API Specification 14A, Specification for Subsurface Safety Valve Equipment

Addendum 2

The following terms and definitions should be considered for inclusion in the Terms and Definitions section of the parent document if used in the text below.

1.1.1 annular safety valve
A subsurface assembly comprised of an annular flow isolation capabilities and annular packer capabilities which prevents prevent uncontrolled annular well flow when closed.

1.1.2 annular flow isolation assembly
Device integral to the ASV which contains a closure mechanism which prevents uncontrolled annular flow when closed.

1.1.3 annular packer assembly
Device integral into the ASV with a packing element used for blocking fluid (liquid or gas) communication through the annular space between conduits by sealing the space between them.

1.1.4 by-pass flow area
the flow area which passes through the ASV closure mechanism and circumvents the packing element

1.1.5 packing element
Seal on an annular packer assembly that blocks fluid communication by sealing on the ID of the conduit.

The following acronym shall be added in the Acronyms section of the API 14A, 12th edition.

ASV Annular Safety Valve
Annex O
(normative)

Annular Safety Valves

O.1 General

This annex contains requirements for annular safety valves (ASVs), as defined herein. Included in these requirements are design, manufacturing, verification, validation and functional testing. For ASVs, when referencing the main body of this industry standard, the term ASV shall apply where SSSV is mentioned.

The ASV shall be designed and manufactured in accordance with Sections 4 through 8 with the exception of the modifications listed herein.

O.2 Functional Specification for ASVs

O.2.1 ASV Functional Characteristics

The following content shall replace 4.3;

The ASV functional characteristics shall include the following, when applicable:

a) type of ASV control;
b) type of ASV retrieval;
c) type of ASV closing mechanism;
d) internal self-equalizing capability;
e) temporary or permanent lock-open system;
f) pump-through capability; and
g) any redundant/independent backup operating systems.

O.2.2 Well Parameters

The following bullet shall be added to 4.4:

- relationship of ASV with other well devices/tubing/casing by means of a well schematic drawing, if applicable.

O.2.3 Operational Parameters

The following content shall replace 4.5.1:

The following operational parameters shall be specified for the ASV:

a) rated working pressure (RWP);
b) rated temperature range; and

c) injection parameters.

In addition to the applicable items listed above, the conditions under which the ASV will operate (closure mechanism equalization and flow conditions) and the conditions under which the valve closes shall be specified, such as:

1) loading conditions, including combined loading (pressures, tension/compression, torque, bending) and the corresponding temperature extremes anticipated to be applied to the ASV;

2) at valve setting depth, the minimum and maximum values of the production/injection pressures and temperatures at the anticipated flow rates; and

3) composition of the production/injection fluid (gas/oil/water) and density of each component.

O.2.4 Optional Parameters

The following shall be added as 4.5.3:

NOTE: API 11D1 provides requirements for the functional specification and technical specification, including design, design verification and validation, materials, documentation and data control, repair, shipment, and storage of packers.

The ASV and the annular packer assembly functional characteristics shall include the following, when applicable:

− requirements for the validation grade of the annular packer assembly to conform to API 11D1;

− requirements for the ASV to be permanent or retrievable;

− end connections above/below the ASV;

− applicable information for the interface and integration with the ASV;

− configuration of tubing (single or multiple strings) and other lines (electrical/hydraulic) that are required to pass through or bypass the annular packer assembly;

− rated working pressures (RWP) above and below annular packer assembly;

− installation method, including conveyance method and setting;

− retrieving method; and

− setting and releasing pressures.

O.2.5 User/Purchaser Grade Selection

The following shall be specified:

a) Validation grades per 4.9 are not applicable to ASV's;
b) The user/purchaser shall select the applicable validation grade for the annular packer assembly per 5.7 in API 11D1.

### O.3 Technical Specification

#### O.3.1 Design Criteria

a) In addition to the criteria in 5.3.2, the following shall replace the content of 5.3.2.3:

- The supplier/manufacturer shall establish verified burst and collapse pressures, tensile load strength, operating temperature range, control chamber pressure rating if applicable, flow area(s), and RWP, excluding end connections. The design shall take into account the effects of pressure containment and pressure-induced loads.

