Specification for Validation of Wellhead Surface Safety Valves and Underwater Safety Valves for Offshore Service

API SPECIFICATION 6AV1
SECOND EDITION, FEBRUARY 2013

AMERICAN PETROLEUM INSTITUTE

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Specification for Validation of Wellhead Surface Safety Valves and Underwater Safety Valves for Offshore Service

1 Scope

This specification establishes design validation requirements for API 6A surface safety/underwater safety valves (SSV/USV) and associated valve bore sealing mechanism(s) for Class II and Class III. These classes are intended for use if substances such as sand can be expected to cause an SSV/USV valve failure. Class III adds requirements for the validation of the valve bonnet assembly inclusive of stem seals and may be selected by the user/purchaser. Validation to Class III also validates the same SSV/USV for Class II.

NOTE Previous editions of this document included reference to and requirements for verification to PR1, standard service (Class I).

2 Normative References

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

API *Manual of Petroleum Measurement Standards* (*MPMS*) Chapter 10.4, *Determination of Sediment and Water in Crude Oil by the Centrifuge Method (Field Procedure)*

API Specification 6A, *Specification for Wellhead and Christmas Tree Equipment*

API Recommended Practice 13B-1, *Recommended Practice for Field Testing Water-based Drilling Fluids*

3 Definitions and Abbreviations

3.1 Definitions

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

3.1.1
failure
Improper performance of a device or equipment item that prevents completion of its design function.

3.1.2
SSV/USV actuator
Device that causes the SSV/USV valve to open when power is supplied and to automatically close when power is lost or released.

3.1.3
SSV/USV valve
Subassembly of the SSV/USV that contains the wellstream and shuts off the flow when closed.

3.1.4
substantive change
Change identified by the manufacturer that affects the performance of the product in the intended service.

3.1.5
surface safety valve
SSV
Automatic wellhead valve assembly that closes upon loss of power supply.

NOTE When used in this specification, the term is understood to include an SSV valve and SSV actuator.

3.1.6
test agency
Independent third party that provides a test facility and administers a testing program that meets the SSV/USV valve validation testing requirements of this specification.

3.1.7
underwater safety valve
USV
Automatic valve assembly installed at an underwater wellhead location that closes upon loss of power supply.

NOTE When used in this specification, the term is understood to include a USV valve and USV actuator.

3.1.8
validation
Confirmation, through the provision of objective evidence (data), that the requirements for a specific intended use or application have been fulfilled.

NOTE Previous editions referred to this term as verification test(ing).

3.1.9
valve bonnet assembly
Pressure containing subassembly of SSV/USV consisting of the valve bonnet, valve stem, stem seals, and body-to-bonnet seals.

3.2 Abbreviations

The following abbreviations are used in this specification.

bbl (m^3)	barrels (cubic meters)
gpm (m^3/min)	gallons per minute (cubic meters per minute)
PR	Performance Requirement
RWP	rated working pressure
SSV	surface safety valve
USV	underwater safety valve

4 Validation

4.1 General

This section includes the SSV/USV validation requirements for the two classes defined in Section 1 of this specification.

The validation requirements in this specification are not represented as duplicating actual well conditions.

Validations (previously known as verifications) for PR2 sandy service or Class II that have been completed in accordance with testing requirements of API 14D or previous editions of API 6AV1 during their validity shall satisfy the requirements of API 6AV1 Class II.

Validation to Class III also validates the same SSV/USV for Class II in accordance with the scaling limitations in 6.1.

NOTE In this edition of the specification, the term “Performance Requirement (PR)” has been replaced with “Class” (i.e. “PR2 sandy service” has now become “Class II”). This was done to ensure full alignment with the related terminology used in the reference document, API 6A. This is for alignment of the identification of the equipment only; no technical changes were made in the performance requirements for Class II.

4.2 Class II and Class III SSV/USV Valve Validation

To qualify a specific SSV/USV valve design for Class II or Class III, the manufacturer shall submit an SSV/USV valve to a test agency that meets the requirements of this specification.

Any substantive change in the design or materials of construction that would affect the SSV/USV valve bore sealing mechanism shall require requalification by validation testing. A substantive change is a change identified by the manufacturer that affects the performance of the product in the intended service condition.

Additionally for Class III, any substantive change to the valve bonnet assembly shall require requalification by validation testing.

4.3 Test Agency

4.3.1 General

The test agency shall provide a facility, personnel, written procedures, and forms to assure conformance to the requirements of this specification. The test agency shall maintain literature that includes as a minimum:

a) a description of the facility including any limitations on size or pressure rating of SSV/USV that may be tested;

b) test procedures and forms actually used at the facility;

c) basis for determining test scheduling priorities;

d) procedures for making application for test, delivery of the SSV/USV, initial installation and checkout of the SSV/USV, and other pertinent information;

e) any limitations on accessibility of the facility, although such limitations shall not preclude reasonable access to the facility for inspection by manufacturers or operators;

f) any limitations on receipt of proprietary information; and

g) any other information considered pertinent by the test agency.

The above literature shall be kept current and shall be furnished to manufacturers or user/purchasers or operators upon written request.

Test agencies shall be licensed by API in order to test SSV/USV equipment to the requirements of this specification. See Annex A of this specification for API licensing requirements.

4.3.2 Facility Requirements

4.3.2.1 General

An example piping arrangement and test section detail of a test facility are shown in Figure 1 and Figure 2.

4.3.2.2 Design Considerations

The test facility shall be designed to permit the validation to be made as detailed in 5.2 and 5.4 of this specification.

4.3.2.3 Circulation System Components

The test facility shall have the following circulation system components as a minimum.

a) *Freshwater Tank*—A freshwater tank shall be provided with a minimum capacity of 5 bbl (0.8 m^3).

b) *Sand Slurry Tank and Associated Accessories*—A cone-bottom sand slurry tank with a minimum capacity of 5 bbl (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.

c) *Circulating Pumps and Controls*—Circulating pumps with drivers and special equipment for pumping the sand slurry and freshwater at the required flow rates and pressures shall be installed. A means of flow control shall be provided.

d) *Circulation Piping and Controls*—The circulation piping should be installed in an arrangement similar to that shown in Figure 1. Block valves should be provided as indicated in Figure 1 and Figure 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 device shall be installed between the circulation pumps and test section and shall be used to control SSV/USV differential pressure to 400 psi (2.8 MPa) during the cycling test (refer to 5.2.3 and 5.4.3).

e) *Circulation Flow Meter*—The circulation flow meter shall be sized so that the flow rate to be measured falls within the flow meter's calibrated measurement range. This flow meter shall provide an output signal suitable for electronic data acquisition.

f) *Instrumentation*—Pressure measuring devices shall meet the requirements of API 6A. Measurement instrumentation shall be provided to monitor the following data at a minimum:

   — circulation flow rate during all testing,

   — SSV/USV valve upstream test pressure during valve seat leakage test, and

   — differential pressure across SSV/USV valve being tested during closure test.

g) *Data Acquisition System*—A data acquisition system shall be provided to gather electronic data from instrumentation on a time-based system.

