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## **Addendum 1**

*Introduction: The fourth, fifth, and sixth paragraphs shall be changed to the following:*

There are 16 design-validation grades to provide the user/purchaser the choice of requirements to meet a specific preference or application. Design-validation grades V0-HR to V6-R are new 4<sup>th</sup> edition grades, and design-validation grades V0 to V6 are for legacy products with design verification and validation requirements listed in Annex A. Design-validation grade V6 is the minimum grade and represents equipment where the validation method has been defined by the supplier/manufacturer. V0-HR and V3-HR are for high pressure high temperature (HPHT) applications with specific requirements listed in Annex B and have replaced the legacy V0-H and V3-H validation grades. The complexity and severity of the validation testing increases as the grade number decreases.

This edition has been completely revised. Changes include moving requirements from the HPHT annex (Annex B) into the main body, consolidating common validation requirements, and organizing the validation tests into tables. New requirements for low temperature ratings validation and test report requirements have been added.

This edition now includes a new normative annex for legacy product requirements (Annex A) and three new informative annexes: optional requirements for validation of hydrostatically set products (Annex E), determining text fixture inside diameter (Annex F), and tubing-to-packer forces and rated performance envelopes (Annex G). Annex B has also been changed from informative to normative.

*Section 1 (Scope): The following annex shall be added to the list:*

— Annex A: Requirements for Legacy Products

*Section 2 (Normative References): The following documents shall be added:*

ASTM E127, *Standard Practice for Fabrication and Control of Flat Bottomed Hole Ultrasonic Standard Reference Blocks*

ISO 10893-4:2011, *Non-destructive testing of steel tubes—Part 4: Liquid penetrant inspection of seamless and welded steel tubes for the detection of surface imperfections*

*Section 2 (Normative References): The following documents shall be removed:*

ASTM E428, *Standard Practice for Fabrication and Control of Metal, Other than Aluminum, Reference Blocks Used in Ultrasonic Testing*

ISO 12095, *Seamless and welded steel tubes for pressure purposes—Liquid penetrant testing*

ISO 13665, *Seamless and welded steel tubes for pressure purposes—Magnetic particle inspection of the tube body for the detection of surface imperfections*

*Section 2 (Normative References): The following document shall be revised as shown in the red box:*

ISO 10893-5 **2011** *Non-destructive testing of steel tubes—Part 5: Magnetic particle inspection of seamless and welded ferromagnetic steel tubes for the detection of surface imperfections*

*3.12: The definition shall be updated to the following:*

Component that comes in direct contact with the movement of well fluids in the flow stream.

*3.15: The following definition shall be inserted as 3.15, and all other definition numbers shall be updated:*

**legacy product**

Existing product that has been validated to the requirements of a previous edition of API Spec 11D1.

*3.27: The definition for retrievable packer/retrievable bridge plug shall be updated to the following:*

Bridge plug or packer that has a design feature facilitating its retrieval.

*3.33: The NOTE below the definition for temperature-cycle range shall be changed to the following:*

NOTE The temperature-cycle range is validated for V3-R, V3, V1-R, V1, V0-R, V0, V0-HR, and V3-HR, and is applicable anywhere within the product's temperature range (see 6.3.4.3).

*Section 5.1: The following shall be added to the end of the paragraph:*

If not provided, the supplier/manufacturer shall generate a functional specification.

*Section 5.2: The section shall be updated to the following:*

The functional specification shall specify the following type:

- permanent packer or bridge plug, or
- retrievable packer or bridge plug, or
- repositionable packer or bridge plug.

*Section 5.3: The opening sentence shall be updated to the following:*

The functional specification shall specify, as applicable, the following well parameters:

*Section 5.4: The opening sentence shall be updated to the following:*

The functional specification shall specify, as applicable, any of the following operational parameters:

*Section 5.5.1: The section shall be updated to the following:*

If the user/purchaser has access to the corrosion property data of the operating environment based on historical data and/or research, the user/purchaser shall state to the supplier/manufacturer which material(s), metals or nonmetals, has/have the ability to perform as required. If the user/purchaser does not provide the material selection to the supplier/manufacturer, the material compatibility shall be determined according to 5.5.2.

*Section 5.5.2: The section shall be updated to the following:*

If the user/purchaser does not provide the material selection, the functional specification shall specify, as applicable, the following well environment parameters:

- a) completion and packer fluid composition, pH, and existence of bromides (Zn, Ca, Na), formates (Cs, K, Na), chlorides (K, Ca, Na), and acetates (Cs);
- b) mud type, mud density, and pH;
- c) aromatic and aliphatic solvents where present (type/amount);
- d) inhibitor treatments (type, concentration, and pH):
  - oxygen scavenger systems;
  - emulsifier systems;
  - continuous or batch treatment;
  - chemical composition of fluid exposures;
  - duration and temperature of exposure.
- e) produced fluid information;

NOTE Produced fluids such as oil, gas, water, water cut, and concentrations of CO<sub>2</sub> and H<sub>2</sub>S.

- f) injected fluid information;

NOTE Injected fluids such as water, pH, inhibitors, and oxygen levels.

- g) NACE service environmental and metallurgical limits.

