International Association of Oil & Gas Producers

SPECIFICATION
S-561J

November 2022

Supplementary Specification to API Specification 17D Subsea Wellhead and Tree Equipment

NOTE This version (S-561J) of the specification document provides the justification statements for each technical requirement, but is otherwise identical in content to S-561.

JIP33 JOINT INDUSTRY PROGRAMME

Revision history

VERSION	DATE	PURPOSE
3.1	November 2022	Issued for Public Review
3.0	December 2018	Third Edition
2.0	November 2016	Second Edition
1.0	September 2016	First Edition

Acknowledgements

This IOGP Specification was prepared by a Joint Industry Programme 33 Standardization of Equipment Specifications for Procurement organized by IOGP with support by the World Economic Forum (WEF).

Foreword

This specification was prepared under Joint Industry Programme 33 (JIP33) "Standardization of Equipment Specifications for Procurement" organized by the International Oil & Gas Producers Association (IOGP) with the support from the World Economic Forum (WEF). Companies from the IOGP membership participated in developing this specification to leverage and improve industry level standardization globally in the oil and gas sector. The work has developed a minimized set of supplementary requirements for procurement, with life cycle cost in mind, resulting in a common and jointly agreed specification, building on recognized industry and international standards.

Recent trends in oil and gas projects have demonstrated substantial budget and schedule overruns. The Oil and Gas Community within the World Economic Forum (WEF) has implemented a Capital Project Complexity (CPC) initiative which seeks to drive a structural reduction in upstream project costs with a focus on industry-wide, non-competitive collaboration and standardization. The CPC vision is to standardize specifications for global procurement for equipment and packages. JIP33 provides the oil and gas sector with the opportunity to move from internally to externally focused standardization initiatives and provide step change benefits in the sector's capital projects performance.

This specification has been developed in consultation with a broad user and supplier base to realize benefits from standardization and achieve significant project and schedule cost reductions.

The JIP33 work groups performed their activities in accordance with IOGP's Competition Law Guidelines (November 2020).

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Introduction

The purpose of this specification is to define a minimum common set of supplementary requirements for procurement of subsea trees to API Specification 17D, Third Edition, October 2021, Specification for Subsea Wellhead and Tree Equipment for application in the petroleum and natural gas industries.

This specification follows a common document structure comprising the four documents as shown below, which together with the purchase order define the overall technical specification for procurement.

JIP33 Specification for Procurement Documents
Supplementary Technical Specification

This specification is to be applied in conjunction with the supporting procurement data sheet, information requirements specification (IRS) and quality requirements specification (QRS) as follows.

IOGP S-561: Supplementary Specification to API Specification 17D Subsea Wellhead and Tree Equipment

This specification defines the technical requirements for the supply of the equipment and is written as an overlay to API Specification 17D, following the API Specification 17D clause structure. Clauses from API Specification 17D not amended by this specification apply as written to the extent applicable to the scope of supply.

Modifications to API Specification 17D defined in this specification are identified as Add (add to clause or add new clause), Replace (part of or entire clause) or Delete.

IOGP S-561D: Procurement Data Sheet for Subsea Trees (API)

The procurement data sheet defines application specific requirements, attributes and options specified by the purchaser for the supply of equipment to the technical specification. The procurement data sheet may also include fields for supplier provided information attributes subject to purchaser's technical evaluation. Additional purchaser supplied documents may also be incorporated or referenced in the procurement data sheet to define scope and technical requirements for enquiry and purchase of the equipment.

IOGP S-561L: Information Requirements for Subsea Trees (API)

The IRS defines the information requirements, including contents, format, timing and purpose to be provided by the supplier. It may also define specific conditions which invoke information requirements.

IOGP S-561Q: Quality Requirements for Subsea Trees (API)

The QRS defines quality management system requirements and the proposed extent of purchaser conformity assessment activities for the scope of supply. Purchaser conformity assessment activities are defined through the selection of one of four generic conformity assessment system (CAS) levels on the basis of evaluation of the associated service and supply chain risks. The applicable CAS level is specified by the purchaser in the data sheet or in the purchase order.

The terminology used within this specification and the supporting procurement data sheet, IRS and QRS follows that of API Specification 17D and is in accordance with ISO/IEC Directives, Part 2 as appropriate.

The procurement data sheet and IRS are published as editable documents for the purchaser to specify application specific requirements. The supplementary specification and QRS are fixed documents.

The order of precedence (highest authority listed first) of the documents shall be:

a) regulatory requirements;

b) contract documentation (e.g. purchase order);

c) purchaser defined requirements (procurement data sheet, IRS, QRS);

d) this specification;

e) API Specification 17D.

2 Normative References

Add to section

API Recommended Practice 17N, *Recommended Practice on Subsea Production System Reliability, Technical Risk, and Integrity Management*

ASTM A370, *Standard Test Methods and Definitions for Mechanical Testing of Steel Products.*

DIN 3015-1, *Fastening clamps – Block clamps*

DNVGL-RP-0034, *Steel forgings for subsea applications - technical requirements*

DNVGL-RP-B202, *Steel forgings for subsea applications - quality management requirements*

DNVGL-RP-O101, *Technical documentation for subsea projects*

EN 10204, *Metallic products —Types of inspection documents*

ISO 8434-2, *Metallic tube connections for fluid power and general use — Part 2: 37° flared connectors*

SAE J514, *Metallic Connections for Fluid Power and General Use - Part 1: 37 Degree Flared Fittings*

3 Terms, Definitions, Acronyms, Abbreviations, and Symbols

3.1 Terms and Definitions

Add new term 3.1.77

3.1.77
tubing hanger annulus isolation device
THAID
Mechanically or hydraulically actuated temporary barrier element in the annulus flow path of a tubing hanger, replacing the annulus wireline plug during well construction and workover for tubing hangers installed in a wellhead.

Add new term 3.1.78

3.1.78
annulus vent valve
AVV
Valve that provides, in addition to the XOV, a second pressure closure to production flow and that is present when the XOV connection to the annulus side is outboard of the AWV.

NOTE Refer to annulus Configuration #1 in Figure 1, Figure 2 and Figure 3.

Add new term 3.1.79

3.1.79
production isolation valve
PIV
Valve that can isolate the production flow and that is downstream of the production choke.

Add new term 3.1.80

3.1.80
provision

Status or condition of a standard design being such that a particular feature can be included as an option, but that feature may only be included in any particular configuration if that option is specified in the data sheet.

3.2 Acronym, Abbreviations, and Symbols

Add to section

AVV annulus vent valve

BPT between plug test (alternatively known as cavity above lower plug or cavity below upper plug)

CP cathodic protection

CIV chemical injection valve

JIC Joint Industry Council (fittings)

LCP lower crown plug

LP low pressure

PIV production isolation valve (alternatively known as flowline isolation valve, pipeline isolation valve, FIV or FLIV)

PTT pressure temperature transducer

SCM subsea control module

SDSS super duplex stainless steel

TH tubing hanger

THAID tubing hanger annulus isolation device

TRL technology readiness level

UCP upper crown plug

SCMMB subsea control module mounting base

4 Application, Service Conditions, and Production Specification Levels

4.1 Application

Delete list item b)

Justification

This list item is deleted due to subsea wellheads not being within the intended scope of this specification.

Delete list item c)

Justification

This list item is deleted due to mudline suspension systems not being within the intended scope of this specification.

Delete list item d)

Justification

This list item is deleted due to drill-through mudline suspension systems not being within the intended scope of this specification.

Add new NOTE 3

NOTE 3 Additional requirements defined by the purchaser (beyond the requirements contained in this specification and associated data sheet selections) are necessary to fully specify the complete subsea tree system design beyond the aspects of tree system design that are defined by supplier standard designs/configurations.

Justification

The scope of this specification is not sufficiently detailed to fully specify a tree system, therefore additional specification by the purchaser is expected. The focus of the document is only the standardization of core tree design requirements that drive the standardization of the core tree within a range of selectable configurations that can be specified by the associated data sheet. This specification does not provide the full extent of the detailed and requirements based on the purchaser's project requirement. The purchaser needs to define the additional project requirement in line with this specification and also consider impact of the additional requirements on the supplier's standard/stock design configurations. Suppliers have also reported receiving requests to supply trees to S-561 without providing the necessary additional requirements.

Add after NOTE 2

This specification covers tree systems configured for a single jumper connection for production (injection) and annulus service, used in a satellite or cluster field configuration, configured for guidelineless installation and designed for operating at water depths up to 10,000 ft (3000 m).

Justification

The scope of this specification is not sufficiently detailed to fully specify a tree system, therefore additional specification by the purchaser is expected. The focus of the document is only on the standardization of the core tree design requirements.

Add to subsection

The scope of this specification excludes the following:

— all-electric subsea trees (i.e. trees without hydraulics);

— subsea wellheads;

— mudline suspension systems;

— drill-through mudline suspension systems.

Justification

The scope of the specification is required to be in alignment with the agreed frame and these exclusions are out of the approved scope for this specification.

4.3 Product Specification Levels

Add after third paragraph

Production and gas injection tree components exposed to retained fluids shall be PSL 3G.

Justification

PSL 3 and PSL 3G are the service ratings used in subsea applications. PSL 3G is required for gas services such as production and gas injection trees.

Add after third paragraph

Water injection tree components shall be specified as either PSL 3 or PSL 3G.

Justification

PSL 3 and PSL 3G are the service ratings used in subsea applications. PSL 3G is required for gas services only. Suppliers would offer their standard products (PSL 3 or PSL 3G) for non-gas service such as water injection trees. This allows suppliers to use their standards instead of standardizing a more stringent PSL 3G rating when it is not needed.

5 Common System Requirements

5.1 Design and Performance Requirements

5.1.1 General

5.1.1.1 Product Capability

Add to subsection

If specified, components, equipment and assemblies that can be defined as new or modified technology shall have a TRL in accordance with the requirements of API 17N.

Justification

This requires TRLs to be documented in accordance with the commonly used API 17N standard (rather than API 17Q) to allow purchasers to consistently assess technology readiness and risk level for qualification or validation program requirements.

5.1.1.3 Thermal Integrity

In list item b), replace "the minimum transitional operating temperature" with

46 °C (-50 °F) as per ASTM A370

Justification

This requirement provides the standard temperature for the performance of Charpy testing that is in alignment with existing industry operating range, is common practice, and satisfies major use cases. Not having this requirement could cause different purchasers to specify different requirements for different projects and prevent standardization.

Add to subsection

Transitional low-temperature effects shall be addressed for pressure-containing and pressure-controlling components downstream of the choke (e.g. the choke body, components out to and including the tree tie-in hub, flange or connector, and components such as valve bonnets, stems and bonnet bolting), excluding actuator or manual operator components outboard of the bonnet.

Justification

This requirement provides clarification on the extent of low-temperature validation required and limits its scope to components downstream of the choke. Not having this requirement could cause different interpretations and (in the worst case) the purchaser could require the entire subsea tree system to be assessed for transitional low-temperature effects.

Add to subsection

Transitional low-temperature effects shall be addressed for metallic pressure-containing and pressure-controlling components using either the method described in 5.1.1.3 a) or the one described in 5.1.1.3 b).

Justification

The means of verifying low-temperature performance are limited to either component validation across the required temperature range or performance of Charpy testing to positively confirm performance capabilities. This requirement offers quantifiable acceptance criteria for temperature performance validation of pressure-containing and pressure-controlling metallic components. The alternative would be a reliance on "documentation supporting suitability" which is subjective and not quantifiable.

Add to subsection

Transitional low-temperature effects shall be addressed for non-metallic components using either the method described in 5.1.1.3 a) or the one described in 5.1.1.3 c).

Justification

The means of verifying the low-temperature performance of non-metallic materials are clarified to exclude the use of Charpy impact testing since that method is not viewed as a relevant validation method for pressure-containing/pressure-controlling non-metallics.

Add to subsection

Where the method described in 5.1.1.3 b) is used for carbon and low alloy steel, Charpy validation acceptance criteria shall be in accordance with DNV-RP-0034.

Justification

With this requirement, Charpy impact testing is conducted using established industry standard acceptance criteria to facilitate acceptance for common use cases. This also aligns with the intention to use DNV-RP-0034 forging and avoid confusion with the use of other industry standards.

Add to subsection

Where the method described in 5.1.1.3 b) is used for metallic material other than carbon and low-alloy steel, Charpy validation acceptance criteria shall be from the applicable industry standards for that material.

Justification

With this requirement, Charpy impact testing is conducted using established industry standard acceptance criteria to facilitate acceptance for majority and common use cases. This requirement drives standardization by covering other materials which may follow other industry standards and provides clear guidance on acceptance criteria.

5.1.1.4 Materials

Add to subsection

Pressure-containing components exposed to well bore fluids in the production flow path inboard of the isolation valve on tree chemical injection ports and below the PSV or LCP shall be material class HH, except for penetrations into the tree and tubing hanger between the UCP and LCP and associated isolation valve.

Justification

The specification of material class HH (with certain specified exceptions) for wellbore-contact pressure-containing components drives the standardization of core tree design to satisfy the majority or common standard use cases. Class HH is the most reliable and suitable for service conditions and relative corrosivity compared to other material classes.

Add to subsection

For a vertical tree, material class HH shall be used for the full production bore above the PSV, up to and including the tree cap seal surface when the tree cap isolates the production bore or for the full production bore above the PSV, up to and including the production bore re-entry stab sealing surface when the tree cap does not isolate the production bore.

Justification

There is a need to define the boundary limit of this requirement toward vertical tree to avoid confusion and misapplication of this specification. The area defined in this requirement is pressure-containing components exposed to wellbore production fluids. The specification of material class HH (with certain specified exceptions) for wellbore-contact pressure-containing components drives the standardization of core tree design to satisfy standard use case requirements.

Add new NOTE 1

NOTE 1 SDSS components may be proposed for use for sensor flanges and housings, flow loops and small-bore injection isolation valves where project specific fluid properties allow.

Justification

The specification of material class HH (with certain specified exceptions) for wellbore-contact pressure-containing components drives the standardization of core tree design to satisfy common standard use cases requirement. This is the most reliable and suitable mean for the service conditions and relative corrosivity compared to other material classes. This note provides commonly utilized exceptions (to the use of CRA) for lesser-exposure service conditions due to fluid properties to leverage OEM's/suppliers' standard offerings.

