

API SC19 Equipment Specifications for HPHT Downhole Completion Equipment

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- API PER 15K - Technical Report - Protocol for Verification and Validation of HPHT Equipment
- API 14A SSSVs - Twelfth Edition – re-written and adds HPHT Annex (Published Jan 2015, effective Jan 2016)
- API 11D1 Packers - Third Edition – adds HPHT Annex
- API 14L Landing Nipples and Lock Mandrels – Second Edition does not have HPHT Annex, Third Edition - HPHT
- 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

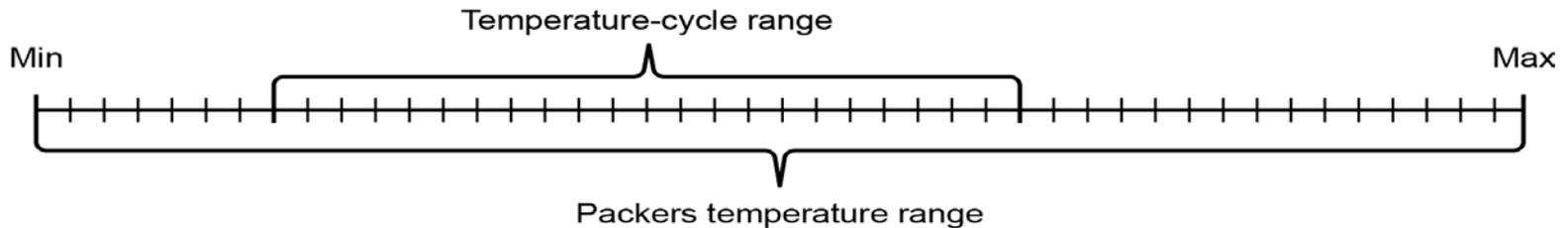
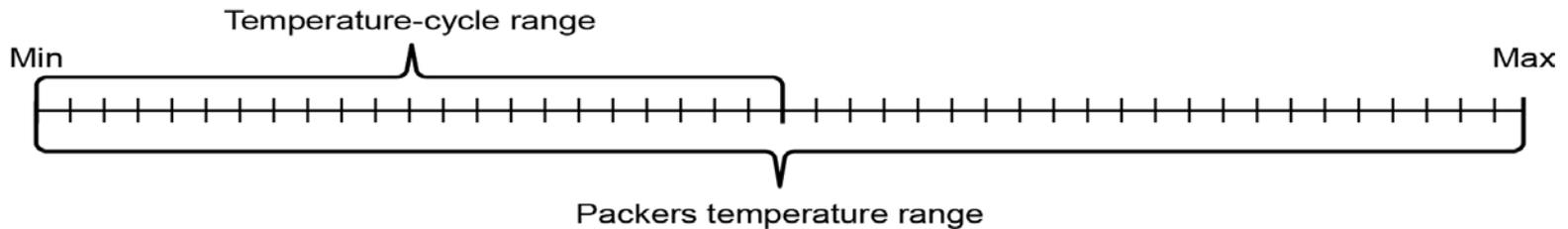
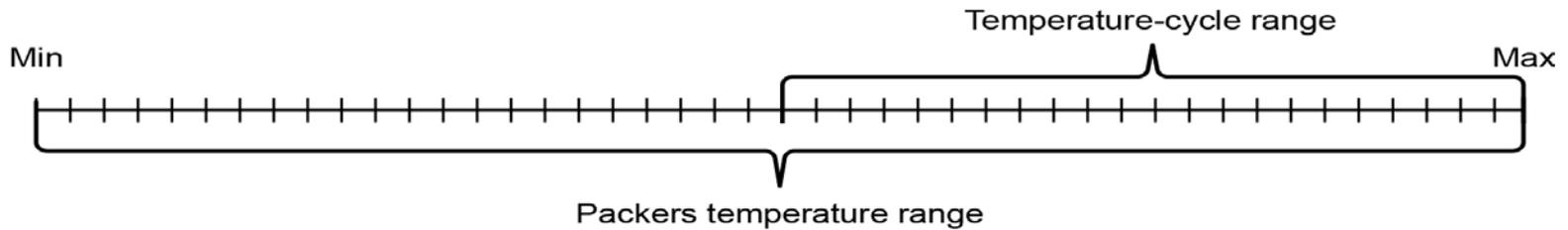
New Design Verification Requirements;