- Supplier/manufacturer shall determine maximum liquid and gas flow rates through the by-pass flow area.

#### O.4 Design Validation

##### O.4.1 General

The following content replaces 5.5:

The objectives of the validation testing requirements of this subsection are to qualify ASV equipment. ASV equipment furnished to this specification requires validation testing to qualify each size, type, and model of ASV. The validation testing requirements in this specification are not represented as well conditions. Designs shall be validated to ensure that the design assumptions and design analysis methods and practices conform to the defined design requirements. The ASVs produced in accordance with this specification shall pass the validation tests required by this subsection and the functional test per O.7.

Successful completion of the validation testing process shall qualify ASVs of the same size, type, and model as the tested ASV.

The validation tests specified in O.4.2 and O.4.3 can be conducted in any order. Each individual test shall be completed without any repair or redress of the test valve; repair and redress between individual tests is allowed,

Products failing one or more of the tests may be retested to meet the requirements of that test or tests; however, substantive design changes (see 5.7.2) to any component of an ASV shall require that all the validation test(s) are repeated.

**NOTE:** Flow validation refers to maximum flow rate (injection). Gas flow validation refers to closure against potential production flow (Annex B.3, Annex K).

##### O.4.2 Annular Flow Isolation Assembly

##### O.4.2.1 General

Successful completion of the validation testing process shall qualify annular flow isolation assemblies of the same size, type, and model as the tested annular flow isolation assembly. The body joints in an annular flow isolation assembly shall be evaluated to ensure that the body joints meet the functional and performance requirements. The evaluation may include design analysis, testing, or history of successful use in the field under conditions that meets or exceeds the current functional and performance requirements.
A functional test as specified in Table O.7 shall be performed prior to commencement of any additional tests.

Flow validation and gas flow testing to be conducted per agreement with user/purchaser.

**O.4.2.2 Opening Differential Unloading of Closure Mechanism**

A SCSSV meeting the requirements of V3, V4-2, or V4-1 in addition to an Opening Differential Test per D.3 or G.4 meet the requirements of O.4.2.2.

To conduct validation testing of the annular flow isolation assembly, perform the following per Table O.1:

Table O.1—Opening Differential Unloading Validation Test — ASV
<table>
<thead>
<tr>
<th>Step</th>
<th>Procedure and Acceptance Criteria</th>
<th>Data to Be Recorded</th>
</tr>
</thead>
</table>
| 1)   | Record the valve identification information. | — validation test number  
— date  
— inspection records |
| 2)   | With the annular flow isolation assembly closed, apply 1.4 MPa ± 0.07 MPa (200 psi ± 10 psi) nitrogen pressure upstream of the closure mechanism.  
Wait a minimum of 1 min, then measure any nitrogen leakage through the closure mechanism.  
**Acceptance criteria:** If the leakage rate is greater than 0.14 m³/min (5 scf/min), the test valve fails. | — test pressure  
— measured leakage  
— pass / fail |
| 3)   | Increase pressure to a minimum of 100 % of the RWP of the ASV. Wait a minimum of 1 min, then measure any nitrogen leakage through the closure mechanism.  
**Acceptance criteria:** If the leakage rate is greater than 0.14 m³/min (5 scf/min), the test valve fails. | — test pressure  
— measured leakage  
— pass / fail |
| 4)   | Maintain a minimum of 100 % of the RWP upstream of the closure mechanism while maintaining downstream pressure at zero.  
Apply the maximum rated hydraulic control pressure to the annular flow isolation assembly hydraulic system. | — test pressure  
— hydraulic control pressure |
| 5)   | Apply pressure to the downstream of the closure mechanism until the closure mechanism rapidly opens. | — test pressure |
| 6)   | Repeat steps 2 through 5 four more times for a total of five operating cycles. | — data recorded during steps 2, 3, 4, and 5 |
### Step Procedure and Acceptance Criteria Data to Be Recorded