Add to subsection

The annulus and other pressure-containing components within the annulus flow path shall be at least material class EE.

Justification

The area defined in this requirement is pressure-containing components exposed to wellbore annulus fluids which is typically more or less corrosive compared to wellbore production fluids. The specification of material class EE allows for a less stringent material class to take into consideration fluid properties and avoid over specification. This also drives standardization of core tree design to satisfy common standard use cases requirement.

Add new NOTE 2

NOTE 2 Penetrations into the tree and tubing hanger between the UCP and LCP and associated isolation valve may be material class EE.

Justification

This note specifies the exception to material class HH for this specific area where material class HH is not needed to drive standardization of core tree design and allow suppliers to offer their standard solution.

Add to subsection

All metal-to-metal sealing surfaces on pressure-containing or pressure-controlling components within the annulus flow path shall be manufactured from, or inlaid with, a corrosion-resistant alloy.

Justification

The area defined in this requirement is the metal-to-metal sealing surfaces contact area which needs to be corrosion-resistant to meet the expected integrity level. The specification of material class EE (with certain specified exceptions) for wellbore-contact pressure-containing components drives standardization of core tree design to satisfy common standard use cases requirement.

Add to subsection

Chemical injection porting through tree and tubing hanger bodies shall be at least material class EE from the production or annulus bore intersection out to the isolation.

Justification

This requirement allows material class EE for small-bore porting through XT and TH bodies. This is driven by the fact that injection chemical exposure is generally compatible with material class EE and the inability to the sleeve or clad some cross-drilled porting arrangements through XT or TH standard designs. Specification of material class EE for injection porting through XT and TH bodies drives standardization of core tree design to satisfy common standard use cases requirement.

Add to subsection

Seal preps, couplers and isolation valve trim shall be at least material class EE for downhole chemical injection ports.

Justification

This requirement allows material class EE for downhole chemical injection ports. This is driven by the fact that injection chemical exposure is generally compatible with material class EE and the inability to sleeve or clad some cross-drilled porting arrangements through XT and TH standard designs. The use of material class EE at a minimum meets the essential minimum for the expected services while allowing (through the data sheet) projects to specify material class suitable for the specific services at hand. The options for material classes FF and HH are provided in the data sheet to cover the purchaser's project requirement if needed. The specification of material class HH for chemical injection line components addresses the risk of seal/fitting/coupler leaks due to corrosion on critical sealing surfaces from exposure to retained fluids and for purpose of standardization of core tree design to satisfy common standard use case requirements.

Add to subsection

Fittings and tubing shall be at least material class FF for downhole chemical injection ports.

Justification

This requirement allows material class FF for downhole chemical injection fitting and tubing. This is driven by the fact that the injection chemical exposure is generally compatible with material class FF and usually made from stainless steel material. The use of material class FF at a minimum meets the essential minimum for the expected services while allowing (through the data sheet) projects to specify material class suitable for the specific services at hand. The specification of material class HH for chemical injection line components addresses the risk of seal/fitting/coupler leaks due to corrosion on critical sealing surfaces from exposure to retained fluids and for purpose of standardization of core tree design to satisfy common standard use case requirements.

Add to subsection

Provision shall be made for one downhole chemical injection port to be full HH trim through both the tree and tubing hanger including seal preps, couplers, fittings and isolation valve.

Justification

This provision covers the purchaser's project requirement where a corrosive chemical is used for downhole injection which requires uprated material class HH. There have been reports of cases of corrosion on this injection line due to a corrosive chemical. This specification of material class HH for chemical injection line components addresses the risk of seal/fitting/coupler leaks due to corrosion on critical sealing surfaces. It also allows data sheet selection of one downhole chemical injection line to be full HH trim due to the common potential for injected chemicals to be incompatible with the TH/XT base metal.

Add to subsection

Tree and suspension equipment re-entry sealing surfaces shall be of corrosion resistant material.

Justification

The area defined in this requirement is the metal-to-metal sealing surfaces contact area which needs to be resistant to corrosion to ensure integrity. The specification of corrosion-resistant material for wellbore-contact pressure-containing components drives standardization of core tree design to satisfy common standard use case requirements.

5.1.3 Design Methods and Criteria

Add to subsection

Values and methods, including supporting validations, for make-up tension (or torque) for closure bolting and critical bolting shall be available at the manufacturer's site for review upon request.

Justification

The verification of bolt make-up is necessary to ensure correct preload remains on connections after the maximum test pressure that the bolts see during connection assembly, i.e. this may be a shell test.

Add to subsection

If the values in Annex F are used for bolt torque make-up, all requirements in Annex F shall be fulfilled.

Justification

The use of Annex F tables is only acceptable when the coefficient of friction in the application is aligned with the coefficient of friction on which the Annex F table values are based. So the coefficient of friction of the equipment needs to be validated to be aligned with the coefficient of friction assumed present by the values in Annex F. The validation of bolt make-up is necessary to ensure the accuracy of the applied torque to maintain stress values within design allowable and to ensure the generation of correct preload.

Add to subsection

For pressure-containing bolting, a validated process shall be used to provide indication of bolt make-up after final assembly of that bolted connection and again after the test with the highest pressure that the assembled bolted joint is subjected to during testing.

Justification

The verification of bolt make-up is necessary to ensure that the correct preload remains on connections after the maximum test pressure that the bolts is subjected to after connection assembly, i.e. this may be a shell test.

Add new subsection

5.1.3.8 Seal Requirements

For vertical tree systems, pressure-containing seals on permanent equipment shall be metal-to-metal except for tree cap, tubing head spool isolation sleeve and tubing hanger external seals where non-metallic seals may be used.

Justification

Pressure-containing seals are considered high criticality elements of the vertical trees and metal-to-metal seals have been agreed by operators and suppliers to mitigate any potential risks of containment due to aging and exposure of non-metallic seals. This requirement drives the standardization of the level of design robustness around sealing integrity to satisfy minimum requirements for common use cases or applications. Exceptions to the requirement are made for lower criticality sealing locations.

For horizontal tree systems, pressure-containing seals on permanent equipment shall be metal-to-metal except for XT isolation sleeve and non-production-wetted TH gallery seals where non-metallic seals may be used.

Justification

Pressure-containing seals are considered high criticality elements of the vertical trees and metal-to-metal seals have been agreed by operators and suppliers to mitigate any potential risks of containment due to aging and exposure of non-metallic seals. This requirement drives the standardization of the level of design robustness around sealing integrity to satisfy minimum requirements for common use cases or applications. Exceptions to the requirement are made for lower criticality sealing locations.

Valve and choke stem primary seals shall be metal-to-metal or thermoplastic.

Justification

This requirement drives the standardization of the level of design robustness around sealing integrity. Exceptions to a metal-seal requirement is allowed for stem seals where thermoplastic seals can provide improved sealing longevity/robustness over metallic seals due to relatively large translation (cycle) requirements.

Valve and choke stem secondary seals shall be metal-to-metal, thermoplastic or encapsulated elastomeric seal.

Justification

This requirement drives the standardization of the level of design robustness around sealing integrity. Exceptions to a metal-seal requirement is allowed for stem seals where thermoplastic seals can provide improved sealing longevity/robustness over metallic seals due to relatively large translation (cycle) requirements.

Metal-to-metal seals shall have a secondary seal element, except for the following:

— wellhead gaskets;

— flowline connection gaskets;

— valve gate to seat seals;

— static seals that are assembled and tested at the factory (e.g. bonnet gasket, BX gasket).

Justification

There is a need to define the boundary of this requirement to avoid confusion and misunderstanding or misapplication. This requirement drives the standardization of the level of design robustness around sealing integrity to align with what is generally specified for majority of trees. Secondary seals are not generally required for static seals assembled and tested at the factory because of the ability to verify sealing integrity prior to installation, and low likelihood of loss of seal integrity when seals are static/shop-mated under controlled conditions in clean environment.

NOTE Secondary seal elements may be non-metallic (e.g. production seal stabs, tubing hanger OD seals) and combined into one sealing assembly.

Justification

Secondary seal elements not being in contact with retained fluids except under (temporary) failure conditions allow an alternative for non-metallic seal elements to be used within acceptable risk levels. This requirement drives the standardization of the level of design robustness around sealing integrity to align with what is generally specified for the majority of trees.

Seals shall not be considered metal-to-metal unless the metal-to-metal sealing element has been validated independently of the sealing of any non-metallic element.

Justification

This requirement provides a standardized definition of what constitutes a "metal-to-metal" seal in the cases of composite seal construction. Classifying a seal as "metal-to-metal" implies that the metallic components are providing the pressure-isolating boundary, therefore the sealing integrity is not likely to be degraded over time and with temperature and pressure as it would be the case for non-metallic sealing elements. This requirement ensures that it is the metallic element that is providing the validated sealing boundary.

Non-metallic seals made up subsea shall be testable or have a non-metallic backup seal element, except for the following:

— isolation sleeve seal to wellhead;

— tree cap seal;

— tubing hanger gallery seal that is downstream of a primary metal seal;

— when hydraulic lock or thermal expansion can cause a trapped pressure to exceed seal design rating.

Justification

This requirement drives the standardization of the level of design robustness around sealing integrity since the subsea makeup of seals includes the risk of damage to the seal during makeup. The secondary sealing requirement improves the robustness of the design/reliability. Exceptions are made for wellhead-sealing isolation sleeves to allow for existing standard designs and due to the nature of this generally being a pressure-testing only seal rather than a necessary barrier element, and made for tree cap and tubing hanger gallery seals due to these seals being downstream of metal-to-metal seals. Exceptions are also made for cases where the risk or cost of including a seal outweighs the benefit of improved robustness/reliability.

5.1.4 Miscellaneous Design Information

5.1.4.6 Cathodic Protection

Add to subsection

CP design shall take into account all connected items that do not have an independent CP system.

Justification

This requirement drives the standardization of CP systems design to ensure consistency and repeatability. This requirement ensures that all equipment is covered by CP as a system and avoids insufficient anode mass later in design life due to unaccounted current drain from another interconnected system/component.

Add to subsection

A CP system shall be provided on the tree frame, tubing head frame and completion guidebase.

Justification

This requirement drives the standardization of CP systems design to ensure consistency and repeatability. This requirement ensures that all equipment is covered by CP as a system and that the main the system is fully covered independently.

Add to subsection

The CP system of each assembly shall provide protection to one half of flying leads and well jumpers connected to that assembly.

Justification

This requirement drives the standardization of CP systems design to ensure consistency and repeatability. This requirement ensures that all equipment is covered by CP as a system and avoids insufficient anode mass later in design life due to unaccounted current drain from other interconnected systems/component.

Add to subsection

The well drain current shall be allocated to the lowermost assembly in the stack up.

Justification

This requirement drives the standardization of CP systems design to ensure consistency and repeatability. This requirement ensures that all equipment is sufficiently covered by the CP system and ensures effective current drain distribution to the well.

5.1.4.8.1

Designs shall achieve electrical continuity among assembled components of subsea equipment that are protected by the CP system.

Justification

This requirement drives the standardization of CP systems design to ensure consistency and repeatability, ensures the robustness of continuity for the CP system effectiveness and avoids components unprotected from CP system.

5.1.4.8.2

Unless they are equipped with alternative measures such as high-performance coatings, components constructed of metals not compatible with the applied CP levels shall be electrically isolated from the CP system.

Justification

This requirement drives the standardization of CP systems design to ensure consistency and repeatability. This requirement ensure the application of common/standard best practices for the CP design to avoid over-protecting/under-protecting in design life considerations due to unaccounted current drain from incompatible systems/components/materials.

5.1.4.8.3

The anti-fouling properties of copper and copper-based alloys shall be considered ineffective where they have continuity with the CP system.

Justification

Copper provides marine growth protection through the presence of copper corrosion-product ions. The connection of copper to the CP system prevents the generation of copper corrosion products, thus ineffective marine growth prevention. This requirement also provides the standardization of requirements to drive consistency in the design of CP systems.

5.1.4.8.4

Copper filters on sea chests shall be isolated from the CP system.

Justification

Issues of the anti-fouling properties of copper being defeated by being connected to the CP system have been reported. The connection of filters to the CP system can result in calcareous growth which would block the venting of the control system through the sea chest filter. Calcareous growth on copper filters due to the CP connection is known to cause blockage and consequential seawater ingress into control systems due to sea-chest functional failure.

NOTE Components constructed of alloys resistant to seawater corrosion under the anticipated service conditions (including temperature, galvanic and crevice affects) do not require electrical continuity with the CP system but may be connected to it.

Justification

This note drives standardization by applying common best practices for the CP design as standard. There is a need to define the boundary of this requirement to avoid confusion and misunderstanding.

5.1.4.8.5

Non-welded connections within component assemblies shall be included in the scope of testing and remediation in accordance with 5.4.8.

Justification

This requirement drives standardization by applying common best practices for the CP system inspection and maintenance as standard to ensure the reliability of the CP system. It also provides clarity and a link to API 17D.

5.1.7 Validation

5.1.7.1 Introduction

Add to subsection

Product designs that have undergone a substantive change as defined in 3.1.60 shall be treated as new product designs requiring validation, with the exception that any portion of the validation that is not affected by the substantive change does not need to be repeated.

Justification

Requalification for any substantive change is needed to address the risk of unintended impact on the performance rating that is not covered by API 17D. This requirement provides clarification for the allowance of taking credit for validation performed consistently.

Add to subsection

Validation for new product designs shall conform to 5.1.7 as amended by Annex Q.

Justification

This requirement provides clarification for the validation of new and substantively changed designs to explicitly invoke both 5.1.7 and Annex Q.

5.2 Materials

5.2.1 General

5.2.1.1 Manufacturing Requirements

Add to subsection

Carbon and low alloy steel forgings shall comply with Annex C.

Justification

This requirement explicitly invokes Annex C for the standardization of requirements for forged materials using commonly accepted industry best practice as standard to facilitate the standardization of core tree manufacturing.

5.2.1.2 Heat Treatment and Qualification Test Coupons

Replace subsection with

For materials manufactured in accordance with DNV-RP-0034 as per Annex C, heat treatment practices and QTCs shall conform to DNV-RP-0034.

Justification

Standardizing requirements for forged materials using an established and accepted industry standard facilitates the standardization of the core tree. Adding the distinction of performing heat treat and QTC as per DNV-RP-0034 eliminates the apparent conflict between applying API 6A requirements for these activities and requiring RP-0034 overall for the material requirements of selected pressure-containing and pressure-controlling forgings.