4.3.2.4 Utility Systems

The manufacturer and test agency shall agree on the utility systems required to operate the SSV/USV and any other associated operating mechanisms.

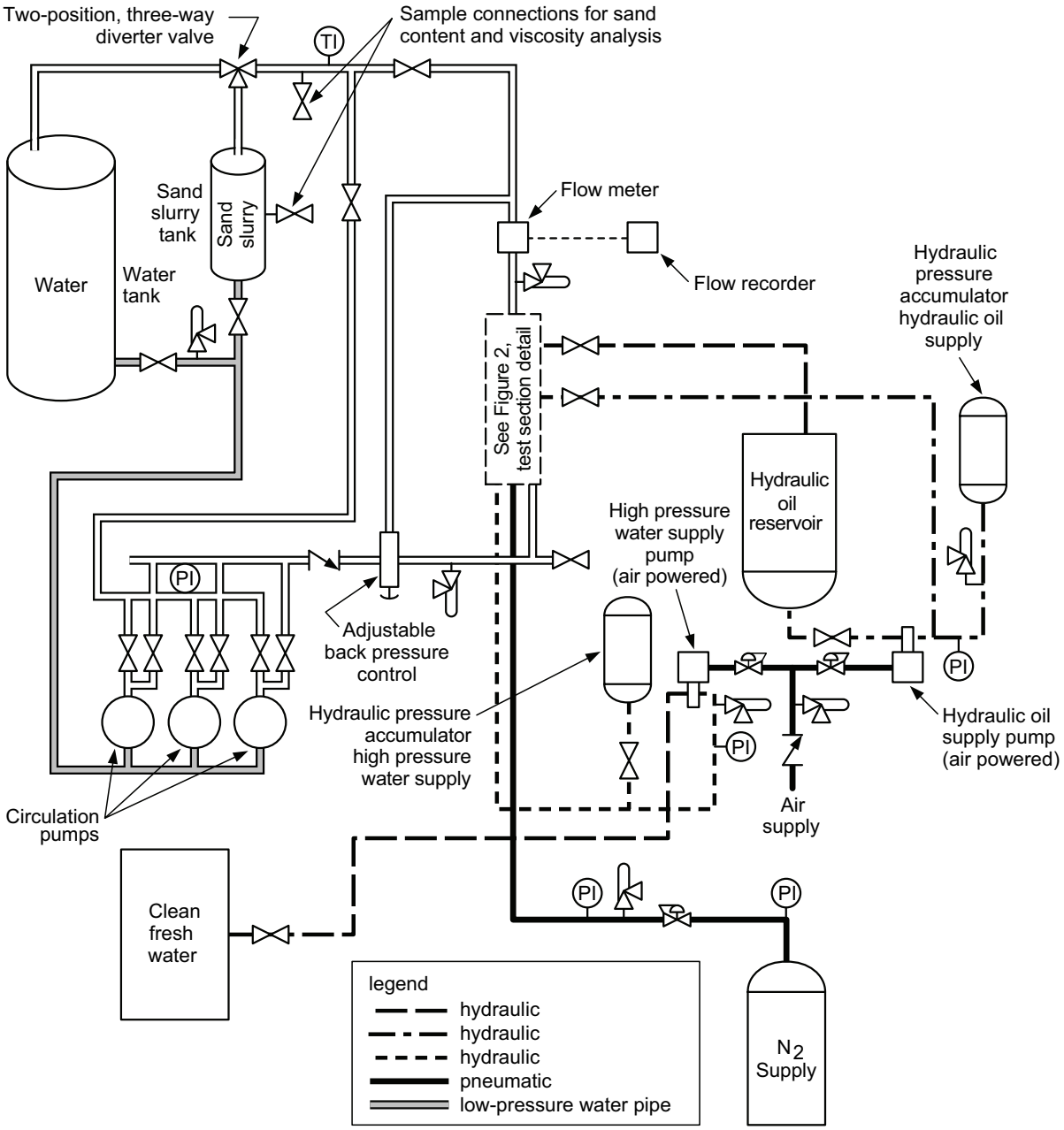

Figure 1—Example Piping Arrangement—Test Facility for Class II SSV/USV Valve Validation

4.4 Validation—Requirements

4.4.1 Class II Requirements for SSV/USV Valve

Unless otherwise noted on the SSV/USV valve manufacturer's application, a $2^{1}/_{16}$ in. (52 mm), 5000 psi (34.5 MPa) rated working pressure (RWP) SSV/USV valve shall be used for the validation test.

The SSV/USV valve manufacturer shall provide the test agency with one SSV/USV valve that meets the requirements of and has been tested to API 6A, PSL2, in exact accordance with the data supplied with the