*Section 5.5.3.1, the following shall be added to the end of the section:*

NACE MR0175 requirements only apply to metallic materials; consideration should be given to nonmetallic materials separately.

*Section 5.6: The section shall be updated with the following:*

The user/purchaser shall specify the required design validation grade. This specification provides nine design validation grades (V6-R to V0-R), as defined in 6.5, including two high pressure high temperature (HPHT) design validation grades (V3-HR and V0-HR) covered by Annex B that may be selected by the user/purchaser. Seven legacy validation grades (V6-V0) are provided in Annex A and may be selected by the user/purchaser.

NOTE Annex E provides information for validation of maximum initiation pressure for hydrostatically set products.

*Section 5.7: The following shall be added to the end of the section:*

When no quality level is selected by the user/purchaser, see 7.4.

*Section 6.3.2: The section shall be replaced with the following:*

Design of products manufactured to this specification shall include documentation of those designs. This documentation shall include the following:

- a) design requirements;
- b) analysis methods;
- c) calculations.

This documentation should also include the following, as applicable:

- d) assumptions;
- e) comparison with previous designs or operating history of similar products;
- f) manufacturing drawings and specifications;
- g) design reviews;
- h) physical testing results (such as design validation testing).

*Section 6.3.3.1: In the first paragraph, the first sentence shall be updated with the following:*

Materials and/or the service environment designation (see 5.5.3.1) being provided shall be stated by the supplier/manufacturer and shall conform to the functional specification.

*Section 6.3.3.1: The third paragraph shall be changed to the following:*

When the user/purchaser specifies NACE service, the metallic materials shall conform to ANSI/NACE MR0175/ISO 15156.

*Section 6.3.3.2.1: Item c) shall be updated with the following:*

- c) mechanical property limits, one or more as applicable:

*Section 6.3.3.2.1: The last paragraph shall be changed to the following:*

The mechanical properties shall be determined by the test methods listed in Table 1 or by an equivalent international standard.

*Table 1: The table header shall be updated as indicated in the red box:*

Parameter	Standards
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*Section 6.3.3.3.1: The last paragraph shall be changed to the following:*

The elastomeric and thermoplastic parameters shall be determined by the test methods listed in Table 2 for elastomers and Table 3 for thermoplastics, or by an equivalent international standard. The specification shall state if the parameters are measured on actual components.

Table 2: The table header shall be updated as indicated in the red box:

Parameter, as Applicable	Standards
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Table 3: The table header shall be updated as indicated in the red box:

Parameter, as Applicable	Standards
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Section 6.3.4.2: The opening paragraph shall be updated with the following:

For products validated to grade V4 through grade V0, grade V4-R through grade V0-R, grade V3-HR, and grade V0-HR, a rated performance envelope is required. The ratings illustrated in the rated performance envelope shall be supported by documented validation testing. The rated performance envelope shall be approved by a qualified person.

Section 6.3.4.2: The introductory sentence to the bulleted list shall be updated with the following:

Rated performance envelopes shall meet the following criteria; required information that is not on the performance envelope shall be on the product data sheet:

Section 6.3.4.2: The NOTE after item c) shall be updated with the following:

NOTE Low temperature rating validation is addressed in 6.5.6.9, Annex A, and Annex B.

Section 6.3.4.2: Bullets j), k), and l) shall be updated with the following, and the NOTE referencing Annex G shall be placed after bullet l):

- j) Unless otherwise specified on the envelope, tubing-to-packer loads shall be applied to the top of the product.
- k) If more than one graph is displayed with the envelope, a legend shall be included for explanation. For example, various shear device options, plugged, unplugged, location of plug, alternate temperatures, alternate rated IDs, can be displayed.
- l) "Above" and "below" on the pressure axis are defined as above and below the product and not internal to the product. If the envelope includes ratings based on pressure internal to the product, this shall be specified on the envelope or illustrated as an additional graphic.

NOTE Annex G includes information on sealing diameters and pressure-induced loads.

Section 6.3.4.3: In the opening paragraph, the definition cross references shall be updated as indicated in the red boxes:

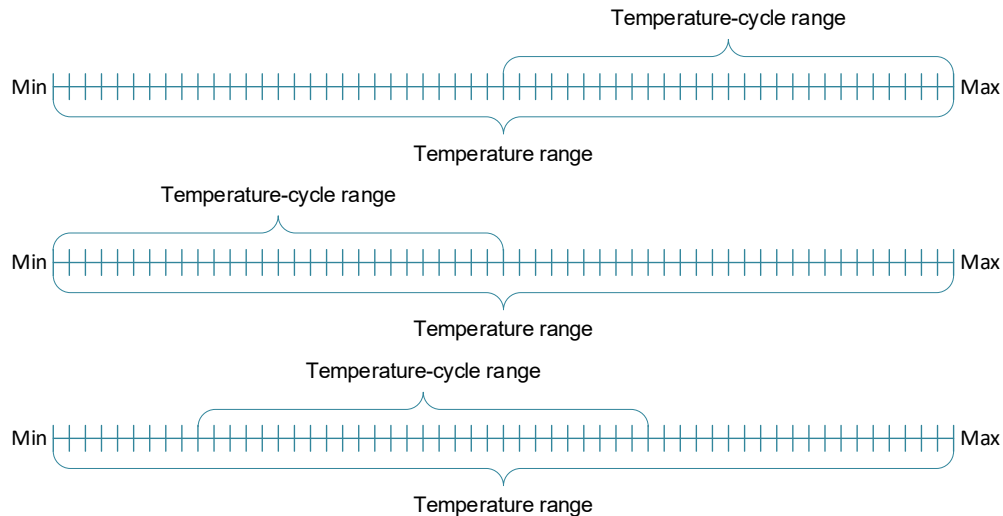
Figure 2 is an illustration of the temperature-cycle range (see 3.33), which is the temperature change over which the product is designed to operate, and the temperature range (see 3.34), which is the range of temperature over which the product is designed to operate.