Heat treatment practices and QTCs for materials other than those manufactured in accordance with DNV-RP-0034 as per Annex C shall conform to API 6A.

Justification

Standardizing requirements for forged materials using a commonly accepted industry standard facilitates the standardization of the core tree. This requirement adds the distinction of performing heat treat and QTC as per API 6A for other metallic material and avoids confusion in the expectation.

Material certification shall be as per EN 10204 level 3.1.

Justification

This requirement is the essential minimum to drive the standardization of requirements for forged materials by using a commonly accepted industry standard to facilitate the standardization of the core tree.

6 General Design Requirements for Subsea Tree Systems

6.1 General

6.1.1 Introduction

Add to subsection

Tree systems shall be designed for a 25-year life, inclusive of pre-production wet storage and post-production prior to abandonment.

Justification

The standardization of design life and design life calculations that cover the majority (80 %) of trees helps the industry achieve a common level of reliability currently required by the majority of the purchasers.

6.1.2 Handling and Installation

Replace "when lifted in the as-run condition" with

when lifted in the as-run condition while made up to the running tool

Justification

This requirement clarifies that 1° air requirement also applies to eccentrically loaded equipment that is levelled using an offset running tool. This minimizes the counter weighting that needs to be applied to the trees instead of utilizing and offset running tool. This reduces the cost, size and weight of the trees.

6.2 Tubing Head and Tree Valving

6.2.1 Master Valves, Vertical Tree

Add to subsection

The production (injection) master valve shall be integral to the tree body.

Justification

This requirement specifies the core tree standard configuration. Integral master valves to the tree body minimize potential leak paths for high-criticality main bore valve from the main production flow path and provide standardized functionality.

Add to subsection

The production (injection) master valve shall be actuated fail-closed.

Justification

An actuated fail-closed minimizes the risk of unintended flow, pressure or leak to the environment in case of control system or hydraulic-supply circuit failure.

Add to subsection

The annulus master valve shall be integral to the tree body.

Justification

This requirement specifies the core tree standard configuration. Integral master valves to the tree body minimize potential leak paths for the high-criticality main bore valve from the main annulus flow path and provide standardized functionality.

Add to subsection

The annulus master valve shall be actuated fail-closed.

Justification

An actuated fail-closed minimizes the risk of unintended flow, pressure or leak to the environment in case of control system or hydraulic-supply circuit failure.

6.2.2 Master Valves, Horizontal Tree

Add to subsection

The production (injection) master valve shall be integral to the tree body.

Justification

This requirement specifies the core tree standard configuration. Integral master valves to the tree body minimize potential leak paths for high-criticality main bore valve from the main production flow path and provide standardized functionality.

Add to subsection

The production (injection) master valve shall be actuated fail-closed.

Justification

An actuated fail-closed minimizes the risk of unintended flow, pressure or leak to the environment in case of control system or hydraulic-supply circuit failure.

Add to subsection

The annulus master valve shall be integral to the tree body.

Justification

This requirement specifies the core tree standard configuration. Integral wing valves to the wing block or tree body minimize potential leak paths for high-criticality main bore valve from the main production flow pat and provide standardized functionality.

Add to subsection

The annulus master valve shall be actuated fail-closed.

Justification

An actuated fail-closed minimizes the risk of unintended flow, pressure or leak to the environment in case of control system or hydraulic-supply circuit failure.

6.2.3 Wing Valves, Vertical Tree

Add to subsection

The production (injection) wing valve shall be integral to the production wing block or tree body.

Justification

This requirement specifies the core tree standard configuration. Integral wing valves to the wing block or tree body minimize potential leak paths for high-criticality main bore valve from the main production flow pat and provide standardized functionality.

Add to subsection

The production (injection) wing valve shall be actuated fail-closed.

Justification

An actuated fail-closed minimizes the risk of unintended flow, pressure or leak to the environment in case of control system or hydraulic-supply circuit failure.

Add to subsection

The annulus wing valve shall be integral to the annulus block or the tree body.

Justification

This requirement specifies the core tree standard configuration. Integral wing valves to the wing block or tree body minimize potential leak paths for high-criticality main bore valve from the main annulus flow path and provide standardized functionality.

Add to subsection

The annulus wing valve shall be actuated fail-closed.

Justification

An actuated fail-closed minimizes the risk of unintended flow, pressure or leak to the environment in case of control system or hydraulic-supply circuit failure.

6.2.4 Wing Valves, Horizontal Tree

Add to subsection

For horizontal subsea trees, the production (injection) wing valve shall be integral to the production wing block or tree body.

Justification

This requirement specifies the core tree standard configuration. Integral wing valves to the wing block or tree body minimize potential leak paths for high-criticality main bore valve from the main production flow pat and provide standardized functionality.

Add to subsection

The production (injection) wing valve shall be actuated fail-closed.

Justification

An actuated fail-closed minimizes the risk of unintended flow, pressure or leak to the environment in case of control system or hydraulic-supply circuit failure.

Add to subsection

The annulus wing valve shall be integral to the annulus block or the tree body.

Justification

This requirement specifies the core tree standard configuration. Integral wing valves to the wing block or tree body minimize potential leak paths for high-criticality main bore valve from the main production flow pat and provide standardized functionality.

Add to subsection

The annulus wing valve shall be actuated fail-closed.

Justification

An actuated fail-closed minimizes the risk of unintended flow, pressure or leak to the environment in case of control system or hydraulic-supply circuit failure.

6.2.5 Crossover Valves

Add to subsection

An actuated fail-closed $2^{1}/_{16}$ in. (52 mm) crossover valve shall be provided.

Justification

This requirement provides standard size and functionality for crossover valves that is in alignment with an existing industry design, is common practice and satisfies common use case requirements.

6.2.8 Production (Injection) and Annulus Flow Paths

Add after third paragraph

Tree and tubing head annulus flow path and main annulus valves (i.e. AMV, ASV, AWV, AAV), excluding the THAID, shall be nominal $2^{1}/_{16}$ in. (52 mm).

Justification

This requirement provides standard size and configuration for annulus bore to drive consistency and alignment with an existing industry design. This requirement is common practice and satisfies common use case requirements.

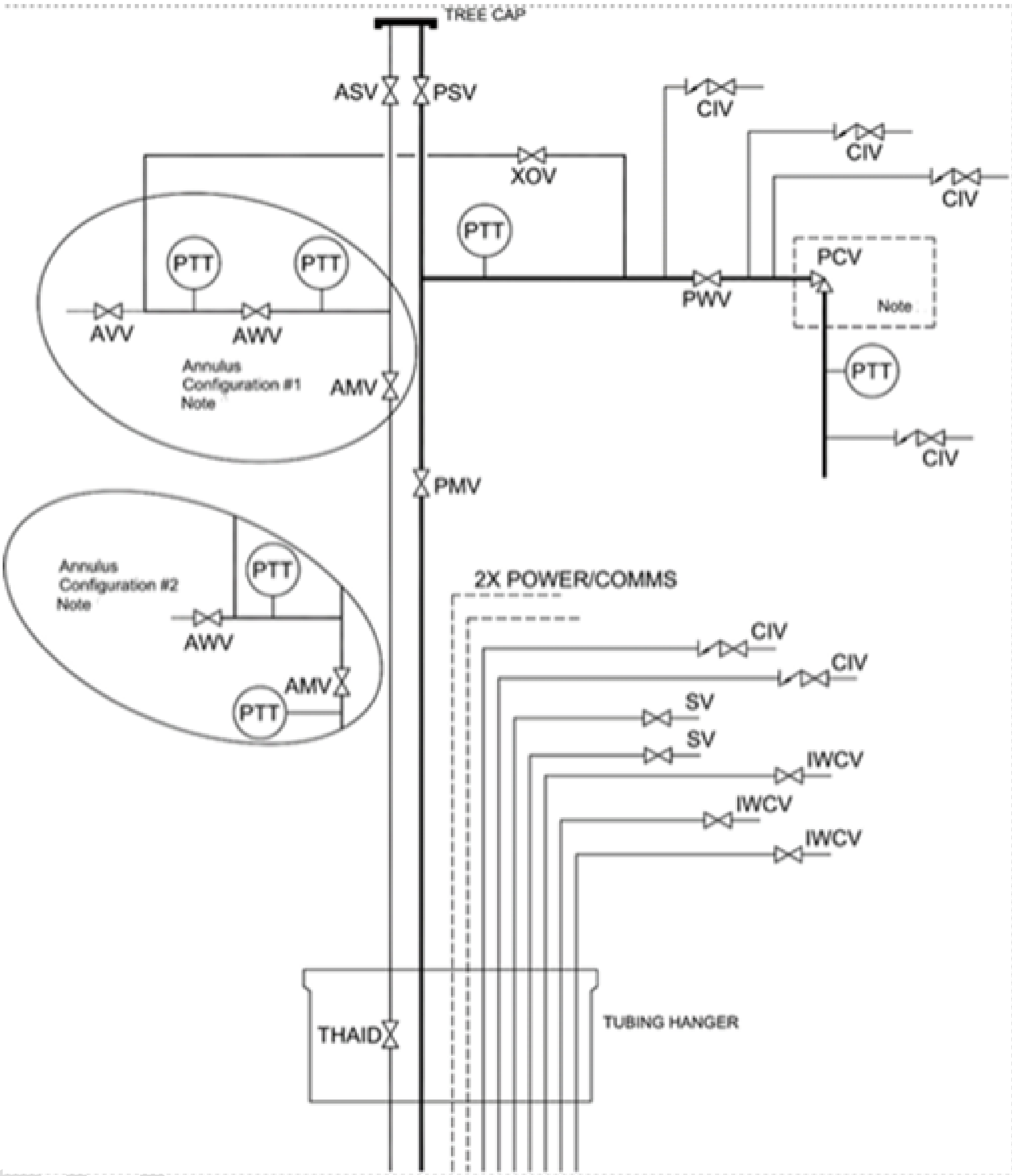
Add after third paragraph

Connections between the tree block, including any horizontal penetrator assembly, and the isolation valve for lines entering or in communication with the well bore, including the annulus, shall be fully welded or flanged.

Justification

This requirement ensures pressure integrity and minimizes the risk of leakage by preventing the use of threaded or other alternative connection types on lines in communication with the wellbore or annulus inboard of isolations. This is achieved by standardizing on the use of flanged or fully welded connection.

Replace Figure 1 with



NOTE This figure shows the crossover production-bore intersection option of inboard of the PWV and an example of sensor and injection location options. In this figure, the downhole function number may be reduced (refer to 6.7.4) and alternative chemical injection isolation valve arrangements may be specified (refer to 6.2.9). The crossover access into the annulus bore can be between the AWV and AVV (Configuration #1) or inboard of the AWV (Configuration #2). Refer to the data sheet and project P&ID for requested crossover bore intersection locations and type and number of functions (sensors, injection points, etc.).

Replace Figure 1 title with

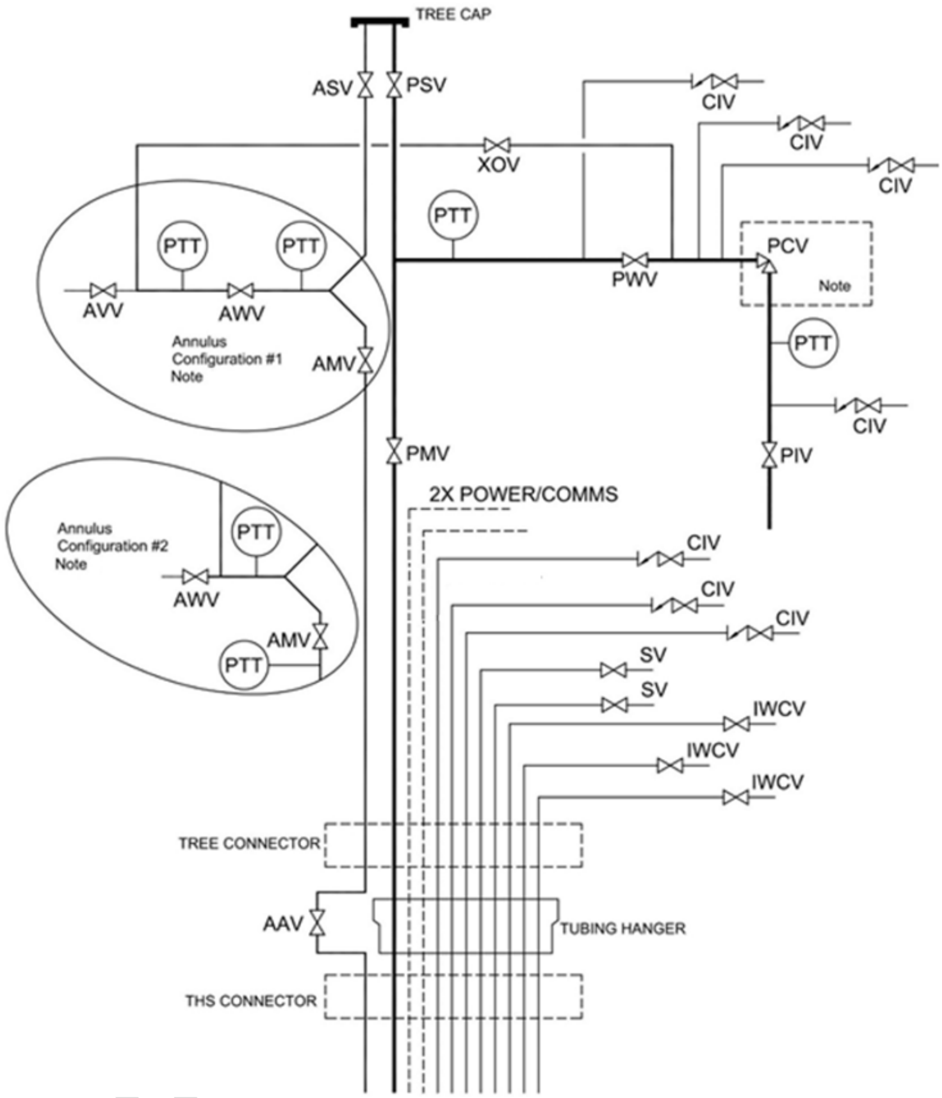
Figure 1—VXT Dual-bore on a Subsea Wellhead

Justification

Figure 1 title is replaced to match with the description of the new figure.