- 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



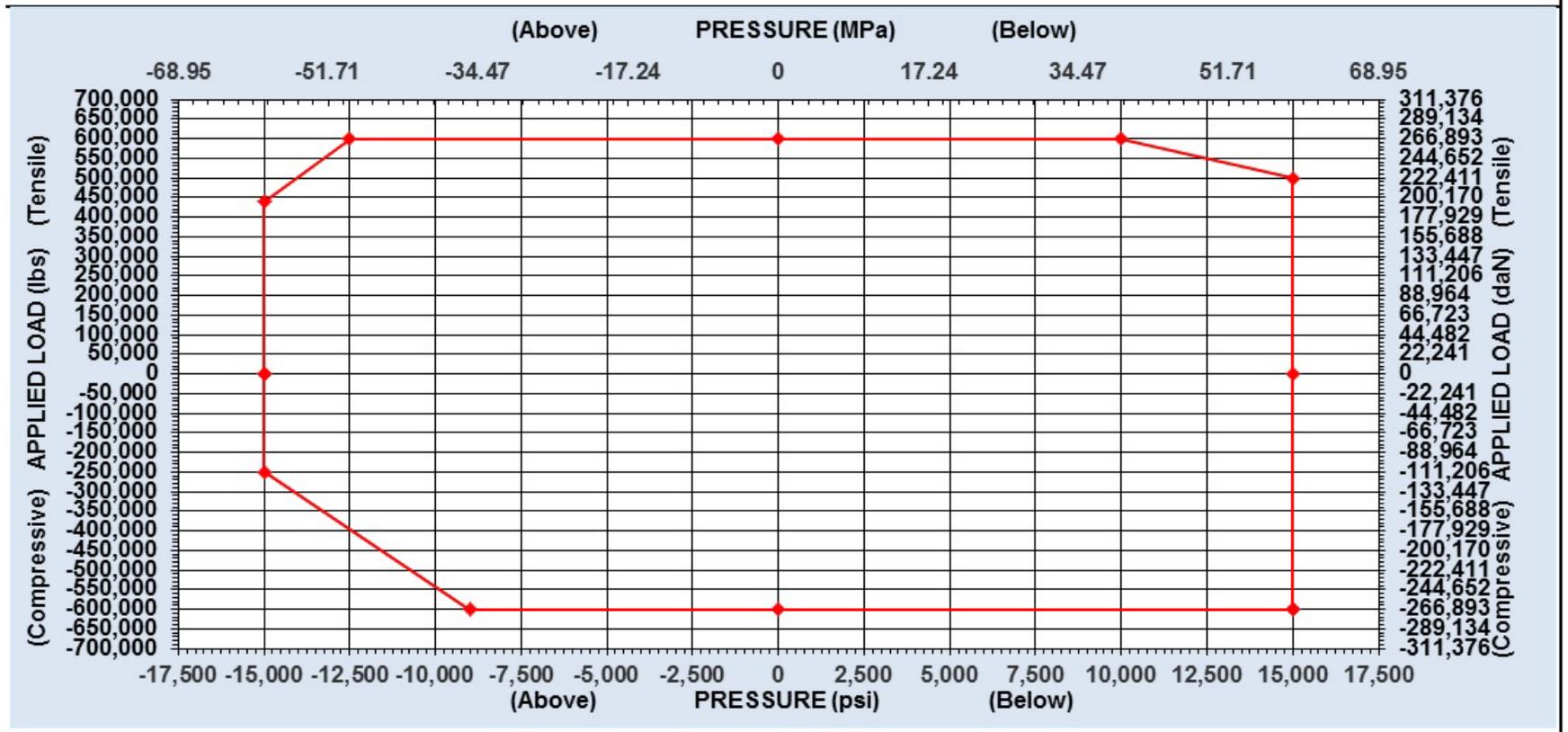
Comparison of 11D1 HPHT Validation Test Requirements

11D1 - V3, V0	11D1 - Annex B HPHT V3-H, V0-H		
One Test	Phase 1 Test	Phase 2 Test	Phase 3 Test
Max ID, Max Temp 15 Min hold	Max Casing, Max Temp 30 min hold	Max Casing, Min Temp 30 min hold	Min Casing, Max Temp 30 min hold
	Atmospheric chambers tested to 80% of setting pressure	Atmospheric chambers tested to 80% of setting pressure	Atmospheric chambers tested to 80% of setting pressure
Set at Max Temp	Set at Max Temp	Set at Min Temp plus Temp Cycle Range	Set at Max Temp minus Temp Cycle Range Increase temp to Max Temp
Two pressure reversals Test each envelope point Reduce by temp cycle range	Three pressure reversals Test each envelope point Reduce temp by temp cycle range	Three pressure reversals Test each envelope point Reduce to Min Rated Temp	Test each envelope point Reduce temp by temp cycle range
Pressure test	Pressure test from below Test each envelope point	Pressure test from below Test each envelope point	Pressure reversal test Test each envelope point
Increase to Max Temp	Increase to Max Temp	Increase to Min Temp plus Temp Cycle Range	
Pressure test	Pressure test from below	Pressure test from below	Pressure test from below

Improved Operating Envelope

Rated Packer Performance Envelope		Qualified Per API 11D1 HP/HT Annex A				
Part Model/Number ABCDEFGHIJ-KL		Test Fixture O.D. (in): Ø12.15	Test Fixture I.D. (in): Ø8.821	Test Fixture Hardness 45 RC	Tested Temp. Cycle Range: °F (°C) 200° (93°)	Sealing Diam for Tube Move Program (in): Ø6.125
Validation Grade: V0-H	Validated by: Test	Pkr. Max. OD (in): Ø8.310	Pkr. Min. ID (in): Ø4.465	Date Envelope Generated February 14, 2014	Temperature Range: °F (°C) 200° (93°) - 500° (260°)	Form Revision Number REV 5.1

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



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 14L Landing Nipples and Lock Mandrels – Second Edition does not have HPHT Annex, Third Edition to add HPHT Annex (2016)
- API 19LH Liner Hangers – First Edition (Publish 2016) – does not have HPHT Annex

Questions?