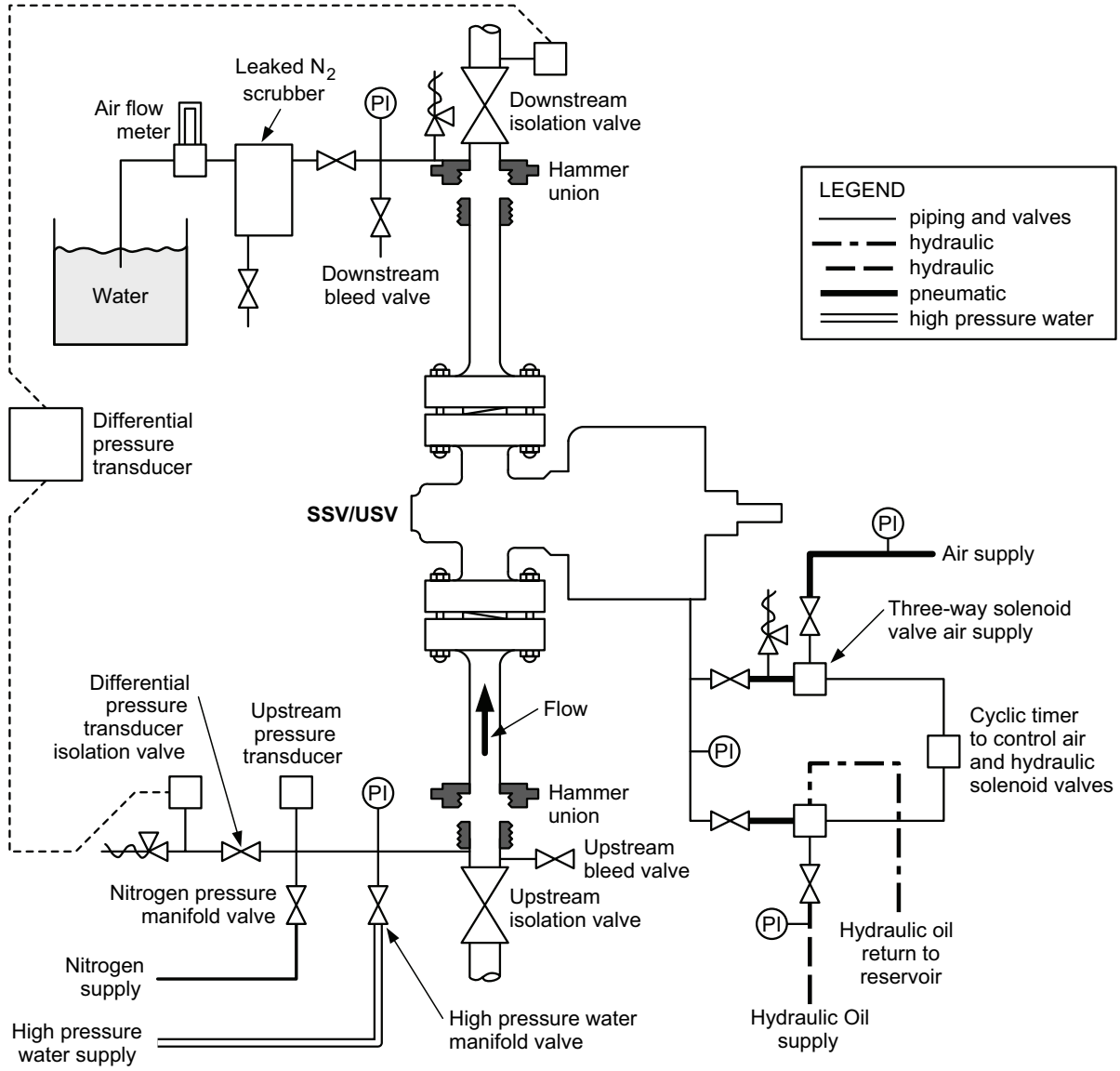

Figure 2—Example SSV/USV Valve Validation Section Detail

manufacturer's test application. It shall be completely assembled with an SSV/USV actuator of the SSV/USV valve manufacturer's choice. The SSV/USV shall be furnished with an appropriate operating manual.

If other than a flanged, $2^{1}/_{16}$ in. (52 mm) 5000 psi (34.5 MPa) RWP 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 representative of the production model or actual production model.

4.4.2 Class III Requirements for SSV/USV Valve

The SSV/USV valve manufacturer shall provide the test agency with one SSV/USV that meets the requirements of and has been tested to API 6A, PSL3G, in accordance with the data supplied with the manufacturer's test application. It shall

be completely assembled with an SSV/USV actuator of the SSV/USV valve manufacturer's choice. The SSV/USV shall be furnished with an appropriate operating manual.

If other than a flanged, $2^{1}/_{16}$ in. (52 mm) 5000 psi (34.5 MPa) RWP 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 representative of the production model or actual production model.

The SSV/USV valve shall be equipped with a provision to monitor stem seal leakage during the testing.

4.4.3 Test Application

The SSV/USV valve manufacturer shall declare that a SSV/USV valve of a specific design and materials of construction is being submitted for the validation test by submitting a formal application to the test agency. The application form shall contain the minimum information shown below. An example of an application form is shown in Table 1.

— Manufacturer’s name, address, representative, and contact information.

— Designation of retest or initial test and class of test (Class II or Class III).

SSV/USV Valve Data	SSV/USV Actuator Data
— Manufacturer	— Manufacturer
— Model or catalog number	— Model or catalog number
— Part number	— Part number
— Serial number	— Serial number
— Size and RWP	— Actuator type (pneumatic, hydraulic, other)
— End connections	— RWP
— Special considerations	— Special considerations

a) If a particular SSV/USV valve has design or operational features that are incompatible with the test facility and test procedures required by this specification, the manufacturer 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 nonspecified equipment or procedures required to test the SSV/USV valve. Responsibility for furnishing and installing nonspecified equipment shall be by agreement between the test agency and the manufacturer. The manufacturer shall document that such nonspecified equipment or procedures are not less stringent than requirements of this specification.

b) The test agency shall conduct the test as specified on the SSV/USV valve manufacturer’s test application. Any variation from the test requirements of this specification shall be prominently recorded in the test report generated by the test agency.

4.4.4 Testing

Conduct the Class II test according to the procedures in 5.2.

Conduct the Class III test according to the procedures in 5.4.

Table 1—Example Application SSV/USV Valve Validation

Test Agency _____ Manufacturer _____

Address _____ Representative _____

_____ Address _____

_____ Telephone _____

_____ Date _____

Application for:

Official Qualification Test (Class II or Class III) _____ Retest _____

SSV/USV to be Tested

SSV/USV Valve Data:

Manufacturer _____ Model or Cat. No. _____ Part Number _____

Serial No. _____ Size _____ RWP _____

End Connections _____

Special Considerations

_____

_____

_____

SSV/USV Actuator Data:

Manufacturer _____ Model or Cat. No. _____ Part Number _____

Serial No. _____ RWP _____

Type: Pneumatic _____ Hydraulic _____ Other _____

Special Considerations

_____

_____

_____

4.4.5 Test Reporting

The test agency shall record the results of the validation test on forms that contain the minimum data specified below:

1) identification of product manufacturer (company name, location/address, etc.);

2) if retest, reference to previous test number;

3) nonstandard equipment required for testing;

4) deviations to the test facility procedures;

5) equipment type, model, part number, serial number, size, and RWP;

6) test results:

   a) dates and times at the start and end of all pressure holds and flow rates;

   b) test pressures applied and notes on leakage;

   c) person(s) performing the tests;

   d) sand slurry flow rates;

   e) sand slurry sand concentration, temperatures, and viscosities at the start and end of tests;

   f) differential test pressures applied during opening/closing cycles;

   g) number of opening/closing cycles completed and average cycles per minute;

   h) type and frequency of preventive maintenance applied;

   i) notes on any testing problems or difficulties; and

   j) assessment of test results (pass/fail).