Section 6.3.4.3: The following shall be added after the opening paragraph:

There shall be only one rated temperature-cycle range and only one rated temperature range for a validated product. If the product cannot be successfully validated using one temperature-cycle range that covers the product's entire temperature range, multiple successful tests shall be performed that cover the maximum

and minimum temperatures of the product's temperature range. The rated temperature-cycle range of the product is the smallest of the validated temperature-cycle ranges.

Figure 2: The figure shall be replaced with the following:



Section 6.4: The section shall be replaced with the following:

#### 6.4.1 General

This specification has three design verification methods for which the product shall be supplied based on the validation grade selected, as defined in 6.5. Products shall be verified by one of the following:

- a) by conforming to the requirements of 6.4.2 for validation grades V0-R through V6-R; or
- b) by conforming to the requirements of Annex A for validation grades V0 through V6 (validated prior to the effective date of the 4<sup>th</sup> edition); or
- c) by conforming to the requirements of Annex B for validation grades V0-HR and V3-HR.

#### 6.4.2 Design Verification Requirements

Design verification shall be performed to ensure that each product design meets the supplier/manufacture technical specifications. Design verification may include activities such as design reviews, design calculations, and comparing the new design with similar proven designs (see API Q1).

The minimum material condition and minimum material yield strength, including the applicable temperature de-rating, shall be used in the calculations.

Design margin(s) and the mode(s) of stress shall be identified for each type 1 component and other relevant components, as determined by the supplier/manufacture, using a documented methodology.

If corrosion or corrosion/erosion allowances are included in the design, the design verification and validations shall consider these allowances.

Verification results shall be approved by a qualified person, and records of the results shall become a portion of the design documentation.

Products that were previously verified in accordance with prior editions of API 11D1 that are being considered to meet the requirements of validation grades V0-HR through V6-R shall be evaluated against the requirements of 6.4.2. Additional verification shall be performed as necessary, with results documented and approved by a qualified person.

**EXAMPLE** If a V3-H product from API 11D1, 3<sup>rd</sup> edition is evaluated against the requirements of V3-HR and found to be in conformance, this evaluation is then documented and approved, and the product is designated as V3-HR from the 4<sup>th</sup> edition.

*Section 6.5.1: The section shall be updated with the following:*

This specification has 16 grades of design validation for which the product shall be supplied. Products shall be validated by one of the following and shall be supplied to at least the design validation grade specified:

- a) by conforming to the requirements of 6.5 for validation grades V0-R through V6-R; or
- b) by conforming to the requirements of Annex A for validation grades V0 through V6 (validated prior to the effective date of the 4<sup>th</sup> edition); or
- c) by conforming to the requirements of Annex B for validation grades V0-HR and V3-HR.

There are nine new 4<sup>th</sup> edition validation grades:

- V6-R: supplier/manufacturer defined;
- V5-R: liquid test;
- V4-R: liquid test plus axial loads;
- V3-R: liquid test plus axial loads plus temperature cycling;
- V2-R: gas test plus axial loads;
- V1-R: gas test plus axial loads plus temperature cycling;
- V0-R: gas test plus axial loads plus temperature cycling plus zero bubble acceptance criterion;
- V3-HR: validation testing for liquid HPHT service per Annex B;
- V0-HR: validation testing for gas HPHT service per Annex B.

Products that were previously validated in accordance with prior editions of API 11D1 that are being considered to meet the requirements of the 4<sup>th</sup> edition validation grades (V0-HR through V6-R) shall be evaluated against the 4<sup>th</sup> edition requirements, with additional validation performed as necessary and results documented and approved by a qualified person.

**EXAMPLE** If a V3-H product from API 11D1, 3<sup>rd</sup> edition is evaluated against the requirements of V3-HR and found to be in conformance, this evaluation is then documented and approved, and the product is designated as V3-HR from the 4<sup>th</sup> edition.

Products without axial load ratings may be validated without axial loading; however, all validation grades are applicable.

Products qualified to higher grades of design validation are qualified for the lower grades of design validation in accordance with Table 4.

The seven validation grades for legacy products are as follows:

- V6: supplier/manufacturer defined;
- V5: liquid test;
- V4: liquid test plus axial loads;
- V3: liquid test plus axial loads plus temperature cycling;
- V2: gas test plus axial loads;
- V1: gas test plus axial loads plus temperature cycling;
- V0: gas test plus axial loads plus temperature cycling plus zero bubble acceptance criterion.