Replace Figure 2 with Figure 2 a) and Figure 2 b)

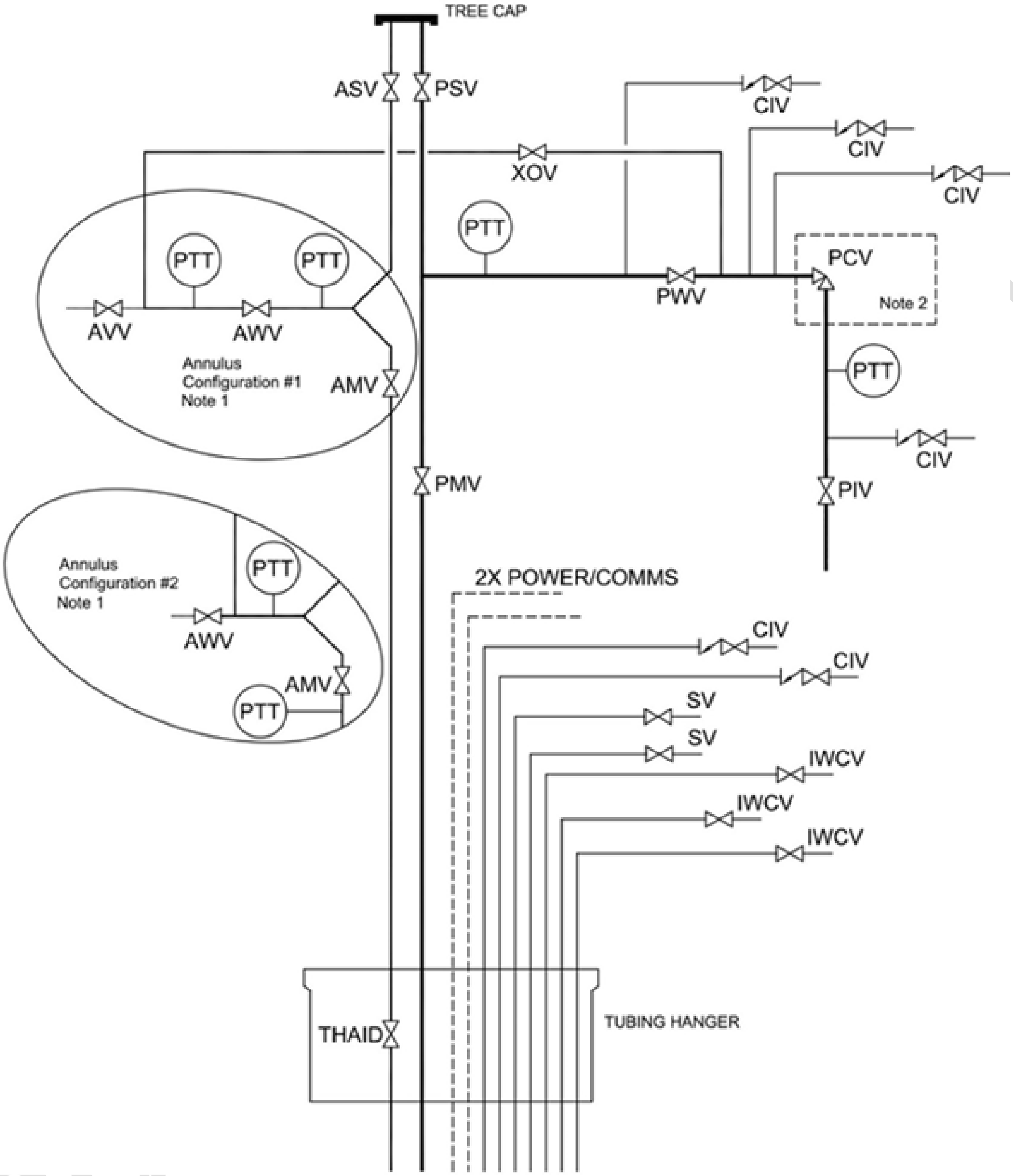
Add new Figure 2 a)



NOTE This figure shows an example of sensor and injection location options and the crossover production-bore intersection option of between PWV and PCV. The alternative downhole function number (refer to 6.7.4) and chemical injection isolations (refer to 6.2.9) may be specified for Figure 2 a). The crossover access into the annulus bore can be between the AWV and AVV (Configuration #1) or inboard of the AWV (Configuration #2). Refer to the data sheet and project P&ID for requested crossover bore intersection locations and type and number of functions (sensors, injection points, etc.).

a) VXT Monobore on a Tubing Head

Add new Figure 2 b)



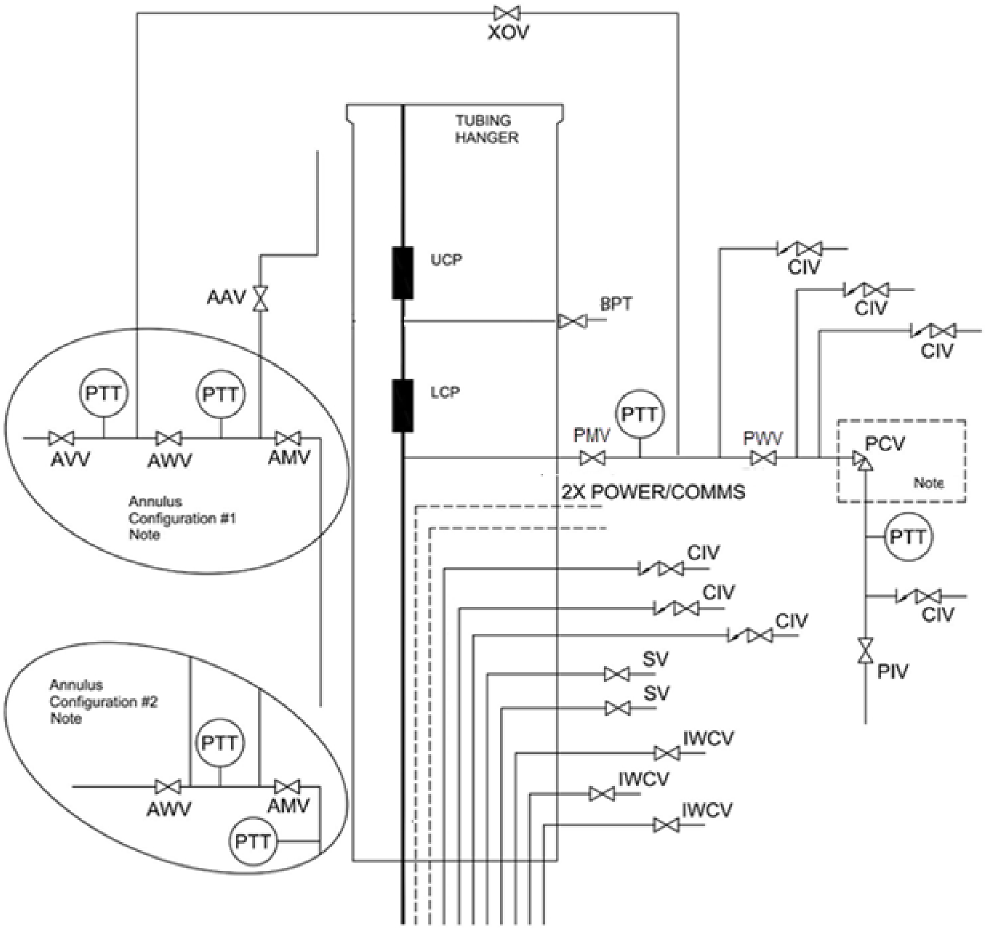
NOTE This figure shows an example of sensor and injection location options and the crossover production-bore intersection option of between PWV and PCV. The alternative chemical injection isolation valve arrangements may be specified (refer to 6.2.9). The crossover access into the annulus bore can be between the AWV and AVV (Configuration #1) or inboard of the AWV (Configuration #2). Refer to the data sheet and project P&ID for requested crossover bore intersection locations and type and number of functions (sensors, injection points, etc.).

b) VXT Monobore on a Subsea Wellhead

Replace Figure 2 title with

Figure 2—Vertical Monobore Trees

Replace Figure 3 with



NOTE This figure shows an example of sensor and injection location options and the crossover production-bore intersection option of inboard of PWV. The alternative chemical injection isolation valve arrangements may be specified (refer to 6.2.9). The crossover access into the annulus bore can be between the AWV and AVV (Configuration #1) or inboard of the AWV (Configuration #2). Refer to the data sheet and project P&ID for requested crossover bore intersection locations and type and number of functions (sensors, injection points, etc.).

Replace Figure 3 title with

Figure 3—Horizontal Tree on a Subsea Wellhead

Figure 4—Examples of Bore Penetrations

Delete Figure 4

Add new subsection

6.2.8.2 Additional Annulus Flow Path Pressure Closures

6.2.8.2.1

If the AVV is not integral or bolted to the annulus wing block, the flow path between the block and the AVV shall have fully welded or flanged connections.

Justification

This requirement provides clarity on the AVV configuration. The AVV is a secondary valve, so it may be either integral to the wing block to reduce the risk of leak paths or bolted to the block or flowloop to facilitate packaging and/or reduce manufacturing costs/risks .

6.2.8.2.2

The AVV and its flow path shall be protected from impact and dropped objects in accordance with API 17A.

Justification

This requirement ensures the AVV integrity from risk of damage from impact and dropped objects.

NOTE Service line tie-in requirements are not covered by this specification as these are project specific defined items.

Justification

This note provides clarity on the scope exclusion and items that are project-specific and left to the purchaser to define.

6.2.8.2.3

There shall be at least two fail-closed valves between the PTT monitoring the A-annulus and the production bore flow path as shown in annulus Configuration #1 and Configuration #2 in Figure 1, Figure 2 and Figure 3.

Justification

This requirement allows for monitoring the annulus pressure continuously via the PTT while still maintaining two pressure closures between the annulus and production bore and minimizing the risk of leakage across the annulus and production bore.

6.2.9 Production and Annulus Bore Penetrations

Add to subsection

Through-block test ports located between crown plugs on HXT or above swab valves on the VXT shall have dual means of isolation of retained fluids for all intervention configurations.

Justification

Dual isolation to the production bore minimizes the risk of leakage from through-block porting during intervention operations.

Add new NOTE 2

NOTE 2 Isolations may be by means of any combination of valve, sealing bore-stab, isolation sleeve, etc.

Justification

This requirement allows the supplier to offer their standard based on the variability of configurations where a standard configuration is not defined.

Add to subsection

Unused features (sensor ports, downhole lines, etc.) shall be blanked off with metal-sealing plugs or flanges.

Justification

This requirement prevents/minimizes the risk of leakage from unused features/penetrations.

<u>*Add new section*</u>

6.2.9.1 Penetration Isolation Configurations

6.2.9.1.1

Isolation and check valves for production and annulus bore chemical injection port penetrations shall be configured in accordance with one of the following three options:

— single remotely actuated gate valve plus a check valve located between the gate valve and the bore;

— two remotely actuated gate valves;

— single remotely actuated gate valve used on a penetration outboard of the PMV or AMV.

Justification

This requirement allows options for configuration limited to those which provide the needed redundancy and lower the risk for leakage due to non-welded fittings, impact or dropped objects.

NOTE 1 These options replace Figure 4 a) and Figure 4 b).

Justification

Replacing options in Figure 4 ensures the reliability of chemical injection port penetration isolations while standardizing options to provide for most use case needs/solutions.

NOTE 2 Different options may be used on different ports on the same tree as needed for valve, operator, and interface packaging and access.

Justification

This requirement allows for variability of configurations to facilitate the packaging of valves by leveraging standard supplier configurations.

6.2.9.1.2

When there is a single remotely actuated gate valve plus a check valve located between the gate valve and the bore, the gate valve shall satisfy the requirement of 6.2.9.2.

Justification

When a single isolation valve is used, the check valve is required to provide sealing redundancy to reduce the risk of leakage/backflow. An integral or bolted connection is required to reduce potential leak paths and risk of damage due to impact and dropped objects. For non-integral or non-bolted connections, additional requirements are imposed to reduce potential leak paths and the risks of damage. The additional requirements ensure the integrity of the pressure containing flow path.

6.2.9.1.3

When there is a single remotely actuated gate valve plus a check valve located between the gate valve and the bore, the check valve shall be block mounted.

Justification

Where the primary isolation for a chemical injection port penetration into the body is not block mounted, the check valve needs to be block mounted within the piping-connection flange to minimize the risk of leakage inboard of the primary isolation valve.

6.2.9.1.4

When there are two remotely actuated gate valves, one gate valve shall be integral or bolted to the block, except on HXT horizontal penetrator system circuits that satisfy the requirement of 6.2.9.2.

Justification

This requirement allows the user to select a redundant isolation without a check valve where backflow prevention is not required or where backflow is needed (i.e. the use of a circuit for pressure monitoring/testing/equalization). An integral or bolted connection is required to reduce potential leak paths and risk of damage due to impact and dropped objects.

NOTE 3 One valve may be panel mounted.

Justification

This requirement allows for variability of configurations to facilitate the packaging of valves by leveraging standard supplier configurations.

6.2.9.1.5

When there is a single remotely actuated gate valve used on a penetration outboard of the PMV or AMV, the gate valve shall satisfy the requirement of 6.2.9.2.

Justification

When a single isolation valve is used, the outboard of the master valve (as the second barrier) can be either integral/bolted or panel mounted. The exception to block mounting of isolation valve enables packaging and panel access for ROV override where required by design layout constraints while standardizing options to provide for most use case needs/solutions.

6.2.9.2 Penetrations Inboard Isolation Requirements

The inboard gate valve on production and annulus penetration shall be either of the following:

— integral or block mounted;

— mounted to a block elbow that is bolted to the block when consideration for extended dead-leg and seawater cooling effect does not preclude the use of a block elbow; or

— connected to the block using fully welded or flanged connections on a circuit that is protected from impact and dropped objects in accordance with API 17A.