<table>
<thead>
<tr>
<th>Step</th>
<th>Procedure and Acceptance Criteria</th>
<th>Data to Be Recorded</th>
</tr>
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<tbody>
<tr>
<td>7)</td>
<td><strong>Apply 1.4 MPa ± 0.07 MPa (200 psi ± 10 psi) pressure upstream of the closure mechanism.</strong>&lt;br&gt;Wait a minimum of 1 min, then measure any leakage through the closure mechanism.</td>
<td><strong>Acceptance criteria:</strong> If the leakage rate is greater than 0.14 m³/min (5 scf/min), the test valve fails</td>
</tr>
<tr>
<td></td>
<td><strong>— test pressure</strong></td>
<td><strong>— measured leakage</strong></td>
</tr>
<tr>
<td>8)</td>
<td><strong>Apply a minimum of 100 % of the RWP of the ASV.</strong></td>
<td><strong>Acceptance criteria:</strong> If the leakage rate is greater than 0.14 m³/min (5 scf/min), the test valve fails</td>
</tr>
<tr>
<td></td>
<td><strong>Wait a minimum of 1 min, then measure any nitrogen leakage through the closure mechanism.</strong></td>
<td><strong>— test pressure</strong></td>
</tr>
<tr>
<td>9)</td>
<td><strong>Perform post-test dimensional inspection which shall be documented as specified by the supplier/manufacturer procedures and acceptance criteria.</strong></td>
<td></td>
</tr>
</tbody>
</table>

### O.4.2.3 Cyclic Temperature Validation
Conduct cyclic temperature validation test per Annex D.2.

### O.4.2.4 Self Equalizing Test (When Applicable)
Conduct self equalizing test per Annex D.4.

### O.4.3 Annular Packer Assembly
The annular packer assembly shall be validated to the requirements of API 11D1, Section 6.5 with a minimum validation grade of V3. The annular packer assembly may be tested individually, or together with the annular flow isolation assembly. When tested separately the interface between the two products shall be validated during the functional test per O.7, Step 17.

### O.5 Design Assessment
Section 5.11 applies to ASVs.
O.6 Equipment Performance Ratings

Individually validated annular isolation flow assemblies and annular packer assemblies may be assembled to form an ASV. The ASV rating(s) shall be the lowest rating(s) of the individual assemblies.

NOTE: The annular isolation flow assembly and annular packer assembly validated individually can have different ratings.

O.7 Documentation and Data Control

O.7.1 Shipping Report

The following shall replace the content of 6.2.2.2;

a) manufacturer’s data:
   1) manufacturer's name and manufacturing address,
   2) manufacturer's part number,
   3) equipment (name) type and model,
   4) serial number,
   5) nominal size,

b) ASV rated performance limits:
   1) RWP annular flow isolation assembly,
   2) RWP packer isolation assembly
   3) maximum rated operating temperature,
   4) minimum rated operating temperature,
   5) secondary feature operation pressure, maximum, if applicable;

c) ASV functional test summary:
   1) opening pressure with zero pressure in test section: maximum and minimum, if applicable,
   2) closing pressure with zero pressure in test section: maximum and minimum, if applicable,
   3) drift test report, if applicable,
   4) performed by: (printed name and signature), date: (month/day/year);

d) statement of compliance to user/purchaser specified requirements, if applicable;

e) inspected by: (printed name and signature), month/day/year.

Additionally, the shipping report shall contain the following when applicable:
a) ASV rated performance limits:
   1) control chamber pressure, maximum (at maximum operating temp);
   2) full open pressure at zero annulus pressure, maximum;
   3) closing pressure at zero annulus pressure, minimum;
   4) unequalized opening pressure differential, maximum;
   5) pump open pressure;
   6) maximum injection flow rate.

b) ASV calculated performance limits:
   1) annular flow isolation assembly internal yield pressure (at maximum rated operating temperature);
   2) annular packer assembly internal yield pressure (at maximum rated operating temperature);
   3) packing element differential pressure (at maximum rated operating temperature);
   4) collapse pressure, minimum (at ambient temperature);
   5) collapse pressure, minimum (at maximum rated operating temperature);
   6) tensile strength (at maximum internal pressure and ambient temperature);
   7) tensile strength (at maximum internal pressure and maximum rated operating temperature);
   8) tensile strength (without pressure at ambient temperature);
   9) tensile strength (without pressure at maximum rated operating temperature).

