot basis for remelt grade materials) in accordance with a recognized industry standard.

403.5b Composition Limits. Table 403.5 lists element limits (wt.%) for carbon, low alloy, and martensitic stainless steels (other than precipitation hardening types) used to manufacture bodies, bonnets, and flanges. When the composition is specified in accordance with a recognized industry standard, those elements specified as residual/trace element limits of the industry standard are within the API limits. Table 403.5 does not apply to other alloy systems. Composition limits of other alloy systems are purposely omitted from these tables in order to provide the manufacturer with freedom to utilize alloy systems for the multiplicity of requirements encountered.

404. CLASS 3C — METALS FOR CHLORIDE STRESS CRACKING SERVCE.

404.1 SSV/USV materials for chloride stress cracking service in direct contact with retained the fluid shall comply with the manufacturer's written specification and Section 403.

404.2 Bonnet bolting material for Class 3C valves shall meet the applicable requirements of *API Spec 6A.*

405. CLASS 4 — METALS FOR METAL LOSS CORROSION SERVICE.

405.1 SSV/USV materials for metal loss corrosion service that will be in direct contact with the fluid shall comply with the manufacturer's written specifications and Section 403.

405.2 SSV/USV actuator materials for metal loss corrosion service shall conform to Section 403.

406. METALS FOR LOW TEMPERATURE APPLICATIONS. For service temperatures -20 degrees Fahrenheit (-29° Celsius) and below, the requirements outlined below are in addition to the requirements for a particular class of service.

406.1 SSV VALVE MATERIALS FOR LOW TEMPERATURE SERVICE. Materials shall meet the applicable requirements of Section 403.

406.2 BONNET BOLTING AND NUT MATERIALS FOR LOW TEMPERATURE APPLICATION. Bonnet bolting and nut materials intended for use in low temperature application must meet the applicable requirements of *API Spec 6A.*

406.3 SSV ACTUATOR MATERIALS FOR LOW TEMPERATURE APPLICATION. Steels used for pressure containing parts shall meet the applicable requirements of Section 403.

407. ACTUATOR MATERIALS. Metallic/non-metallic materials exposed only to control fluids shall require written material specifications. The manufacturer's written specifications shall define mechanical property requirements/physical property requirements, chemical compositions/generic base polymers, and heat treatment procedure, if required. Materials for SSV/USV actuator cylinders and pistons shall be ductile iron or steel with the exception that pistons for actuators having a working pressure of 375 psi (2,6 MPa) or less may be malleable iron.

408. BOLTING AND NUT MATERIALS. Bolting and nut materials shall meet the applicable requirements of *API Spec 6A.*

409. NON-METALLIC MATERIALS.

409.1 GENERAL. The non-metallic material used in SSVs/USVs shall be capable of withstanding the working pressure within the temperature range specified by the manufacturer and shall be compatible with the intended service for the designated class of SSV/USV service.

409.2 SEALING MATERIALS. O-rings and other sealing materials shall be compatible with the product to be handled and the service class specified. O-rings and other sealing materials shall be inspected and tested in accordance with Section 605.3.

410. QUALIFICATION TEST COUPONS.

410.1 GENERAL. The properties exhibited by the Qualification Test Coupon (QTC) shall represent the properties of the thermal response of the material comprising the production parts it qualifies.

Depending upon the hardenability of a given material, the test bar results may not always correspond with the properties of the actual components at all locations throughout their cross-section.

A single QTC may be used to represent the impact and/or tensile properties of the part(s) produced from the same heat provided it satisfies the requirements of this Specification.

When the QTC is a trepanned outlet or a prolongation removed from a production part, the QTC shall qualify only the same production parts. When the QTC is a sacrificial production part, it shall qualify only the same production parts.

A QTC shall only qualify material and parts produced from the same heat.

410.2 EQUIVALENT ROUND (ER).

410.2a Selection. The size of a QTC for a part shall be determined using the following equivalent round (ER) methods.

410.2b ER Methods. Figure 410.1 illustrates the basic models for determining the ER of simple solid and hollow parts and more complicated parts.

The ER of a part shall be determined using the actual dimensions of the part in the "as heat treated" condition.

The ER of a studded type part shall be determined by using T equal to the thickness of the thickest flange of that part. ER determination for these parts shall be in accordance with the methods for complex shaped parts.

410.2c Size Requirements. The ER of the QTC shall be equal to or greater than the dimensions of the part it qualifies, except as follows:

Forging – size not required to exceed 2½ inches (63mm) ER. Casting — size not required to exceed *ASTM A 370,* Figure 3.

NOTE: *At the option of the manufacturer, the ER of the QTC can meet ASME Section VIII, Division 2, AM-201 and AM-202 in lieu of the above requirements.*

410.3 PROCESSING.

410.3a Melting, Casting, and Hot Working.

410.3a(1) Melting Practices. In no case shall the QTC be processed using a melting practice(s) cleaner than that of the material it qualifies (e.g., A QTC made from a remelt grade or vacuum degassed material may not qualify material from the same primary melt which has not experienced the identical melting practice(s). Remelt grade material removed from a single remelt ingot may be used to qualify other

remelt grade material which has been and is from the same primary melt; no additional alloying shall be performed on these individual remelt ingots.

410.3a(2) Casting Practices. To assure accurate representation, the manufacturer shall use the same foundry practice(s) for the QTC as those used for the part(s) it qualifies.

410.3a(3) Hot Working Practices. The manufacturer shall use hot working ratios on the QTC which are equal to or less than those used in processing the production part(s) it qualifies. The total hot work ratio for the QTC shall not exceed that total hot work ratio of the part(s) it qualifies.

410.3b Welding. Welding on the QTC is prohibited, except for attachment-type welds.

410.3c Heat Treating.

410.3c(1) Equipment Qualification. All heat treatment operations shall be performed utilizing equipment qualified in accordance with Section 607.

410.3c(2) Methods. The QTC shall experience the same specified heat treatment processing as the part(s) it qualifies. The QTC shall be heat treated using the manufacturer's specified heat treating procedure(s).

When the QTC is not heat treated as part of the same heat treatment load as the part(s) it qualifies, the austenitizing (or solutionizing, if applicable) temperatures for the QTC shall be within 25 Fahrenheit degrees (14° Celsius) of those for the part(s). The tempering temperature for the part(s) shall be no lower than 25 Fahrenheit degrees (14° Celsius) below that of the QTC. The upper limit shall be no higher than permitted by the heat treat procedure for that material. The cycle time at each temperature shall not exceed that for the part(s).

410.4 MATERIAL QUALIFICATION.

410.4a Tensile and Impact Testing.

410.4a(1) Test Specimens. When tensile and/or impact test specimens are required, they shall be removed from the same QTC after the final QTC heat treatment cycle.

Tensile specimens shall be removed from the QTC such that their longitudinal center line axis is wholly within the center core 1/4 T envelope for a solid QTC or within 1/8 inch (3mm) of the midthickness of the thickest section of a hollow QTC (refer to Figure 410.1).

Test specimens shall be removed from the QTC such that the tensile specimen gage length and Charpy V-Notch root are at least 1/4 T from the ends of the QTC.

When a sacrificial production part is used as a QTC, the impact and/or tensile test specimens shall be removed from the 1/4 T envelope location of the thickest section in that part.

Tensile and impact specimens shall be in accordance with *ASTM A370*.

410.4a(2) Methods shall be in accordance with Section 605.2(a) and (b).

410.4b Hardness Testing.

410.4b(1) General. A minimum of two Brinell hardness tests shall be performed on the QTC after the final heat treatment cycle.

The QTC heat treatment cycles prior to hardness testing shall be the very same heat treatment cycles experienced by the tensile and impact test specimens.

410.4b(2) Methods. Hardness testing shall be performed in accordance with procedures specified in Section 605.2c

411. HEAT TREATING EQUIPMENT QUALIFICATION. All heat treating of parts and QTC's shall be performed with "Production Type" equipment meeting the requirements specified by the manufacturer and calibrated in accordance with Section 607.

"Production Type" heat treating equipment shall be considered equipment that is routinely used to process production parts having an ER equal to or greater than the ER of the subject QTC.

MATERIAL REQUIREMENTS (continued)

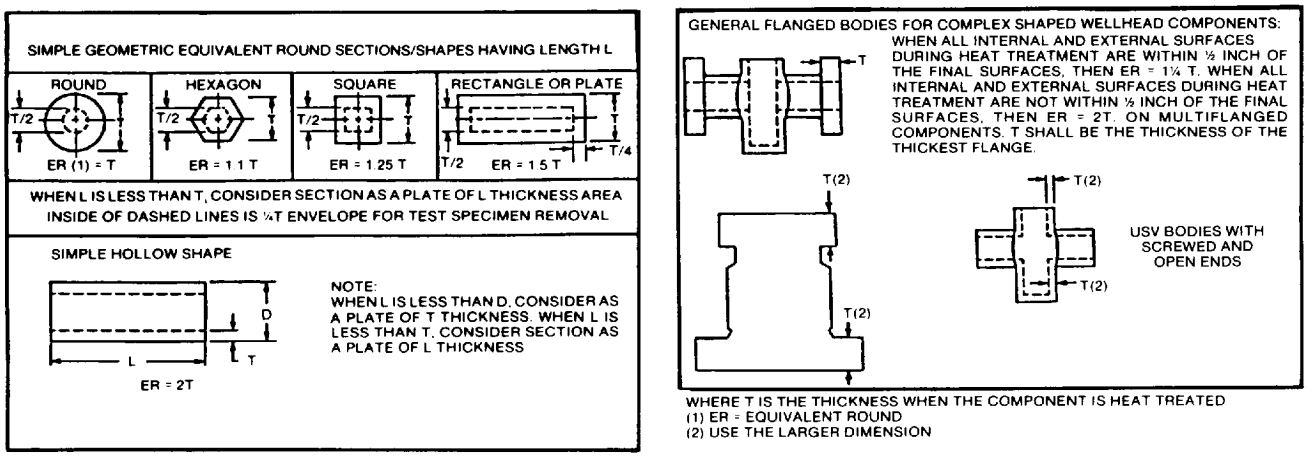


FIG. 410.1
EQUIVALENT ROUND MODELS

SECTION 500
WELDING — GENERAL REQUIREMENTS

501. GENERAL. All fabrication, repair, and overlay welding on pressure containing and controlling parts shall meet the requirements of this Section. Welding is not permitted on ductile iron or malleable iron components.

502. PRESSURE CONTAINING FABRICATION WELDMENTS FOR BODIES, BONNETS, AND END AND OUTLET CONNECTIONS.

502.1 Joint Design. Design of groove and fillet welds with tolerances shall be documented in the manufacturer's specifications. Appendix E of this Specification provides recommended weld groove designs. Welds which carry the full load of the pressure containing wall must be a full penetration weld.

502.2 Materials.

502.2a Welding Consumables. Welding consumables shall conform to AWS or manufacturer's specifications. The manufacturer shall have a written procedure for storage and control of welding consumables. Materials of low hydrogen type shall be stored and used as recommended by the consumable manufacturer to retain their original low hydrogen properties.

502.2b Deposited Weld Metal Properties. The deposited weld metal mechanical properties, as determined by the procedure qualification record (PQR), shall meet or exceed the minimum specified mechanical properties for the base material.

502.3 Welding Procedure Qualifications.

502.3a Written Procedure. Welding shall be performed in accordance with welding procedure specifications (WPS), written and qualified in accordance with Article II of ASME Section IX. The WPS shall describe all the essential, non-essential, and supplementary essential (when required — refer to ASME Section IX) variables.

The PQR shall record all essential and supplementary essential (when required) variables of the weld procedure used for the qualification test(s). Both the WPS and the PQR shall be maintained as records in accordance with the requirements of Section 606 of this Specification.

502.3b Base Metal Groupings. The manufacturer may establish a P-number grouping for material(s) not listed in ASME Section IX.

502.3c Heat Treat Condition. All testing shall be done with test weldment in the post weld heat treated condition. Post weld heat treatment of the test weldment shall be according to the manufacturer's written specification.

502.3d Hardness Testing. For materials used in Service Class 3, hardness tests across the weld and base material heat affected zone (HAZ) cross section shall be performed and recorded as part of the PQR. Results shall be in conformance with NACE requirements.

The manufacturer shall specify the hardness testing locations in order to determine maximum hardness. Testing shall be performed on the weld and base material HAZ cross section in accordance with *ASTM E-18,* Rockwell Method; or *ASTM E-92,* Vickers 10 kg Method. Results shall be converted to Rockwell C, as applicable, in accordance with *ASTM E-140.*

502.3e Hardness Testing (Optional) — Minimum Mechanical Properties. For the purpose of hardness inspection and qualifying production weldments, a minimum of 3 hardness tests in the weld metal shall be made and recorded as part of the PQR. These tests shall be made by the same methods as used to inspect production weldments. These tests may be used to qualify weld metal with hardness less than shown in Section 605.2c by the method shown in that Section.

502.3f Impact Testing. When impact testing is required for the base material, the testing shall be performed in accordance with *ASTM A-370* using the Charpy V-Notch technique. Results of testing in the weld and base material HAZ shall meet the minimum requirements of the base material. Records of results shall become part of the PQR.

Any retests of impact testing shall be in accordance with *ASTM A-370.*

502.4 Welding Performance Qualification.

502.4a Testing Requirements. Welders and welding operators shall be qualified in accordance with Article III of ASME Section IX.

502.4b Records. Records of welding performance qualification (WPQ) tests shall include all applicable welding parameters as required by ASME Section IX.

502.4c Base Metal Groupings. A WPS for each base material, which is not listed in an ASME Section IX P-number grouping, shall be specifically qualified for the manufacturer's specified base material.

502.4d Impact Testing. When impact testing is required by the base material, one set of three (3) test specimens each shall be removed at the 1/4 thickness location of the test weldment for each of the weld metal and base material HAZ. The root of the notch shall be oriented normal to the surface of the test weldment and located as follows:

(a) Weld Metal Specimens (3 each) 100% weld metal.

(b) HAZ Specimens (3 each) include as much HAZ material as possible.

502.5 Welding Requirements.

502.5a Qualifications. Welding shall be in compliance with the qualified WPS and shall be performed by qualified welders/welding operators.

502.5b Use of WPS. Welders and welding operators shall have access to and shall comply with the welding parameters, as defined in the WPS.

502.5c Designed Welds. All welds that are considered part of the design of a production part shall be specified by the manufacturer to describe the requirements for the intended weld.

502.5d Preheating. Preheating of assemblies or parts when required by the WPS shall be performed to manufacturer's written procedures.

502.5e Post Weld Heat Treatment — Furnace Heating. Furnace post weld heat treatment shall be performed with equipment meeting the requirements specified by the manufacturer.

502.5f Post Weld Heat Treatment — Local Heating. Local post weld heat treatment shall consist of heating a circumferential band around the weld at a temperature within the ranges specified in the qualified welding procedure specification. The minimum width of the controlled band at each side of the weld on the face of the greatest weld width shall be the thickness of the weld or 2 inches (51mm) from the weld edge, whichever is less. Heating by direct flame impingement on the material shall not be permitted.

503. PRESSURE CONTAINING REPAIR WELDMENTS FOR BODIES, BONNETS, AND END AND OUTLET CONNECTIONS.

503.1 General. All repair welding procedures shall define the WPS and NDE requirements. Welding shall be performed in accordance with the specified WPS.

503.2 Base Material. The base material requirements for material composition, API material designation, impact toughness, if required, and heat treatment condition shall be known prior to selecting a qualified WPS. Any repair weld shall not impair the strength of pressure containing parts.

503.3 Fusion. The WPS selected and the access for repair shall be such to ensure complete fusion.

503.4 PQR. The WPS selected shall be supported by a PQR as described in Section 502.3.

503.5 Access. There shall be access to evaluate, remove, and inspect the nonconforming condition.

503.6 Welder/Welding Operator Qualification. The welder/welding operator shall possess an existing qualification in accordance with Section 502.4.

503.7 Bolt Hole, Tapped Hole, and Machined Blind Hole Repair — Performance Qualification.

The welder/welding operator shall perform an additional repair welding performance qualification test using a mock-up hole.