Table 4: The table shall be replaced with the following:

**Table 4—Design Validation Grade Hierarchy, 4<sup>th</sup> Edition**

Design Validation Grade	Grades Covered
V0-HR	V0-HR, V3-HR, V0-R, V0, V1-R, V1, V2-R, V2, V3-R, V3, V4-R, V4, V5-R, V5, V6-R and V6
V3-HR	V3-HR, V3-R, V3, V4-R, V4, V5-R, V5, V6-R and V6
V0-R	V0-R, V0, V1-R, V1, V2-R, V2, V3-R, V3, V4-R, V4, V5-R, V5, V6-R and V6
V1-R	V1-R, V1, V2-R, V2, V3-R, V3, V4-R, V4, V5-R, V5, V6-R and V6
V2-R	V2-R, V2, V4-R, V4, V5-R, V5, V6-R and V6
V3-R	V3-R, V3, V4-R, V4, V5-R, V5, V6-R and V6
V4-R	V4-R, V4, V5-R, V5, V6-R and V6
V5-R	V5-R, V5, V6-R and V6
V6-R	V6-R and V6

Table 5: The following table shall be added after Table 4, and all subsequent tables and references to the tables shall be renumbered:

**Table 5—Design Validation Grade Hierarchy Legacy Products Annex A**

Design Validation Grade	Grades Covered
V0	V0, V1, V2, V3, V4, V5, and V6
V1	V1, V2, V3, V4, V5, and V6
V2	V2, V4, V5, and V6
V3	V3, V4, V5, and V6
V4	V4, V5, and V6
V5	V5 and V6
V6	V6



*Section 6.5.1: The opening sentence of the paragraph following Table 5 shall be updated with the following:*

Products validated to grade V5-R through grade V0-HR shall not be rated for use in casing or tubing sizes and masses (weights) that can have a maximum ID larger than the nominal or as-measured fixture ID up to the maximum allowable tolerance, whichever is greater, used in the validation test [refer to 6.5.2 m)].

*Section 6.5.2: The opening sentence shall be replaced with the following:*

The following apply to product validation testing grade V5-R through grade V0-HR.

*Section 6.5.2: Item a) shall be updated with the following, and the NOTE shall be removed:*

The validation-tested product shall conform to the requirements of Section 7 (except 7.2.2, 7.2.3, and 7.3) and a minimum of QL3.

*Section 6.5.2: Item m) shall be replaced with the following:*

m) Test fixture:

- 1) Validation testing shall be performed within a test fixture that is designed to have no OD plastic deformation at the planned test or proof test pressures.

NOTE This fixture simulates supported casing or tubing to validate the performance of the product. Unsupported casing or tubing application are outside the scope of this specification and can require analysis and/or additional testing.

- 2) The fixture nominal ID shall be the maximum casing or tubing ID, and the fixture nominal ID tolerance shall be a maximum of  $\pm 0.76$  mm ( $\pm 0.030$  in.).

NOTE Annex F provides information on determining maximum and minimum test fixture IDs.

- 3) Inflatable packing elements are energized to form a seal by applying fluid pressure directly to the element. Products with inflatable packing elements shall be tested horizontally; centralization at one end of the test fixture is acceptable.
- 4) Products with no anchoring devices or anchoring devices that hold in one direction may be restrained by the test fixture to prevent movement in the unanchored direction(s).

*Table 6: The table shall be updated with the following:*

Media	Requirement
Liquid	Use a liquid test medium of water, with or without additives, or hydraulic oil. The density shall be less than 1100 kg/m <sup>3</sup> (68.67 lb/ft <sup>3</sup> ). Liquid shall be visibly free from particulate matter or other material. <sup>a</sup>
Gas	Use a gas test medium of air, nitrogen, or other gas or mixture of gases.
<sup>a</sup> Particulate matter and other material can conceal a small leak that would otherwise be evident.	

*Section 6.5.3: The section shall be replaced with the following:*

Validation test pressure reversal sequences as used in 6.5.6 are defined as follows.

One pressure reversal shall be achieved by either of the following sequences:

- above to below; or
- below to above.

Two pressure reversals shall be achieved by either of the following sequences:

- above to below to above; or
- below to above to below.

Three pressure reversals shall be achieved by either of the following sequences:

- above to below to above to below; or
- below to above to below to above.

*Section 6.5.5: The NOTE shall be updated to a statement as follows:*

Where pressure is used to generate an axial load, it is acceptable to record pressure in lieu of load.