**O.7.2 Operating Manual**

In addition to 5.10.3, the following additional requirements shall apply:

a) operational injection rates and flowing properties.

**O.8 Quality Control**

**O.8.1 Shear Device Verification**

At least one shear device per heat lot shall be sheared in accordance with the supplier/manufacturer's documented procedure to verify that the shear value meets the supplier/manufacturer's documented specification.

**O.8.2 Packer Element Inspection**

In addition to 6.4.3.2.1 and 6.4.2, perform the following:

1. 100% visual and dimensional inspection per supplier's/manufacturer's documented specifications
2. 100% hardness inspection of elastomeric packing elements shall be in accordance with an international standard or national standard, such as ASTM D2240 or ASTM D1415.

O.8.3 Calibration Systems

In addition to 6.4.6.2, add the following:

Technologies for measuring and testing equipment with verifiable accuracies equal to, or better than, those listed in this standard may be applied with appropriate documentation and when approved by a qualified person.

O.8.4 Product Identification

Conform to 6.3 as applicable.

O.9 Functional Testing

The following shall replace the content of 6.5:

ASV functional testing shall be performed by the supplier/manufacturer on each new ASV manufactured in accordance with Table O.2. Results of the functional test shall be traceable to the valve tested and retained in accordance with 6.2.1.