The repair welding qualification test hole shall be qualified by radiography in accordance with Section 605.2j(4) or shall be cross sectioned through the center line of the hole in two places 90 degrees apart and macroetched to verify complete fusion. One surface of each of the four matching pairs shall be macroetched. This evaluation shall include the total depth of the hole.

The repair weld qualification shall be restricted by the following essential variables for performance controls:

The hole diameter used for the performance qualification test is the minimum diameter qualified. Any hole with a greater diameter than the diameter used for the test shall be considered qualified.

The depth-to-diameter ratio of the test hole shall qualify all repairs to holes with the same or smaller depth-to-diameter ratio.

The performance qualification test hole shall have straight parallel walls. If any taper, counter bore, or other aid is used to enhance the hole configuration of the performance test, that configuration shall be considered an essential variable.

503.8 QUALITY CONTROL REQUIREMENTS. Weld NDE shall conform to requirements as defined by the manufacturer and this Specification as shown in Table 605.1.

504. WELD OVERLAY FOR CORROSION RESISTANCE AND/OR HARD FACING AND OTHER MATERIAL SURFACE PROPERTY CONTROLS.

504.1 Ring Grooves. This Section applies to loose connectors and integral end and outlet connections.

504.1a Welding Procedure/Performance Qualification. Qualification shall be in accordance with Articles II and III of ASME Section IX, for weld overlay.

504.1a(1) Chemical Analysis. Chemical analysis shall be performed in the weld metal in accordance with the requirements of ASME Section IX at a location of 0.125 inch (3mm) or less from the original base metal surface. The chemical composition of the deposited weld metal at that location shall be as specified by the manufacturer. For 300 Series stainless steel, however, the chemical composition shall be:

Nickel — 8.0% minimum
Chromium — 16.0% minimum
Carbon — 0.08% maximum

504.1a(2) Welds for use in hydrogen sulfide service shall conform to the requirements of *NACE Standard MR0175.*

504.1b Application.

(1) Post Weld Heat Treatment. End and outlet connections with corrosion resistant weld overlaid ring grooves shall be subjected to post weld heat treatment in accordance with the weld procedure qualification.

(2) API grooves for welding shall be prepared in accordance with *API Spec 6A* requirements.

(3) Other weld preparations may be used where the mechanical properties of the deposited weld metal equals or exceeds that of the base metal.

504.1c Hardness Testing for Ring Groove Overlay. Hardness testing shall be performed in the weld metal as part of the procedure qualification testing. Test locations shall be within 0.125 inch (3mm) of the original base material. The average of 3 or more test results shall be equal to or greater than Rockwell B-83 and recorded as part of the PQR.

504.2 Other Corrosion Resistant Overlay. This Section applies to use of corrosion resistant weld overlay for bodies, bonnets, and end and outlet connectors for purposes other than ring grooves. These requirements do not apply to hardfacing or to the weld overlay of valve bore sealing mechanisms or of valve stems. NOTE: Weld clad of bodies and bonnets for example, but not gates and seats. Refer to Section 504.4.

504.2a Welding Procedure/Performance Qualification. Qualification shall be in accordance with Articles II and III of the ASME Section IX for weld overlay.

(1) Chemical Analysis: Chemical analysis shall be performed in the weld metal in accordance with the requirements of ASME Section IX at the minimum overlay thickness as specified by the manufacturer for the finished component.

For 300 Series stainless steel the chemical composition shall be:

Nickel — 8.0% minimum

Chromium — 16.0% minimum

Carbon — 0.08% maximum

For other compositions which must conform to the requirements of *NACE Standard MR0175,* the chemical analysis of the overlay shall conform to the specification limits of the corresponding NACE approved material(s).

For all other compositions, the chemical analysis of the overlay shall conform to the specified limits of the manufacturer's written specification.

(2) Mechanical Properties. The manufacturer shall specify the methods to assure these mechanical properties and record the results as part of the PQR.

Base Metal Mechanical Properties. The base material shall retain the API minimum mechanical properties after post weld heat treatment.

Overlay Mechanical Properties. When the overlay material is not considered as part of the manufacturer's or of the API design criteria, a tensile test and a charpy test of the overlay material are not required.

When the overlay material is considered as part of the manufacturer's or of the API design criteria, mechanical testing of the overlay material is required.

(3) Weld Conformance to *NACE Standard MR0175.* Welds for use in hydrogen sulfide service shall conform to the requirements of *NACE Standard MR0175.*

Hardness Testing. When the welding procedure is to be qualified for use on bodies, bonnets, or flanges used for Service Class 3, hardness testing shall be by the Rockwell method or the Vickers 10 kg method. Hardness tests shall be performed at a minimum of three test locations each: in the base material, in the heat affected zone, and in each layer of overlay up to a maximum of two layers. Refer to Figure 504.2 for required hardness test locations.

(4) Guided Bend Tests. Guided bend tests and acceptance criteria shall be in accordance with ASME Section IX to verify weld overlay/base material bond integrity.

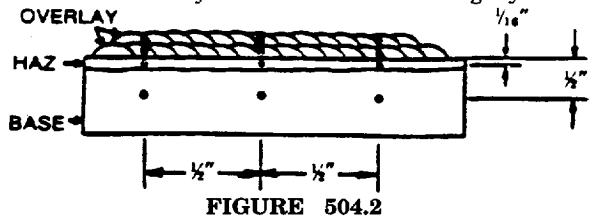


FIGURE 504.2
HARDNESS TEST LOCATIONS

504.2b Base Material Conformance To *NACE Standard MR0175.* The base material shall conform to *NACE Standard MR0175* after weld overlay and any subsequent heat treatments.

504.3 OTHER.

504.3a Mechanical Properties. Mechanical properties of the base material shall retain the minimum mechanical property requirements after post weld heat treatment. The manufacturer shall specify the methods to assure these mechanical properties and record the results as part of the PQR.

504.4 QUALITY CONTROL REQUIREMENTS. The quality control requirements for weld metal overlays are shown in Table 605.1.

504.4a Other. This Section applies to use of weld overlay for purposes other than those covered by Sections 504.1 and 504.2.

504.4b Welding Procedure/Performance Qualification. Qualification requirements are not specified; however, a manufacturer shall use a written procedure that provides adequate controls for consistently meeting the manufacturer-specified material surface properties in the final machined condition.

SECTION 600
QUALITY CONTROL REQUIREMENTS

601. GENERAL. This Section specifies the quality control requirements for equipment and material manufactured to meet this Specification.

602. QUALITY CONTROL RECORDS. This Section also summarizes the quality control record requirements of this Specification.

603. MEASURING AND TESTING EQUIPMENT.

603.1 Equipment used for final acceptance shall be identified, controlled, calibrated, and adjusted at specified intervals, in accordance with documented manufacturer instruction and consistent with referenced industry standards, to maintain the accuracy required by this Specification.

603.2 Measurement Standards and Measuring Equipment. Measurement standards and measuring equipment shall be controlled and calibrated to maintain accuracies within the limits specified by the measuring equipment manufacturer or the manufacturer's written specifications or procedures.

603.2a Measurement Equipment Markings. After receipt and prior to being placed in service, each piece of measuring equipment (gage) will be verified to have a permanent unique identification. If no identification exists, the manufacturer shall apply one. The manufacturer may also choose to apply additional unique identification to comply with the manufacturer's written specifications. The method of application of the identification shall be such that it will not affect the accuracy of the gage. In the event that the identification cannot be applied directly to the gage it may be applied to a tag affixed to the gage or the gage container.

603.2b Measuring Equipment Records. The manufacturer shall maintain individual records of measurement standards and equipment. Functionally simple and rugged measuring equipment, such as drifts, micrometers, dial calipers, vernier calipers, fixed member functional gages, etc., would only be required to provide calibration information in Section 603.2b(1) through 603.2b(7). Measurement standards and measuring equipment used for high accuracy measurements would require the additional information in Section 603.2b(8) through 603.2b(9).

603.2b(1) Unique identification of measurement standard or equipment.

603.2b(2) Identification of measurement standard, equipment, and calibration procedure utilized in the calibration process.

603.2b(3) Planned calibration interval.

603.2b(4) Date and results of each calibration including actual readings taken prior to adjustment, corrections, or repairs.

603.2b(5) Interval when due for next calibration.

603.2b(6) Individual performing calibration and facility performing calibration.

603.2b(7) Assigned location.

603.2b(8) The environmental conditions for calibration and the measurement data as measured and as corrected to reference standards.

603.2b(9) Details of any maintenance, servicing, adjustment, repairs, or modification which could affect the calibration status.

603.2c Adequacy of Measurement Standards. Measurement standards and procedures used to calibrate measuring equipment shall be evaluated by the manufacturer to assure that any random and systematic errors in the calibration measurement process do not exceed 25% of the tolerance of the parameter being measured. Measuring equipment requiring high levels of accuracy, which approach state of art or natural physical constant limitations, would be excluded from this requirement.

603.2d Calibration Intervals. Measurement standards and measuring equipment shall be calibrated at intervals established based upon stability, purpose, and degree of usage. Intervals shall be shortened and they may be lengthened, as required, to assure continued accuracy and stability, as evidenced by the results of previous calibrations.

603.2e Calibration Labeling. All measurement standards and measuring equipment shall be labeled, coded, or otherwise identified to indicate the calibration status. Any limitation or restriction of use shall be clearly indicated on the equipment. When neither labeling or coding is practical, other methods, as defined by the manufacturer's written procedure, shall be used.

603.3 PRESSURE MEASURING DEVICES.

603.3a Type and Accuracy. Test pressure measuring devices shall be either pressure gauges or pressure transducers. Pressure transducers, digital readouts, and gauges shall be accurate to at least 0.5% of full scale range.

603.3b Pressure measuring devices shall be calibrated to maintain ± 2% accuracy of full scale range.

603.3c Useable Range. Pressure measurements with gauges shall be made at not less than 25% nor more than 75% of the full pressure span of the gauges. Pressure transducers can be used for full pressure span.

603.3d Calibration Procedure. Pressure measuring devices shall be periodically recalibrated with a master pressure measuring device or a dead weight tester at 25%, 50%, and 75%, ± 5 percentage points.

603.3e Calibration Intervals

603.3e(1) Calibration intervals shall be established for calibrations based on repeatability and degree of usage. Intervals may be lengthened and shall be shortened based on recorded calibration history.

603.3e(2) Calibration intervals shall be a maximum of three months until recorded calibration history can be established by the manufacturer.

604. QUALITY CONTROL PERSONNEL QUALIFICATIONS.

604.1 NONDESTRUCTIVE EXAMINATION (NDE) PERSONNEL. NDE personnel shall be qualified in accordance with requirements specified in *Recommended Practice SNT-TC-1A,* Level II minimum for evaluation and interpretation.

604.2 VISUAL EXAMINATION PERSONNEL. Personnel performing visual examinations shall have an annual eye examination in accordance with *SNT-TC-1A.*

604.3 WELDING INSPECTORS. Personnel performing visual examinations of welding operations and completed welds shall be qualified and certified as follows:

604.3a AWS certified welding inspector or,

604.3b AWS certified associate welding inspector, or

604.3c Welding inspector certified by the manufacturer's documented training program.

604.4 OTHER PERSONNEL. All personnel performing other quality control activities directly affecting material and product quality shall be qualified in accordance with the manufacturer's documented requirements.

605. QUALITY CONTROL REQUIREMENTS.

605.1 GENERAL.

605.1a Quality Control Tables. Tables have been included in this Section that provide a matrix of quality control requirements for specific parts and equipment.

605.1b Materials. Section 400 of this Specification includes detailed qualification requirements for valve bodies, bonnets, and flanges, actuators, and qualification test coupons.

605.1c Quality Control Instructions. All quality control work shall be controlled by manufacturer's documented instructions, which include appropriate methodology and quantitative or qualitative acceptance criteria.

Nondestructive examination (NDE) instructions shall be detailed regarding the requirements of this Specification and those of all applicable referenced standards. All NDE instructions shall be approved by a Level III Examiner in accordance with *SNT-TC-1A.*

605.1d Quality Control Procedures for threads not listed in API Spec 5B or *ANSI B1.2* shall conform to the manufacturer's written specifications.

605.1e Acceptance Status. The acceptance status of all equipment, parts, and materials shall be indicated either on the equipment, parts, or materials or in records traceable to the equipment, parts, or materials.

605.1f Service Class 3S. Quality control testing or examination shall be performed on all pressure containing and pressure controlling parts to be used in hydrogen sulfide service to verify that *NACE Standard MR0175* values and requirements have been satisfied. If the other requirements of this Section satisfy this requirement, additional testing or examination is not required.

605.2 PRESSURE CONTAINING PARTS.

605.2a Tensile Testing. Refer to Section 403.2b.

605.2b Impact Testing (for temperature classifications K, L, and P). Refer to Section 403.2c.

605.2c Hardness Testing.

Bodies, Bonnets, and Stems (2,000, 3,000, and 5,000 psi (13,8; 20,7; 34,5 MPa) W.P.).

Parts shall be hardness tested by heat treat per *MIL-STD-105D,* Level II, 4.0 AQL.

Bodies, Bonnets, and Stems (10,000, 15,000, and 20,000 psi (69,0; 103,5; 138,0 MPa) W.P.).

Each part shall be hardness tested.

Methods. Hardness testing in accordance with *ASTM E-10* or *ASTM E-18.*

Hardness conversion to other measurement units shall be in accordance with *ASTM E 140.*

Tests shall be performed at a location determined by the manufacturer's specifications and following the last heat treatment cycle (including all stress relieving heat treatment cycles) and all exterior machining.

When bodies and flanges connections have different API material designations, each part shall be tested.

Acceptance Criteria. Parts shall exhibit the following minimum values.

API Material Designations	Brinell Hardness
36K,45K	HB140
60K	HB174
75K	HB197

Parts not complying with these minimum hardness levels are acceptable when the measured value satisfies the following requirement.

The average tensile strength, as determined from the tensile tests results, shall be used with the QTC hardness measurements in order to determine the minimum acceptable hardness value for production parts fabricated from the same heat. The minimum acceptable hardness value for any part shall be determined by:

$$H_{BC} = \frac{UTS}{UTS_{QTC}} (HB_{QTC})$$

where:

H_{BC} = Minimum acceptable Brinell hardness for the part after the final heat treatment cycle (including stress relieving cycles).

UTS = Minimum acceptable ultimate tensile strength for the applicable material designation.

UTS_{QTC} = Average ultimate tensile strength determined from the QTC tensile tests.

HB_{QTC} = The average of the Brinell hardness values observed among all tests performed on the QTC.

605.2d Dimensional Verification.

Sampling. API tapered thread & straight thread in accordance with *MIL-STD-105D,* Level II, 1.5 AQL.

Acceptance Criteria. In accordance with *API Spec 5B* or *ANSI B1.1* and *B1.2,* as applicable.

The manufacturer shall specify and verify critical dimensions.

Acceptance criteria for critical dimensions shall be as required by the manufacturer's written specification.

605.2e Traceability.

Job traceability is required.

Identification shall be maintained on materials and parts to facilitate traceability, as required by documented manufacturer requirements.

Manufacturer documented traceability requirements shall include provisions for maintenance or replacement of identification marks and identification control records.

605.2f Chemical Analysis.

Sampling. Chemical analysis shall be performed on a heat basis.

Methods. Chemical analysis shall be performed in accordance with recognized industry standards specified by the manufacturer.

Acceptance Criteria. The chemical composition shall meet the requirements of Section 402 and the manufacturer's written specification.

605.2g Visual Examination.

Sampling. Each part shall be visually examined.

Methods. Visual examinations of castings shall be performed in accordance with procedures specified in *MSS-SP-55.*

Visual Examination of forgings shall be performed in accordance with manufacturer's written specifications.

Acceptance Criteria.

Castings. In accordance with *MSS-SP 55:*

Type 1 — None acceptable.

Type 2-12 — A and B.

Forgings. In accordance with manufacturer's written specifications.

605.2h Surface NDE — Ferromagnetic Materials.

Sampling. All accessible wetted surfaces and all accessible sealing surfaces of each finished part shall be magnetic particle inspected after final heat treatment and final machining operations.

Method. All ferromagnetic materials shall be examined in accordance with procedures specified in *ASTM E 709.* The wet fluorescent method shall be used. Prods are not permitted on well fluid surfaces or sealing surfaces.

