API 14A 12th Edition Overview
Addressing Critical Service and HPHT
SSSV Applications

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API 14A 12th Edition – Addressing Critical Service and HPHT SSSV Applications

- API 14A Twelfth Edition Overview
- New Validation Levels and Associated Testing Requirements
- Additional Testing Requirements (when specified)
- HPHT Annex Requirements for Design Verification and Validation
- HPHT Additional Requirements
API 14A  12th Edition Overview

• Published Jan 2015, Effective Jan 2016
  • Extensive changes justified 12 month implementation timeframe

• Key Revision highlights –
  • Entire document reviewed and modified
  • Added 6 new Validation Grades in lieu of Classes of Service
  • Scope now includes Injection Valves (SSISV) with validation testing
API 14A 12th Edition Overview

• Key Revision highlights –
  • Added Normative and Informative Test Annexes to align with new Validation Levels
  • Insert SCSSV’s harmonized with API RP14B.
  • Design analysis methods added, including FEA and CFD
  • Design Verification and Validation added for:
    • HPHT Environments and Applications (new Annex)
    • Alternate technology SSSV’s
    • Secondary Tools for SSSV’s (new Annex)
API 14A 12th Ed - New Validation Levels and Associated Testing Requirements

• New Validation Levels replace previous Classes of Service designations
  • Allows better alignment with SSSV requirements based on end user determination of testing required

• Accommodates legacy equipment for previous Class 1 and Class 2 validation ratings

• New V1 and V1-H defined for critical or HPHT applications
  – New V2 and V3 builds upon previous Class 1 & 2 with additional testing requirements

• Removed Class 3 & 4, now in mat’l req’s section
## API 14A 12th Ed - New Validation Levels and Associated Testing Requirements

<table>
<thead>
<tr>
<th>Validation Grade</th>
<th>Comments</th>
<th>Historical Class of Service (API 14A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V4-1</td>
<td>Validation grade V4-1 shall only be used for SSSVs that have a validation test date prior to the effective date of this specification. The validation requirements are specified in Annex B and are equivalent to API 14A, 9th, 10th, and 11th editions, Class 1 requirements.</td>
<td>1—standard service</td>
</tr>
<tr>
<td>V4-2</td>
<td>Validation grade V4-2 shall only be used for SSSVs that have a validation test date prior to the effective date of this specification. The validation requirements are specified in Annex B and are equivalent to API 14A, 9th, 10th, and 11th editions, Class 2 requirements.</td>
<td>2—sandy service</td>
</tr>
<tr>
<td>V3</td>
<td>Validation grade V3 (see 5.5.1 and 5.5.3) contains the validation test requirements specified in Annex B and additional supplier/manufacturer tests in Annex D. It also contains requirements for special feature validation (see 5.5.9) and electronics qualification (see G.7), if applicable.</td>
<td>None—new to this edition</td>
</tr>
<tr>
<td>V2</td>
<td>Validation grade V2 (see 5.5.1 and 5.5.4) contains the validation test requirements specified in Annex B and additional supplier/manufacturer tests in Annex D. It also contains requirements for special feature validation (see 5.5.9) and electronics qualification (see G.7), if applicable.</td>
<td>None—new to this edition</td>
</tr>
<tr>
<td>V1</td>
<td>Validation grade V1 (see 5.5.5) SSSVs meet all the requirements of Annex B in this edition of API 14A plus additional testing detailed in Annex G.</td>
<td>None—new to this edition</td>
</tr>
<tr>
<td>V1-H</td>
<td>Validation grade V1-H (see Annex H) SSSVs meet all the requirements of Annex B in this edition of API 14A plus additional testing detailed in Annex G, Annex J, and Annex L.</td>
<td>None—new to this edition</td>
</tr>
<tr>
<td>N/A</td>
<td>This edition of API 14A does not provide requirements for Class 3 or Class 4 SSSVs. Material requirements for all SSSVs are defined in Sections 4 and 5.</td>
<td>3—stress cracking service 4—mass loss corrosion service</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Validation Grade</th>
<th>Grades Covered</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1-H</td>
<td>V1-H, V1, V2, V3, V4-2, V4-1</td>
</tr>
<tr>
<td>V1</td>
<td>V1, V2, V3, V4-2, V4-1</td>
</tr>
<tr>
<td>V2</td>
<td>V2, V3, V4-2, V4-1</td>
</tr>
<tr>
<td>V3</td>
<td>V3, V4-1</td>
</tr>
<tr>
<td>V4-2</td>
<td>V4-2, V4-1</td>
</tr>
<tr>
<td>V4-1</td>
<td>V4-1</td>
</tr>
</tbody>
</table>

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*a When validation testing is completed, a fully validated HPH T SSSV has been tested to Annex C functional test, Annex B V2 testing, Annex G opening test, differential opening test, equalizing mechanism endurance test, special feature validation, alternate technology qualification (if applicable), Annex J combined load operational testing at temperature, and Annex L dynamic piston seal system test.*
API 14A 12th Ed - New Validation Levels and Associated Testing Requirements

**V3 Validation Test**

B.2 Table B.1 - Test Agency V3 steps
- B.3 Gas flow test
- B.5 Liquid leakage test
- B.6 Unequalized opening test
- B.7 Operating-pressure test
- B.8 Propane test
- B.9 Nitrogen leakage test
- B.7 Operating-pressure test
- B.10 V3 water flow test
- Repeat B.9, B.7, and B.10 four times
- B.5 Liquid leakage test
- B.11 Controlled-temperature test
- B.4 OD/ID Drift per B.4.2/B.4.3