*Section 6.5.6.2: The title shall be changed to the following:*

#### **Grade V6-R—Supplier/Manufacturer Defined**

*Section 6.5.6.3: The title shall be changed to the following:*

#### **Grade V5-R—Liquid Test**

*Table 7: The title shall be changed to the following:*

#### **Grade V5-R —Liquid Test**

*Section 6.5.6.4: The title shall be changed to the following:*

#### **Grade V4-R—Liquid Plus Axial Load Test**

*Table 8: The title shall be changed to the following:*

#### **Grade V4-R—Liquid Plus Axial Load Test**

*Section 6.5.6.5: The title shall be changed to the following:*

#### **Grade V3-R —Liquid Plus Axial Loads Plus Temperature Cycling Test**

*Table 9: The title shall be changed to the following:*

#### **Grade V3-R —Liquid Plus Axial Loads Plus Temperature Cycling Test**

*Section 6.5.6.6: The title shall be changed to the following:*

#### **Grade V2-R —Gas Plus Axial Load Test**

*Table 10: The title shall be changed to the following:*

#### **Grade V2-R —Gas Plus Axial Load Test**

*Section 6.5.6.7: The title shall be changed to the following:*

**Grade V1-R —Gas Plus Axial Loads Plus Temperature Cycling Test**

*Table 11: The title shall be changed to the following:*

**Grade V1-R —Gas Plus Axial Loads Plus Temperature Cycling Test**

*Section 6.5.6.8: The title shall be changed to the following:*

**Grade V0-R —Gas Plus Axial Loads Plus Temperature Cycling Test Plus Zero Bubble Acceptance Criterion**

*Table 12: The title shall be changed to the following:*

**Grade V0-R —Gas Plus Axial Loads Plus Temperature Cycling Test Plus Zero Bubble Acceptance Criterion**

*Section 6.5.6.9: The first paragraph, second paragraph, and NOTE shall be replaced with the following:*

For validation grades V0-R, V1-R, and V3-R where the low temperature rating was not validated during the temperature-cycle range test, the low temperature rating of the product shall be validated using Method A or B. Low temperature rating validation is not required for validation grades V2-R, V4-R, V5-R, and V6-R. See 6.3.4.3 for temperature-cycle range and temperature range.

*Section 6.5.6.9: The content under item a) shall be replaced with the following:*

The low temperature rating shall be validated by product testing per the requirements of 6.5.6.5 (V3-R), 6.5.6.7 (V1-R), or 6.5.6.8 (V0-R). The low temperature rating is the lowest temperature achieved during the temperature-cycle range test.

To achieve a lower low temperature rating, additional V0-R, V1-R, or V3-R validation tests shall be conducted. The product shall be set at or above the specified minimum rated temperature plus the temperature-cycle range.

**EXAMPLE** A product was tested multiple times under the requirements of V0-R validation testing with the following temperature-cycle ranges achieved: 50 °F to 200 °F and 250 °F to 350 °F. The published temperature range of the product is 50 °F to 350 °F, and the temperature-cycle range is 100 °F.

*Section 6.5.6.9: Item c) shall be removed.*

*Section 6.8.1: The section shall be replaced with the following:*

Scaling may be used to validate variations in a product family in accordance with the requirements and limitations of 6.8.2.

Each scaled product requires design verification, evaluation, and justification that the scaled design meets the requirements of this section. The design scaling activities shall be included in the design documentation and shall be approved by a qualified person other than the person who performed the design.

*Section 6.8.2: The section shall be replaced with the following:*

The limitations for scaling are as follows:

- a) The supplier/manufacturer shall establish the minimum design margin within the previously validated design type 1 components and in the same components of the scaled design. The mode of stress and same method of calculation(s)/verification(s) shall be applied to the identified type 1 components of the validated design and the scaled design. For the type 1 component with the lowest design margin, the scaled design's design margin shall not be less than the design margin of the same component of the validated design.
- b) The scaled design shall not be rated for IDs larger than the rated ID for the previously validated product.
- c) Packing elements and antiextrusion components shall have the same material specifications and drawing dimensions as the previously validated product.
- d) The ID of the packing element(s) and OD of the component under the packing element(s) shall be the same as the previously validated product.
- e) Scaling shall not be used to validate products with higher pressure ratings, a higher temperature rating, a larger temperature range, a larger temperature-cycle range, higher axial load ratings, higher combined loads, or to a higher validation grade than the previously validated product.

*Section 7.2.1: The first paragraph shall be changed to the following:*

The supplier/manufacturer shall establish and maintain documented procedures in conformance to API Q1 to control all documents and data that relate to the requirements of this specification. All documents and data shall be available to, and auditable by, the user/purchaser.

*Section 7.2.3: Items n), o), p), and u) shall be updated with the following:*

- n) temperature-cycle range for V3-R, V3, V1-R, V1, V0-R, V0, V3-HR, and V0-HR;
- o) rated performance envelope for V4 through V0, and V4-R through V0-HR;
- p) pressure rating for V6-R, V6, V5-R and V5;
- u) maximum conveyance OD, inclusive of running/repositioning equipment;

*Section 7.2.3: Items bb) through ff) shall be updated with the following:*

- bb) edition and specification or industry standard under which the original validation test was conducted;
- cc) validation test number;
- dd) low temperature rating validation, Method A, Method B, or Method C;

NOTE Method C only applies to legacy products per Annex A.

- ee) seal diameter;
- ff) hydrostatic setting pressure range;

*Section 7.3: Item e) shall be updated with the following:*

- e) API 11D1 and design validation grade;

Section 7.4.1: The opening paragraph shall be changed to the following:

Products shall be supplied to at least the quality level specified. When no quality level is selected by the user/purchaser, a minimum of QL3 shall be supplied. Quality requirements are detailed in 7.4.2 through 7.4.17 and summarized in Table 13. Where there are no requirements listed in 7.4.2 through 7.4.17, the word “None” appears in Table 13.