Example forms are shown in Table 2 and Table 3. The results 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.

4.4.6 Assessment

The SSV/USV valve being tested shall successfully complete all steps of the validation test procedure within the limits specified. The validation test 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 validation 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 shall be responsible for determining the cause of valve failure.

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 API 6A. Such information shall be placed in the manufacturer’s test file before that SSV/USV valve is submitted for retest.

Table 2—Example Class II SSV/USV Valve Test Reporting Form

Test Report Number _____

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

	Manufacturer	Model	Type	Part No.	Serial No.	Size	RWP
SSV/USV Valve							
SSV/USV Actuator							

II. Initial SSV/USV Valve Seat Leakage Test (Refer to 5.2.1) Date _____ Time _____

Test Performed by

1) Liquid 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 5.2.2) Date _____ Time _____

Test Performed by

1) ____ gpm (m^3/min) circulation rate of sand slurry.
2) ____ % by volume of 40 to 60 US mesh 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. ____ Liquid 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 5.2.3) Date _____ Time _____

Test Performed by

1) ____ gpm (m^3/min) circulation rate of sand slurry.
2) ____ % by volume of 40 to 60 US mesh 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. Liquid 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 II (Yes, No) _____

Certified: _____ Date: _____

Table 3—Example Class III SSV/USV Valve Test Reporting Form

Test Report Number _____

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

	Manufacturer	Model	Type	Part No.	Serial No.	Size	RWP
SSV/USV Valve							
SSV/USV Actuator							

II. Initial SSV/USV Valve Seat Leakage Test (Refer to 5.4.1) Date _____ Time _____

Test Performed by

1) Liquid 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 5.4.2) Date _____ Time _____

Test Performed by

1) ____ gpm (m^3/min) circulation rate of sand slurry.
2) ____ % by volume of 40 to 60 US mesh 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. ____ Liquid 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 5.4.3) Date _____ Time _____

Test Performed by

1) ____ gpm (m^3/min) circulation rate of sand slurry.
2) ____ % by volume of 40 to 60 US mesh 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. Liquid 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 II (Yes, No) _____

Certified: _____ Date: _____

4.4.7 Records

The manufacturer shall maintain a validation 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 10 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:

a) all detailed dimensional drawings and material specifications applicable to the tested SSV/USV valve at the time that particular SSV/USV valve was manufactured;

b) all applications for official test or retest;

c) all design and material modifications or other justification for retests of SSV/USV valves that did not pass any validation;

d) all test data specified in this specification; and

e) model numbers and other pertinent identifying data on all other sizes and RWP of SSV/USV valves of the same basic design and materials of construction that were qualified for Class II or Class III by the validation of this particular SSV/USV valve.

5 Test Procedures

5.1 Class II Validation Test Summary

The following procedures describe the general requirements for Class II SSV/USV valve validation. Figure 3 summarizes the test in flow diagram format.

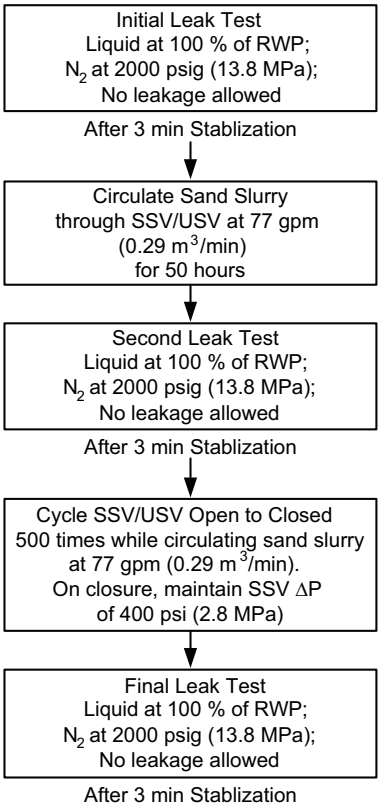

Figure 3—Class II SSV/USV Validation Summary Flow Diagram

5.2 Class II Test Procedure

5.2.1 Initial Leakage Test

Perform the initial leakage test per Table 4.

Warning—High-pressure gas testing involves potential hazards. Appropriate safety precautions should be taken.

5.2.2 Sand Slurry Flow Test

Perform the sand slurry flow test per Table 5 to check for erosion and fouling.

5.2.3 Sand Slurry Flow Test While Opening and Closing During Circulation

Perform the sand slurry flow test while opening and closing during circulation per Table 6.

5.3 Class III Validation Test Summary

The following procedures describe the general requirements for Class III SSV/USV valve validation. Figure 4 summarizes the test in flow diagram format.