**New Requirements:**
- D.2 Temperature Cycle Test
- D.3 Differential Opening Testing
- D.4 Self-Equalizing Test (if applicable)
- Body Joint Evaluation

**V2 Validation Test**

B.2 Table B.2 - Test Agency V2 steps
- Table B.1 (Steps 1-15)
- B.7 Operating-pressure test
- B.12 V2 Slurry Flow Test
- B.9 Nitrogen Leakage Test
- Repeat B.12 and B.9 six times
- B.5 Liquid leakage test
- B.4 OD/ID Drift per B.4.2/B.4.3

**New Requirements:**
- D.2 Temperature cycle test
- D.3 Differential opening testing
- D.4 Self-Equalizing Test (if applicable)
- Body Joint Evaluation

**V2 validation completed**
**API 14A 12th Ed - New Validation Levels and Associated Testing Requirements**

**V1 Validation Test**
From a V2 validated valve, add:
- G.3 Operating Life Test (500 cycles min.)
- G.4 Differential Opening Testing
- G.5 Equalization Mechanism Endurance Testing
- G.6 Special feature validation
- G.7 ESSSV Electronics qualification (if applicable)
- Annex M Rated Performance Envelope

**V1-H Validation Test**
From a V1 validated valve, add:
- • Annex J Combined Load Operational Test
- • Annex L Dynamic Seal System Test
Additional testing has been defined for user/purchasers to specify when required.

<table>
<thead>
<tr>
<th>Annex Identification</th>
<th>Annex Title</th>
<th>General Description of Content</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>Alternative requirements for closure mechanism</td>
<td>Provides alternative leakage acceptance criteria for the functional test</td>
<td>Provides more stringent leak rate acceptance criteria</td>
</tr>
<tr>
<td></td>
<td>minimal leakage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>Extended sand endurance testing</td>
<td>Enhanced sand endurance testing</td>
<td>Evaluates the ability of the valve design to close and seal in sandy conditions</td>
</tr>
<tr>
<td>J</td>
<td>Combined loads operational test</td>
<td>Validation of closed end rated performance envelope limits</td>
<td>Confirms the ability of the SSSV to operate at the limits of the performance envelope</td>
</tr>
<tr>
<td>K</td>
<td>Gas slam closure testing</td>
<td>Testing requirements for high-rate slam closures</td>
<td>Evaluates closure of SSSV in increased flow rate gas wells</td>
</tr>
<tr>
<td>L</td>
<td>Dynamic seal system test</td>
<td>Testing requirements for primary dynamic seal systems at intermediate positions at static conditions</td>
<td>Evaluates gas sealing integrity of the dynamic seal system</td>
</tr>
</tbody>
</table>
API 14A 12th Ed – HPHT Annex Requirements for Design Verification and Validation

• New Annex H defines HPHT SSSV requirements
  – Defines the additional verification and validation requirements that shall be followed in designing and manufacturing SSSV and secondary tools for use in HPHT environment

• H.2 – Functional specification (User/purchaser requirements)
  – Additional requirements are to be specified including max flowing temperature, shut in static temperature, and duration of time that SSSV will operate at temperature

• H.3 – Technical specification (Supplier/manufacturer requirements)
  – **Temperature effects** – use temperature de-rated yield strength and modulus of elasticity with testing on samples at mid-wall or mid radius conducted in accordance with ASTM E21 and E111
  – **Environmental effects** – compatibility of metals with well fluids shall be evaluated, limits on castings (API 20A), limits on welding/structural components
• H.3 – Technical specification (Supplier/manufacturer requirements)
  – **Non-metals** – completions and stimulation fluid exposure to be specified, compound evaluation for RGD and ageing along with compound validation testing and evaluation
  – **Design Verification** – User/purchaser specifies max anticipated shut-in tubing pressure (SITP) at the SSSV and specify RWP > SITP.
  – The component shall conform to the requirements of 6.4 and the following additional requirements:
    • For all metallic components integral to the tubing string and closure mechanism, perform an elastic-plastic FEA using ASME BPVC Section VIII, Division 2
    • Localized stress discontinuities and localized yielding shall be evaluated by a qualified person to determine if the design is acceptable or if additional analysis is required
    • When FEA has identified plastic strain in excess of 0.2 %, a ratcheting analysis shall be performed per ASME BPVC Section VIII, Division 3, Paragraph KD-234 or ASME BPVC Section VIII, Division 2, Paragraph 5.5.7
    • Perform a fatigue screening per ASME BPVC Section VIII, Division 2, Paragraph 5.5.2. If the design exhibits fatigue sensitivity, conduct a fatigue analysis per API 579/ASME FFS-1 using a safety factor of 2 on anticipated operating life
API 14A 12th Ed – HPHT Annex Requirements for Design Verification and Validation

- **H.3 – Technical specification (Supplier/manufacturer requirements)**
  - **Design Validation** – V1-H is normative, post-test NDE is required on all critically stressed components from combined load test
  - **Scaling of HPHT SSSV’s** – comprehensive material review for scaled designs (metal & non-metal) shall be reviewed and accepted

- **H.4 – Additional supplier/manufacturer requirements**
  - **Metals verification** – yield strengths and modulus of elasticity for components integral to the tubing string and the closure mechanism shall be documented at max rated operating temperature
  - **Functional Test Requirements** – the functional test pressure used in Annex C shall be a minimum of 1.25 times RWP
  - **Quality Plan** – shall be prepared per ISO 10005 and 6.4 for each order placed and approved in writing by user/purchaser, any changes shall go through the same approval process
  - **Final Design Review** – final design review to verify that the SSSV and secondary tools are suitable for the applicable HPHT environment
Questions?