API SC19 Equipment Specifications for HPHT Downhole Completion Equipment

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- API 14A SSSVs - Twelfth Edition – re-written and adds HPHT Annex (Published Jan 2015, effective Jan 2016)
- API 19AC Accessories - First Edition (future) – does not have HPHT Annex, Second Edition to add HPHT
- API 19LH Liner Hangers – First Edition (future) – does not have HPHT Annex
API 11D1 Third Edition
Packers and Bridge Plugs

• 3rd Edition – Revision Highlights
  – Annex B, Requirements for HPHT Equipment
  – Annex C, Design validation and functional testing for operational tools
  – Annex D, Requirements for external flow testing

• Published – April 2015
Annex B - Requirements for HPHT Environment Equipment

Pressure ratings greater than 15,000 psi or with a temperature rating greater than 350 °F.

- This annex was developed considering the guidelines of API PER15K-1.
- Requires conformance to API Q1 for the design and manufacture of HPHT Packers.
- Expanded list of Operational Parameters for user/purchaser to supply operational information.
Annex B - Requirements for HPHT Environment Equipment

• Non-metals;
  – User/purchaser to supply additional fluid information required for the selection of non-metals.
  – Compound assessment testing for ageing and compression set
  – Added ASTM references to Material Specifications

• Castings cannot be used for pressure containing or tensile carrying components that are integral to the tubing string.

• Added welding NDE requirements and acceptance criteria.
Annex B - Requirements for HPHT Environment Equipment

New Design Verification Requirements;

• Temperature de-rated yield strength and modulus of elasticity
• Finite Element Analysis (FEA) shall be performed on pressure containing or tensile carrying components, ASME BPVC, Section VIII, Division 2, Part 5 or ASME Boiler and Pressure Vessel Code, Section VIII Division 3, article KD-2
• FMEA assessment of validation testing
• Limitations on Design Scaling – stress factors on scaled designs cannot exceed the validated design.
Annex B - Requirements for HPHT Environment Equipment

• Two new HPHT validation grades;
  – V0-H: gas test plus axial loads plus temperature cycling plus zero bubble acceptance criterion.
  – V3-H: liquid test plus axial loads plus temperature cycling.

• Three phases of validation testing;
  – Phase 1 - Max Casing, Max Temp
  – Phase 2 - Max Casing, Min Temp
  – Phase 3 - Min Casing, Max Temp

• Added releasing test for retrievable packers
• Added Rated internal test pressure
• Functional Testing Requirements – test to rated internal test pressure
Graphical representation of Temperature Cycle Range

Temperature-cycle range

Packers temperature range
<table>
<thead>
<tr>
<th><strong>11D1 - V3, V0</strong></th>
<th><strong>11D1 - Annex B HPHT V3-H, V0-H</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>One Test</strong></td>
<td><strong>Phase 1 Test</strong></td>
</tr>
<tr>
<td>Max ID, Max Temp</td>
<td>Max Casing, Max Temp</td>
</tr>
<tr>
<td>15 Min hold</td>
<td>30 min hold</td>
</tr>
<tr>
<td></td>
<td>Atmospheric chambers tested to 80% of setting pressure</td>
</tr>
<tr>
<td><strong>Set at Max Temp</strong></td>
<td>Set at Max Temp</td>
</tr>
<tr>
<td><strong>Two pressure reversals</strong></td>
<td>Three pressure reversals</td>
</tr>
<tr>
<td>Test each envelope point</td>
<td>Test each envelope point</td>
</tr>
<tr>
<td>Reduce by temp cycle range</td>
<td>Reduce temp by temp cycle range</td>
</tr>
<tr>
<td>Pressure test</td>
<td>Pressure test from below</td>
</tr>
<tr>
<td></td>
<td>Test each envelope point</td>
</tr>
<tr>
<td>Increase to Max Temp</td>
<td>Increase to Max Temp</td>
</tr>
<tr>
<td>Pressure test</td>
<td>Pressure test from below</td>
</tr>
<tr>
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</tbody>
</table>
### Improved Operating Envelope

#### Rated Packer Performance Envelope

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>ABCDEFGH-JKL</td>
<td>Ø12.15</td>
<td>Ø8.821</td>
<td>45 RC</td>
<td>200° (93°)</td>
<td>Ø6.125</td>
</tr>
</tbody>
</table>

#### Validation Grade:

<table>
<thead>
<tr>
<th>Validation Grade:</th>
<th>Validated by:</th>
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</thead>
<tbody>
<tr>
<td>V0-H</td>
<td>Test</td>
</tr>
</tbody>
</table>

#### Date Envelope Generated:

- February 14, 2014

#### Temperature Range:

- 200° (93°) - 500° (260°)

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**LIMITATION OF LIABILITY AND ANY NECESSARY LEGAL STATEMENTS ETC.**

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**Diagram**

- Graph showing the relationship between pressure, applied load (tensile), and compressive load. The graph includes a range of pressures from -68.95 to 68.95 MPa (psi). The x-axis represents pressure in psi, with values from -17,500 to 17,500. The y-axis represents applied load (tensile) and compressive load (lbs and kPa). The graph illustrates how pressure affects the forces acting on the packer under different conditions.
API 11D1 Additional Annexes

Annex C - Requirements for HPHT Operational Tools
• Validation requirements for running and pulling tools

Annex D - Requirements for External Flow Testing
• Provides uniform methods for performing external flow (swab-off) testing
API 19AC First Edition
Accessories

First Edition is modified adopt-back of ISO 14998
• Adds Validation Testing Requirements
• First Ballot closed May 5th
• Projected publication – Q4 2015
• HPHT Annex – mid to late 2016

Completion Accessory - Equipment that forms an integral part of the tubing and is not covered by any other API downhole equipment standard.
API 19AC Completion Accessories

Major Categories of Functionalities -

• Pressure containing, load bearing; (Anchor, Blast Joint, Flow Coupling, etc)
• Disconnect/reconnect; (On-Off Tool, Shear out Safety Joint)
• Tubing movement; (Seal Assy, PBRs, Travel Joints, Expansion Joints)
• Opening a port; (Sliding Sleeves, Sand Control Sliding Sleeves)

Validation Testing Requirements by Functionality
API 19AC Completion Accessories

- Tubing anchors
- Blast joints
- Chemical injection mandrels
- Cross-overs
- Entry guides
- Expansion [travel] joints
- Extension/spacer subs
- Fill valves
- Filter mandrels
- Flow couplings
- Gauge mandrels
- Locator
- Mill-out extension
- Non-sealing space out joints
- On-off tool
- Perforated sub
- Polished bore receptacles
- Sand control expansion joints
- Sand control sliding sleeves
- Seal assemblies
- Sealing space out joints
- Seal bore extension
- Shear-out safety joints
- Sliding sleeves
- Telescoping swivel subs
- Y-blocks
API 14L and API 19LH


- API 19LH Liner Hangers – First Edition (Publish 2016) – does not have HPHT Annex
Questions?