Justification

This requirement provides clarity on additional requirements to ensure the integrity of the pressure-containing flow path for valves configured outside the core tree (e.g. panel mounted) as these valves may be at risk from impact and dropped objects.
Fully welded or flanged connections are required when the main isolation is not block mounted to eliminate mechanical fittings and minimize seals to ensure the circuit between the block and isolation is minimally at risk for leakage inboard of the primary isolation. Where the primary isolation for a chemical injection port penetration into the body is not block mounted, protection from impact and dropped objects is required to minimize the risk of damage-induced leakage inboard of the primary isolation.
It also allows suppliers to offer their standard based on the variability of configurations/use of block elbow needed to facilitate the packaging of valves in standard supplier configurations. It requires an assessment on dead-leg and seawater cooling effect to ensure that there is no potential hydrate presence or other adverse impact.

6.2.10 SCSSV Control Line Penetrations

Figure 5—Examples of Tree Valving for Downhole Chemical Injection and SCSSV

Delete Figure 5

6.2.11 Downhole Chemical Injection Line Penetrations

Replace third paragraph with

If a check valve is used as one of the two required isolation barriers, the check valve shall be located inboard of the other isolation barrier.

Justification

This requirement provides clarity on the check valve location. Check valves are located inboard toward the bore to provide backflow prevention as close as possible to the bore and to reduce the risk of hydrate, leak, etc. At least one of the valves is an actuated, fail-closed valve as per API 17D.

If a check valve is used as one of the two required isolation barriers, the other isolation barrier shall be a fail-closed gate valve.

Justification

This requirement provides clarity on the check valve location. Check valves are located inboard toward the bore to provide backflow prevention as close as possible to the bore and to reduce the risk of hydrate, leak, etc. At least one of the valves is an actuated, fail-closed valve as per API 17D.

6.3 Thermally Induced Pressure Changes

Add to subsection

Areas requiring analysis shall include the following:

— isolated chambers used for testing secondary barriers (e.g. gasket test chambers);

— cavity between the crown plugs in the HXT and the area above the swab valves but below the tree cap in a VXT;

— other areas that create or may create an isolated volume (e.g. areas between dual seals, and areas between valves on the crossover loop that remain closed during start-up or shutdown); and

— unused, plugged off or isolated functions (e.g. unused downhole penetrations).

Justification

The analysis of trapped volumes is required to ensure that expected thermal cycles do not cause overpressure in the system and jeopardize integrity. This requirement provides clarity as to when this analysis needs to be performed.

6.4 Testing of Subsea Tree Assemblies

6.4.2 Factory Acceptance Testing

Add to subsection

Valves exposed to retained fluids, including small bore injection isolation valves (including check valves) and chokes, shall be PSL 3G tested in accordance with 5.4.6, except that there is no requirement for the following:

— gas back seat testing;

— gas testing of valves in hydraulic circuits;

— gas testing of gallery areas that are not exposed to retained fluids in production and intervention modes and configurations;

— repeat of gas testing already performed at sub-assembly level;

— gas testing of the tubing hanger interface with the XT at the XT assembly FAT when necessary gas testing of internal features has been completed and verified at other stages of FAT;

— gas testing of the tubing hanger interface with the tubing head at the tubing head assembly FAT when necessary gas testing of internal features has been completed at other stages of FAT.

Justification

This requirement provides clarity on the boundary of testing to avoid confusion. It sets PSL 3G service as the standard rating for trees to standardize the core tree design based on the most commonly specified application philosophy. PSL 3G for all retained fluid valves allows trees to be standardized and available for use on both gas wells and oil wells that may see a gas breakout at some point during their field life.
Exceptions are provided for testing equipment that does not see gas in normal service. Gas back seat testing is not applicable to subsea valves because bonnet changeouts are not performed while subsea with pressure in the valve. Valves in the hydraulic system do not see gas in service so they are excepted from the gas testing requirements. Gallery areas that are not exposed to retained fluids do not see gas in service and are also excepted from the gas testing requirements.

Add to subsection

Full production and annulus flow paths of production and gas injection tree final tree assemblies shall be submerged gas tested.

Justification

Gas testing are required to be performed submerged for both safety and assurance of the quality of the test as leaking bubbles are easier to detect in water.

Add new NOTE 3

NOTE 3 Any subcomponents not previously gas tested may be included in this test to satisfy their gas test requirement.

Justification

Gas testing are required be performed submerged for both safety and assurance of the quality of the test. This note allows components not previously tested to be included in the test.

<u>*Add to subsection*</u>

The hold period shall be 1 hour after stabilization from submersion for the submerged gas test of the full production and annulus flow paths of production and gas injection tree final tree assemblies.

Justification

A one-hour hold period ensures that slow-seeping gas leaks are detected on a large assembly with complex geometry. This ensures that there is no false indication from initial submersion after stabilization is achieved.

<u>*Add to subsection*</u>

Acceptance criteria for the submerged gas test shall be no bubbles during the hold period.

Justification

This requirement aligns acceptance criteria with API 17D requirements for gas testing.

<u>*Add new section*</u>

6.7 Tree Configurations

6.7.1 Pressure and Temperature Sensors

6.7.1.1

XTs shall include provision for a single housing between the PMV and PWV.

Justification

This provision covers the purchaser's project requirement where single housing pressure and temperature sensor need to meet reliability/redundancy requirements. It also drives the standardization of locations of PT sensors to satisfy common operator use cases and allow for standard tree designs. It provides clarity on the location which requires single housing pressure and temperature sensor. This location is important as it provides the ability to monitor for leakage of the PMV as well as provide measurement to facilitate equalization before opening valves.

6.7.1.2

XTs shall include provision for a single housing in the production bore downstream of the choke.

Justification

This requirement provides clarity on the location which requires single housing pressure and temperature sensor. This location is important as it provides the ability to monitor downstream pressure for confirmation of appropriate choke settings. It also provides measurement to facilitate equalization before opening valves or retrieving choke/insert.

6.7.1.3

XTs shall include provision for a single housing between the AMV and AWV.

Justification

This requirement provides clarity on the location which requires single housing pressure and temperature sensor. This location is important as it provides ability to monitor for leakage of AMV and provides measurement to facilitate equalization prior to opening valves. It also provides means of monitoring the annulus pressure while maintaining annulus isolation.

6.7.1.4

XTs shall include provision for a single housing outboard of the AWV (Configuration #1) or inboard of the AMV (Configuration #2).

Justification

This requirement provides clarity on the location which requires single housing pressure and temperature sensor. This location is important as it provides measurement to facilitate equalization before opening valves and also provides primary (Configuration #2) or secondary (Configuration #1) means of monitoring the annulus pressure.

6.7.1.5

Single housings shall allow for either single or dual sensor elements.

Justification

This requirement allows suppliers to offer their standard based on the variability of configurations for single housing pressure and temperature sensor to meet reliability/redundancy requirements. It also drives standardization of housing types to facilitate both single and dual element sensors at each location of PT sensors to satisfy the majority of operators use cases and allow for standard tree designs.

6.7.1.6

The gap between the sensor nose and the bore intersection of the associated port shall be sized to avoid vortex induced erosion.

Justification

Placing the sensor sufficiently close to the flow path in the bore eliminates the issue with vortex-induced erosion.

6.7.2 Blockage Avoidance

6.7.2.1

The tree configuration shall orient injection ports and gauge bores to be self-draining.

Justification

Self-draining ports minimize the potential for hydrate formation. These standard best practices are commonly specified and minimize the possibility of hydrates forming. This requirement drives the standardization of the core tree design for common use cases.

NOTE The risk of blockage and hydrates increases with the length of dead leg bores that intersect the production flow path.

Justification

Lengths need to be minimized to reduce the available dead-leg volume where hydrates could form. It is important to require limited/minimum unavoidable dead-leg subjected to seawater cooling effect to ensure that there is no potential hydrate presence or adverse impact.

6.7.2.2

To be considered self-draining, horizontal penetrations shall enter into the top half of the bore, i.e. at or above the 9 and 3 o'clock positions.

Justification

Clarification is provided to ensure standard means of meeting the "self-draining" requirement to minimize the risk of hydrate formation.

6.7.2.3

Where the first isolation on a chemical injection line is not block-mounted, the connection line between the block and the isolation shall be insulated unless thermal analysis confirms that the line remains above hydrate formation temperature during normal flowing conditions.

Justification

Insulation is required to prevent hydrates on dead legs potentially exposed to low temperatures. Alternatively, an assessment of dead-leg and seawater cooling effect must be completed to ensure that there is no potential hydrate presence or adverse impact.

6.7.3 Chemical Injection / Control Line Provision

6.7.3.1 Downhole Control and Chemical Injection

6.7.3.1.1

All tree types, except monobore VXT, shall have provision for nine total downhole lines.

Justification

It allows the variability of line population/configuration where there is not a standard agreed design/solution without negatively impacting the standardization of the core tree. The provision of seven downhole control and injection lines with two electrical/FO lines satisfies the majority of operator use cases and allows for standard tree designs as discussed/agreed with suppliers.

6.7.3.1.2

Monobore VXTs on tubing head shall have provision for ten total downhole lines.

Justification

It allows the variability of line population/configuration where there is not a standard agreed design/solution without negatively impacting standardization of the core tree. Industry standard design of monobore VXTs can accommodate one additional downhole line compared to other type of tree as discussed/agreed with suppliers.

NOTE Grouping downhole chemical injection line ports together at the bottom of the tubing hanger avoids the need to cross downhole lines over each other along the production tubing downhole.

Justification

Grouping the injection lines together avoids the difficulty of crossing downhole lines over each other in the downhole completion operation, which is time-consuming and difficult.

6.7.3.1.3

Valves and porting for hydraulic or chemical lines shall be sized equivalent to at least $^3/_8$ in. (10 mm) OD tubing.

Justification

This requirement achieves standardization of line sizing for downhole circuits and correction to API 17D which states a minimum 3/16 in. tubing ID as opposed to an equivalent 3/8 in. OD.

6.7.3.1.4

For all tree types, up to two of the downhole lines shall be configurable as electrical or fiber optic lines.

Justification

This requirement allows the variability of line population/configuration where there is not a standard solution without negatively impacting the standardization of the core tree. The provision of seven downhole control and injection lines with 2 electrical/FO lines satisfies the majority of operator use cases and allows for standard tree designs as discussed/agreed with suppliers.

6.7.3.1.5

Features not required, i.e. as per data sheet specified configuration or P&IDs, shall be blanked or not machined.

Justification

This requirement provides the ability to meet the purchaser's specific system configuration with a standardized design. The option for an actual number of function lines is provided in the data sheet to cover the purchaser's project-specific requirements.

6.7.3.2 Chemical Injection at Tree

6.7.3.2.1

Tubing on tree chemical injection lines shall be at least ½ in. (12.7 mm) OD tubing, except for the two lines specified in 6.7.3.2.3 and 6.7.3.2.8 as higher flow rate.

Justification

This requirement drives the standardization of chemical injection configuration/coverage to align with the majority of operators use cases and allows for standard tree designs.

6.7.3.2.2

The bores of valves and porting on all other tree chemical injection lines shall be at least equivalent to ½ in. (12.7 mm) OD tubing, except for the two lines specified in 6.7.3.2.3 and 6.7.3.2.8 as higher flow rate.

Justification

The standardization of chemical injection configuration/coverage aligns with the majority of operators use cases and allows for standard tree designs.

6.7.3.2.3

There shall be one high flow rate chemical injection line between the PMV and the PWV.

Justification

This requirement provides the ability to spot chemicals into the bore between main production valves as well as provides access for equalization. The standardization of chemical injection configuration/coverage aligns with the majority of operators use cases and allows for standard tree designs.

6.7.3.2.4

The tubing on the high flow rate chemical line between the PMV and the PWV shall be at least 1 in. (25 mm) OD tubing.

Justification

This requirement provides sufficient ID for necessary flowrate to address hydrates issues with methanol. This drives standardization of chemical injection configuration/coverage to aligns with the majority of operator use cases and allows for standard tree designs.

6.7.3.2.5

The bores of valves and porting on the high flow rate chemical injection line between the PMV and the PWV shall be at minimum ¾ in. (19 mm).

Justification

This requirement provides a sufficient ID for necessary flowrate to address hydrates issues with methanol. It also drives standardization of chemical injection configuration/coverage to satisfy the majority of operators use cases and allow for standard tree designs.

6.7.3.2.6

There shall one chemical injection line outboard of the PCV.

Justification

The standardization of chemical injection configuration/coverage aligns with the majority of operators use cases and allows for standard tree designs.

6.7.3.2.7

There shall be two chemical injection lines between the PWV and the PCV.

Justification

This requirement provides the ability to spot two same/different chemicals into the bore between main production valves as well as provides access for equalization. The standardization of chemical injection configuration/coverage aligns with the majority of operators use cases and allows for standard tree designs.

6.7.3.2.8

One of the chemical injection lines inboard or outboard of the PCV shall be designed as high flow rate line as specified.

Justification

This requirement provides the ability to spot chemicals into bore in vicinity of choke valve valves. It also provides access for equalization. The standardization of chemical injection configuration/coverage aligns with the majority of operators use cases and allows for standard tree designs.

6.7.3.2.9

The tubing on the high flow rate chemical line the chemical injection line inboard or outboard of the PCV shall be at least 1 in. (25 mm)OD tubing.

Justification

This requirement provides a sufficient ID for necessary flowrate to address hydrates issues with methanol. It also drives standardization of chemical injection configuration/coverage to satisfy the majority of operators use cases and allow for standard tree designs.

6.7.3.2.10

The bores of valves and porting on the high flow rate chemical injection line inboard or outboard of the PCV shall be at minimum ¾ in. (19 mm).

Justification

This requirement provides a sufficient ID for necessary flowrate to address hydrates issues with methanol. It also drives standardization of chemical injection configuration/coverage to satisfy the majority of operators use cases and allow for standard tree designs.

6.7.4 Drill-Through Requirement

6.7.4.1

If drill-through is specified, the HXT and tubing head shall be sized for through bore drilling of bottom hole sections using a 12¼ in. (315 mm) bit.

Justification

This requirement provides a minimum bore size to allow drilling using a 12¼ in. (315 mm) bit instead of other bit sizes to facilitate drill-through capability if specified and drive standardization. This allows common/standard understanding/application and avoids misinterpretation of requirements.

6.7.4.2

If drill-through is specified, the HXT and tubing head internals (e.g. seal areas and landing/locking profiles for the TH) shall be protected with a bore protector during drilling and downhole operations.

Justification

This requirement provides the required internal protection during drill-through operations to avoid damage to seal areas and landing/locking profiles.