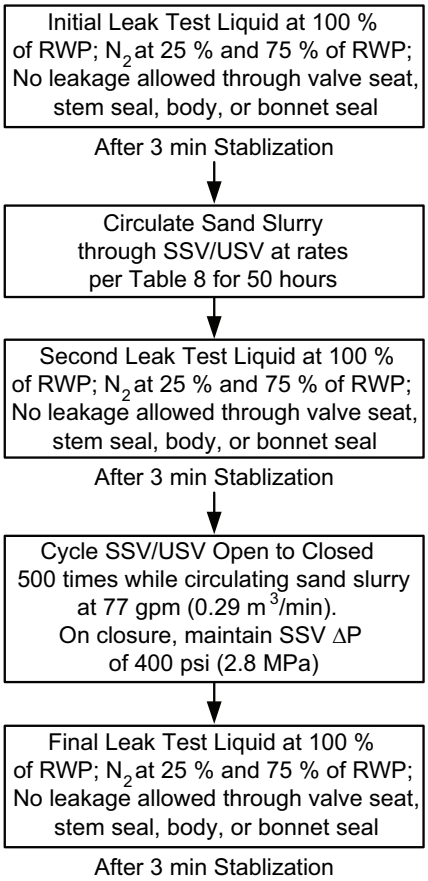

Figure 4—Class III Validation Summary Flow Diagram

Table 4—Initial Leakage Test

Step	Procedure Step and Acceptance Criteria	Data to be Recorded
0)	Verify the identification (model and serial number) of the valve and actuator before starting the test.	— Valve mfg. — Valve model — Valve part number — Valve serial number — Valve size — Valve RWP — Actuator mfg. — Actuator model — Actuator part number — Actuator serial number — Actuator type — Actuator RWP
1)	Install SSV/USV in the test section.	
2)	Check SSV/USV valve for leakage with liquid: a) circulate freshwater at a minimum flow rate of 77 gpm (0.29 m^3/min) but no more than 90 gpm (0.34 m^3/min) 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 % to 105 % of the RWP of the SSV/USV valve; and f) after the pressure has stabilized within the acceptable range for 3 minutes minimum, check for SSV/USV valve seat leakage from the downstream leak detection valve for a period of 5 minutes minimum. **Acceptance Criteria:** No visible leakage shall occur during the 5 minute hold period.	— Date (month/day/year) — Person performing test **Flow Period** — Test start time of flow — Flow rate — Test end time of flow **Pressure Holding** — Test start time of pressure monitoring — Test end time of pressure monitoring — Pressure at start of test — Pressure at end of test — Test passed (yes/no)
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 of water; e) apply 2000 psi (13.8 MPa) ±5 % nitrogen on upstream side of SSV/USV valve; and f) after the pressure has stabilized within the acceptable range for 3 minutes minimum, check for valve seat leakage by observing for gas bubbles for a period of 5 minutes minimum. **Acceptance Criteria:** No visible leakage shall occur during the 5 minute hold period.	— Test start time of pressure monitoring — Test end time of pressure monitoring — Pressure at start of test — Pressure at end of test — Test passed (yes/no)

Table 5—Sand Slurry Flow Test

Step	Procedure Step and Acceptance Criteria	Data to be Recorded
1)	Circulate sand slurry at a minimum flow rate of 77 gpm (0.29 m^3/min) while bypassing the test section until slurry viscosity and sand content stabilize with slurry agitator on.	— Date (month/day/year) — Person performing test
2)	Determine sand content of slurry by filling two oil gaugers' 100 ml sample tubes with slurry sample and centrifuge with oil gaugers' centrifuge according to API *MPMS* Ch. 10.4. The use of solvents and temperature controls are not required. Adjust sand content of circulating fluid to 2 % ($1^1/2$ % to $2^1/2$ % acceptable) by adding 40 to 60 US mesh sand or diluting mixture with freshwater.	— Sand concentration (%)
3)	Determine viscosity of sand slurry sample with Marsh funnel viscometer according to API 13B-1. Adjust viscosity to 100 sec (120 sec maximum and 90 sec minimum) by adding polymer viscosifier or diluting mixture with freshwater.	— Slurry viscosity (sec)
4)	If dilution or strengthening was necessary in Step 3, return to procedure in Step 1.	
5)	Adjust flow rate to a minimum of 77 gpm (0.29 m^3/min).	— Flow rate at start of circulation period — Slurry viscosity (sec) — Sand concentration (%)
6)	Pump sand slurry through SSV/USV valve for 25 hours (±1 hour).	— Time at start of slurry circulation through valve — Time at end of slurry circulation through valve
7)	Check sand content and viscosity of slurry as before in Step 2 and Step 3; adjust as required.	— Slurry viscosity (sec) — Sand concentration (%)
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/min). The total duration of the flow periods in Step 6 and Step 8 shall be a minimum of 50 hours.	— Time at start of slurry circulation through valve — Flow rate at start of circulation period — Time at end of slurry circulation through valve
9)	Check SSV/USV valve for leakage with liquid: a) close SSV/USV by releasing actuator power; b) close isolation valves upstream and downstream from SSV/USV; c) open downstream liquid leak detection valve; d) apply water pressure upstream of the SSV/USV equal to 95 % to 105 % of the RWP of the SSV/USV valve; and e) after the pressure has stabilized within the acceptable range for 3 minutes minimum, check for SSV/USV valve seat leakage from the downstream leak detection valve for a period of 5 minutes minimum. **Acceptance Criteria:** No visible leakage shall occur during the 5 minute hold period.	— Date (month/day/year) — Person performing test **Pressure Holding** — Test start time of pressure monitoring — Test end time of pressure monitoring — Pressure at start of test — Pressure at end of test — Test passed (yes/no)
10)	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 of water; e) apply 2000 psi (13.8 MPa) ±5 % nitrogen on upstream side of SSV/USV valve; and f) after the pressure has stabilized within the acceptable range for 3 minutes minimum, check for valve seat leakage by observing for gas bubbles for a period of 5 minutes minimum. **Acceptance Criteria:** No visible leakage shall occur during the 5 minute hold period.	— Test start time of pressure monitoring — Test end time of pressure monitoring — Pressure at start of test — Pressure at end of test — Test passed (yes/no)

Table 6—Sand Slurry Flow Test While Opening and Closing During Circulation

Step	Procedure Step and Acceptance Criteria	Data to be Recorded
1)	Circulate sand slurry at a minimum flow rate of 77 gpm (0.29 m^3/min) while bypassing the test section until slurry viscosity and sand content stabilize with slurry agitator on.	— Date (month/day/year) — Person performing test
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 *MPMS* Ch.10.4. The use of solvents and temperature controls are not required. Adjust sand content to 2 % (1.5 % to 2.5 % acceptable) by adding 40 to 60 US mesh sand or diluting mixture with freshwater.	— Sand concentration (%)
3)	Determine viscosity of slurry sample with Marsh funnel viscometer according to API 13B-1. Adjust viscosity to 100 sec (120 sec maximum, 90 sec minimum) by adding polymer viscosifier or diluting mixture with freshwater.	— Slurry viscosity (sec)
4)	If dilution or strengthening was necessary in Step 3, return to procedure in Step 1.	
5)	Adjust flow rate to a minimum of 77 gpm (0.29 m^3/min).	— Flow rate at start of circulation period — Slurry viscosity (sec) — Sand concentration (%)
6)	Cycle SSV/USV valve from fully opened to fully closed at a maximum rate of 7 cycles per minute.	
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.	— Differential pressure across valve when closed (psi)
8)	Open and close SSV/USV a minimum of 500 cycles but no more than 510 cycles. 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 and during Step 9 and Step 10.	— Number of cycles — Cycles per minute (nominal) — Type and frequency of maintenance performed (list)
9)	Check SSV/USV valve for leakage with fresh water: a) close SSV/USV by releasing actuator power; b) close isolation valves upstream and downstream from SSV/USV; c) open downstream liquid leak detection valve; d) apply water pressure upstream of the SSV/USV equal to 95 % to 105 % of the RWP of the SSV/USV valve; and e) after the pressure has stabilized within the acceptable range for 3 minutes minimum, check for SSV/USV valve seat leakage from the downstream leak detection valve for a period of 5 minutes minimum. **Acceptance Criteria:** No visible leakage shall occur during the 5 minute hold period.	— Date (month/day/year) — Person performing test **Pressure Holding** — Test start time of pressure monitoring — Test end time of pressure monitoring — Pressure at start of test — Pressure at end of test — Test passed (yes/no)
10)	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 of water; e) apply 2000 psi (13.8 MPa) ±5 % nitrogen on upstream side of SSV/USV valve; and f) after the pressure has stabilized within the acceptable range for 3 minutes minimum, check for valve seat leakage by observing for gas bubbles for a period of 5 minutes minimum. **Acceptance Criteria:** No visible leakage shall occur during the 5 minute hold period.	— Test start time of pressure monitoring — Test end time of pressure monitoring — Pressure at start of test — Pressure at end of test — Test passed (yes/no)