Definitions:

Relevant Indication. Only those indications with major dimensions greater than $^1/_{16}$ inch (1,6mm) shall be considered relevant. Inherent indications not associated with a surface rupture (i.e., magnetic permeability variations, non-metallic stringers...) are considered non-relevant. If indications are believed to be non-relevant, they shall be examined by liquid penetrant surface NDE methods, or removed and reinspected to prove their non-relevancy.

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

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

Acceptance Criteria. No relevant indication with a major dimension equal to or greater than $^3/_{16}$ inch (5 mm). No more than ten relevant indications in any continuous 6-square-inch area. Four or more relevant indications in a line separated by less than $^1/_{16}$ inch (1,6 mm) (edge to edge) are unacceptable. No relevant indications in the pressure contact sealing surfaces.

605.2i Surface NDE — Non Ferromagnetic Materials.

Sampling. All accessible wetted and all accessible sealing surfaces of each finished part shall be liquid penetrant inspected after final heat treatment and after final machining operations.

Method. All non-ferromagnetic materials shall be examined in accordance with procedures specified in ASTM E 165.

Definitions:

Same definitions as in Section 605.2h, as applicable.

Acceptance Criteria. No relevant linear indications. No relevant rounded indication with a major dimension equal to or greater than 3/16 inch (5 mm). Four or more relevant rounded indications in a line separated by less than 1/16 inch (1,6 mm) (edge to edge) are unacceptable. No relevant indications in pressure contact sealing surfaces.

605.2j Weld NDE, General. When examination is required herein, refer to Table 605.1, essential welding variables and equipment shall be monitored; in-process welding shall be audited; and completed weldments (a minimum of 1/2 inch (13 mm) of surrounding base metal and the entire accessible weld) shall be examined in accordance with the methods and acceptance criteria of this Section.

Requirements and acceptance criteria for corrosion resistant weld overlay of bodies, bonnets, and flanges can be different from those for other weld types and shall meet the manufacturer's written specifications. The manufacturer's written specification for corrosion resistant weld overlay shall include a technique for measuring the specified overlay thickness.

605.2j(1) Weld Examination — Visual.

Sampling. 100% of all welds (except weld metal overlay) shall be visually examined after postweld heat treatment and machining operations.

Examinations shall include a minimum of 1/2 inch (13 mm) of adjacent base metal on both sides of the weld.

Acceptance Criteria. All pressure containing welds shall have complete joint penetration.

Undercut shall not reduce the thickness in the area (considering both sides) to below the minimum thickness.

Surface porosity and exposed slag are not permitted on or within 1/8 inch (3mm) of sealing surfaces.

605.2j(2) Weld NDE — Surface.

Sampling. 100% of all pressure containing fabrication welds and weld overlay shall be examined by either magnetic particle (in the case of ferromagnetic materials) or liquid penetrant (in the case of non-ferromagnetic materials) methods after all welding, postweld heat treatment, and machining operations.

Examinations shall include a minimum of 1/2 inch (13 mm) of adjacent base metal on both sides of the weld.

Magnetic particle examination shall be performed as described in Section 605.2h, with additional requirements as follows:

No relevant linear indications.

No rounded indications greater than 1/18 inch (3mm) for welds whose depth is 5/8 inch (16mm) or less; or 3/16 inch (5mm) for welds whose depth is greater than 5/8 inch (16mm).

Liquid penetrant examination shall be performed as described in Section 605.2i with additional requirements as follows:

No rounded indications greater than 1/8 inch (3mm) for welds whose depth is 5/8 inch (16mm) or less; or 3/16 inch (5mm) for welds whose depth is greater than 5/8 inch (16mm).

605.2j(3) Repair Welds.

All repair welds shall be examined using the same methods and acceptance criteria as used in examining the base metal or weld metal in the case of a repair to a weld.

Examinations shall include 1/2 inch (13mm) of adjacent base metal on all sides of the weld.

Surfaces prepared for welding shall be examined prior to welding to ensure defect removal to acceptable levels. Methods and acceptance criteria shall be as described in Section 605.2j(2).

605.2j(4) Weld NDE — Volumetric.

Sampling. 100% of all pressure containing welds shall be examined by either radiography or ultrasonic methods after all welding, postweld heat treatment, and machining operations. All repair welds where the repair is greater than 25% of the original wall thickness or 1 inch (25 mm) (whichever is less) shall be examined by either radiography or ultrasonic methods after all welding and postweld heat treatment. Examinations shall include at least 1/2 inch (13mm) of adjacent base metal on all sides of the weld.

Method — Radiographic Examination. Radiographic examinations shall be performed in accordance with procedures specified in *ASTM E 94,* to a minimum equivalent sensitivity of 2%.

Both X-ray and gamma ray radiation sources are acceptable within the inherent thickness range limitation of each. Real time imaging and recording/enhancement methods may be used when the manufacturer has documented proof that these methods will result in a minimum equivalent sensitivity of 2%. Wire type image quality indicators are acceptable for use in accordance with *ASTM E 747.*

Acceptance Criteria — Radiographic Examination. No type of crack, zone of incomplete fusion, or penetration. No elongated slag inclusion which has a length equal to or greater than the following:

Weld thickness (T), in. (mm)	Inclusion length, in. (mm)
Less than 0.76 (19)	0.25(6,4)
0.76 to 2.25 (19-57)	0.33T
greater than 2.25 (57)	0.75(19,0)

No group of slag inclusions in a line having an aggregated length greater than the weld thickness (T) in any total weld length of 12T, except when the distance between successive inclusions exceeds six times the length of the longest inclusion.

No rounded indications in excess of that specified in ASME Section VIII, Division 1, Appendix 4.

Method — Ultrasonic Examination. Ultrasonic examinations shall be performed in accordance with procedures specified in ASME Section V, Article 5.

Acceptance Criteria — Ultrasonic Examination. No indication whose signal amplitude exceeds that reference level.

No linear indications interpreted as cracks, incomplete joint penetration, or incomplete fusion.

No slag indications with amplitudes exceeding the reference level whose length exceeds the following:

Weld thickness (T), in. (mm)	Inclusion length in. (mm)
Less than 0.76 (19)	0.25 (6,4)
0.76 to 2.25 (19-57)	0.33 T
greater than 2.25 (57)	0.75 (19,0)

where: T is the thickness of the weld being examined; if a weld joins two members having different thicknesses at the weld, T is the thinner of the two thicknesses.

TABLE 605.1
QUALITY CONTROL REQUIREMENTS
WELDING

WELD TYPE	STAGES	SSV/USV
Pressure Containing	Preparation* Completion** over 375 psi (2,6MPa)	 a,b,c or d
Non-pressure Containing	Preparation Completion	— a
Repair	Preparation* Completion**	h a,b,f or g
Weld Metal Overlay	Preparation Completion	— b

Examination Test — Codes

a—Visual examination
b—Penetrant, magnetic particle exam (MT for all ferromagnetic material)
c—Radiation (radiography or imaging) examination
d—Ultrasonic examination
e—Hardness test (weld)
f—Ultrasonic examination only when weld is greater than 25% of wall thickness or 1 inch (13mm), whichever is less.
g—Radiation (radiography or imaging) examination only when weld is greater than 25% of wall thickness or 1 inch (13 mm), whichever is less.
h—Penetrant or magnetic particle as applicable for material defects only.

**Preparation = Surface prep., joint prep., fitup & preheat.*

***Completion = After all welding, thermal, and machining activities.*

605.3 NON-METALLIC SEALING MATERIAL. The quality of non-metallic seals shall be controlled in accordance with the following specification.

605.3a Dimensional Verification.

Sampling. Sampling shall be performed on non-metallic seals in accordance with *MIL-STD-105D,* Level II, 2.5 AQL for O-rings and 1.5 AQL for other seals.

Method. Each piece of the sample shall be dimensionally inspected for compliance to specific tolerances in *SAE AS 586A,* or equivalent. Other sealing materials shall meet dimensional tolerances of the manufacturer's written specifications.

Acceptance Criteria. If inspection methods produce rejections less than allowed in sampling, the batch shall be accepted.

605.3b Visual Examination.

Sampling. Sampling shall be performed in accordance with *MIL-STD-105D,* Level II, 2.5 AQL for O-rings and 1.5 AQL for other seals.

Method. Each piece of the sample shall be visually inspected according to the manufacturer's written requirements or in accordance with

MIL STD 413C. Other sealing materials shall be visually inspected for lip damage, flashing, breaks, cracks, or other visible damage.

Acceptance Criteria: If inspection methods produce rejections less than allowed, the batch shall be accepted.

605.3c Hardness Testing.

Sampling. Sampling shall be performed in accordance with *MIL-STD-105D,* Level II, 2.5 AQL for O-rings and 1.5 AQL for other seals.

Method. Hardness testing shall be performed in accordance with procedures specified in *ASTM D2240* or *ASTM D1415.*

Acceptance Criteria. The hardness shall be in accordance with the manufacturer's written specification.

605.3d Documentation.

Cure date shall be recorded by month and year.

606. QUALITY CONTROL RECORDS REQUIREMENTS.

606.1 GENERAL.

606.1a Purpose. The quality control records required by this Specification are necessary to substantiate that all materials and products made to meet this Specification do conform to the specified requirements.

606.1b NACE Records Requirements. Records required to substantiate conformance of service class 3S equipment to *NACE Standard MR0175* requirements shall be in addition to those described in Section 606.2, unless the records required by this Specification also satisfy the *NACE Standard MR0175* requirements.

606.1c Records Control.

606.1c(1) Quality control records required by this Specification shall be legible, identifiable, retrievable, and protected from damage, deterioration, or loss.

606.1c(2) Quality control records required by this Specification shall be retained by the manufacturer for a minimum of five years following the date of manufacture, as marked on the equipment associated with the records.

606.1c(3) All quality control records required by this Specification shall be signed and dated.

606.2 RECORDS TO BE MAINTAINED BY MANUFACTURER.

606.2a Pressure Containing Metallic Parts.

Weld Procedure Specification

Weld Procedure Qualifications Record

Welder Qualification Record

Material Test Records:
Chemical Analysis
Tensile Tests (QTC)
Impact Tests (QTC, if required)
Hardness Tests (QTC)

NDE Personnel Qualification Records

Hardness Tests (if applicable)

NDE Records
Surface NDE Records
Weld Volumetric NDE Records
Repair Weld NDE Records

Heat Treatment Certification of Compliance

Equipment Pressure Test Records

606.2b Non-Metallic Sealing Materials. Non-metallic sealing material records shall be required according to Section 605.3.

606.2c Traceability Documentation. Material listed below must be traceable:

1. **SSV/USV valve body, bonnet, and stem.**

   SSV/USV actuator cylinder and piston for SSV/USV actuators having a rated working pressure greater than 375 psi (2,6MPa).

2. **Elastomers.** Elastomers shall be traceable to batch and cure date.

   Note: *A batch is the quantity of a compound run through a mill or mixer at any one time.*

3. Metal traceability is considered sufficient when the part can be traced to a job lot which identifies the included heat lot(s). All components in a multi-heat job which are not identifiable shall be rejected if any heat lot does not comply with the manufacturer's written specifications.

606.3 RECORDS TO BE FURNISHED TO PURCHASERS.

606.3a General.

606.3a(1) These records shall be provided by the manufacturer to the original purchaser of *API Spec 14D* equipment.

606.3a(2) These records, where applicable, shall be identical to or contain the same information as those retained by the manufacturer.

606.3a(3) These records provided by the manufacturer shall prominently reference part serial number(s).

606.3b Documentation. Each SSV/USV shall be delivered to the purchaser with a completed SSV/USV Functional Test Data Sheet, (refer to Table 908.1). Further requirements for documentation are shown in this Section.

606.3c Shipping Report. A report in accordance with Table 606 shall be furnished.

606.3d Operating Manual. Furnished to the purchaser. An operating manual (refer to Section 606.4) shall be furnished on SSV/USV equipment supplied to this Specification.

606.4 MINIMUM CONTENTS OF MANUFACTURER'S OPERATING MANUAL.

606.4a Design Information.

606.4a(1) Type, model, and sizes for which the manual is applicable.

606.4a(2) Catalog or figure numbers for Item 606.4a(1).

606.4a(3) Classes of service for which these type, model, and sizes are suitable.

606.4a(4) Temperature and working pressure ranges for which the unit(s) are designed.

606.4a(5) Drawings and illustrations giving dimensional data of unit(s), as required, for installation or operation.

606.4a(6) Parts list with information necessary for reordering, including necessary addresses and telephone numbers.

606.4b Inspection and Testing.

606.4b(1) A checklist shall be provided for visual inspection prior to hookup.

606.4b(2) Written and graphic instructions for field hookups shall be provided.

606.4b(3) Appropriate test procedures.

606.4c Installation.

606.4c(1) Proper. Proper installation methods shall be clearly written and illustrated as necessary. Any necessary preliminary lubrication or greasing shall be specified in detail. Warnings to indicate potential danger to personnel, or cautions to indicate potential danger to equipment, shall be clearly marked "Warning" or "Caution".

606.4c(2) Improper. Any known configurations of installing the unit which may result in non-operation should be noted both in writing and by picture or schematic. Such illustrations and written warning shall be clearly marked with the word "Wrong".

606.4d Operation and Maintenance.

Maintenance requirements including recommended intervals of maintenance.

Proper operating techniques.

606.4e Troubleshooting.

Disassembly and assembly instructions.

Assembly diagram showing individual parts in proper relation to one another.

Repair instructions and precautions including a chart listing symptoms, probable cause or causes of the problem, and repairs necessary.

607. HEAT TREATING EQUIPMENT QUALIFICATION.

607.1 Furnace Calibration.

607.1a General. Heat treating of production parts shall be performed with heat treating equipment that has been calibrated and surveyed.

607.1b Records. Records of furnace calibration and surveys shall be maintained for a period not less than two years.

607.1c Frequency. 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.

607.1d Methods. Batch type and continuous type heat treating furnaces shall be calibrated in accordance with one of the following procedures:

607.1d(1) Procedures specified in *MIL-H-6875H,* "Heat Treatment of Steels — Aircraft Practice Process," Section 3.

607.1d(2) Procedures specified in *MIL-STD-1684A,* "Control of Heat Treatment (NOFORN)," Section 4.3.3.

607.1d(3) Procedures specified in *British Standard M54:1982,* "Specification for Temperature Control in the Heat Treatment of Metals," Section 5.

607.1d(4) Procedures specified in Appendix H of *API Specification 6A.*

607.1d(5) Manufacturer's written specified requirements including acceptance criteria.

607.2 INSTRUMENTS.

607.2a General. Automatic controlling and recording instruments shall be used.

Thermocouples shall be located in the furnace working zone(s) and protected from furnace atmospheres by means of suitable protecting devices.

607.2b Accuracy. The controlling and recording instruments used for the heat treatment processes shall possess an accuracy of ±1% of their full scale range.

607.2c Calibration.

607.2c(1) Temperature controlling and recording instruments shall be calibrated at least once every three (3) months.

607.2c(2) Equipment used to calibrate the production equipment shall possess an accuracy of ±0.25% of full scale range.

TABLE 606
SURFACE SAFETY VALVE OR UNDERWATER SAFETY VALVE
SHIPPING AND RECEIVING REPORT (EXAMPLE)
(Minimum Data Requirement)

EQUIPMENT DATA:

SSV/USV Valve, Manufacturer _____

Catalog or Mode No. _____ Serial No. _____ Size _____

Working Pressure Rating _____ Temperature Rating: Max. _____ Min. _____

API Class of Service _____

Date of Manufacture (month and year) _____

Class 2 SSV/USV Valve Performance Test Agency _____ Test Report No. _____

SSV/USV Actuator, Manufacturer _____

Catalog or Model No. _____ Serial No. _____ Size _____

Working Pressure Rating _____ Temperature Rating: Max. _____ Min. _____

API Class of Service _____

Date of Manufacture (month and year) _____

Customer _____ Purchase Order No. _____

Function Test Date _____ Shipment Date _____

OPERATOR DATA:

Date Received _____

Company Name _____ Organization Unit _____

Field _____ Lease _____ Well _____

Condition of SSV/USV Prior to Installation

1. Connections Tight _____
2. Opening Pressure* _____ Closing Pressure* _____
3. General _____

_____

_____

_____

_____

*Actuating Pressure

Inspected By: _____ Inspector/Supervisor _____

SECTION 700
EQUIPMENT MARKING

701. MARKING. All SSV/USV valves and SSV/USV actuators shall be marked on the exterior surface with the manufacturer's name or trademark, and shall be marked in accordance with all other specific instructions and identifications as stipulated in other sections of this Specification and as follows:

701.1 SSV/USV VALVE MARKING. The valve portion of SSV/USV equipment shall be marked as shown in Table 701.1. The manufacturer may arrange required nameplate markings as suitable to fit available nameplate space.