Table 13: The “Metallic material” row shall be updated as indicated in the red box:

Item	Quality Level <sup>a</sup>		
	QL3	QL2	QL1
Metallic material	COC or MTR	MTR for type 1 components COC or MTR for type 2 components	MTR for type 1 components COC or MTR for type 2 components

Table 13: The Component NDE section shall be updated as indicated in the red boxes:

Component NDE			
Type 1 components	Visual	Surface NDE per sampling plan	Surface NDE 100 % Ultrasonic inspection of raw material
Type 2 components	Visual	Visual	Visual
Nonmetallic components	Visual	Visual	Visual

Table 13: The Assembly Verification section shall be updated as indicated in the red boxes:

Assembly Verification			
Assembly verification	None	Functional test ID drift Visual	Functional test ID drift Visual OD dimensional Torque documentation

Section 7.4.7: Item c) shall be removed.

Section 7.4.7: The following shall be added after the bulleted list:

Components that are castings, or are manufactured from castings, do not require traceability for levels QL3 and QL2.

Section 7.4.9: Item c) shall be removed.

Section 7.4.9: The following shall be added after the bulleted list:

Additionally, welding of type 1 components for NACE service products shall meet the requirements of ANSI/NACE MR0175/ISO 15156.

*Section 7.4.10: Item c) shall be removed.*

*Section 7.4.10: The following shall be added after the bulleted list:*

Type 2 components do not require hardness inspection.

*Section 7.4.11: Item e) 1) shall be changed to the following:*

Wet magnetic particle examinations shall be conducted per ISO 10893-5 or ASTM E709. Indications shall be described as one of the following:

*Section 7.4.11: Item e) 2) shall be changed to the following:*

Liquid penetrant examinations shall be conducted per ISO 10893-4 or ASTM E165 with acceptance criteria of:

*Section 7.4.11: Item j) shall be changed to the following:*

Type 1 metallic components and welds for quality level QL3 shall be visually inspected per the supplier/manufacturer-documented specifications.

*Section 7.4.11: Item k) shall be changed to the following:*

Type 2 metallic components shall be visually inspected per the supplier/manufacturer-documented specifications.

*Section 7.4.12: Item a) shall be updated with the following:*

a) method—in accordance with ASTM E127 and ASTM A388;

*Section 7.4.14.1: In the last paragraph, the last sentence shall be changed to the following:*

Observed damage shall be documented in the functional test documentation and evaluated for acceptance.

*Section 7.4.14.2: In item a), the first sentence shall be changed to the following:*

For quality level QL1, an internal pressure test shall be performed on each product by pressurizing to a minimum of 50 % of the equipment internal to external differential rating or the minimum rated setting pressure, whichever is greater, for hydraulically set products using either liquid or gas as the test medium.

*Section 7.4.14.2: Item e) shall be changed to the following:*

For quality level QL1, when required by the supplier/manufacturer-documented specifications, actual torque values for metal-to-metal sealing connections shall be recorded and verified. End connections are specifically excluded from this requirement.

*Section 7.4.14.3: Items g) and h) shall be changed to the following:*

g) results of specific evaluations, as defined by the supplier/manufacturer such as:

- 1) operational tools used;
- 2) special features;

h) test fixtures, test fluids, and, if applicable, lubricants;

*Section 7.4.15: The first and second paragraphs shall be changed to the following:*

Testing, measuring, monitoring, and detection equipment with verifiable accuracies equal to or better than those listed in this specification may be applied with appropriate documentation and when approved by a qualified person.

*Annex A (normative), Requirements for Legacy Products, has been added.*

*Annex B: The annex type shall be changed from “informative” to “normative”.*

*Section B.1: The section shall be replaced with the following:*

This annex shall be used when a user/purchaser specifies a product validation grade of V0-HR or V3-HR from this specification. The requirements specified in this annex are in addition to Sections 1 through 9 of this specification.

Activities required by this annex shall be performed by a qualified person(s). All results shall conform to the acceptance criteria and be supported by approved documentation.

This annex can be specified by the user/purchaser for packers and bridge plugs for use in HPHT environments with a pressure rating greater than 103.4 MPa (15,000 psi) or with a temperature rating greater than 177 °C (350 °F). This annex can be specified by the user/purchaser for non-HPHT products.

This annex was developed considering the guidelines of API 1PER15K-1.

*Section B.2: The second sentence shall be replaced with the following:*

The functional specification may include user/purchaser-defined internal test pressure requirements (see B.5.3), type and scope of failure modes and effects analysis (FMEA) and required participation (see B.3.3.3), and required load factors for finite element analysis (FEA) at rated conditions (see B.3.2.2).

*Section B.3.1.1.1: The second sentence shall be changed to the following:*

The test material samples shall be taken from heat(s) representative of those to be used for the intended components and shall be removed from midwall or midradius unless the equipment supplier/manufacturer determines that an alternate testing location is required.