5.4 Class III Test Procedure

5.4.1 Initial Leakage Test

Perform the initial leakage test per Table 7.

Warning—High-pressure gas testing involves potential hazards. Appropriate safety precautions should be taken.

Table 7—Initial Leakage Test

Step	Procedure Step and Acceptance Criteria	Data to be Recorded
0)	Verify the identification (model and serial number) of the valve and actuator before starting the test.	— Valve mfg. — Valve model — Valve part number — Valve serial number — Valve size — Valve RWP — Actuator mfg. — Actuator model — Actuator part number — Actuator serial number — Actuator type — Actuator RWP
1)	Install SSV/USV in the test section.	
2)	Check SSV/USV valve for leakage with liquid: a) circulate freshwater at a minimum flow rate of 77 gpm (0.29 m^3/min) but no more than 90 gpm (0.34 m^3/min) 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 % to 105 % of the RWP of the SSV/USV valve; and f) after the pressure has stabilized within the specified range for 3 minutes minimum, check for SSV/USV valve seat, stem seal, body, and bonnet seal leakage for a period of 5 minutes minimum. **Acceptance Criteria:** No visible leakage shall occur during the 5 minute hold period.	— Validation test number — Date (month/day/year) **Flow Period** — Test start time of flow — Flow rate — Test end time of flow **Pressure Holding** — Test start time of pressure monitoring — Test end time of pressure monitoring — Pressure at start of test — Pressure at end of test — Leakage location (if any) — Test passed (yes/no)
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 of water; e) apply 25 % of RWP ±5 % using nitrogen on upstream side of SSV/USV valve; and f) after the pressure has stabilized within the specified range for 3 minutes minimum, check for valve seat, stem seal, body, and bonnet seal leakage by observing for gas bubbles for a period of 5 minutes minimum. **Acceptance Criteria:** No visible leakage shall occur during the 5 minute hold period. g) apply 75 % of RWP ±5 % using nitrogen on upstream side of SSV/USV valve; and h) after the pressure has stabilized within the specified range for 3 minutes minimum, check for valve seat stem seal, body, and bonnet seal leakage by observing for gas bubbles for a period of 5 minutes minimum. **Acceptance Criteria:** No visible leakage shall occur during the 5 minute hold period.	**25 % RWP Test** — Test start time of pressure monitoring — Test end time of pressure monitoring — Pressure at start of test — Pressure at end of test — Leakage location (if any) — Test passed (yes/no) **75 % RWP Test** — Test start time of pressure monitoring — Test end time of pressure monitoring — Pressure at start of test — Pressure at end of test — Leakage location (if any) — Test passed (yes/no)

5.4.2 Sand Slurry Flow Test

5.4.2.1 Sand slurry composition

The sand slurry composition for the Class III test shall meet the following requirements:

1) sand content of 1.5 % to 2.5 % by volume and

2) sand mixture shall be equal quantities by volume of 20/40, 40/60, and 80/100 US mesh sand.

5.4.2.2 Sand Slurry flow rate

The Class III sand slurry flow rate shall obtain a flow velocity greater than or equal to the flow velocity through a $2^{1}/_{16}$ valve at 77 gpm (7.4 ft/sec). Based on a flow rate of 77 gpm for a $2^{1}/_{16}$ valve size, Table 8 lists the minimum flow rates for other common valve sizes.

Table 8—Class III Sand Slurry Flow Rates

Valve Size (nominal ID)	**Slurry Flow Rate** (gpm)	**Slurry Flow Rate** (bpm)
2.06	77	1.8
2.56	119	2.8
3.12	177	4.2
3.19	185	4.4
4.06	299	7.1
4.12	308	7.3
4.25	328	7.8
5.12	476	11.3
6.00	653	15.6
6.12	680	16.2
6.38	739	17.6
6.62	795	18.9
7.06	904	21.5
7.12	920	21.9
9.00	1470	35.0

5.4.2.3 Test Method

Perform the sand slurry flow test per Table 9.