6.7.5 Horizontal Tree Systems

6.7.5.1

At least one access port to the cavity between the crown plugs shall be provided.

Justification

Access ports provide the ability to displace the bore between the crown plugs and spot corrosion inhibitor. Displacing bore fluid while landing the upper plug reduces the risk of improper/incomplete landing of the plug due to trapped volume and also reduces the risk of damage to seals during plug installation by providing an alternative route for displacing fluid. It also provides the ability to confirm the sealing of the installed crown plug as well as the ability to vent pressure between plugs to facilitate upper plug removal.

6.7.5.2

Each test and vent lines shall be fitted with an ROV operated isolation gate valve.

Justification

ROV intervention is required for valve operation because the valve is only used during intervention. Block mounting of valves is needed to minimize the risk of leakage of through-block ports in communication with production bore.

6.7.5.3

Tubing for test and vent lines shall be $^3/_8$ in. (10 mm) OD or larger.

Justification

Providing sufficient ID is necessary as there is potential for bleed-back of bore fluid during setting and testing of plugs, so lines are required to be tolerant for debris concerning bleed-back of contaminated fluid.

6.7.5.4

Porting and isolation valves for test and vent lines shall be $^1/_4$ in. (6.35 mm) ID minimum.

Justification

Providing sufficient ID is necessary as there is potential for bleed-back of bore fluid during setting and testing of plugs, so lines are required to be tolerant for debris with respect to bleed back of contaminated fluid.

6.7.5.5

Access to the TH gallery seal shall be provided via the test port to test the sealing ability of penetrators and upper and lower gallery seals.

Justification

This requirement defines standard requirements for the TH gallery access to satisfy common use cases. The ability to test the seals of penetrators provides confirmation of the proper makeup of TH penetrators and avoids leakage.

NOTE There is no requirement for online monitoring of the pressure in the TH gallery port or the port between the crown plugs.

Justification

This note provides clarity on non-mandatory online monitoring.

6.7.6 Insulation Provision

The tree system geometry shall accommodate thermal insulation.

Justification

The insulation requirements are not defined as standard, therefore this standardizes on requirements applicable to common use cases by providing the ability to add insulation if necessary. This provision covers the purchaser's project requirement where thermal insulation is required to meet the cooldown time.

7 Specific Requirements—Subsea Tree-related Equipment and Subassemblies

7.8 Tree and Tubing Head Connectors

7.8.1 General

7.8.1.1 Tree and Tubing Head Connectors

Add to subsection

The tree and tubing head connector gasket sealing profile shall be integral to the main block.

Justification

This requirement eliminates bolted or threaded connections in the main body-to-connector load path to ensure leak, load capacity and fatigue integrity.

Add to subsection

The tree and tubing head connector design shall allow to replacement of the connector gasket without retrieving the connector to the surface, except for tree or tubing head configurations where the isolation sleeve seals directly to the wellhead ID or could interfere with the subsea gasket changeout functionality.

Justification

This requirement enables connector and gasket functioning, testing and replacement of the gasket subsea in the event of a gasket test failure without the need to retrieve the connector.

Add to subsection

The test port shall be fitted with an ROV operated valve to provide the connector gasket sealing testing capability.

Justification

The ability to lock in the test pressure and isolate pressure from the source is required to facilitate the testing of the gasket sealing.

Add to subsection

The valve shall have a pressure rating corresponding to that of the tree system.

Justification

This test circuit is part of the barrier envelope, and for that reason it is required to have the same pressure rating as the envelope.

Add new subsection

7.8.4 Isolation Sleeve for HXT and Tubing Head

7.8.4.1

The isolation sleeve shall provide pressure sealing above the wellhead gasket, i.e. in the spool/body, and below the wellhead gasket, i.e. in the wellhead system.

Justification

This requirement allows the area isolation and minimizes the volume to enable offshore testing of the installed gasket.

7.8.4.2

The isolation sleeve shall be capable of withstanding the HXT and tubing head rated working pressure internally and externally.

Justification

This requirement facilitates full pressure testing of the subsea made-up gasket connection in order to withstand potential pressure exposure of all normal conditions and ensure the required integrity.

7.10 Valves, Valve Blocks, and Actuators/Operators

7.10.2 Design

7.10.2.1 Valves and Valve Blocks

7.10.2.1.1 General

Add to subsection

Valves exposed to retained fluids, including small bore injection isolation valves (including check valves), shall be designed, manufactured and tested for API 6A/API 17D PSL 3G service.

Justification

This requirement specifies valve design, manufacture, and testing to a well-established standard to drive standardization. This requirement ensures that valves can be used across common use cases of service, including cases where gas may be present in the produced fluid.

Add to subsection

Valves on water injection trees shall be PSL 3 or PSL 3G.

Justification

Water injection service is excepted from the PSL 3G requirement as injected water does not contain gas. This requirement allows suppliers to use their standard design for water injection service.

Add to subsection

Tree gate valves in production and crossover bores, excluding CIVs, shall be rated for class II sandy service as defined by API 6AV1, except for valves on water injection trees.

Justification

Tree gate valves in production and cross-over bores are directly exposed to produced sand from the formation. This requirement standardizes the sandy service requirements to align with common use cases. Water injection service is excepted from the sandy service requirement as these valves are not exposed to produced sand from the reservoir.

Add to subsection

Gate valves shall be designed to seal bi-directionally.

Justification

Bidirectional sealing valves facilitate testing of adjacent upstream and downstream valves during subsea diagnostic testing.

Add to subsection

Actuated gate valves sized $2^{1}/_{16}$ in. (52 mm) nominal bore and larger shall accommodate ROV override.

Justification

An ROV override on the valve provides a standardized method and interface of override for subsea operations and interventions.

Add to subsection

Stem seals shall function under all combinations of the rated internal and external pressures, including pressure changes during deployment.

Justification

This requirement ensures sealing in all operational scenarios, since stem seals may nominally/normally be unidirectional seals.

7.11 Re-entry Interface

7.11.1 General

Add to subsection

The upper hub or mandrel shall be integral to the tree body.

Justification

This requirement ensures structural integrity and minimizes leak paths of the primary barrier envelope. The requirement also eliminates bolted or threaded connection in the main body-to-upper hub or mandrel load path for both leak, load capacity and fatigue integrity.

7.11.2 Design

7.11.2.2 Re-entry Interface Upper Connection/Profile

Add to subsection

For trees and tubing heads, the upper re-entry interface shall be a mandrel profile with an $18^{3}/_{4}$ in. (476 mm) nominal ID and 27 in. (685.8 mm) nominal OD.

Justification

The workgroup has selected common mandrel size to facilitate standardization of intervention equipment for deepwater tree system. This was reviewed with OEMs.

Add to subsection

Re-entry mandrels shall be designed to accept a contingency gasket that seals in a different location than the primary gasket.

Justification

This requirement ensures the ability to obtain primary barrier integrity during operation/intervention if the primary sealing location is damaged.

Add to subsection

On HXTs and tubing heads, the mandrel shall facilitate a funnel down BOP connector with a swallow of 41 in. (1040 mm) below the mandrel top and diameter of 68 in. (1730 mm).

Justification

The workgroup has selected the BOP funnel and connector interface size to facilitate the standardization of intervention equipment and allow the designer to design the upper part of the tree to avoid clashes with the BOP connector and funnel. This was reviewed with OEMs.

7.12 Subsea Tree Cap

7.12.1 General

Add "(Debris Cap)" to subsection 7.12.1.2 title

7.12.1.2 Non-pressure-containing Tree Cap (Debris Cap)

Add after first paragraph

The debris cap shall cover and protect the tree and tubing head re-entry mandrel.

Justification

This requirement ensures the integrity of the re-entry mandrel by protecting it from debris and dropped objects.

The debris cap shall accommodate the use of a subsea corrosion inhibitor.

Justification

This requirement ensures the integrity of re-entry mandrel by protecting it from fouling and corrosion.

7.12.1.3 Pressure-containing Tree Cap

Add to subsection

Pressure-containing tree caps shall have a means, whether visual or mechanical, to verify that the cap is locked.

Justification

This requirement ensures the integrity of the connection of the tree cap to the mandrel.

Where overpull is used to verify that cap is locked, overpull load allowable range shall be provided.

Justification

This requirement provides information necessary to develop installation procedures to ensure that lock confirmation is achieved and release/damage does not occur within operating conditions (e.g. vessel heave).

Retrieval load capacity and its range shall be provided by the supplier.

Justification

This requirement prevents damage to the debris cap mechanism during standard installation and retrieval methods by allowing the operator to specify procedural limits to applied retrieval loads.

For VXT tree systems, the tree system shall be designed to enable circulation through the vent lines to ensure that there is no trapped pressure before removal of the pressure-containing tree cap.

Justification

This requirement prevents damage to the system during removal/retrieval due to unexpectedly trapped pressure.

NOTE This may be achieved in the tree cap or through porting into the cavities below the tree cap.

Justification

This requirement prevents damage to the system during removal/retrieval due to unexpectedly trapped pressure.

7.14 Tree and Tubing Head Guide Frames

7.14.2 Design

7.14.2.1 Guidance and Orientation

Add to subsection

The tree (or tree running tool) shall allow for ROV guidance for wire installation.

Justification

This requirement drives the standardization of installation equipment and methods. It allows to reach the required precision of trees heading alignment within field layout requirements. Other methods would be drip pipe which would be time consuming, costly and less precise.

7.14.2.3 Design Load/Conditions

Add to subsection

All pressure-containing components up to the second well barrier (PWV/AWV) shall be protected or designed to withstand dropped object impact loads as per API 17A.

Justification

This requirement ensures the integrity of the system with protection from dropped objects.

Add to subsection

Shipping and handling protection shall be provided.

Justification

This requirement ensures the integrity of the system with protection from shipping and handling impacts/damages.

7.16 Tree, Tubing Head, and Completion Guidebase Piping

7.16.2 Design

7.16.2.3 Tree Piping Flowloops

Add to subsection

Crossover piping shall be $1^1/_2$ in. (38.1 mm) ID minimum.

Justification

This requirement drives the standardization of piping size to align with the majority of operators use cases.

When crossover porting is drilled in the forged body, the porting shall be $1^1/_2$ in. (38.1 mm) ID minimum.

Justification

This requirement drives the standardization of piping size to align with the majority of operators use cases.

7.19 Tree-mounted Hydraulic/Electric/Optical Control Interfaces

7.19.2 Design

7.19.2.2 Size and Pressure

Replace first sentence with

All pipe/tubing/hose shall be $^3/_8$ in. (10 mm) OD or larger.

Justification

The agreed size mitigates the risk of blockage from particulates in hydraulic system porting. Sizing has been selected based on the operators' history and experience and agreed upon with suppliers.

7.19.2.6 Small-bore Tubing and Connections

Add new list subsection to first paragraph

— Mechanical connections shall provide leak tight performance for the life of the field.

Justification

Vibrations are a root cause of leakage and reliability if they are not properly accounted for. This requirement prevents leakage due to vibration and other operational loads.

Add new list subsection to first paragraph

— Tubing connections shall be one or more of the following:

a) fully welded or flanged;

b) cone and threaded metal-to-metal axially loaded non-rotating seal face fitting with anti-vibration collet;

c) 37° cone seal (JIC) fittings, conforming to SAE J514 (or ISO 8434-2);

d) twin ferrule compression fittings;

e) other tubing connection that has been validated for relevant load cases including vibration from transportation, shock loads, pressure fluctuations and production loadings.

Justification

These connections are located inboard of the isolation and there is no way to mitigate the failure of these connections. For these reasons, high integrity connections are required to be used.
This requirement ensures the use of high-integrity alternatives for tubing connections.

Add new list subsection to first paragraph

— Connections shall be fully welded or flanged between the tree block (including any horizontal penetrator assembly) and the isolation valve for lines entering or in communication with the well bore, including the annulus.

Justification

These connections are located inboard of the isolation and there is no way to mitigate the failure of these connections. For these reasons, high integrity connections are required to be used.
This requirement ensures the use of high-integrity alternatives for pressure-containing connections

Add new list subsection to first paragraph

— Rotational back-off preventative measures such as coned and threaded tube anti-vibration collars shall be used at all mechanical fittings.

Justification

Vibrations are a root cause of leakage and reliability if they are not properly accounted for. This requirement prevents leakage due to fitting loosening from insufficiently supported tubing motions or excessive tubing vibration.

Add new list subsection to first paragraph

— Tubing runs shall be secured to prevent rotation of the tube and unthreading of the fitting.

Justification

Vibrations are a root cause of leakage and reliability if they are not properly accounted for. This requirement prevents leakage due to fitting loosening from insufficiently supported tubing motions or excessive tubing vibration.

Add new list subsection to first paragraph

— Tubing runs to tree connectors shall be accessible so that they can be cut by an ROV to release locked-in fluid.

Justification

This requirement provides the ability for contingency release of the tree connector in case of blockage or failure of hydraulic system.

Add new list subsection to first paragraph

— Transitions between tubing of differing wall thicknesses shall use tapered transition joints.

Justification

This requirements prevents stress concentrations at weld joints in tubing and minimizes pressure drop in the hydraulic system.

Add new list subsection to first paragraph

— Socket weld connections shall not be used.

Justification

This requirement ensures pressure integrity of tubing connections by avoiding the use of socket weld.

Add new list subsection to first paragraph

— Tubing runs shall be supported with clamps at intervals as defined in Table 36.

Justification

This requirement prevents leakage due to fitting loosening from insufficiently supported tubing motions or excessive tubing vibration. It is based on the alignment with industry-standard clamp manufacturer's recommendations. Table 36 is aligned with the recommendations of the Energy Institute "Avoid leakage due to fitting loosening from insufficiently supported tubing motions or excessive piping vibration", second edition.

Add new list subsection to first paragraph

— Clamps shall conform to DIN 3015-1.

Justification

The standard clamp design guidance offered in DIN 3015 is intended to avoid leakage due to fitting loosening from insufficiently supported tubing motions.

Add new list subsection to first paragraph

— Tubing runs shall be a single piece from starting point to ending point wherever possible.

Justification

This requirement ensures the pressure integrity of hydraulic circuits.

Delete second paragraph (For a line that penetrates the wellbore...) including list items

Justification

These requirements have been deleted to eliminate the use of socket welds which have inherent susceptibility to crevice corrosion and cracking prevents full weld penetration.