*Section B.3.1.2.1 a): The second paragraph shall be changed to the following:*

NOTE Ageing testing may require agreement between the user/purchaser and the supplier/manufacturer for test fluid(s), test temperatures, test pressures, test times, specimen shape, and trapped gas.

*Section B.3.1.2.2: The second paragraph shall be changed to the following:*

For thermoplastic materials, the supplier/manufacturer specification shall include requirements and acceptance criteria for the following parameters listed in Table B.1, as applicable.

*Table B.1: The table header shall be updated as indicated by the red box:*

Parameter	Standards
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*Section B.3.3.4.1: The section shall be changed to the following:*

This section contains the requirements for design validation of products for use in HPHT environments and contains two grades of design validation, V0-HR and V3-HR.

*Section B.3.3.4.2: The opening sentence shall be changed to the following:*

The supplier/manufacturer shall adhere to the requirements of 6.5 and to the following test parameters and criteria for conformance to validation grade V0-HR or V3-HR.

*Section B.3.3.4.4: The opening paragraph shall be changed to the following:*

Each product design shall be successfully tested in each of the following test phases (1, 2, and 3). This applies to products in conformance with validation grades V0-HR and V3-HR as identified in each phase.

*Section B.3.3.4.4: The NOTE shall be changed to the following:*

NOTE As stated in 6.3.4.3, there is only one temperature-cycle range rating for a validated product. Where the temperature-cycle range in test phases 1, 2, and 3 are different, the final rated temperature-cycle range of the product is the smallest of the validated temperature-cycle ranges.

*Section B.3.3.4.5, the title shall be updated with the following:*

**Validation Testing Process, Grades V3-HR and V0-HR, Phase 1 (Maximum ID/Maximum Temperature)**

*Section B.3.3.4.5: The second sentence shall be changed to the following:*

The test media for grade V3-HR shall be liquid per Table 6; the test media for grade V0-HR shall be gas per Table 6.

*Table B.2: The title shall be changed to the following:*

**Grades V3-HR and V0-HR, Phase 1—Validation Testing Process, Maximum ID/Maximum Temperature**

*Table B.2: In step b), Procedure and Acceptance Criteria column, the first paragraph shall be changed to the following:*

For products with an atmospheric pressure chamber assembly configured with all design features for primary hydrostatic set (such as rupture discs, shear pins, etc.), a pressure hold of the atmospheric pressure chamber assembly shall be performed to a minimum of 80 % of the minimum rated setting pressure [see step c)] for a minimum of 30 minutes at the maximum rated temperature. This pressure is applied to the inside and outside of the product simultaneously.

*Table B.2: In step d), Procedure and Acceptance Criteria column, the Acceptance Criteria titles shall be changed to the following:*

**Acceptance criteria for V3-HR:**

**Acceptance criteria for V0-HR:**



*Table B.2: In step e), Procedure and Acceptance Criteria column, the Acceptance Criteria titles shall be changed to the following:*

**Acceptance criteria for V3-HR:**

**Acceptance criteria for V0-HR:**

*Table B.2: In step f), Procedure and Acceptance Criteria column, the Acceptance Criteria titles shall be changed to the following:*

**Acceptance criteria for V3-HR:**

**Acceptance criteria for V0-HR:**

*Table B.2: In step g), Procedure and Acceptance Criteria column, the Acceptance Criteria titles shall be changed to the following:*

**Acceptance criteria for V3-HR:**

**Acceptance criteria for V0-HR:**

*Table B.2: In step i), Procedure and Acceptance Criteria column, the Acceptance Criteria titles shall be changed to the following:*

**Acceptance criteria for V3-HR:**

**Acceptance criteria for V0-HR:**

*Section B.3.3.4.6: The title shall be changed to the following:*

**Validation Testing Process, Grades V3-HR and V0-HR, Phase 2 (Maximum ID/Minimum Temperature)**

*Section B.3.3.4.6: The second sentence shall be changed to the following:*

The test media for grade V3-HR shall be liquid per Table 6; the test media for grade V0-HR shall be gas per Table 6.

*Table B.3, the title shall be changed to the following:*

**Grades V3-HR and V0-HR, Phase 2—Validation Testing Process, Maximum ID/Minimum Temperature**

*Table B.3: In step b), Procedure and Acceptance Criteria column, the first paragraph shall be changed to the following:*

For products with an atmospheric pressure chamber configured with all design features for primary hydrostatic set (such as rupture discs, shear pins, etc.), a pressure hold of the atmospheric pressure chamber assembly shall be performed to a minimum of 80 % of the minimum rated setting pressure [see step c)] for a minimum of 30 minutes at the minimum rated temperature. This pressure is applied to the inside and outside of the product simultaneously.