701.2 SSV/USV ACTUATOR MARKING. The actuator portion of the SSV/USV shall be marked as shown in Table 701.2. The manufacturer may arrange required nameplate markings as suitable to fit available nameplate space.

701.3 CLASS OF SERVICE. The SSV/USV valve and SSV/USV actuator shall be marked to identify the applicable class of service as shown in Table 701.3.

701.4 NAMEPLATES. Nameplates must be securely attached. Nameplates must remain legible after prolonged exposure to the surrounding environment.

For underwater use, nameplates shall remain legible until installation.

701.5 METHODS. All die stamp marking done directly on pressure containing components, excluding peripheral marking on API flanges, shall be stress relieved after marking, or marked using low stress methods in accordance with *NACE Standard MR0175.*

TABLE 701.1
MARKING FOR SSV/USV VALVES

	MARKING	APPLICATION
1.	Manufacturer's name or trademark	Body (if accessible) and nameplate
2.	The letters 14D and SSV or USV or SSV/USV	Nameplate
3.	Rated working pressure	Body (if accessible), bonnet, and nameplate
*4.	API monogram	Nameplate
5.	Class of service	Nameplate
6.	Nominal SSV/USV valve size and, when applicable, the restricted or oversized bore	Body or nameplate or both at manufacturer's option
7.	Flange size and ring gasket designation where applicable. The letter(s) R, RX, or BX and number indicating ring size	SSV/USV valve flange periphery. Refer to Note 1
8.	Direction of flow (if applicable)	Body or nearest accessible location
9.	Serial or identification number unique to the particular SSV/USV valve	Nameplate and body if accessible
10.	Maximum and minimum temperature range or temperature classification (Refer to Table 303.2)	Nameplate
11.	Date of manufacture (month/year)	Nameplate

*API licensees only. Contact API for information on licensing.
Note 1: Some USVs may use other than flanged connections.

TABLE 701.2
MARKING FOR SSV/USV ACTUATORS

	MARKING	APPLICATION
1.	Manufacturer's name or trademark	Nameplate and cylinder
2.	The letters 14D and SSV or USV or SSV/USV	Nameplate
3.	Rated working pressure of the cylinder	Nameplate
4.	Manufacturer's model number	Nameplate
5.	Serial identification number unique to the particular SSV/USV actuator	Nameplate and cylinder
6.	Maximum and minimum temperature or temperature classification (Refer to Table 303.2)	Nameplate
7.	Class of service	Nameplate
8.	Hydrostatic test pressure	Cylinder (and piston as applicable)
*9.	API monogram	Nameplate
10.	Date of manufacture (month/year)	Nameplate

*API licensees only. Contact API for information on licensing.

EQUIPMENT MARKING (continued)

TABLE 701.3
CLASS OF SERVICE IDENTIFICATION SYMBOLS FOR SSV/USV VALVES AND SSV/USV ACTUATORS

Identification Symbol	Identification Symbol (Alternate Method)	Service Description
1	1	Standard Service
-3S	1-3S	Standard Service, sulfide stress cracking resistant
-3C	1-3C	Standard Service, chloride stress cracking resistant
-3	1-3S-3C	Standard Service, sulfide and chloride stress cracking resistant
-4	1-4	Standard Service, metal loss corrosion (CO_2) resistant
-3S-4	1-3S-4	Standard Service, sulfide stress cracking and metal loss corrosion (CO_2) resistant
-3C-4	1-3C-4	Standard Service, chloride stress cracking and metal loss corrosion (CO_2) resistant
-3-4	1-3S-3C-4	Standard Service, sulfide and chloride stress crackling and metal loss corrosion (CO_2) resistant
2	2	Sandy Service and Standard Service
2-3S	2-3S	Sandy Service, sulfide stress cracking resistant
2-3C	2-3C	Sandy Service, chloride stress cracking resistant
2-3	2-3S-3C	Sandy Service, sulfide and chloride stress cracking resistant
2-4	2-4	Sandy Service, metal loss corrosion (CO_2) resistant
2-3S-4	2-3S-4	Sandy Service, sulfide stress cracking and metal loss corrosion resistant
2-3C-4	2-3C-4	Sandy Service, chloride stress cracking and metal loss corrosion resistant
2-3-4	2-3S-3C-4	Sandy Service, sulfide and chloride stress cracking and metal loss corrosion resistant

SECTION 800
STORING AND SHIPPING

801. DRAINING AFTER TESTING. All equipment shall be drained and lubricated after testing and prior to storage or shipment.

802. RUST PREVENTION. Prior to shipment, parts and equipment shall have exposed metallic surfaces protected with a rust preventive which will not become fluid and run at a temperature less than 150 degrees Fahrenheit (66° Celsius).

803. SEALING SURFACE PROTECTION. Exposed sealing surfaces shall be protected from mechanical damage for shipping.

804. CRATING OR MOUNTING. Reasonable precautions in crating or mounting shall be taken to protect threads, ring grooves, and other operating parts from transportation damage.

SECTION 900
TESTING AND ASSEMBLY

901. GENERAL.

901.1 The objectives of this section are:

901.1a To verify the basic Class 1 SSV/USV valve design.

901.1b To verify the basic SSV/USV actuator design.

901.1c To verify the basic Class 2 SSV/USV valve design.

901.1d To demonstrate the verification testing covered by Section 902 that is required to qualify specific valve bore sealing mechanism manufactured under this specification for Class 2 — Sandy Service.

901.1e To demonstrate the hydrostatic testing covered by Section 907 and the functional testing covered by Section 908 that are required for each individual SSV/USV manufactured, which represents a part of the requirements.

902. CLASS 1 SSV/USV VERIFICATION TESTING. To verify a specific Class 1 SSV/USV design, the manufacturer must test in accordance with the procedures of Section 905, Section 906, and Section 907, using water or other suitable fluids for test media. Qualification for Class 2 service also qualifies the SSV/USV for Class 1 service.

903. CLASS 2 SSV/USV VALVE VERIFICATION TESTING — GENERAL. To qualify a specific SSV/USV valve design for Class 2 Service, the manufacturer must submit an SSV/USV valve of the same basic design and materials of construction for a verification test by a Test Agency which meets the requirements of Section 904. An example design for the test facility and detailed test procedures are included in Section 900 of this Specification. Verification testing at a Test Agency is not required for SSV/USV equipment other than the valve bore sealing mechanism, Class 2 Service.

904. TEST AGENCY. The Test Agency shall meet the following minimum requirements. An independent third party, who wishes to conduct verification tests as a service to manufacturers or operators, shall provide a facility, personnel, written procedures, and form to assure conformance with all verification test requirements of this Specification, including procedures to assure conformance with all Test Agency requirements specified in Section 910.2. The Test Agency shall publish literature which includes as a minimum:

904.1 A description of the facility including any limitations on size or pressure rating of SSV/USV that may be tested.

904.2 The test procedures and forms actually used at the facility.

904.3 The test procedures for maintenance and calibration of measuring equipment.

904.4 The basis for determining test scheduling priorities.

904.5 The procedures for making application for test, delivery of SSVs/USVs, initial installation and checkout of SSVs/USVs, and other pertinent information.

904.6 Any limitations on accessibility of the facility. Such limitations should not preclude reasonable access to the facility for inspection by manufacturers or operators.

904.7 Any limitations on receipt of proprietary information.

904.8 Any other information considered pertinent by the Test Agency.

904.8a The above literature shall be kept current and shall be furnished to manufacturers or operators upon written request. The Test Agency shall be responsible for assuring themselves, the manufacturer, and the operator that their facility, procedures, and forms comply with this Specification.

904.9 The Test Agency must meet the criteria of *API Spec 14D* and applicable requirements of *API Spec Q1* or the criteria of *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 (refer to Appendix D, "Test Agency License Criteria") in order to test SSV/USV equipment that is intended to be marked with the API Monogram, or be accredited in accordance with the requirements of *ASME SPPE-2* in order to test SSV/USV equipment that is intended to be marked with the ASME SPPE OCS Symbol.

905. GENERAL VERIFICATION TEST REQUIREMENTS.

905.1 Unless otherwise noted on the SSV/USV valve manufacturer's application for official Class 2 SSV/USV Valve Verification Test, a flanged, $2^{1}/_{16}$" (52mm), 5,000 psi (34,5 MPa) rated working pressure SSV/USV valve shall be used for the official qualifying test. Successful completion of the official test shall qualify all sizes and all pressure ratings of that manufacturer's SSV/USV valves of the same basic design and materials of construction for Class 2 service. Any significant change in the design or materials of construction which would affect the SSV/USV valve bore sealing mechanism shall require requalification by verification testing.

905.2 The SSV/USV valve manufacturer must declare that a SSV/USV valve of a specific design and materials of construction is being submitted for the official Class 2 SSV/USV Valve Verification Test by submitting a formal application to the Test Agency. The application form shall contain the minimum information shown in Table 905.1.

905.2a If a particular SSV/USV valve has design or operational features which are incompatible with the test facility and test procedures required by this Specification, the manufacturer

TABLE 905.1
EXAMPLE APPLICATION FOR CLASS 2 SSV/USV VALVE VERIFICATION TESTING

Test Agency_____ Manufacturer_____
Address_____ Representative_____
_____ Address_____
_____ Telephone_____
Date_____
Application for: Official Qualification Test_____ Retest_____

SSV/USV to be Tested

SSV/USV Valve Data:
Manufacturer_____ Model or Cat. No._____ Serial No._____
Size_____ Rated Working Pressure_____
Special Considerations_____
_____
_____

SSV/USV Actuator Data:
Manufacturer_____ Model or Cat. No._____ Serial No._____
Type: Pneumatic_____ Hydraulic_____ Other_____
Cylinder Diameter_____ Rated Working Pressure_____
Special Considerations_____
_____
_____

SPACE BELOW FOR TEST AGENCY USE ONLY

Test Schedule _____
Month/Day/Year

Test Location _____
_____
_____
_____

Applicant Notified _____ By_____
Month/Day/Year

TESTING AND ASSEMBLY (continued)

TABLE 905.2
EXAMPLE CLASS 2 SSV/USV VALVE TEST FORM

Test Report Number_____

I. Tested SSV/USV Valve and SSV/USV Actuator Verification

	Manufacturer	Manufacturer's Contact	Model	Serial No.	Size	Working Pressure
SSV/USV Valve						
SSV/USV Actuator						

II. Initial SSV/USV Valve Seat Leakage Test (Refer to Section 906.2).
Date_____ Time_____
Test Performed By_____
1. Fresh water SSV/USV valve seat leakage test
Test Pressure_____psi Leaked Yes_____ No_____
2. Nitrogen leakage test
Test Pressure_____psi Leaked Yes_____ No_____

III. Sand Slurry Flow Test (Refer to Section 906.3)
Date_____ Time_____
Test Performed By_____
1._____gpm circulation rate of sand slurry.
2._____% by volume of 40-60 mesh frac sand in circulating sand slurry.
3._____seconds. Viscosity determined by Marsh funnel viscometer.
4._____°F(°C) slurry temperature.
5._____hours of sand slurry circulation.
6.a. Fresh water SSV/USV valve seat leakage test.
Test Pressure_____psi Leaked Yes_____ No_____
b. Nitrogen leakage test.
Test Pressure_____psi Leaked Yes_____ No_____

IV. Sand Slurry Flow Test While Opening and Closing During Circulation (Refer to Section 906.4).
Date_____ Time_____
Test Performed By_____
1._____gpm circulation rate of sand slurry.
2._____% by volume of 40-60 mesh frac sand in circulating sand slurry.
3._____seconds. Viscosity determined by Marsh funnel viscometer.
4._____°F(°C) slurry temperature.
5._____psi differential pressure across SSV/USV valve when opened.
6._____seconds, time for one complete cycle.
7._____number of SSV/USV cycles.
8.a. Fresh water SSV/USV valve seat leakage test.
Test Pressure_____psi Leaked Yes_____ No_____
b. Nitrogen leakage test.
Test Pressure_____psi Leaked Yes_____ No_____

9.a. Type and frequency of preventive maintenance. Describe in detail.
_____
_____
_____
_____

b. Number of cycles completed at last preventive maintenance operation:
_____

V. SSV/USV Valve Performance Test Certification (To be completed by person performing the test or by test facility designated certifying officer.) Remarks—Note any testing problem or difficulties.
_____
_____
_____
_____
_____

SSV/USV valve qualified for Class 2 service (yes, no) _____
Certified:_____
_____
Date:_____

shall advise the Test Agency of the nature of the incompatibility and shall request and fully describe on the test application, or attachment thereto, any non-specified equipment or procedures required to test the SSV/USV valve. Responsibility for furnishing and installing non-specified equipment shall be by agreement between the Test Agency and the manufacturer. The manufacturer shall document that such non-specified equipment or procedures are not less stringent than requirements of this Specification.

905.2b The Test Agency shall conduct the test as specified on the SSV/USV valve manufacturer's test application. Any variation from the verification test requirements of this Specification shall be prominently recorded on the test data form by the Test Agency.

905.3 The SSV/USV valve manufacturer shall provide the Test Agency with one SSV/USV valve, in exact accordance with the data supplied with the manufacturer's test application, completely assembled with an SSV/USV actuator of the SSV/USV valve manufacturer's choice, and hydrostatically and functionally tested in accordance with Sections 907 and 908 of this Specification. The SSV/USV shall be furnished with an appropriate operating manual. If other than a flanged, $2^{1}/_{16}$" (52mm) valve, manufacturer shall also furnish to the Test Agency all piping components necessary to install the SSV/USV in the facility test loop, unless the manufacturer has made other arrangements with the Test Agency. The test valve may be either a prototype or production model.

905.4 The Test Agency shall record the results of the official verification test on forms which contain the minimum data specified in the example form shown in Table 905.2. This form shall be retained by the manufacturer and by the Test Agency, and shall be available to the operator upon request to the manufacturer. Results shall be confidential to the party requesting the test and the Test Agency.

905.5 The SSV/USV valve being officially tested must successfully complete all steps of the performance testing procedure within the limits specified. Official verification testing cannot continue if the SSV/USV 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 of a malfunction or failure within the test facility. The basis for terminating the test, and any unusual conditions observed at or prior to the time of termination, shall be noted on the test data form by the Test Agency; however the manufacturer not the Test Agency shall be responsible for determining the cause of failure.

905.6 If an SSV/USV valve fails to meet the requirements of this Section, that SSV/USV, or any other SSV/USV valve of the same basic design and materials of construction, shall not be submitted for retest until the SSV/USV valve manufacturer has determined and documented both the need for corrective action and the corrective action taken as specified in Appendix C of this Specification. Such information need not be submitted to the Test Agency, but must be placed in the manufacturer's test file before that SSV/USV valve is submitted for retest.

905.7 The manufacturer shall maintain a Verification Test File on each test, including any retest that may have been required to qualify a particular SSV/USV valve design and materials of construction. This file shall be available to the operator for inspection upon request and shall be retained by the SSV/USV valve manufacturer for a period of at least ten years after SSV/USV valves of that design and materials of construction are discontinued from the manufacturer's product line. As a minimum this file shall contain sufficient documentation to identify and permit retrieval of the following:

905.7a All detailed dimensional drawings and material specifications applicable to the tested SSV/USV valve at the time that particular SSV/USV valve was manufactured.

905.7b All applications for official test or retest.

905.7c All design and/or material modifications or other justification for retests of SSV/USV valves which did not pass any verification test.

905.7d All test data specified in this Specification.

905.7e Model numbers and other pertinent identifying data on all other sizes and rated working pressure or SSV/USV valves of the same basic design and materials of construction that were qualified for Class 2 service by the verification test of this particular SSV/USV valve.