Delete third paragraph (For a line that does not penetrate the wellbore…)

Justification

These requirements have been deleted to eliminate the use of socket welds which have inherent susceptibility to crevice corrosion and cracking prevents full weld penetration.

Add new Table 36

Table 36—Maximum Allowable Distance Between Tubing Clamps

Tube OD		Maximum Allowable Distance	
in.	(mm)	in.	(mm)
$^{3}/_{8}$ to $^{1}/_{2}$	(10 to 12)	24	(600)
$^{5}/_{8}$ to $^{7}/_{8}$	(14 to 22)	40	(1000)
1	(25)	60	(1500)

7.20 Subsea Chokes and Actuators/Operators

7.20.1 General

Add to subsection

Chokes on production trees and on gas injection trees shall be designed, manufactured and tested for API 6A/API 17D PSL 3G service.

Justification

This requirement ensures that the chokes can be used across common use cases of service, including cases where gas may be present in the produced fluid.

Add to subsection

Chokes for only water injection service shall be PSL3 or PSL3G.

Justification

Water injection service is excepted from PSL3G requirement as injected water does not contain gas.

Add to subsection

Subsea chokes shall be ROV insert retrievable type unless the choke is mounted on a retrievable package (e.g. flow control module).

Justification

This requirement provides the ability to replace and service wear items without tree retrieval.

Add to subsection

There shall be two independent methods of determining the choke position as described in 7.20.1 a) and b).

Justification

This requirement ensures the ability to determine the choke position for diagnostics in the event of primary indication method malfunction.

a) Chokes shall be provided with a primary means of position indication via feedback through the production control system.

Justification

This requirement ensures the ability to determine the choke position for diagnostics in the event of primary indication method malfunction.

b) Chokes shall be provided with a secondary means of position indication via an external position indicator.

Justification

This requirement ensures the ability to control the choke position for diagnostics in the event of primary indication or operation method malfunction.

NOTE Secondary external position indication may be by means of tooling or local indicator.

Justification

This note allows the use of existing industry alternatives that meet the minimum functional objective of the secondary position indication.

9 Specific Requirements—Subsea Tubing Hanger System

9.1 Design

9.1.1 General

Add to subsection

Horizontal tree type tubing hangers shall be of dual crown plug design.

Justification

This requirement provides the benefits of a reduced number of running operations during installation and interventions to reduce cost and schedule. This design is being adopted by the industry. The workgroup has agreed on standardized configuration to align with the majority of operators' use cases.

Add to subsection

For horizontal tree type tubing hangers, the orientation feature shall allow the tubing hanger to be installed from any heading.

Justification

This requirement ensures that the orientation feature is not damaged beyond functionality if the hanger is landed outside of the intended capture window so that the hanger can be subsequently rotated to within the capture window and landed to ensure the reliability of installation operations.

9.1.2 Design Load/Conditions

Add to subsection

The TH shall resist rotational torque of 35,000 ft-lbs (47,500 N m) to accommodate built-up torque when setting the hanger, especially in deviated wells.

Justification

This requirement ensures the ability to orient and land TH. The workgroup has agreed on this value to ensure adequate rotational resistance to prevent back-out of the production tubing string.

Add to subsection

The rated rotational load capacity shall be provided by the supplier.

Justification

This requirement ensures that the purchaser can develop operational procedures that stay within equipment capacities and determine when contingencies are appropriate.

9.1.9 Stab Design for SCSSV, Other Hydraulic, and Chemical Injection Control Lines

Add to subsection

For a VXT, where a spring-loaded relief valve is utilized on the SCSSV line, the relief valve shall not maintain a pressure within the SCSSV circuit of more than 100 psi (0.69 Mpa).

Justification

This requirement ensures that the SCSSV line vents to an acceptably low residual internal pressure to ensure closure of the SCSSV upon coupler disconnect.

Add to subsection

It shall be possible to lock open the SCSSV during installation of the TH.

Justification

This requirement provides the ability to maintain and monitor the downhole pressure during the running of completion.

Add new subsection

9.1.11 Tubing Hanger Annulus Isolation Device

The THAID shall provide isolation of the annulus flow path through the tubing hanger.

Justification

This requirement ensures that the THAID satisfies functionality and performance equivalent to the TH plug.

The THAID shall withstand a differential of full RWP of the tubing hanger in either direction when in the closed position.

Justification

This requirement ensures that the THAID satisfies functionality and performance equivalent to the TH plug.

The THAID shall be operable closed to open with differential pressure of RWP from below, without compromising the sealing capability.

Justification

This requirement ensures that the THAID satisfies functionality and performance equivalent to the TH plug and maintains functionality after repeated operations. It also ensures the ability to open the annulus when the pressure in the annulus is unknown (i.e. no way to determine the required equalization pressure).

The THAID shall be operable by an ROV or a workover control system.

Justification

This requirement ensures that the THAID satisfies functionality and performance equivalent to the TH plug and provides design flexibility for means of operation.

The THAID shall not be operable by the production control system.

Justification

This requirement ensures that inadvertent operation of the THAID during normal production operations is not possible.

The THAID shall be operable during land out of the tubing hanger with the BOP installed on the wellhead and with the tree installed on the wellhead.

Justification

This requirement ensures that the THAID satisfies functionality and performance equivalent to the TH plug.

The THAID shall be fail-as-is or fail-close.

Justification

This requirement ensures that the THAID satisfies functionality and performance equivalent to the TH plug.

The THAID shall not result in unintentional operation due to the application of pressure from above or below.

Justification

This requirement ensures that the THAID satisfies functionality and performance equivalent to the TH plug.

The THAID shall have a secondary actuation method for closing the THAID.

Justification

This requirement reduces the risk of inability to operate the THAID, which could lead to the inability to isolate the annulus.

The THAID shall be capable of remaining open for the majority of its life and still function at the end of its design life.

Justification

This requirement ensures that the THAID satisfies functionality and performance equivalent to the TH plug, even at the end of its design life.

The annulus porting through the tubing hanger shall have a minimum flow-by area of 1 $in.^2$ (645.16 mm^2), with the THAID in the fully open position.

Justification

Flow-by area sized to allow a target for design standardization that has been selected as a compromise between required circulation rate and available equipment design footprint in the TH body, with the understanding that 1 $in.^2$ is sufficient for the majority of required gas-lift flow rates.

Annex J
(informative)

Validation of Valves and Actuators/Operators

J.2 General Requirements

Add before first paragraph

The valve and hydraulic actuator assembly performance limits shall be validated in accordance with the criteria given in 7.10.4.1.2.

Justification

This requirement standardizes the definition of valve and actuator validation requirements.

Add to third paragraph

Hyperbaric cycles shall be in accordance with 7.10.4.1.3.

Justification

This requirement standardizes the definition of valve and actuator validation requirements.

NOTE This satisfies the 200 pressure/load cycles and 200 of the 600 endurance cycles detailed in Table 5.

Justification

This requirement standardizes the definition of valve and actuator validation requirements.

Add to fifth paragraph

Pressure testing shall be performed in the expected direction of flow.

Justification

This requirement standardizes the definition of valve and actuator validation requirements.

The direction of flow shall be consistent throughout all testing, with the exception of the final bi-directional low-pressure seat test for gate valves as specified in API 6A, F.2.2.2.15 and of the FAT gas seat test as specified in API 17D, 5.4.6.4.

Justification

This requirement standardizes the definition of valve and actuator validation requirements.

Add to sixth paragraph

Each type of cycle (endurance, hyperbaric, PR2) shall be fully completed prior to progressing to the next one.

Justification

This requirement standardizes the definition of valve and actuator validation requirements.

<u>*Add to subsection*</u>

Acceptance criteria for all gas stages of validation shall be in accordance with API 17D, 5.4.6.4 for PSL 3G equipment and pressure-containing seals, and API 6A, F.1.6.2 for pressure-controlling seals.

Justification

This requirement standardizes the definition of valve and actuator validation requirements.

J.5 Validation of Valves with Manual Operator (ROV/Diver Operated)

J.5.4 Hyperbaric Pressure Testing

<u>*Add to second paragraph*</u>

Hyperbaric cycles in accordance with Annex N shall be conducted at a temperature not to exceed 120 °F (49 °C).

Justification

No temperature is specified in API 17D and different operators and suppliers have currently been using different temperatures to perform this test. The workgroup and suppliers agree to standardize on this temperature. This reduces the cost, schedule and complexity of hyperbaric testing.

Annex Q
(informative)

Validation Testing

Q.1 Introduction

Q.1.1

This annex provides guidance with respect to validation testing.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.1.2

This annex addresses clarifications and informative additions to API 17D validation testing and should be read concurrently with 5.1.7.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.1.3

The intent of this annex is to provide a standard interpretation of API 17D validation testing requirements.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.1.4

The stated requirements are value adding practice for the validation of new products or re-validation of existing products due to a substantive change.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.1.5

The intent of this annex is also to define a standard practice for current and future equipment validation.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.1.6

It is not intended to imply that equipment that has been previously validated to API 17D needs to have additional validation or re-validation.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.2 General

Q.2.1

Pressure cycles, temperature cycles and endurance cycles should be performed as specified in API 17D, in a cumulative test using one product without changing any seals or components.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.2.2

Grease, sealant or lubricant should not be used to mask defects in sealing systems.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Lubricants can be used to aid in the assembly and break-in period of the equipment.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.2.3

In the event of failure during validation testing resulting in modification to fit, form or function, or replacement of components, testing should restart from a point in the test sequence which ensures that affected components are subjected to the full test sequence.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.3 Temperature Cycling Tests

Objective evidence should not be utilized as an alternative to testing.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4 Life cycle / Endurance Testing

Q.4.1 General

All valves, seals and other components whose operation may be affected by external hydrostatic pressure should be tested in a hyperbaric chamber. If a component does not fit in a hyperbaric chamber, the test can be performed in a suitable test fixture simulating hyperbaric pressure.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Validation testing should include accurate simulations of all design loads and service conditions to the extent practical.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

The source of these loads can be either from environmental effects or other interfacing equipment.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Except where explicitly stated in the following clauses, validation should be performed in a cumulative test on one product without maintenance, addition of a lubricant or sealant, changing seals or components, or disassembly for the duration of the testing.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Pressure and temperature stabilization requirements should be in accordance with API 6A, F.1.10.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.2 Seals

Primary seals exposed to well bore and associated secondary seals, either metal-to-metal or non-metallic, should be validated in accordance with Table 3 as seals exposed to well bore in production.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Validation should also follow the intent of the API 6A, Annex F PR2 sequence as described in a) through e).

NOTE 1 This satisfies the 200 pressure/load cycle tests and 3 temperature cycle tests of Table 3.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

a) Before performing all the steps described in b) through d), the seal should undergo FAT including a gas test as follows:

   — at ambient temperature;

   — at rated working pressure;

   — with a hold period of 15 minutes.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

b) Pressure and temperature cycles should be performed in accordance with API 6A, F.1.11.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

c) 200 pressure cycles at ambient temperature should be performed in accordance with 5.1.7.4.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

NOTE 3 Steps b) and c) can be performed in either order.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

d) After steps b) and c) have been completed, a gas test should be performed as follows:

— at ambient temperature;

— at rated working pressure;

— with a hold period of 15 minutes.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

e) Seals should be validated with hyperbaric testing in accordance with Annex N where the seal is exposed to external hydrostatic pressure, and the seal, surrounding geometry or tolerances are asymmetrical.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Acceptance criteria for seals should be in accordance with 5.4.6.4 for PSL 3G equipment.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Acceptance criteria for minimum/maximum temperature tests should be in accordance with API 6A, F.1.6.2.3.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Seals that are identical in function but different in size, shape or configuration should be validated separately.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Bi-directional seals should follow the full test sequence from both directions if the seal is exposed to pressure variations from both directions by design.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Where the bi-directional seal, surrounding geometry and tolerances are symmetrical, the full test sequence may be performed in one direction only.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Unidirectional seals should be validated from the primary pressure direction.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

At the beginning and the end of the validation test, it should be proven that the seal relieves pressure from the reverse direction, if this function is required by the design.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.3 Subsea valves

Q.4.3.1 General

Q.4.3.1.1

Validation of subsea valves should be in accordance with Annex J.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.3.1.2

Valve validation testing should be in accordance with Table Q.1.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.3.1.3

After performing all testing described in Q.4.3.1.2, the valve should undergo a gas body and gas seat test in accordance with 5.4.6.3 and 5.4.6.4, with acceptance criteria as stated in Q.4.3.1.4, Q.4.3.1.5 and Q.4.3.1.6.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.3.1.4

Acceptance criteria for all gas stages of validation should be in accordance with 5.4.6.4 for PSL 3G equipment and for pressure-containing seals, and API 6A, F.1.6.2 for pressure-controlling seals.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.3.1.5

For hyperbaric testing in accordance with Annex N, there is no requirement to maintain the test medium at 40 °F ± 10 °F (4 °C ± 5 °C) throughout the test.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.3.1.6

The testing described in Q.4.3 satisfies the validation requirements for valve seals including those of Q.4.2.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.3.2 Gate Valves

Tree gate valves in production and crossover bores should be validated for Class II sandy service in accordance with API 6AV1. It is not required that the valve used for Q.4.3.1 should be the same valve used for API 6AV1 validation.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.3.3 Check Valves

For check valves without any penetrations running through the body wall, communicating wellbore and the environment, 200 endurance cycles can be performed in lieu of the 200 hyperbaric cycles.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.3.4 Needle Valves

The validation testing of needle valves should be performed in accordance with the requirements of Q.4.3.1. There are no additional validation requirements.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.4 Subsea Valve Actuators

Q.4.4.1 General

Q.4.4.1.1

The general requirements in this subclause should apply to valve actuators, both hydraulically and manually operated.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

NOTE The actuator may be validated concurrently with valve validation testing or with a test valve or fixture that provides the functionality and output forces/torques required of a production-style valve.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.4.1.2

When size restrictions prevent hyperbaric validation testing of the valve and actuator simultaneously, the actuator should be coupled with a dummy valve that replicates the valve functional loading, for all hyperbaric validation test conditions.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.4.1.3

Valve actuator validation testing should meet API 17D requirements as described in a) through c) (see Table Q.1).

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

a) PR2 sequence should be performed in accordance with API 6A, F.2.3 for PR2F actuators.