*Table B.3: In step d), Procedure and Acceptance Criteria column, the Acceptance Criteria titles shall be changed to the following:*

**Acceptance criteria for V3-HR:**

**Acceptance criteria for V0-HR:**

*Table B.3: In step e), Procedure and Acceptance Criteria column, the Acceptance Criteria titles shall be changed to the following:*

**Acceptance criteria for V3-HR:**

**Acceptance criteria for V0-HR:**

*Table B.3: In step g), Procedure and Acceptance Criteria column, the Acceptance Criteria titles shall be changed to the following:*

**Acceptance criteria for V3-HR:**

**Acceptance criteria for V0-HR:**

*Table B.3: In step i), Procedure and Acceptance Criteria column, the Acceptance Criteria titles shall be changed to the following:*

**Acceptance criteria for V3-HR:**

**Acceptance criteria for V0-HR:**

*Section B.3.3.4.7, the title shall be changed to the following:*

**Validation Testing Process, Grades V3-HR and V0-HR, Phase 3 (Maximum ID/Minimum Temperature)**

*Section B.3.3.4.7, the second sentence shall be changed to the following:*

The test media for grade V3-HR shall be liquid per Table 6; the test media for grade V0-HR shall be gas per Table 6.

*Table B.4, the title shall be updated with the following:*

**Grades V3-HR and V0-HR, Phase 3—Validation Testing Process, Minimum ID/Maximum Temperature**

*Table B.4: In step d), Procedure and Acceptance Criteria column, the Acceptance Criteria titles shall be changed to the following:*

**Acceptance criteria for V3-HR:**

**Acceptance criteria for V0-HR:**

*Table B.4: In step f), Procedure and Acceptance Criteria column, the Acceptance Criteria titles shall be changed to the following:*

**Acceptance criteria for V3-HR:**

**Acceptance criteria for V0-HR:**

*Section B.3.3.5.1: The section shall be changed to the following:*

The scaling of validated product designs shall conform to the requirements of 6.8, and the following.

*Section C.2: In the second paragraph, the first sentence shall be changed to the following:*

Design verification by evaluation shall include activities such as design reviews, design calculations, comparison with similar designs, and historical records of defined operating conditions (see API Q1).

*Section C.3.4: The fourth paragraph shall be changed to the following:*

During validation testing of hydraulically operated tools, fluid metering may be used to provide readable control signals during the testing to simulate downhole conditions.

*Section C.3.5: The section shall be changed to the following:*

Except for tools from alternate suppliers (see C.3.2), a final report shall be prepared and approved by qualified personnel and shall be retained as part of the design documentation for the product. The report shall include the following information at a minimum:

- a) identification of product supplier/manufacturer;
- b) test facility name and location;
- c) date(s) testing was conducted;
- d) date and unique identification of the validation test report;
- e) validation test performed and summary of results, including comparison to supplier/manufacturer acceptance criteria;
- f) identification of the validation test procedures used and records required (see 6.5.4);
- g) equipment type, size, description, and model;
- h) product identification;
- i) serial number, as applicable;
- j) drawings and/or documents that show applicable dimensions and tolerances of components, and material specifications, including revisions;
- k) traceability records for components in the validation-tested product, if applicable;
- l) results of specific inspections and tests with acceptance criteria evaluation and acceptance justification, such as:
  - 1) photograph(s) and/or visual inspections, including any evidence of malfunction(s), anomalies, or damage;
  - 2) pre-test and post-test dimensional inspection of critical operational areas, as determined by the supplier/manufacturer;
- m) remarks (describing any nonspecified equipment or procedures requested by the manufacturer, unusual conditions observed during test, etc.).

Section C.6.1: The section shall be changed to the following:

Operational tools shall be manufactured to the requirements of 7.4 (as applicable and as determined by the supplier/manufacturer) with a minimum of quality level QL3.

Table E.1: In step a), the second sentence shall be updated as indicated in the red box:

Step	Procedure and Acceptance Criteria	Data to Be Recorded
a)	Assemble the product with the hydrostatic setting device and perform pre-test inspection. The test media shall be in accordance with <span style="border: 1px solid red; padding: 2px;">Table 6.</span>	<ul style="list-style-type: none"> <li>— Product identification</li> <li>— Date</li> <li>— Description of test media</li> <li>— Inspection results</li> </ul>

Table E.1: In step c), the table shall be updated as indicated in the red box:

c)	Perform a validation grade <span style="border: 1px solid red; padding: 2px;">V4-R</span> or higher test with the exception of setting at minimum rated setting force or pressure, per step b).	— Reference applicable validation grade test table
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Section F.2.3.2: The equations after the second paragraph shall be updated as indicated in the red boxes::

$$\pi / 4 \times (OD_{\max}^2 - ID_{\max}^2) \times \rho$$

$$\pi / 4 \times (OD_{\text{nom}}^2 - ID_{\text{nom}}^2) \times \rho \times 0.965$$

Section F.2.3.3: The equations after the second paragraph shall be updated as indicated in the red boxes:

$$\pi / 4 \times (OD_{\min}^2 - ID_{\min}^2) \times \rho$$

$$\pi / 4 \times (OD_{\text{nom}}^2 - ID_{\text{nom}}^2) \times \rho \times 1.065$$

Section G.1: The first sentence of the second paragraph shall be changed to the following:

There may be variation on how rated performance envelopes are generated with respect to which seal diameters (see 3.29) are used for the underlying analysis behind the rated performance envelopes.

Section G.4: The fourth paragraph shall be changed to the following:

Hydraulic effects acting on the tubing, identified by the hydraulic area up to the seal diameter, should be included when calculating the tubing-to-packer forces.