Table 9—Class III Sand Slurry Flow Test

Step	Procedure Step and Acceptance Criteria	Data to be Recorded
1)	Circulate sand slurry while bypassing the test section until slurry viscosity and sand content stabilize with slurry agitator on.	— Date (month/day/year) — Person performing test
2)	Determine sand content of slurry by filling two oil gaugers' 100 ml sample tubes with slurry sample and centrifuge with oil gaugers' centrifuge according to API *MPMS* Ch. 10.4. The use of solvents and temperature controls are not required. Adjust sand content of circulating fluid to 2 % ($1^1/2$ % to $2^1/2$ % acceptable) by adding sand mixture or diluting slurry with freshwater.	— Sand concentration (%)
3)	Determine viscosity of sand slurry sample with Marsh funnel viscometer according to API 13B-1. Adjust viscosity to 70 sec (75 sec maximum and 65 sec minimum) by adding polymer viscosifier or diluting slurry with freshwater.	— Slurry viscosity (sec)
4)	If dilution or strengthening was necessary in Step 3, return to procedure in Step 1.	
5)	Adjust flow rate to a minimum per Table 8 corresponding to valve size.	— Flow rate at start of circulation period — Slurry viscosity (sec) — Sand concentration (%)
6)	Pump sand slurry through SSV/USV valve for 25 hours (±1 hour).	— Time at start of slurry circulation through valve — Time at end of slurry circulation through valve
7)	Check sand content and viscosity or slurry as before in Step 2 and Step 3; adjust as required.	— Slurry viscosity (sec) — Sand concentration (%)
8)	Pump sand slurry through SSV/USV valve for an additional 25 hours (±1 hour) at a minimum flow rate per Table 8 corresponding to valve size. The total duration of the flow periods in Step 6 and Step 8 shall be a minimum of 50 hours.	— Time at start of slurry circulation through valve — Flow rate at start of circulation period — Time at end of slurry circulation through valve
9)	Check SSV/USV valve for leakage with fresh water: a) close SSV/USV by releasing actuator power; b) close isolation valves upstream and downstream from SSV/USV; c) open downstream liquid leak detection valve; d) apply water pressure upstream of the SSV/USV equal to 95 % to 105 % of the RWP of the SSV/USV valve; and e) after the pressure has stabilized within the acceptable range for 3 minutes minimum, check for SSV/USV valve seat, stem seal, body, and bonnet seal leakage for a period of 5 minutes minimum. **Acceptance Criteria:** No visible leakage shall occur during the 5 minute hold period.	— Validation test number — Date (month/day/year) **Pressure Holding** — Test start time of pressure monitoring — Test end time of pressure monitoring — Pressure at start of test — Pressure at end of test — Leakage location (if any) — Test passed (yes/no)

Table 9—Class III Sand Slurry Flow Test (Continued)

Step	Procedure Step and Acceptance Criteria	Data to be Recorded
10)	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 of water; e) apply 25 % of RWP ±5 % using nitrogen on upstream side of SSV/USV valve; and f) after the pressure has stabilized within the acceptable range for 3 minutes minimum, check for valve seat, stem seal, body, and bonnet seal leakage by observing for gas bubbles for a period of 5 minutes minimum. **Acceptance Criteria:** No visible leakage shall occur during the 5 minute hold period. g) apply 75 % of RWP ±5 % using nitrogen on upstream side of SSV/USV valve; and h) after the pressure has stabilized for 3 minutes minimum, check for valve seat, stem seal, body, and bonnet seal leakage by observing for gas bubbles for a period of 5 minutes minimum. **Acceptance Criteria:** No visible leakage shall occur during the 5 minute hold period.	**25 % RWP Test** — Test start time of pressure monitoring — Test end time of pressure monitoring — Pressure at start of test — Pressure at end of test — Leakage location (if any) — Test passed (yes/no) **75 % RWP Test** — Test start time of pressure monitoring — Test end time of pressure monitoring — Pressure at start of test — Pressure at end of test — Leakage location (if any) — Test passed (yes/no)

5.4.3 Sand Slurry Flow Test While Opening and Closing During Circulation

Perform the sand slurry flow test while opening and closing during circulation per Table 10.

Table 10—Sand Slurry Flow Test While Opening and Closing During Circulation

Step	Procedure Step and Acceptance Criteria	Data to be Recorded
1)	Circulate sand slurry while bypassing the test section until slurry viscosity and sand content stabilize with slurry agitator on.	— Date (month/day/year) — Person performing test
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 *MPMS* Ch. 10.4. The use of solvents and temperature controls are not required. Adjust sand content to 2 % (1.5 % to 2.5 % acceptable) by adding sand mixture or diluting slurry with freshwater.	— Sand concentration (%)
3)	Determine viscosity of slurry sample with Marsh funnel viscometer according to API 13B-1. Adjust viscosity to 70 sec (75 sec maximum, 65 sec minimum) by adding polymer viscosifier or diluting mixture with freshwater.	— Slurry viscosity (sec)
4)	If dilution or strengthening was necessary in Step 3, return to procedure in Step 1.	
5)	Adjust flow rate to a minimum of 77 gpm (0.29 m^3/min).	— Flow rate at start of circulation period — Slurry viscosity (sec) — Sand concentration (%)
6)	Cycle SSV/USV valve from fully opened to fully closed at a maximum rate of 7 cycles per minute.	
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.	— Differential pressure across valve when closed (psi)
8)	Open and close SSV/USV a minimum of 500 cycles but no more than 510 cycles. 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 and during Step 9 and Step 10.	— Number of cycles — Cycles per minute (nominal) — Type and frequency of maintenance performed (list)

Table 10—Sand Slurry Flow Test While Opening and Closing During Circulation (Continued)

Step	Procedure Step and Acceptance Criteria	Data to be Recorded
9)	Check SSV/USV valve for leakage with fresh water: a) close SSV/USV by releasing actuator power; b) close isolation valves upstream and downstream from SSV/USV; c) open downstream liquid leak detection valve; d) apply water pressure upstream of the SSV/USV equal to 95 % to 105 % of the RWP of the SSV/USV valve; and e) after the pressure has stabilized within the acceptable range for 3 minutes minimum, check for SSV/USV valve seat, stem seal, body, and bonnet seal leakage for a period of 5 minutes minimum. **Acceptance Criteria**: No visible leakage shall occur during the 5 minute hold period.	— Validation test number — Date (month/day/year) **Pressure Holding** — Test start time of pressure monitoring — Test end time of pressure monitoring — Pressure at start of test — Pressure at end of test — Leakage location (if any) — Test passed (yes/no)
10)	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 of water; e) apply 25 % of RWP ±5 % using nitrogen on upstream side of SSV/USV valve; and f) after the pressure has stabilized within the acceptable range for 3 minutes minimum, check for valve seat, stem seal, body, and bonnet seal leakage by observing for gas bubbles for a period of 5 minutes minimum. **Acceptance Criteria:** No visible leakage shall occur during the 5 minute hold period. g) apply 75 % of RWP ±5 % using nitrogen on upstream side of SSV/USV valve; and h) after the pressure has stabilized for 3 minutes minimum, check for valve seat, stem seal, body, and bonnet seal leakage by observing for gas bubbles for a period of 5 minutes minimum. **Acceptance Criteria:** No visible leakage shall occur during the 5 minute hold period.	**25 % RWP Test** — Test start time of pressure monitoring — Test end time of pressure monitoring — Pressure at start of test — Pressure at end of test — Leakage location (if any) — Test passed (yes/no) **75 % RWP Test** — Test start time of pressure monitoring — Test end time of pressure monitoring — Pressure at start of test — Pressure at end of test — Leakage location (if any) — Test passed (yes/no)

6 Scaling of Test Results

6.1 Scaling of Class II Validation Results

Successful completion of the validation test on a $2^{1}/_{16}$ in. (52 mm), 5000 psi (34.5 MPa) RWP SSV/USV valve 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 II service.