<table>
<thead>
<tr>
<th>Step</th>
<th>Procedure and Acceptance Criteria</th>
<th>Data to Be Recorded</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Record the valve identification information.</td>
<td>— valve supplier/manufacturer</td>
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<tr>
<td></td>
<td></td>
<td>— equipment name</td>
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<tr>
<td></td>
<td></td>
<td>— ASV type and size</td>
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<tr>
<td></td>
<td></td>
<td>— manufacturer's part number</td>
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<tr>
<td></td>
<td></td>
<td>— unique serial number</td>
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<tr>
<td></td>
<td></td>
<td>— working pressure rating</td>
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<tr>
<td>2)</td>
<td>Place the ASV in a fixture capable of retaining and sealing the annular flow isolation assembly.</td>
<td>— start time and pressure</td>
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<tr>
<td></td>
<td>NOTE: See figures O.1 and O.2 for examples of test fixture setup.</td>
<td>— end time and pressure</td>
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<tr>
<td></td>
<td></td>
<td>— beginning section pressure</td>
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<tr>
<td></td>
<td></td>
<td>— ending section pressure</td>
</tr>
<tr>
<td>3)</td>
<td>Fill the ID of the annular flow isolation assembly with water or other suitable liquid to displace air, and proceed as follows.</td>
<td>—</td>
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<tr>
<td>Step</td>
<td>Procedure and Acceptance Criteria</td>
<td>Data to Be Recorded</td>
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</table>
| 1    | Close the ASV. Thoroughly dry the accessible portions of the annular flow isolation assembly. Adjust and stabilize the pressure to a minimum of 100% of the RWP. Hold the pressure a minimum of 5 min. Reduce the pressure to zero. Repeat the test once. **Acceptance criteria:** The ASV fails the functional test if leakage is detected on the exterior or through the hydraulic control line port(s). | — leakage within 5 min? (yes or no)  
— test passed? (yes or no) |
| 4    | Open the ASV with vented zero pressure in the ID of the annular flow isolation assembly. Adjust and stabilize the hydraulic control pressure to the supplier/manufacturer’s recommended hold-open pressure. Isolate the hydraulic control pressure from the source. Monitor for a minimum of 5 min. **Acceptance criteria:** If a hydraulic control pressure loss greater than 5% of the applied pressure is detected after stabilization, the ASV fails the functional test. | — start time and pressure  
— end time and pressure  
— beginning control pressure  
— ending control pressure  
— calculated pressure loss over minimum of 5 min  
— test passed? (yes or no) |
| 5    | Close and open the ASV five times with zero pressure in the ID of the annular flow isolation assembly. **Acceptance criteria:** Each control pressure shall repeat within ±5% of the average pressure of the five valve operating cycles as well as falling within the supplier/manufacturer’s specified control pressure tolerance. If each pressure is not within these the limits, the ASV fails the functional test. For each of 5 operating cycles: | — full open hydraulic control pressure  
— full closed hydraulic control pressure  
Calculated average of 5 operating cycles:  
— full open hydraulic control pressure  
— full closed hydraulic control pressure  
— test passed? (yes or no) |
| 6    | If applicable, fill the ID of the annular flow isolation assembly with water or another suitable liquid to displace air, and proceed as follows. Apply pressure below the closure mechanism to a minimum of 50% of the RWP. Hold the pressure a minimum of 5 min. and monitor above the closure mechanism for leakage. Reduce the pressure in the ID of the annular flow isolation assembly to zero. **Acceptance criteria:** If the leakage rate exceeds 10 cm³/min (0.6 in.³/min), the SCSSV fails the functional test. | — start time and pressure  
— end time and pressure  
— beginning pressure below closure mechanism  
— ending pressure below closure mechanism  
— leakage? |
<table>
<thead>
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</table>
| 7)   | Apply pressure of 50% of the ASV’s RWP (allowable range of 45% to 55% of RWP) to the ID of the annular flow isolation assembly and ensure pressure is equalized above and below the closure mechanism. Close and open test valve five times while maintaining pressure within the specified range.  
**NOTE** The pressure can increase as the valve is opened and then can decrease as the valve is closed due to the differential volume of the hydraulic operating piston.  
**Acceptance criteria:** If the five adjusted hydraulic control pressures (or actual control pressures for tubing-pressure-insensitive valves) do not repeat within ±10% of their average, or ±0.7 MPa (±100 psi), whichever is greater. | — test passed? (yes or no)  
— annular flow isolation assembly ID pressure (base pressure) at 50% of RWP  
— full open hydraulic control pressure and actual pressure in the ID of the annular flow isolation assembly  
— full closed hydraulic control pressure and actual pressure in the ID of the annular flow isolation assembly  
Calculate and record the following values:  
— adjusted fully closed hydraulic control pressure  
— average of adjusted fully closed hydraulic control pressure  
— adjusted fully open hydraulic control pressure  
— average of adjusted fully open hydraulic control pressure  
— repeatability test passed (yes or no) |
| 8)   | Adjust and stabilize pressure in the ID of the annular flow isolation assembly to 100% of the RWP (allowable range of 95% to 105% of RWP) of the SCSSV. Close the ASV. | — pressure above and below annular flow isolation assembly  