NOTE 1 This satisfies 200 of the 600 endurance cycles and the 3 temperature cycles required by Table 5.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

b) 200 hyperbaric cycles should be performed in accordance with Annex N.

NOTE 2 This satisfies the 200 pressure/load cycles and 200 of the 600 endurance cycles required by Table 5.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

c) 200 endurance cycles should be performed in accordance with API 6A, F.2.3.2.2 except that the number of cycles should be 200.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Steps a) through c) should complete the 600 endurance cycles required by Table 5.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.4.1.5

The valve position indicator should be verified such that indicator shows the true position of valve flow path.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.4.2 Hydraulic Valve Actuators

No seal replacement, actuator redress or disassembly should be allowed during testing.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Before the testing described in Q.4.4.1, the actuator should undergo FAT including hydrotests at 20 % and 100 % of the RWP of the actuator, as described in 7.10.4.2.3.3.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.4.3 Valve Actuators with ROV Linear Override

Q.4.4.3.1

The force required and linear travel to fully stroke and override the valve, determined with calculations and confirmed during testing, should be measured and recorded before and after completion of testing in Q.4.4.1.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.4.3.2

Force measurement should be conducted under atmospheric conditions and the following data recorded:

a) operating force required to stroke the valve from its failed position (i.e. compress the spring) with zero pressure in bore;

b) operating force required to fully open a fail-closed valve with the RWP pressure differential across the gate;

c) operating force required to fully close a fail-open valve with the RWP in the valve bore and body.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.4.3.3

Valve signatures may be used in lieu of direct force measurement where they provide equivalent data to Q.4.4.3.2 a), b) and c).

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.4.3.4

Either during validation testing or as a separate test, the maximum operating force (i.e. force determined by the supplier that can be applied in the fully stroked position, without damage or deformation to any valve component that would impair or affect performance) should be applied.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.4.4 Valve Actuators with ROV Rotary Override and Manual Valve Actuators

Q.4.4.4.1

Torque required, number of turns and direction of rotation to operate should be measured and recorded before and after completion of testing in Q.4.4.1.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.4.4.2

The following measurements should be under atmospheric conditions as follows:

a) operating torque required to stroke the valve fully open and closed with zero pressure in the bore;

b) operating torque required to stroke the valve fully open, starting from the closed position with the RWP differential across the gate;

c) operating torque required to stroke the valve fully closed from the open position with the RWP in the valve bore and body;

d) number of turns and direction to operate.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.4.4.3

In Q.4.4.4.2 d), performance of the open/close indicator should be validated against the number of turns.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.4.4.4

Either during validation testing or as a separate test, the maximum operating torque (maximum rated torque determined by supplier that can be applied in fully open and fully closed positions, without damage or deformation to any valve component that would impair or affect performance) should be applied.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.5 Tubing Hanger Annulus Isolation Device

Q.4.5.1

The annulus isolation device validation testing should meet the requirements described in Q.4.5.2 and Q.4.5.3.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.5.2

Individual seals should be validated by completion of the pressure and temperature sequence cycling described in API 6A, F.1.11.

NOTE This test should be performed on individual seals in a test fixture, but can be performed in the assembled annulus isolation device where appropriate test ports are provided.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.5.3

The annulus isolation device assembly should be validated by completion of the test sequence described in a) through m), based on API 6A, Annex F PR2 requirements.

NOTE 1 Seals may be changed out prior to the start of this test sequence.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

a) Before performing all the steps described in b) through m), the device should undergo FAT including a gas body and gas seat test in accordance with 5.4.6.3 and 5.4.6.4.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

b) Force or torque measurement should be performed in accordance with API 6A, F.2.2.2.1, except that the measurement should be conducted twice with 100 % RWP pressure differential, once from below and once from above.

NOTE 2 The test fluid may be liquid.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

c) Dynamic test cycles should be performed in accordance with API 6A, F.2.2.2.2, except that the reduced number of cycles and temperature should be maintained at 39 °F ± 4 °F (4 °C ± 2 °C) throughout testing.

NOTE 3 A cycle is defined as the device stroking from fully closed, to fully open, to fully closed.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

— Dynamic cycles with both liquid and gas test mediums should be performed.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

— With a liquid test medium, 20 cycles should be performed with 100 % RWP pressure differential from below and 20 cycles performed with 100 % RWP pressure differential from above.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

- With a gas test medium, 3 cycles should be performed with 100 % RWP pressure differential from below.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

d) API 6A, F.2.2.2.3 and F.2.2.2.4 should not be performed.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

e) Gas seat test should be performed in accordance with API 6A, F.2.2.2.5, except that it should be performed twice with the pressure differential, once from both above and once from below, and the temperature maintained at 39 °F ± 4 °F (4 °C ± 2 °C).

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

f) Low-pressure seat test should be performed in accordance with API 6A, F.2.2.2.6, except that it should be performed twice with the pressure differential, once from both above and once from below, and the temperature maintained at 39 °F ± 4 °F (4 °C ± 2 °C).

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

g) API 6A, F.2.2.2.7 through F.2.2.2.10 should not be performed.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

h) Body pressure/temperature cycles should be performed in accordance with API 6A, F.2.2.2.11, except that steps F.1.11.3 a) through o) should be performed with the device remaining closed throughout and the test pressure applied from below.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

i) Body pressure holding test should be performed in accordance with API 6A, F.2.2.2.12, except that the temperature should be maintained at 39 °F ± 4 °F (4 °C ± 2 °C).

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

j) Gas seat test should be performed in accordance with API 6A, F.2.2.2.13, except that it should be performed twice with the pressure differential, once from both above and once from below, and the temperature maintained at 39 °F ± 4 °F (4 °C ± 2 °C).

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

k) API 6A, F.2.2.2.14 should not be performed.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

l) Low-pressure seat test should be performed in accordance with API 6A, F.2.2.2.15, except that it should be performed twice with pressure differential, once from both above and once from below, and the temperature maintained at 39 °F ± 4 °F (4 °C ± 2 °C).

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

m) Force or torque measurement should be performed in accordance with API 6A, F.2.2.2.16, except that the measurement should be conducted twice with 100 % RWP pressure differential, once from below and once from above.

NOTE 4 The test fluid may be liquid.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.5.4

All seals or other components whose operation may be affected by external hydrostatic pressure should be tested in a hyperbaric chamber or suitable test fixture simulating hyperbaric pressure.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.5.5

It should be demonstrated that the annulus isolation device, including the actuating mechanism, functions at the design water depth.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.5.6

Acceptance criteria for all gas stages of validation should be in accordance with 5.4.6.2.3 PSL 3G for equipment for pressure-containing seals, and in accordance with API 6A, F.1.6.2 for pressure-controlling seals.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.6 Chokes

Q.4.6.1

The choke valve validation testing should be conducted on the same valve, without the following:

a) maintenance;

b) addition of lubricant or sealant;

c) replacement of any seals or components for the duration of the testing.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.6.2

The choke valve should not be disassembled for any reason during testing.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.6.3

The choke valve validation testing should meet API 17D requirements as described in a) through e) (see Table Q.2).

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

a) Before performing all the steps described in b) though d), the choke valve should undergo FAT including a gas body test in accordance with 5.4.6.3.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

b) PR2 sequence should performed in accordance with API 6A, F.2.4 for PR2F chokes.

NOTE 1 This satisfies 200 of the 500 endurance cycles and the 3 temperature cycles required by Table 3.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

c) 200 hyperbaric cycles should performed in accordance with Annex N.

NOTE 2 This satisfies the 200 pressure/load cycles and 200 of the 500 endurance cycles required by Table 3.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

d) 100 endurance cycles should performed in accordance with API 6A, F.2.4.4 except that the number of cycles should be 100.

NOTE 3 This completes the 500 endurance cycles required by Table 3.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

e) After performing all testing described in a) through d), choke valve should undergo a gas body test in accordance with 5.4.6.3.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.7 Choke Actuators

Q.4.7.1

The actuator may be validated concurrently with choke validation testing or with a test choke or fixture that provides the functionality and output forces required of a production-style choke.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.7.2

Choke actuator seals should be tested in accordance with API 17D.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.7.2

The choke position indicator should be verified for accurate position reading.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.7.2

Both mechanical and electrical (if applicable) indicator function should be verified.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

NOTE As used in the following sections the term "endurance cycle" follows the definition for PR2F actuators (open-close-open) and "choke actuator endurance cycle" follows the definition of Table 5 footnote e (full-open to full-close or full-close to full-open).

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.4.7.3

The choke actuator validation testing should meet API 17D requirements as described in a) through e) (see Table Q.3).

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

a) Before performing all the steps described in b) through d), the choke actuator should undergo FAT and hydrotest at 20 % and 100 % of the RWP of the actuator, as described in 7.20.3.5.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

b) PR2 sequence should be performed in accordance with API 6A, F.2.3 for PR2F actuators.

NOTE 1 This satisfies 400 of the 1000 choke actuator endurance cycles and the 3 temperature cycles required by Table 5.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

c) 200 hyperbaric cycles should performed in accordance with Annex N.

NOTE 2 This satisfies the 200 pressure/load cycles and 400 of the 1000 choke actuator endurance cycles required by Table 5.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

d) 100 endurance cycles should be performed in accordance with API 6A, F.2.3.2.4, except that the number of cycles should be 100.

NOTE 3 This satisfies the 200 of the 1000 choke actuator endurance cycles required by Table 5.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

e) After performing all the steps described in a) through d), the actuator should undergo FAT and hydrotest at 20 % and 100 % of the RWP of the actuator, as described in 7.20.3.5.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.5 Product Family Validation

Q.5.1

Validation of product family by API 17D scaling methods should not be used to meet equipment validation testing requirements except for the sand slurry test.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.5.2

Validation of product family by API 17D scaling methods should only be used for the sand slurry test if the valves are members of a product family, as defined in API 6AV1, and have the same geometric shape at the body cavity, gate, seat and seals.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.6 Documentation

Q.6.1

All validation test records should be continuous for both pressure and temperature tests (i.e. no breaks in the recording/logging of any of the test data).

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Q.6.2

Validation testing documentation should include the following:

a) validation test procedure;

b) test charts;

c) photographs and/or video of testing/equipment;

d) signatures of testing technicians and witnesses;

e) assembly and component traceability (assembly number, part numbers, revisions, serial numbers, material, weld non-destructive examination, etc.);

f) general assembly drawings of all equipment, including test equipment;

g) stack-up drawing of test setup;

k) validation testing report;

l) dimensional report of all critical parts before and after testing.

Justification

API 17D offers several means of performing product validation, which leads to differences in detailed validation methods and requirements between operators and suppliers. The workgroup has agreed to standardize this definition of product validation requirements in order to achieve consistent and repeatable validation programs and eliminate the need for repeated validations to meet slightly different requirements.

Table Q.1—Interpretation of API 17D, Table 5 Cycles for Valves and Valve Actuators

API 17D, Table 5 Requirement for Valves and Valves Actuators		Pressure/Load Cycling Test	Temperature Cycling Test	Endurance Cycling Test (Total Cumulative Cycles)
		200	**3**	**600**
To be satisfied by:				
Gate valves Needle valves	Validation test	API 6A, F.2.2 Design validation for PR2F valves 200 cycles + 3 temperature cycles	API 17D, Annex N Hyperbaric testing 200 cycles	API 6A, F.2.2.2.2.1 Modified endurance cycling test 200 cycles
	Number of API 17D, Table 5 cycles accumulated for each test	200 endurance cycles 3 temperature cycles	200 endurance cycles 200 pressure/load cycles	200 endurance cycles
Check valves	Validation test	API 6A ,F.2.2 Design validation for PR2F valves 200 cycles + 3 temperature cycles	API 17D Annex N Hyperbaric testing 200 cycles or (if design is not affected by hyperbaric pressure) API 6A, F.2.2.2.2.2 Modified endurance cycling test 200 cycles	API 6A, F.2.2.2.2.2 Modified endurance cycling test 200 cycles
	Number of API 17D, Table 5 cycles accumulated for each test	200 endurance cycles 3 temperature cycles	200 endurance cycles 200 pressure/load cycles	200 endurance cycles
Valve actuators	Validation test	API 6A, F.2.3 Design validation for PR2F actuators 200 cycles + 3 temperature cycles	API 17D, Annex N Hyperbaric testing 200 cycles	API 6A, F.2.3.2.2 Modified endurance cycling test 200 cycles
	Number of API 17D, Table 5 cycles accumulated for each test	200 endurance cycles 3 temperature cycles	200 endurance cycles 200 pressure/load cycles	200 endurance cycles

Table Q.2—Interpretation of API 17D, Table 5 Cycles for Choke Valves

API 17D, Table 5 Requirement for Choke Valves		**Pressure/Load Cycling Test**	**Temperature Cycling Test**	**Endurance Cycling Test (Total Cumulative Cycles)**
		200	**3**	**500**
To be satisfied by:				
Choke valves	Validation test	API 6A, F.2.4 Design validation for PR2F chokes 200 cycles + 3 temperature cycles	API 17D, Annex N Hyperbaric testing 200 cycles	API 6A, F.2.4.4 Modified endurance cycling test 100 cycles
	Number of API 17D, Table 5 cycles accumulated for each test	200 endurance cycles 3 temperature cycles	200 endurance cycles 200 pressure/load cycles	100 endurance cycles

Table Q.3—Interpretation of API 17D, Table 5 Cycles for Choke Valve Actuators

API 17D, Table 5 Requirement for Choke Valve Actuators		**Pressure/Load Cycling Test**	**Temperature Cycling Test**	**Endurance Cycling Test (Total Cumulative Cycles)**
		200	**3**	**1000** **(Choke Actuator Endurance Cycles)**
To be satisfied by:				
Choke valve actuators	Validation test	API 6A, F.2.3 Design validation for PR2F actuators 200 cycles + 3 temperature cycles	API 17D, Annex N Hyperbaric testing 200 cycles	API 6A, F.2.3.2.2 Modified endurance cycling test 100 cycles
	Number of API 17D, Table 5 cycles accumulated for each test	400 choke actuator endurance cycles 3 temperature cycles	400 choke actuator endurance cycles 200 pressure/load cycles	200 choke actuator endurance cycles
	Additional testing	Further endurance cycles as per API 6A, F.2.3.2.2 except that the number of cycles should be performed to reach a cumulative one million actuator steps		

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