Successful completion of the validation test on a size or pressure rating other than $2^{1}/_{16}$ in. (52 mm), 5000 psi (34.5 MPa) RWP SSV/USV valve shall qualify that size and larger for all pressure ratings of that manufacturer's SSV/USV valves of the same basic design and materials of construction for Class II service.

Any substantive change in the design or materials of construction that would affect the SSV/USV valve bore sealing mechanism shall require requalification by validation testing.

6.2 Scaling of Class III Validation Results

6.2.1 General

Scaling may be used to validate the members of a product family in accordance with the requirements and limitations described in this section.

NOTE The intent of this section is to limit scaling due to the uncertainties associated with solids deposition and throttling flow during cycling of the valve.

6.2.2 Product Family

A product family shall meet the following design requirements.

— The design principles of physical configuration and functional operation are the same.

— The allowable design stress levels in relation to material mechanical properties are based on the same criteria.

6.2.3 Limitations of Scaling

6.2.3.1 Design Validation by Pressure Rating

The test product may be used to validate products of the same product family having equal or lower pressure ratings.

6.2.3.2 Design Validation by Size

Testing of one size of a product family shall validate products one nominal size larger and one nominal size smaller than the tested size. Testing of two sizes of a product family also validates all nominal sizes between the two sizes tested and the sizes one nominal size larger and one nominal size smaller than the tested size (if applicable). The valve nominal size shall be defined as the nominal size of the end connections, as defined in API 6A. For valves of the same product family, the $1^{13}/_{16}$ and $2^{1}/_{16}$ sizes (46 mm and 52 mm) may be considered as one size for scaling purposes.

6.2.4 Design Validation by PSL

Validation of equipment is independent of the PSL of the production equipment.

Annex A
(informative)

API Monogram Program

A.1 Scope

The API Monogram® is a registered certification mark owned by the American Petroleum Institute (API) and authorized for licensing by the API Board of Directors. Through the API Monogram Program, API licenses product manufacturers to apply the API Monogram to products which comply with product specifications and have been manufactured under a quality management system that meets the requirements of API Q1. API maintains a complete, searchable list of all Monogram licensees on the API Composite List website (www.api.org/compositelist).

The application of the API Monogram and license number on products constitutes a representation and warranty by the licensee to API and to purchasers of the products that, as of the date indicated, the products were manufactured under a quality management system conforming to the requirements of API Q1 and that the product conforms in every detail with the applicable standard(s) or product specification(s). API Monogram program licenses are issued only after an on-site audit has verified that an organization has implemented and continually maintained a quality management system that meets the requirements of API Q1 and that the resulting products satisfy the requirements of the applicable API product specification(s) and/or standard(s). Although any manufacturer may claim that its products meet API product requirements without monogramming them, only manufacturers with a license from API can apply the API Monogram to their products.

Together with the requirements of the API Monogram license agreement, this annex establishes the requirements for those organizations who wish to voluntarily obtain an API license to provide API monogrammed products that satisfy the requirements of the applicable API product specification(s) and/or standard(s) and API Monogram Program requirements.

For information on becoming an API Monogram Licensee, please contact API, Certification Programs, 1220 L Street, N. W., Washington, DC 20005 or call 202-682-8145 or by email at certification@api.org.

A.2 References

In addition to the referenced standards listed earlier in this document, this annex references the following standard:

API Specification Q1, *Specification for Quality Management System Requirements for Manufacturing Organizations for the Petroleum and Natural Gas Industry*

ISO/IEC 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*

For Licensees under the Monogram Program, the latest version of this document shall be used. The requirements identified therein are mandatory.

A.3 API Monogram Marking Requirements

These marking requirements apply only to those API Licensees wishing to apply the API Monogram.

There are no specific marking requirements for the API Monogram on API 6AV1 test reports.

Application of the API Monogram shall be per the manufacturer's procedures as specified in API Specification Q1, which requires marking of the license number and date of original manufacture.

A.4 Test Agency License Criteria

A.4.1 Independence

The test agency performing validation testing must meet the requirements of API 6AV1. In addition, for compliance with these API Monogram Program requirements, the test agency must be an independent third party and must be licensed by API in order to test SSVs or USVs that are intended to be marked with the API Monogram.

A.4.2 Quality Program Requirements

Laboratories desiring license under this annex shall have a functional quality program in accordance with ISO/IEC 17025 and the requirements of API Q1 except for the requirements related to Design and Development, Control of Production and Service, and Release of Nonconforming Product under Concession. All remaining requirements of API Q1 shall apply. Laboratories desiring licensing under this annex shall make application, pay applicable fees and undergo audits (both scheduled and unscheduled) per program procedures. 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. Removal of the laboratory from the API Composite List shall occur for failure to meet the requirements of the API Monogram Program such as not satisfying audit obligations or for failure to pay applicable program fees.

A.4.3 Use of the API Monogram in Advertising

Licensee shall not use the API Monogram on letterheads or in any advertising (including company-sponsored web sites) without an express statement of fact describing the scope of Licensee's authorization (license number). The Licensee should contact API for guidance on the use of the API Monogram other than on products.

A.5 Capability

The API Monogram Program is designed to identify facilities that have demonstrated the ability to manufacture equipment or provide testing services that conform to API specifications and/or standards. API may refuse initial licensing or suspend current licensing based on a facility's level of manufacturing or testing capability. If API determines that additional review is warranted, API may perform additional audits (at the organization's expense) of any subcontractors to ensure their compliance with the requirements of the applicable API product specification(s) and/or standard(s).

A.6 API Monogram Program: Nonconformance Reporting

API solicits information on nonconformances associated with API specified requirements, as well as field failures (or malfunctions), which are judged to be caused by either specification deficiencies or nonconformities with API specified requirements. Customers are requested to report to API all problems with API monogrammed products. A nonconformance may be reported using the API Nonconformance Reporting System available at http://compositelist.api.org/ncr.asp.

Bibliography

[1] API *Manual of Petroleum Measurement Standards* (*MPMS*) Chapter 15, *Guidelines for Use of the International System of Units (SI) in the Petroleum and Allied Industries*

[2] API Specification 14D, *Wellhead Surface Safety Valves for Offshore Service*

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