906. VERIFICATION TEST PROCEDURE. The following procedures are general and are intended to show the limits and extent of the Class 2 SSV/USV Valve Verification Test. Table 906.1 summarizes the primary steps in flow diagram format. Detailed procedures are presented in Section 910.

906.1 The SSV/USV shall be installed in the test section of a fluid circulating system as depicted in Figures 906.1 and 906.2.

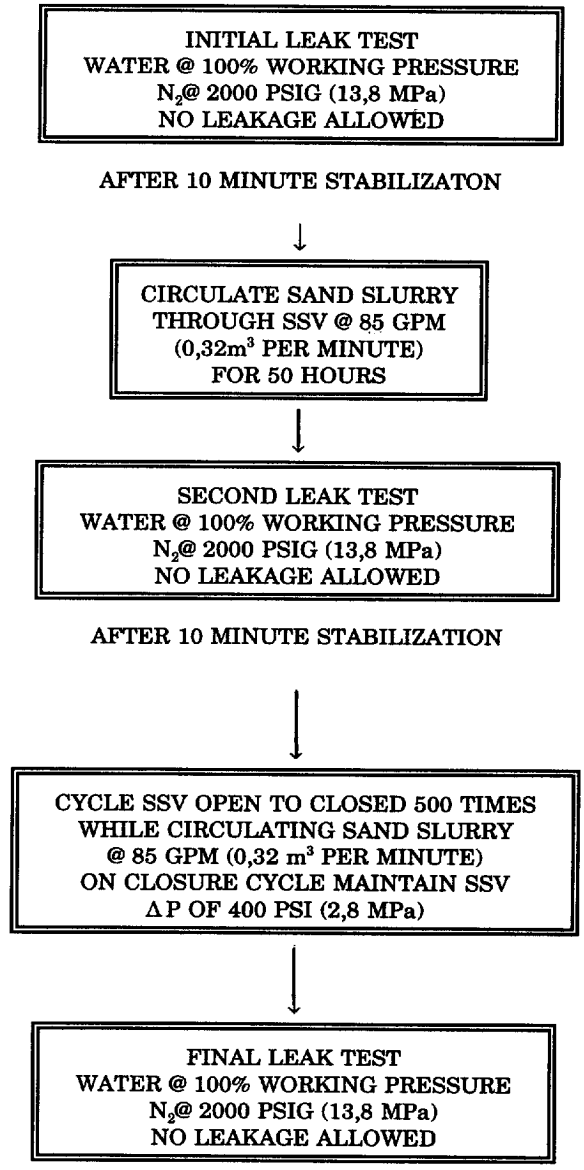
906.2 The SSV/USV valve shall be seat tested for pressure integrity at rated working pressure using fresh water and at 2,000 psi (13,8 MPa) using nitrogen. No leakage shall be allowed after a 10 minute stabilization period.

906.3 Sand slurry fluid shall be circulated through the SSV/USV valve with the SSV/USV valve in a full open position for a fifty hour period. At the end of this period, the SSV/USV valve seat test of Section 906.2 shall be repeated. No leakage shall be allowed after a 10 minute stabilization period.

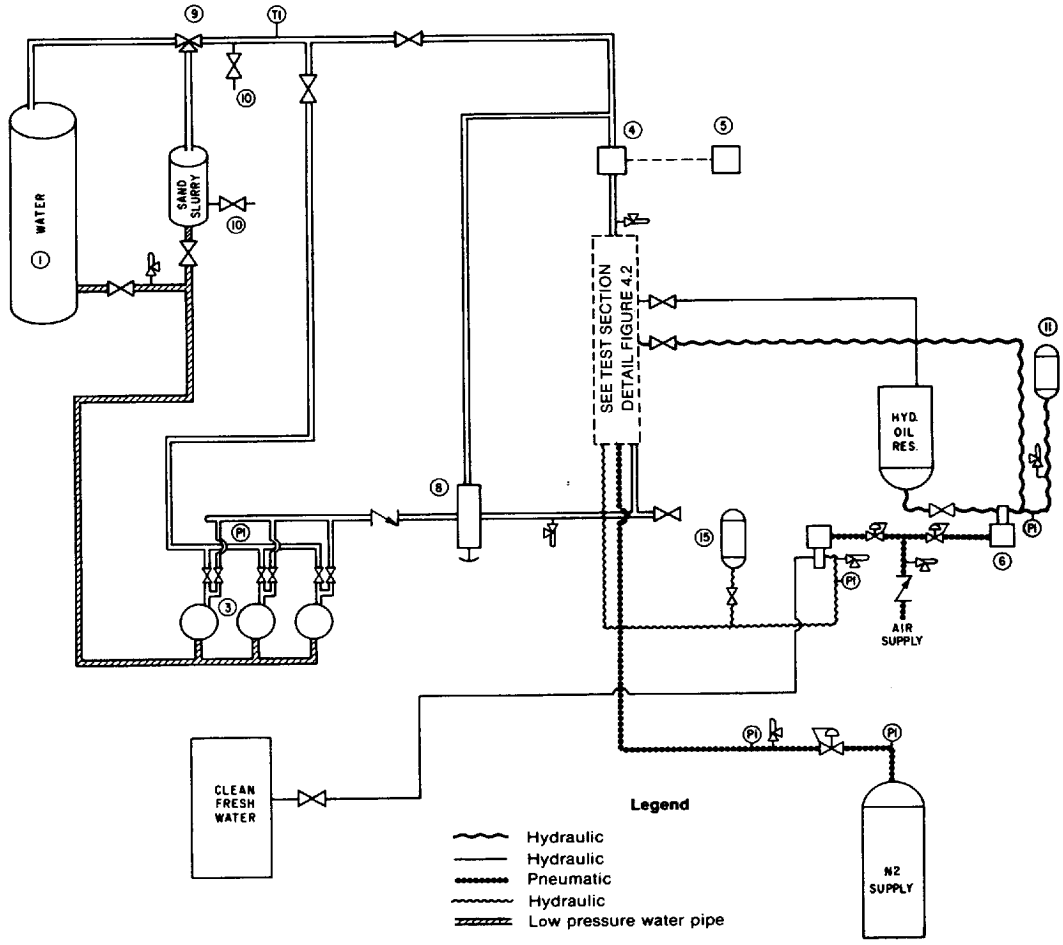
906.4 Sand slurry shall be circulated through the SSV/USV valve while cycling the SSV/USV from the fully open to the fully closed position. Differential pressure across the SSV/USV valve seat will increase to approximately 400 psi (2,8 MPa) upon each SSV/USV valve closure. Following 500 cycles of operation the SSV/

TESTING AND ASSEMBLY (continued)

TABLE 906.1
CLASS 2 SSV VERIFICATION
FLOW DIAGRAM



TESTING AND ASSEMBLY (continued)



DETAIL

1. Water tank.
2. Sand slurry tank.
3. Circulation pumps.
4. Flow meter.
5. Flow recorder.
6. Hydraulic oil supply pump (air powered).
7. High pressure water supply pump (air powered).
8. Adjustable back pressure control.
9. Two position; 3-way diverter valve.
10. Sample connections for sand content and viscosity analysis.
11. Hydraulic pressure accumulator hydraulic oil supply.
12. 3-way solenoid valve air supply.
13. 3-way solenoid valve hydraulic oil supply.
14. Cyclic timer to control air and hydraulic solenoid valves.
15. Hydraulic pressure accumulator high pressure water supply.

FIGURE 906.1
EXAMPLE PIPING ARRANGEMENT — TEST FACILITY FOR CLASS 2 SSV/USV VALVE VERIFICATION TESTING

TESTING AND ASSEMBLY (continued)

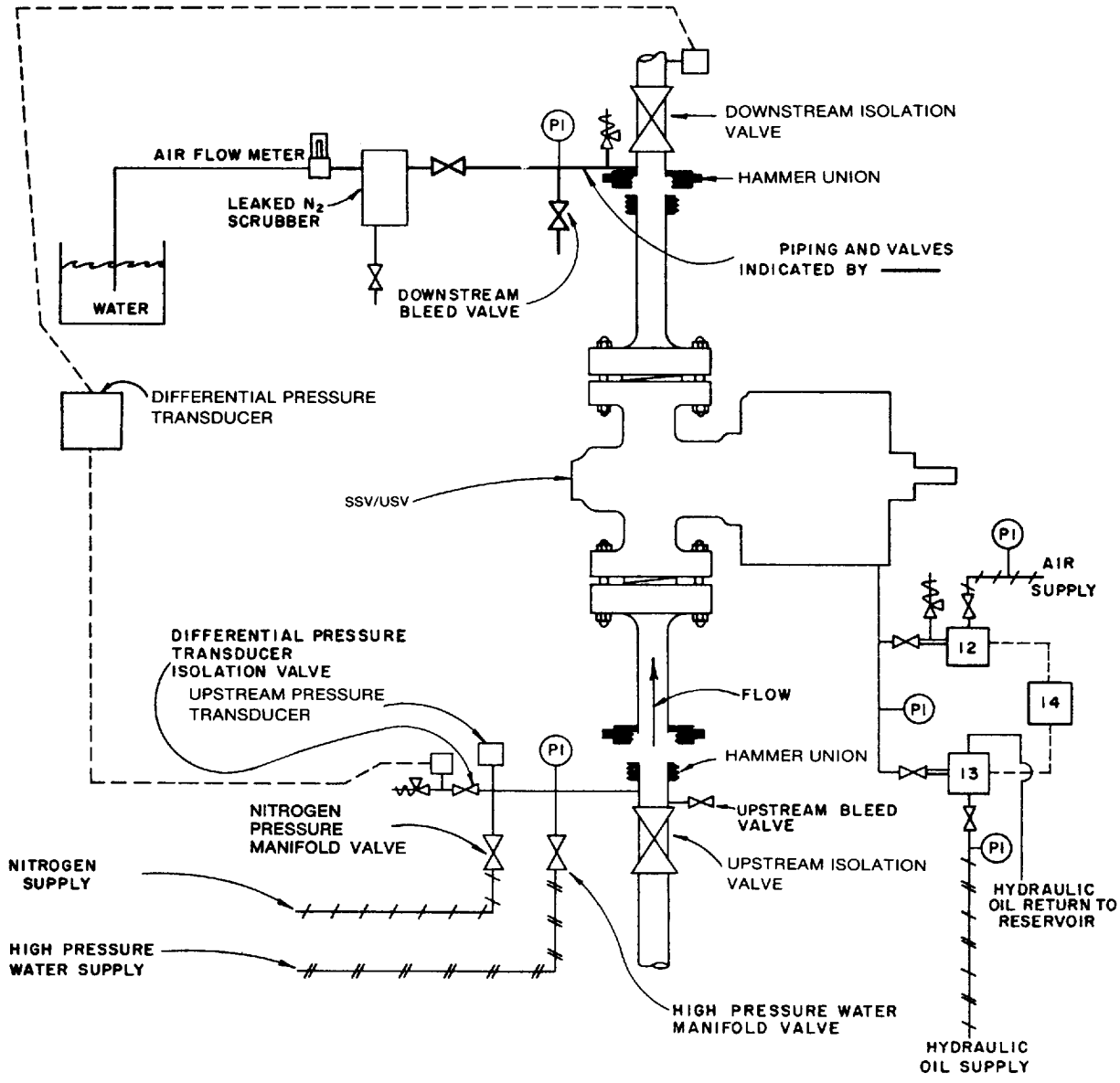


FIGURE 906.2
EXAMPLE SSV/USV VALVE VERIFICATION TEST SECTION DETAIL

USV valve seat test of Section 906.2 shall be repeated. No leakage shall be allowed after a 10 minute stabilization period. During this phase of testing, normal preventive maintenance procedures, if any, as prescribed in the manufacturer's operating manual, shall be performed except that no preventive maintenance shall be allowed during the last 100 cycles of operation in the test.

907. HYDROSTATIC TESTING. Each SSV/USV valve body, SSV/USV bonnet, and each SSV/USV actuator, cylinder, and piston, shall be subjected to a hydrostatic test as indicated in Section 907.1 or 907.2. Such test shall be made prior to the application of paint or other coatings; however, painted units or subassemblies from stock which have been previously tested in an unpainted condition may be retested without removal of the paint or coating. The body or shell test for each member shall consist of three parts:

The primary pressure holding period.

The reduction of pressure to zero.

The secondary pressure holding period.

Each pressure holding period shall not be less than three minutes duration, the timing of which shall not start until the test pressure is reached, the SSV/USV valve and the pressure monitoring gauge have been isolated from the pressure source, and the exterior of the body or shell members have been thoroughly dried. Water or other suitable fluid shall be used as the testing medium.

907.1 SSV/USV VALVE HYDROSTATIC TEST. After final assembly of each new SSV/USV, the SSV/USV valve body and bonnet assembly shall be subjected to a hydrostatic test and shall show no leakage under the test pressure. Both ends shall be blanked off and the gate or plug shall be partially or fully opened, as required, to ensure that the test pressure is achieved throughout the SSV/USV valve body cavity.

Test pressures shall be as shown in Table 907.1. A lock open device may be used when performing the SSV/USV valve hydrostatic test if the actuator is not capable of holding the SSV/USV valve in an open position. This test shall be performed as a part of the functional testing requirements of Section 908 and shall precede the SSV/USV valve seat test described in Section 908.1e.

TABLE 907.1
VALVE BODY HYDROSTATIC TEST PRESSURES

Rated Working Pressure

SSV/USV Valve Body & Bonnet, psi (MPa)	Hydrostatic* Test Pressure, psi (MPa)
2,000 (13,8)	4,000 (27,6)
3,000 (20,7)	6,000 (41,4)
5,000 (34,5)	10,000 (69,0)
10,000 (69,0)	15,000 (103,4)
15,000 (103,4)	22,500 (155,2)
20,000 (138,0)	30,000 (207,0)

*Minimum pressure gauge reading. Maximum test pressures are determined by manufacturer.

907.2 SSV/USV ACTUATOR HYDROSTATIC TEST. Prior to coating, each new SSV/USV actuator cylinder and piston shall be subjected to a hydrostatic test to demonstrate structural integrity. The test pressure shall be a minimum of 1.5 times the actuator rated working pressure up to 20,000 psi (138 MPa). At 20,000 psi (138 MPa) and above, the test pressure will be 1.25 times the rated working pressure. No leakage shall be allowed. The SSV/USV actuator cylinder and piston may be hydrostatically tested simultaneously or separately. After successful completion of the hydrostatic test, each SSV/USV actuator cylinder and piston shall be permanently marked with the test pressure, in accordance with Section 700, to provide future identification of tested pieces. If hydrostatic testing of the cylinder and piston is performed after final SSV/USV actuator assembly, stamping of the piston shall not be required. If necessary, the pressure relief device may be removed during the seal test of the SSV/USV actuator.

908. FUNCTIONAL TESTING. After final assembly, each new SSV/USV shall be subjected to a functional test to demonstrate proper assembly and operation. All test data shall be recorded on a data sheet similar to that shown in Table 908.1 and shall be maintained for at least five years. The test data sheet shall be signed and dated by the person(s) performing the functional test(s). A copy of the test data sheet shall be delivered to the purchaser with each completed SSV/USV.

908.1 TEST PROCEDURES.

908.1a SSV/USV Actuator Seal Test. The SSV/USV actuator seals shall be pressure tested in two steps. In the first step, 20% of the maximum allowable working pressure shall be applied to the SSV/USV actuator. In the second step, 80 to 100 percent of the maximum allowable working pressure shall be applied to the SSV/USV actuator. No leakage shall be allowed in either step. The test media shall be air or nitrogen for pneumatic SSV/USV actuators; a suitable hydraulic fluid for hydraulic SSV/USV actuators. The minimum test duration for each pressure shall be: ten minutes at 20% pressure and five minutes at 80% to 100% pressure for pneumatic SSV/USV actuators; three minutes at each test pressure for hydraulic SSV/USV actuators. The test period shall not begin until the test pressure has been reached and the SSV/USV actuator and the pressure monitoring gauge have been isolated from the pressure source. The test pressure reading and time at the beginning and at the end of each pressure holding period shall be recorded. If necessary, the pressure relief device may be removed during the seal test of SSV/USV actuators.