— full closed hydraulic control pressure |
<table>
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</thead>
</table>
| 9)   | Bleed the pressure above the annular flow isolation assembly closure mechanism to zero. Adjust and stabilize the pressure below the annular flow isolation assembly closure mechanism to 100 % of the RWP (allowable range of 95 % to 105 % of RWP) of the ASV. Measure liquid leakage for a minimum of 5 min. **Acceptance criteria:** If the leakage rate exceeds 10 cm³/min (0.6 in.³/min), the SCSSV fails the functional test. | — pressure below the annular flow isolation assembly closure mechanism  
— start time and pressure  
— end time and pressure  
— measured leakage  
— test passed? (yes or no) |
| 10)  | Bleed all pressures to zero and remove the liquid from the ID of the annular flow isolation assembly. | |
| 11)  | Open the ASV. Record the full open hydraulic control pressure. | — full open hydraulic control pressure |
| 12)  | Adjust and stabilize the pressure above and below the annular flow isolation assembly closure mechanism with gas to 1.4 MPa ± 0.07 MPa (200 psi ± 10 psi). Close the ASV. Bleed the hydraulic control pressure to zero. Monitor for gas leakage at the hydraulic control port(s) for a minimum of 5 min. **Acceptance criteria:** If any leakage is detected, the ASV fails the functional test. | — pressure above and below the annular flow isolation assembly closure mechanism  
— start time and pressure  
— end time and pressure  
— full closed hydraulic control pressure  
— control port leakage within 5 min? (yes or no)  
— test passed? (yes or no) |
| 13)  | Bleed the pressure above the annular flow isolation assembly closure mechanism to zero. Adjust and stabilize the pressure below the annular flow isolation assembly closure mechanism to 1.4 MPa ± 0.07 MPa (200 psi ± 10 psi) with gas. Measure the leakage rate for a minimum of 5 min. **Acceptance criteria:** If the leakage rate exceeds 0.14 m³/min (5 scf/min), the SCSSV fails the functional test. | — pressure below the annular flow isolation assembly closure mechanism  
— start time and pressure  
— end time and pressure  
— measured leakage  
— test passed? (yes or no) |
<p>| 14)  | Repeat Steps 12) and 13) with 8.3 MPa ± 0.41 MPa (1200 psi ± 60 psi) instead of 1.4 MPa ± 0.07 MPa (200 psi ± 10 psi). | |
| 15)  | Bleed all pressures to zero. | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>16)</td>
<td>Open and close the ASV two times.</td>
<td>For each of 2 operating cycles:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>— full open hydraulic control pressure</td>
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<tr>
<td></td>
<td></td>
<td>— full closed hydraulic control pressure</td>
</tr>
<tr>
<td>17</td>
<td>When required by O.4.3, an internal test shall be performed on the connection(s) between the annular flow isolation assembly and annular packer assembly by plugging the end connections and pressurizing to a minimum of 100% of RWP using liquid and hold pressure for 10 minutes.</td>
<td>— start time and pressure</td>
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<td></td>
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<td>— end time and pressure</td>
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<td></td>
<td></td>
<td>— visible leakage?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>— test passed? (yes or no)</td>
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<td></td>
<td></td>
<td>— test date</td>
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<tr>
<td>18)</td>
<td>Prepare the ASV for drift tests; If the ASV fails the drift test, it fails the functional test. Open the ASV, then, proceed as follows. 1) Drift the interior of the ASV assembly with the supplier/manufacturer’s specified drift bar. Pass the drift bar completely through the test valve from top to bottom. Repeat the drift test in the opposite direction. 2) When required by the functional specification, drift the exterior of the ASV with the supplier/manufacturer’s specified drift sleeve. Repeat the drift test in the opposite direction.</td>
<td>— drift bar/sleeve unique identifier</td>
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<td></td>
<td></td>
<td>— drift bar/sleeve size</td>
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<td></td>
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<td>— internal/external drift test passed? (yes or no)</td>
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<tr>
<td>19)</td>
<td>Special features unique to a supplier/manufacturer’s ASV shall be tested in accordance with the supplier/manufacturer’s operating manual. Failure to meet the requirements of these tests fails the ASV. These tests can be incorporated in the existing sequence of functional tests. Such special-feature test procedures, the sequence, acceptance criteria, and the results shall be fully described in the test report.</td>
<td>— data required by supplier/manufacturer’s procedures</td>
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<td></td>
<td>— special features test passed? (yes or no)</td>
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<tr>
<td>20)</td>
<td>If the ASV performs within the limits of the functional test, it passes the functional test. Attach all recorded data to the supplier/manufacturer’s test form.</td>
<td>— test date</td>
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<td></td>
<td></td>
<td>— person performing test printed name</td>
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<td></td>
<td>— person performing test signature</td>
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<tr>
<td></td>
<td></td>
<td>— document test results</td>
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</tbody>
</table>

Acceptance criteria: The ASV fails the functional test if visible leakage is detected at the test connection(s).