908.1b Drift Test. The SSV/USV valve opening of each full bore SSV/USV valve shall be checked for proper bore alignment by passing a drift mandrel of the dimensions shown in Table 908.2 through the opening with the SSV/USV valve stroked to the fully open position. The drift mandrel OD shall be recorded. The SSV/USV valve opening of each reduced opening SSV/USV valve shall be visually inspected for proper bore alignment in the fully open position.

TESTING AND ASSEMBLY (continued)

TABLE 908.1
SSV/USV FUNCTIONAL TEST DATA SHEET
(Example)

SSV/USV Valve Data:

Manufacturer _____

SSV/USV Valve Catalog or Model No._____Serial No. _____ Size_____

Rated Working Pressure_____Temperature Classification _____

SSV/USV Valve Bore_____Service Class _____

Class 2 SSV/USV Valve Performance Test Agency_____ Test Report No._____

SSV/USV Actuator Data:

Manufacturer _____

SSV/USV Valve Catalog or Model No. _____Serial No. _____Size _____

Rated Working Pressure _____Temperature Classification _____

SSV/USV Valve Bore _____Service Class _____

Functional Test Data

I. SSV/USV Actuator Seat Test Performed By _____

Pneumatic _____Hydraulic _____

At 20% of Working Pressure Rating

Beginning Time_____Test Gauge Pressure Reading _____

Ending Time_____Test Gauge Pressure Reading _____

At 80% to 100% of Working Pressure Rating

Beginning Time_____Test Gauge Pressure Reading _____

Ending Time_____Test Gauge Pressure Reading _____

II. Drift Check Performed By_____

Drift Mandrel OD _____

Visual Inspection Performed By _____

III. SSV/USV Actuator Operational Test Performed By _____

Number of Cycles Completed _____

IV. SSV/USV Valve Body and Bonnet Hydrostatic Test Performed By _____

Required Test Pressure _____

Primary Pressure Holding Period

Beginning Time _____Test Gauge Pressure Reading _____

Ending Time _____Test Gauge Pressure Reading _____

Secondary Pressure Holding Period

Beginning Time _____Test Gauge Pressure Reading _____

Ending Time _____Test Gauge Pressure Reading _____

V. SSV/USV Valve Seat Test Performed By _____

SSV/USV Valve Type: Uni-Directional _____Bi-Directional _____

Required Test Pressure _____

Primary Seal Test (Pressure Applied From Downstream End)

Beginning Time _____Test Gauge Pressure Reading _____

Ending Time _____Test Gauge Pressure Reading _____

Secondary Seal Test (Pressure Applied From Downstream End)

Beginning Time _____Test Gauge Pressure Reading _____

Ending Time _____Test Gauge Pressure Reading _____

Tertiary Seal Test (Pressure Applied From Downstream End)

Beginning Time _____Test Gauge Pressure Reading _____

Ending Time _____Test Gauge Pressure Reading _____

Certified By _____Company _____

Title _____Date _____

908.1c SSV/USV Actuator Operational Test. The SSV/USV shall be tested for proper operation by stroking the SSV/USV actuator from the fully closed position to the fully open position a minimum of three times with the SSV/USV valve body at atmospheric pressure. The SSV/USV shall operate smoothly in both directions. Test media for pneumatic SSV/USV actuators shall be air or nitrogen. Test media for hydraulic SSV/USV actuators shall be a suitable hydraulic fluid.

908.1d SSV/USV Valve Body Hydrostatic Test. The SSV/USV valve body shall be hydrostatically tested as described in Sections 907 and 907.1 with the SSV/USV valve in the partially or fully open position, as required to ensure that the test pressure is achieved throughout the valve body cavity. The test pressure reading and the time at the beginning and at the end of each of the pressure holding periods shall be recorded. No leakage shall be allowed. (This test shall precede the SSV/USV valve seat test.)

908.1e SSV/USV Valve Seat Test. SSV/USV valves shall have the hydrostatic seat test pressure, which is equal to the rated working pressure, applied to one side of the gate or plug with the other side open to the atmosphere. Bidirectional SSV/USV valves shall be tested in both directions. Unidirectional SSV/USV valves shall be tested in the direction indicated on the body.

After the pressure has been applied to one side of the gate or plug, the pressure shall be held and monitored for a minimum of three minutes.

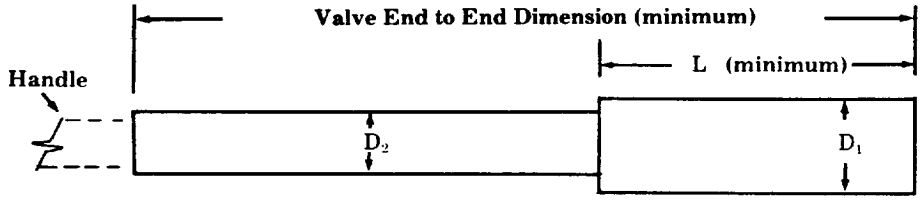
The SSV/USV valve shall then be opened while under full differential pressure. The downstream bore may be filled with water and/or covered with a blind flange when the valve is stroked open.

The above two steps shall be repeated.

The one side of the gate or plug shall then be pressurized, held, and monitored a third time for a minimum of 3 minutes.

Bidirectional SSV/USV valves shall next be tested on the other side of the gate or plug using the same procedure outlined above. Split-gate valves may have both seats tested simultaneously.

TABLE 908.2
DRIFT DIAMETER FOR VALVES



NOMINAL FLANGE SIZE, in.	BORE SIZE, in. (+.030/-0)	L, in. (minimum)	D_1, in. (+.027/-0)	D_2, in. (+.027/-0)
1 13/16	1.81	3.00	1.78	1.52
2 1/16	1.81	3.00	1.78	1.52
2 1/16	2.06	3.00	2.03	1.90
2 9/16	2.56	3.00	2.53	2.35
3 1/16	3.06	3.06	3.03	2.88
3 1/8	3.12	3.12	3.09	2.88
4 1/16	4.06	4.06	4.03	3.83
5 1/8	5.12	5.12	5.09	4.97
7 1/16	6.00	6.00	5.97	5.85
7 1/16	6.12	6.12	6.09	5.97
7 1/16	6.38	6.38	6.34	6.22
7 1/16	6.62	6.62	6.59	6.47
7 1/16	7.06	7.06	7.03	6.91
9	9.00	9.00	8.97	8.85

Valves shall show no visible leakage during each holding period. The test pressure reading and the time at the beginning and at the end of the pressure holding periods shall be recorded.

908.2 TEST EQUIPMENT.

908.2a Test pressure measuring devices shall be either pressure gauges or pressure transducers.

908.2b Pressure measuring devices shall meet the requirements of Section 603.3.

908.2c Master pressure measuring devices shall be recalibrated with a dead weight tester in accordance with Section 603.3a.

908.2d Dead weight testers shall be calibrated at intervals based on repeatability and degree of usage. Intervals may be lengthened and shall be shortened based on recorded calibration history provided they not exceed three months maximum until history can be established.

909. HEAT SENSITIVE LOCK OPEN DEVICES. Verification Testing. The manufacturer shall have data available to show that the device has been sufficiently tested to ensure that it is capable of satisfying the design requirements of Section 301.6.

910. CLASS 2 SSV/USV VALVE VERIFICATION TESTING PROCEDURE.

910.1 MATERIAL SUPPLIED TO TEST AGENCY BY SSV/USV VALVE MANUFACTURER.

910.1a Application for Class 2 SSV/USV valve verification testing, Table 905.1.

910.1b One hydrostatically and functionally tested SSV/USV with an appropriate operating manual.

910.1c All test section piping required for the installation of the SSV/USV in the test facility described in Section 910.2. Unless otherwise agreed by the SSV/USV valve manufacturer and the Test Agency, this shall include all special piping components necessary to install SSV/USV valves of sizes or rated working pressures other than $2^{1}/_{16}$" (52mm), 5000 psi (34,5 MPa).

(1) The ends of the test section shall be equipped with end connections compatible with those provided by the Test Agency.

(2) The complete removable test section with SSV/USV installed must be of a length compatible with the Test Agency's facility, as described in the Test Agency's literature.

(3) The test section shall be capable of withstanding the rated working pressure of the SSV/USV valve to be tested.

910.1d The test agency will inspect the SSV/USV and verify the identification (model and serial number) of the valve and actuator before completion of the test.

910.2 GENERAL REQUIREMENTS FOR A CLASS 2 SSV/USV VALVE VERIFICATION TEST FACILITY.

910.2a General. The typical piping arrangement and test section detail of a test facility for Class 2 SSV/USV Valve Verification Testing are shown in Figures 906.1 and 906.2.

910.2b Design Considerations.

(1) The test facility shall be designed to permit the Verification Tests to be made as detailed in Sections 910.3, 910.4, and 910.5.

(2) The circulation piping shall be of sufficient working pressure rating to withstand the circulation pressure. The test section upstream isolation valve and the pressure measuring devices, valves, and fittings, between it and the SSV/USV valve being tested, shall be designed for a working pressure of at least that of the valve being tested. Components of lower pressure ratings shall be protected with appropriate pressure relief valves.

910.2c Circulation System Components.

(1) Fresh Water Tank. A fresh water tank shall be provided with a minimum capacity of 5 barrels ($0.8m^3$) and shall be equipped with a low level pump shutdown control.

(2) Sand Slurry Tank and Associated Accessories. A cylindrical, cone-bottom sand slurry tank with a minimum capacity of 5 barrels ($0.8\ m^3$) shall be provided. The tank shall be equipped with agitation as required to obtain proper slurry consistency. Sample connections shall be provided in the tank and in the return line to the tank so that representative sand content and viscosity analysis samples may be taken. High and low level shutdowns shall be provided in the tank to signal shutdown of the circulating pumps. Viscosity and sand content shall be determined in accordance with *API RP 13B* and *API Manual of Petroleum Measurement Standards,* Chapter 10, Section 4.

(3) Circulating Pumps and Controls. Circulating pumps with drivers and special equipment for pumping the sand slurry and fresh water at the required flow rates and pressures shall be installed. At least one pump shall be provided with a variable speed motor for circulation flow rate control. Each pump motor shall be provided with a non-resetable elapsed time meter to monitor pumping duration. The pump motors shall be equipped to shut down on high or low pump discharge pressures and a high or low tank level.

(4) **Circulation Piping and Controls.** The circulation piping shall be installed in an arrangement similar to that shown in Figure 906.1. Block valves shall be provided as indicated in Figures 906.1 and 906.2. The return piping to the sand slurry tank shall be installed in such a manner as to provide agitation to aid in preventing sand accumulation in the bottom of the tank. A choke or other suitable means or back pressure control shall be installed between the circulation pumps and test section as shown in Figure 906.1, and shall be used to control SSV/USV differential pressure to 400 psi (2,8 MPa) during the cycling test (refer to Section 910.5).

(5) **Circulation Flow Meter.** A circulation flow meter covering a minimum flow rate of 77 gpm (0,29m³ per minute) shall be provided. This flow meter shall provide an output signal suitable for strip chart recording.

(6) **Recorders.** Recording instruments shall be provided to monitor the following data:

(a) Circulation flow rate during all flow testing.

(b) SSV/USV valve upstream test pressure during valve seat leakage test.

(c) Differential pressure across SSV/USV valve being tested during closure test.

Recorders shall be of appropriate ranges and equipped with variable chart speeds to allow resolution of time varying analog signals.

910.2d Utility Systems. The test facility shall be provided with the following utility systems complete with associated pumps, controls, gauges, instruments, and piping, as required to perform the tests described in Sections 903 and 910.3 through 910.5 of this Specification.

(1) Compressed air supply.

(2) Hydraulic oil supply.

(3) High pressure water supply.

(4) Nitrogen supply.

910.3 SSV/USV VALVE SEAT LEAKAGE TEST PROCEDURE FOR CLASS 2 SSV/USV SERVICE. Record results on Table 905.2.

Initial Leakage Tests

Step 1 — Install SSV/USV in the test section.

Step 2 — Check SSV/USV valve for leakage with fresh water.

(a) Circulate fresh water at a minimum flow rate of 77 gpm (0,29 m³ per minute) for at least 10 minutes with SSV/USV valve fully open.

(b) Close SSV/USV by releasing actuator power.

(c) Close isolation valves upstream and downstream from SSV/USV.

(d) Open downstream liquid leak detection valve.

(e) Apply water pressure upstream of the SSV/USV equal to 95-105% of the rated working pressure of the SSV/USV valve.

(f) After the pressure has stabilized for three minutes minimum, check for SSV/USV valve seat leakage from the downstream leak detection valve for a period of five minutes minimum. No leakage is acceptable.

Step 3 — Check SSV/USV valve for leakage with nitrogen pressure:

(a) Close upstream and downstream block valves.

(b) Bleed all pressure and drain water on both sides of SSV/USV valve. (Open and close SSV/USV valve three times while draining water.)

(c) Close SSV/USV.

(d) With bleed valve open, immerse the end of a flexible tube connected thereto in a container water.

(e) Apply 2,000 psi (13,8 MPa) ±5% nitrogen on upstream side of SSV/USV valve.

(f) After the pressure has stabilized for three minutes minimum, check for valve seat leakage by observing for gas bubbles for a period of five minutes minimum. No leakage is acceptable.

910.4 SAND SLURRY FLOW TEST PROCEDURE FOR CLASS 2 SSV/USV VALVE SERVICE. (Record Results on Table 905.2)

First flow test to check for erosion and fouling.

Step 1 — Circulate sand slurry at a minimum flow rate of 77 gpm (0,29 m³ per minute) while bypassing the test section until slurry viscosity and sand content stabilize with slurry agitator on.

Step 2 — Determine sand content of slurry by filling two oil gauger's 100 ml sample tubes with slurry sample and centrifuge with oil gauger's centrifuge according to *API Manual of Petroleum Measurement Standards,* Chapter 10.4. Adjust sand content of circulating fluid to 2% (1½% to 2½% acceptable) by adding 40-60 U. S. mesh sand or diluting mixture with fresh water.

Step 3 — Determine viscosity of sand slurry sample with Marsh funnel viscometer according to *API RP 13B.* Adjust viscosity to 100 seconds (120 seconds maximum and 90 sec-

onds minimum) by adding polymer viscosifier or diluting mixture with fresh water.

Step 4 — If dilution or strengthening was necessary in Step 3, return to procedure in Step 1.

Step 5 — Adjust flow rate to a minimum of 77 gpm (0,29 m^3 per minute). Record flow rate, sand percentage, and viscosity.

Step 6 — Pump sand slurry through SSV/USV valve for 25 hours (±1 hour).

Step 7 — Check sand content and viscosity or slurry as before in Steps 2 and 3. Adjust as required.

Step 8 — Pump sand slurry through SSV/USV valve for an additional 25 hours (± 1 hour) at a minimum flow rate of 77 gpm (0,29 m^3 per minute).

Step 9 — Check for leakage using procedure in Section 910.3 Steps 2(b) through 2(f).

Step 10 — Check for leakage with nitrogen using the procedure in Section 910.3, Step 3.

910.5 SAND SLURRY FLOW TEST WHILE OPENING AND CLOSING DURING CIRCULATION FOR CLASS 2 SSV/USV VALVE SERVICE. (Record Results on Table 905.2)

Flow Test

Step 1 — Circulate sand slurry at a minimum flow rate of 77 gpm (0,29 m^3 per minute) while bypassing the test section with slurry agitator on.

Step 2 — Determine sand content of slurry by filling two oil gauger's, 100 ml sample tubes with slurry samples. Centrifuge with oil gauger's centrifuge according to *API Manual of Petroleum Measurement Standards,* Chapter 10.4. Adjust sand content to 2% ($1^1/_2$% to $2^1/_2$% acceptable) by adding 40-60 U.S. mesh sand or diluting mixture with fresh water.

Step 3 — Determine viscosity of slurry sample with Marsh funnel viscometer according to *API RP 13B.* Adjust viscosity to 100 seconds (120 seconds maximum, 90 seconds minimum) by adding polymer viscosifier or diluting mixturing with fresh water.

Step 4 — If dilution or strengthening was necessary in Step 3, return to procedure in Step 1.

Step 5 — Adjust flow rate to a minimum of 77 gpm (0,29 m^3 per minute). Record sand slurry flow rate, sand percentage, and viscosity.

Step 6 — Cycle SSV/USV valve from fully open to fully closed at a maximum rate or 7 cycles per minute.

Step 7 — Adjust choke (or equivalent) upstream from SSV/USV valve to provide a differential pressure of 400 psi (2,8 MPa) ± 10% across the SSV/USV valve when closed.

Step 8 — Open and close SSV/USV 500 cycles (-0, +10 cycles).

Step 9 — Check for leakage using procedure in Section 910.3, Steps 2(b) through 2(f).

Step 10 — Check for leakage with nitrogen using the procedure in Section 910.3, Step 3.

SECTION 1000
REPAIR AND REMANUFACTURE REQUIREMENTS

1001. GENERAL. This section provides requirements for the repair and remanufacture of SSVs and USVs originally manufactured to *API Spec 14D.*

1002. CLASSES OF SERVICE. This section establishes requirements for the repair/remanufacture for classes of service. The classes of service are as described in Section 102.

1003. MATERIAL FOR REPLACEMENT PARTS. Material requirements for repair shall meet the requirements for materials specified by Section 400 of this Specification.

Repair shall be done with qualified parts which meet the requirements of Sections 300, 400, 500, and 600.

1004. REMANUFACTURE. Remanufacture shall be done in accordance with the requirements of Sections 300, 400, 500, and 600 to meet the performance requirements of Section 900.

1005. REPAIR.

1005.1 GENERAL.

1005.1a This Section applies to repair operations.

1005.1b Field repair is beyond the scope of this Specification.

1005.1c Personnel performing the repair operations described in this Section shall be qualified in accordance with written procedures which address minimum requirements for personnel training and qualifications.

1005.1d Personnel performing quality control activities on repaired equipment shall be qualified in accordance with the requirements of Section 600.

1005.2 REPAIR PROCEDURE.

1005.2a Equipment Identification. Equipment to be repaired shall be identified as to:

1. Manufacturer.
2. Size and working pressure.
3. Class of service and temperature rating.
4. Serial number and any other traceable identification as applicable.
5. Comments as to general condition.

1005.3 DOCUMENTATION OF IDENTIFICATION. The information noted above shall be documented to control the various repair operations and become a part of the records kept by the repairer.

1005.4 EQUIPMENT DISASSEMBLY. Equipment shall be disassembled and cleaned in accordance with the repairer's written specifications. Control features shall be included to segregate or otherwise identify the components of each assembly to avoid the mixing or mismatching of components during reassembly.

1005.5 EQUIPMENT EVALUATION. Following disassembly and cleaning, the equipment shall be evaluated in accordance with the written requirements of the repairer. Evaluation shall consist of the following items as a minimum:

1005.5a Visual inspection.

1005.5b Verification of all API specified dimensions in accordance with specification.

Results of the evaluation shall be documented and shall become part of the repair procedure control document and shall be included in the records kept by the repairer.

1005.6 REPLACEMENT PARTS. Qualified parts shall be used. These parts shall meet the requirements of the class of service to which the equipment is being repaired. (Refer to Section 1002.)

1005.7 EQUIPMENT REASSEMBLY. Repaired equipment shall be reassembled in accordance with the repairer's written specifications.

1005.8 ASSEMBLED EQUIPMENT TESTING. Repaired equipment shall be functionally tested in accordance with Section 908.

1006. REMANUFACTURING REQUIREMENTS.

1006.1 PERSONNEL QUALIFICATIONS.

1006.1a Personnel performing welding operations shall be qualified in accordance with the requirements of Section 500.

1006.1b Personnel performing quality control activities shall be qualified in accordance with the requirements of Section 600.

1006.1c Personnel performing other functions described in this Section shall be qualified in accordance with the written procedures which address minimum requirements for personnel training and qualifications.

1006.2 REMANUFACTURING PROCEDURE.

1006.2a Equipment Identification. Equipment to be remanufactured shall be identified as follows:

1. Original manufacturer.
2. Size and working pressure.
3. Class of service and temperature rating.
4. Serial number and any other traceable identification.
5. Comments as to general condition.

1006.2b Documentation of Identification. The information noted above shall be documented to control the various remanufacturing operations and become a part of the records kept by the remanufacturer.

1006.2c Equipment Disassembly. Equipment shall be disassembled and cleaned in accordance with the remanufacturer's written specification. Control features shall be included to segregate or otherwise identify the components of each assembly during the disassembly to avoid mixing or mismatching of components during the reassembly.

1006.2d Equipment Evaluation. Following disassembly and cleaning, the equipment shall be evaluated in accordance with written procedures of the remanufacturer. The evaluation shall consist of, as a minimum, the following:

1. Visual inspection.
2. Verification of all dimensions in accordance with this Specification.

Results of the evaluation shall be documented and shall become a part of the remanufacturer's control document and shall be included in the remanufacture records kept by the remanufacturer.

1006.2e Replacement Parts. Qualified parts shall be used. These parts shall meet the requirements for the class of service to which the equipment is being remanufactured. (Refer to Section 1002.)

1006.2f Control of Manufacturing Operation. When manufacturing operations are required, they shall be performed in accordance with the remanufacturer's written specification.

SPECIAL NOTE: *The alteration of equipment profiles during remanufacturing operations shall be based on all applicable requirements of this Specification. Dimensional tolerances, as referenced in this Specification, shall be maintained.*

1006.2g Equipment Reassembly. Remanufactured equipment shall be reassembled in accordance with the remanufacturer's written specifications.

1006.2h Assembled Equipment Testing. Remanufactured equipment shall be functionally tested in accordance with Section 908.

1006.3 WELDING. Equipment which requires welding during the remanufacturing process shall be welded in accordance with requirements of Section 500 of this Specification.

1007. QUALITY CONTROL.

1007.1 GENERAL. Quality control requirements for repaired/remanufactured equipment shall be in accordance with Section 600 of this Specification.

1007.2 BODIES, BONNETS, AND END AND OUTLET CONNECTIONS (REUSED PARTS)

1007.2a Visual Examination: All bodies, bonnets, and end and outlet connections to be reused shall be visually examined. The repairer/remanufacturer shall have written specifications including acceptance criteria controlling this activity. Minimum specification criteria is contained in Section 600 of this Specification.

1007.2b Hardness Testing: All bodies, bonnets, and end and outlet connections to be reused which are intended for Class 3 Service shall be hardness tested in accordance with Section 600 of this Specification.

1007.2c Traceability: No parts may be reused when the serialization markings, as required by Section 606.2c, are no longer legible or otherwise traceable to the component.

1007.3 WELD REPAIR. Quality control requirements for repair welds shall meet the requirements of Section 605.2 (j).

1007.4 STEMS (REUSED PARTS).

1007.4a Visual Examination. All stems to be reused shall be visually examined. The repairer/remanufacturer shall have written specifications including acceptance criteria controlling this activity.

1007.4b Hardness Testing. All stems to be reused shall be hardness tested in accordance with Section 600 of this Specification.

1007.5 VALVE BORE SEALING MECHANISMS (VBSM) (REUSED PARTS).

1007.5a Visual Examination. All VBSM to be reused shall be visually examined. The repairer/manufacturer shall have written specifications including acceptance criteria controlling this activity.

1007.6 ASSEMBLED EQUIPMENT. The quality control requirements for assembled equipment shall conform to Section 600. (Refer to Sections 1005.8 for repaired equipment and 1006.2h for remanufactured equipment.)

1007.7 QUALITY CONTROL RECORDS REQUIREMENTS. The quality control records required by this Section shall conform to Section 600.

1008. EQUIPMENT MARKING.

1008.1 GENERAL. Equipment repaired/remanufactured shall be marked to the requirement of this Section. These marking requirements are in addition to and do not replace the requirements of Section 700.

1008.1a Metallic Marking Locations. Metallic locations for repaired/remanufactured equipment are shown in Section 700, Table 701.

Markings shall be placed in close proximity to original marking on a separate nameplate.

1. "RMFR" for remanufacturer or "RPR" for repair.
2. API Monogram* or other registered mark such as the ASME SPPE OCS Symbol. This is applicable only for API licensees and SPPE certificate holders. Equipment that is repaired or remanufactured in accordance with this Specification may be marked with the API Monogram only if it was originally marked with the API Monogram and was manufactured under the API quality assurance program in accordance with *API Spec 14D* and *API Spec Q1*.
3. Repairer's/remanufacturer's name or mark.
4. Date of repair or remanufacture.

*For API licensees only. Contact API for licensing information. Applicable only to equipment which is identifiable as both previously monogrammed and *API Spec 14D*, Seventh Edition and later.

1008.1b Previous Equipment Marking. Repaired equipment shall have the original monogram and all other original markings retained.

APPENDIX A
METRIC CONVERSION

English units are in all cases preferential and shall be the standard in this Specification. These factors are taken from the *API Manual of Petroleum Measurement Standards,* Chapter 15.

LENGTH

1 inch (in.)	= 25.4 millimetres (mm) exactly

PRESSURE

1 pound per square inch (psi)	= 0.06894757 Bar

NOTE: 1 Bar = 100 kilopascals (kPa)

STRENGTH OR STRESS

1 pound per square inch (psi)	= 0.006894757 Mega-pascals (MPa)

IMPACT ENERGY

1 foot-pound (ft-lb)	= 1.355818 Joules (J)

TORQUE

1 foot-pound (ft-lb)	= 1.355818 newton-metres (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)	= 0.4535924 kilograms (kg)

APPENDIX B
SUGGESTIONS FOR ORDERING WELLHEAD SURFACE SAFETY VALVES AND UNDERWATER SAFETY VALVES FOR OFFSHORE SERVICE

In placing orders for SSVs/USVs to be manufactured in accordance with this Specification, the operator should specify the following on his purchase order:

GENERAL

Specification _____ Designation of this Specification.

API Monogram Required? Yes ☐ No ☐

Class Service _____

Special Environmental Conditions _____ Unusual ambient or operating temperatures, or atmospheric conditions conducive to corrosion or underwater use.

Coating _____

Shipping Instructions

SSV/USV VALVE

Performance Test Agency (for Class 2 SSV/USV Valves) _____

Manufacturer _____ Model and Type

Size _____

Rated Working Pressure _____

Temperature Range _____

SSV/USV ACTUATOR

Manufacturer _____ Model and Type

Cylinder Rated Working Pressure _____

Operating Pressure _____ Purchaser should specify available supply pressure, if applicable.

Temperature Range _____

Lock Open Device _____

USV _____ Working Water Depth

APPENDIX C
FAILURE REPORTING

USER RECOMMENDATION

1. The operator of SSV/USV equipment manufactured to this Specification shall provide a written report of equipment failure to the manufacturer. This report should include, as a minimum, the information included in Table C-1.
2. The failure report shall be submitted to the equipment manufacturer within 30 days from the discovery and identification of the failure. A copy shall also be sent to Manager, API Exploration & Production Quality Program. An investigation in the form of a failure analysis to define the cause of the failure shall be performed and the results documented.

   The Operator's options for performing failure analysis on failed equipment shall be as follows:

   (a) the Operator removes the failed equipment from service and returns the equipment to the equipment manufacturer who, in cooperation with the Operator, performs the failure analysis; or

   (b) the Operator does not immediately remove the equipment from service. However, if the Operator removes the equipment within 5 years from the date of the shipping report, the Operator shall return the equipment to the equipment manufacturer for failure analysis; or

   (c) the Operator elects to perform an independent failure analysis.

   The Operator shall notify the equipment manufacturer of the option selected for failure analysis as part of the initial failure report. If option (c) is selected, upon completion of the failure analysis a copy of the analysis report shall be sent to the equipment manufacturer and the Manager, API Exploration & Production Quality Program within 45 days of completion of the analysis.

3. After receiving a failure report from the Operator (Items 2a or 2b above), the equipment manufacturer shall respond in writing to the Operator within 6 weeks of receipt, describing progress in the analysis. He shall also notify the Operator in writing of the final results of his analysis and the corrective action. If the failure analysis causes the equipment manufacturer to change the design, assembly, or operating procedures of a model equipment, he shall, within 30 days of such changes, report them in writing to all Purchasers and known Operators of equipment having similar potential problems. Copies of all reports to the Operator shall also be sent to the Manager, API Exploration & Production Quality Program.

TABLE C-1
FAILURE REPORT FOR SAFETY VALVES (SSV)
AND UNDERWATER SAFETY VALVES (USV)
(Minimum Data)

Failure _____ of SSV/USV Actuator _____

SSV/USV Valve _____

Heat Sensitive Lockopen device ___(Not required for USVs)

To be completed by operator.

1. Identification.
   - 1.1 Operator.
   - 1.2 Date.
   - 1.3 Field and or Area.
   - 1.4 Lease Name and Well Number.
   - 1.5 Type Device: Makes, Models, Sizes, Serial Numbers, include data on both SSV/USV valve and SSV/USV actuator.
2. Well Data.
   - 2.1 Well Test Rate. Include percent sand, H_2S, CO_2.
   - 2.2 Well Pressures and Temperatures: (Surface).
3. Description of Failure.
   - 3.1 Suspected cause.
   - 3.2 Field Conclusions.

To be completed by manufacturer.

4. Failed Components.
   Include provisions to list failed components.
5. Miscellaneous Failure.
   Include provision to list associated equipment failure.
6. Cause of Failure.
   Include provisions to list probable and secondary causes.
7. Corrective Action.
   Include provision to list all corrective action taken.
8. Other
   - 8.1 Include provision to list any information the operator deems important.
   - 8.2 Mode of failure.
   - 8.3 Leakage rate.
   - 8.4 SSV/USV actuator control fluid.
   - 8.5 Copy sent to the originator.
9. Submitted by:
   Signatures of Qualified Person (Inspector) and Operator's Representative.

APPENDIX D
TEST AGENCY LICENSE CRITERIA

1. The purpose of this Appendix is to provide the requirements by which laboratories may be licensed in accordance with the requirements of the definition of Test Agency.

2. Laboratories desiring licensing under this Appendix shall have a functional quality program in accordance with the *ISO/IEC Guide 25-1982: General Requirements for the Technical Competence of Testing Laboratories* and the following sections of *API Spec Q1:* 1.0 General, 2.0 Responsibilities, 3.0 Quality Program Criteria (except 3.6, Design Control; 3.8, Manufacturing Control; 3.11 Traceability; 3.12 Special Processes; 3.16 Acceptance Status, and 3.21 Field Non-Conformance Reporting). API shall maintain a list of licensed laboratories, which shall appear in the *API Composite List of Manufacturers Licensed for Use of the API Monogram.* Refer to *API Bulletin S1,* Par. 3.12 for detailed information on this publication. Laboratories desiring licensing under this Appendix shall make application and pay fees as follows:

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

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

3. The laboratory shall submit a controlled copy of their Quality Manual to API. The manual will be reviewed by API Staff for conformance to the requirements of Section 2 of this Appendix and specific test methods identified in this or other API Specifications. Upon acceptance of the manual, API shall arrange for a survey, as follows:

   Initial and Renewal Surveys. First-time applicants and current licensed laboratories on every third year renewal of licensing shall be surveyed by qualified surveyors. The parameters of these surveys shall be the appropriate API Specifications and the laboratory's API approved quality manual. The surveys will be performed to gather objective evidence for API's use in verifying that the laboratory is in conformance with the provisions of the Laboratory Quality Program as applicable to this API specification and the requirements of Section 2 of this Appendix. The laboratory will be invoiced for the cost of these surveys.

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

4. Removal of laboratory from licensed list shall occur due to the following:
   (a) Failure to meet the requirements of a survey.
   (b) Failure to pay annual renewal fee.

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

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

6. **Appeals.** An interested party may appeal a decision by the Institute to withhold license rights. Appeals shall be sent to the Director, API Exploration & Production Department and be handled by the General Committee of the Exploration & Production Department, with a further right of appeal to the API Management Committee. Competing suppliers of the service to which the standard applies or might apply may not be involved in appeals. The General Committee and the Management Committee may convene appeals boards to hear and act on appeals.

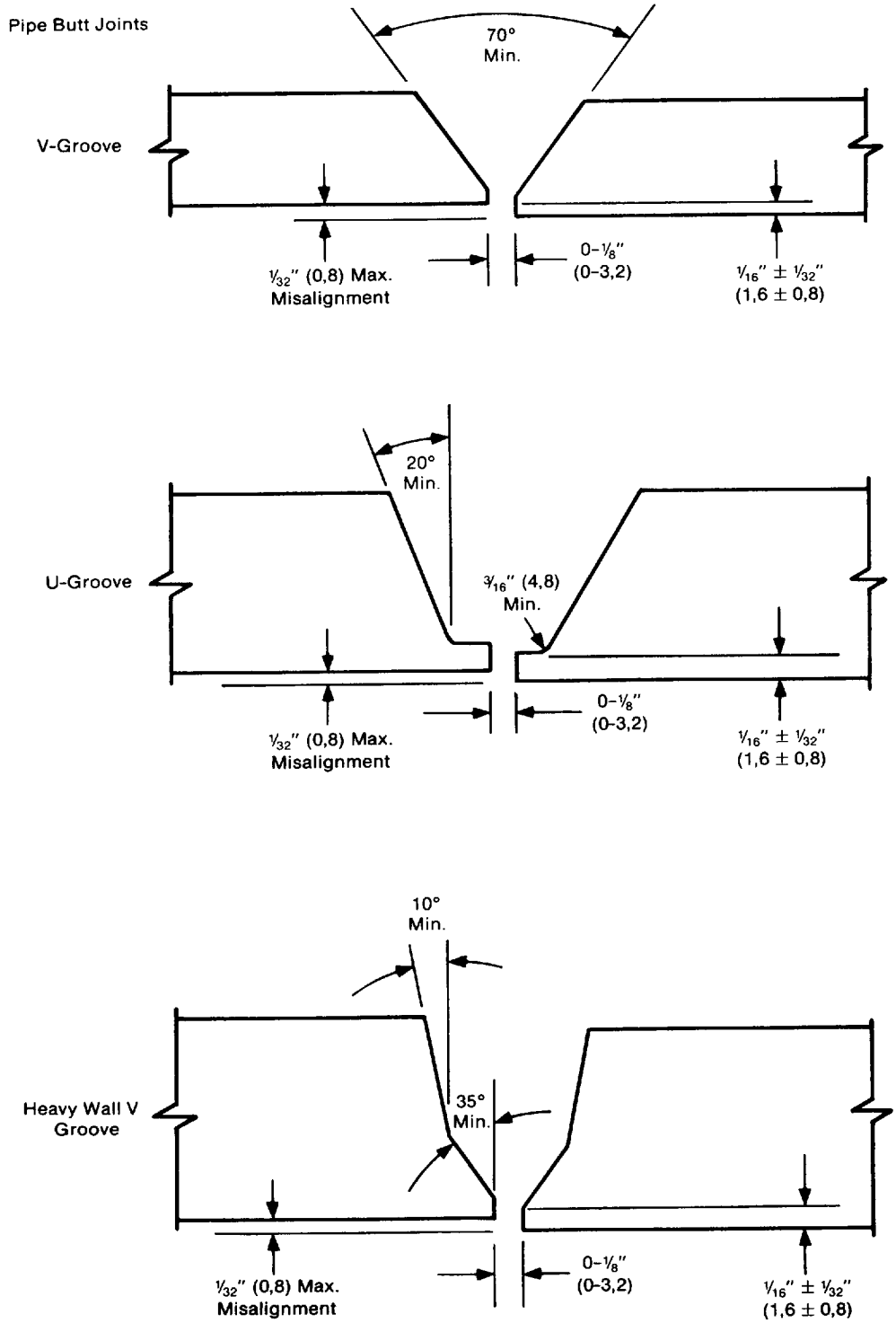
7. Test reports completed by a licensed laboratory shall include the following:
   (a) general information (date, location, manufacture, model, serial number, size, rating, etc.);
   (b) summary of test results (quantities and characteristics);
   (c) description of the characteristics of equipment under test;
   (d) observed data (including calculations and test personnel);
   (e) test conditions (limits required by the standard);
   (f) identification of test methods and procedures;
   (g) supporting data (log sheets, calibration records);
   (h) graphic presentation (curves);
   (i) identification of instruments involved in the test data;
   (j) certification and license number.

   Test reports shall be traceable to the tested equipment, and shall be certified by the laboratory.

APPENDIX D (continued)

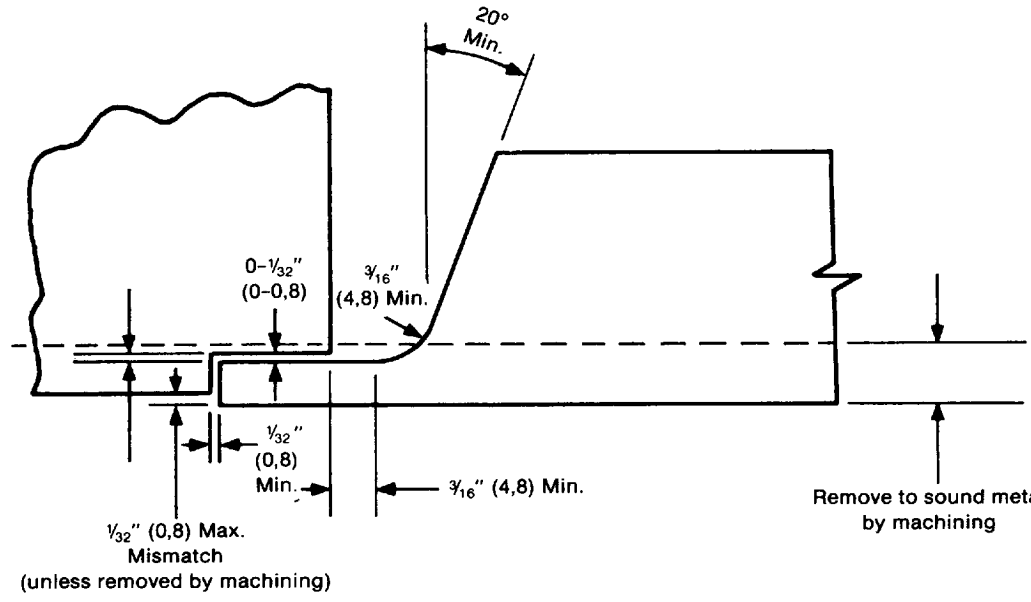
8. Unless otherwise specified in the appropriate referenced standard(s), the Licensed Laboratory shall keep the following records for 5 years from completion of all tests for equipment tested:
   - (a) test data and test reports
   - (b) calibration
   - (c) nonconformance reports
   - (d) audit and corrective action records
   - (e) personnel qualification records
   - (f) test procedures
   - (g) special testing
9. Any changes to a Licensed Laboratory's approved Quality Assurance Manual must be approved by API in writing prior to implementation.

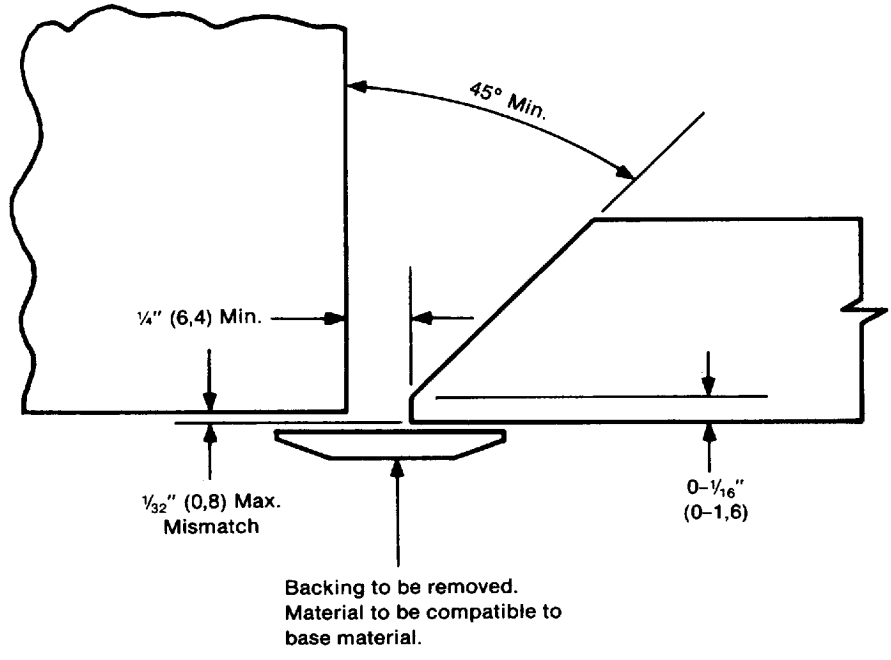
APPENDIX E
RECOMMENDED WELD GROOVE DESIGNS
DIMENSIONS IN INCHES (mm)



APPENDIX E (continued)

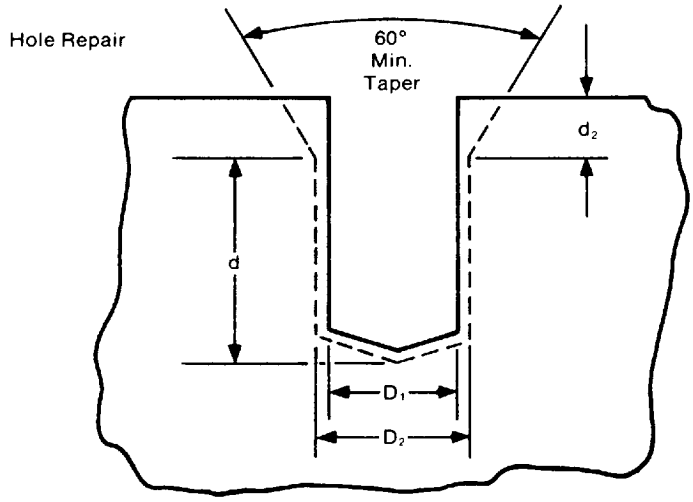
ATTACHMENT WELDS





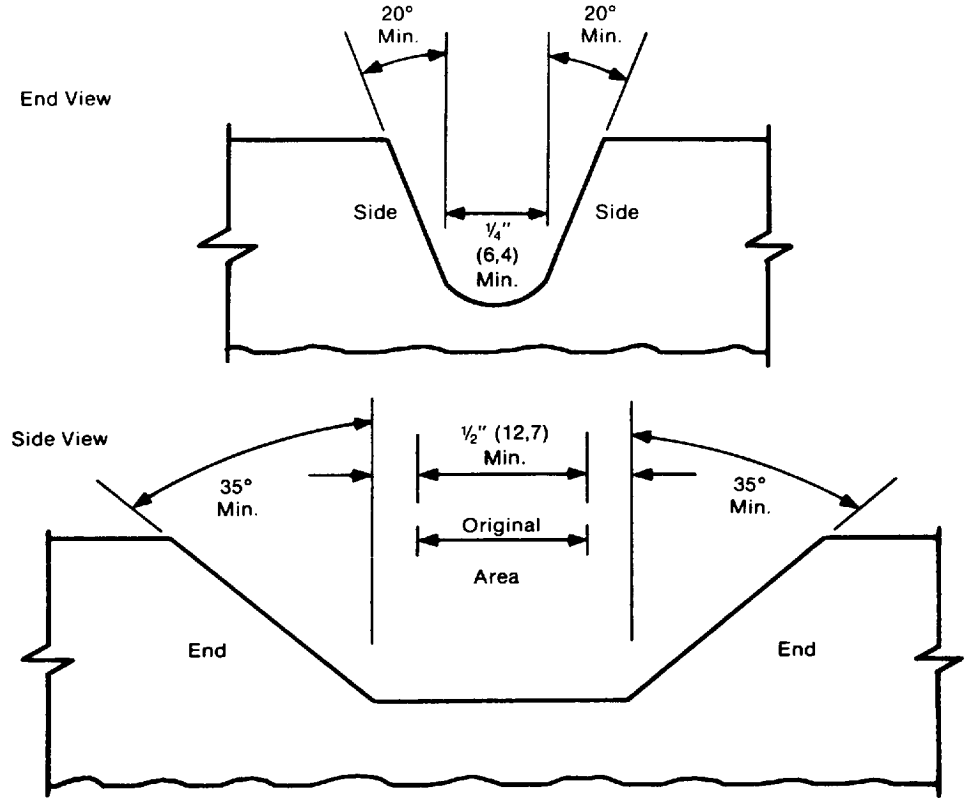
APPENDIX E (continued)

REPAIRS



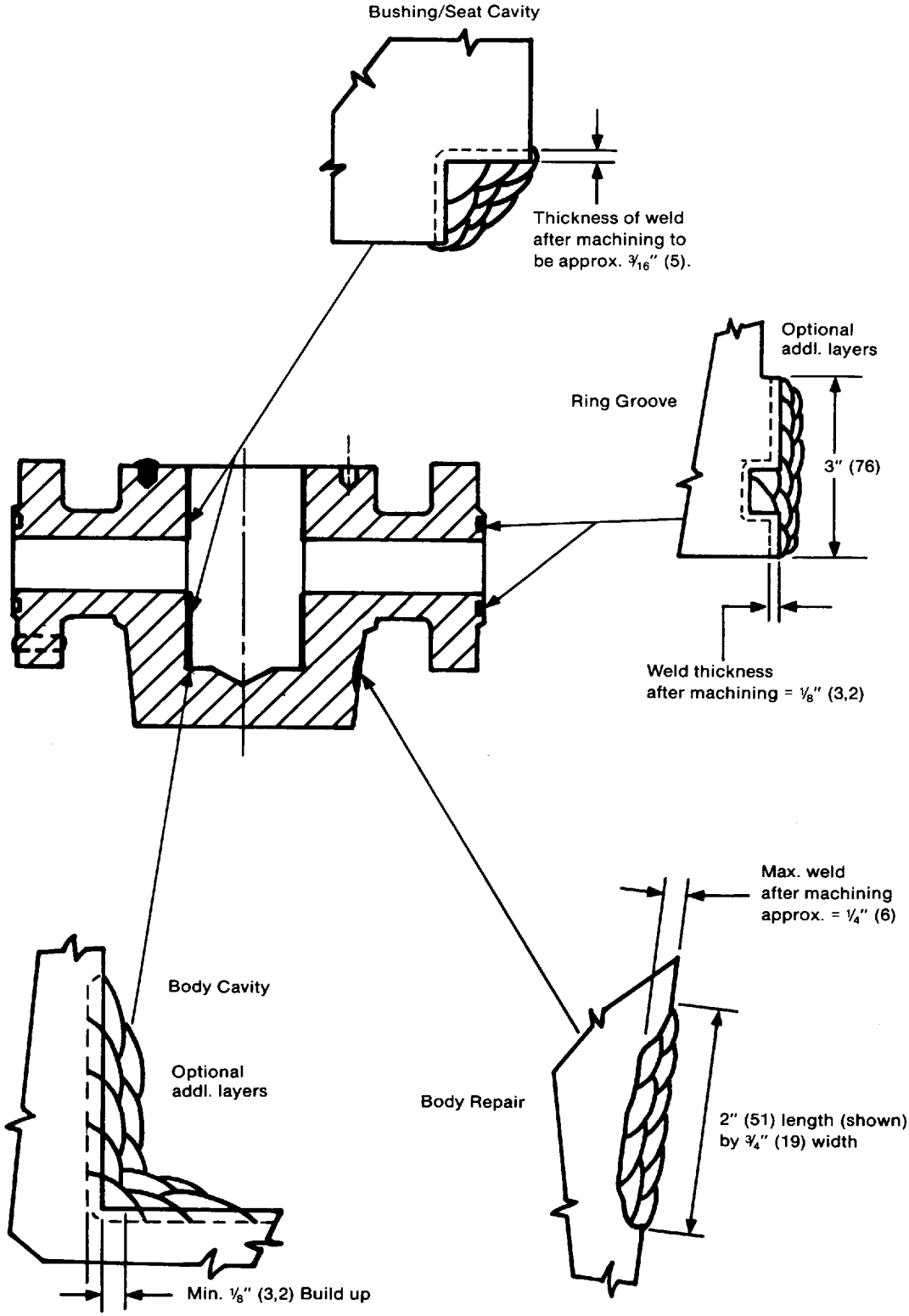
d_1 to D_2 does not exceed 1½: 1.
d_2 = depth required to maintain a maximum of 1½: 1 depth (d_1) to diameter (D_2) ratio.

Excavation for Repair (Removal of sample discontinuities in weld metal and base metal).



APPENDIX E (continued)

WELD REPAIR AND OVERLAY TYPICAL WELD BEAD SEQUENCES



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