Standard for Repair and Remanufacturing of Marine Drilling Riser Equipment

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This standard replaces the repair and remanufacturing requirements from API 16F.

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Suggested revisions are invited and should be submitted to the API, Standards Department, 1220 L Street, NW, Washington, DC 20005, or by email to standards@api.org

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1 Scope

This standard specifies requirements for repair and remanufacturing of marine drilling riser built under API 16Fand equipment produced prior to existence of API 16F.

This standard also covers the testing, inspection, welding, marking, certification, storing, and shipping of equipment repaired or remanufactured per this standard.

Maintenance activities are not governed by this document, but the documentation of those activities is included in the scope.

This standard is applicable to and establishes requirements for the repair and remanufacturing of the following specific equipments:

1. Riser Joint (including external line, main tube, riser coupling)
2. Buoyancy

2 Normative Reference

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

API

API Specification 16F, Specification for Marine Drilling Riser Equipment

API Specification 20E, Alloy and Carbon Steel Bolting for Use in the Petroleum and Natural Gas Industries

API Specification 20F, Corrosion Resistant Bolting for Use in the Petroleum and Natural Gas Industries

API Specification Q1: Specification for Quality Management System Requirements for Manufacturing Organizations for the Petroleum, Petrochemical and Natural Gas Industry

ASME

ASME Boiler and Pressure Vessel Code (BPVC) Section V - Nondestructive Examination, Article 5, UT Examination Methods for Materials and Fabrication

ASME Boiler and Pressure Vessel Code Section IX

ASME Boiler and Pressure Vessel Code, Section VIII, DIV1 - Rules for Construction of Pressure Vessels

ASNT

ASNT-SNT-TC-1A, Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing

ASTM

ASTM E110, Standard Test Method for Indentation Hardness of Metallic Materials by Portable Hardness Testers

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

ASTM E10, Standard Test Method for Brinell Hardness of Metallic Materials

ASTM E18, Standard Test Methods for Rockwell Hardness of Metallic Materials

ASTM E94, Standard Guide for Radiographic Testing

ASTM E140, Hardness Conversion Tables for Metals

ASTM E165, Standard Test Method for Liquid Penetrant Examination

ASTM E384, Standard Test Method for Knoop and Vickers Hardness of Materials

ASTM A388, Ultrasonic Examination of Steel Forgings

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

ASTM E709, Standard Guide for Magnetic Particle Examination

AWS

AWS QC1 Standard for AWS Certification of Welding Inspectors.

AWS D1.1, ASME BPVC, Section IX

ISO

ISO 6506-1, Metallic materials, Brinell hardness test, Part 1: Test method

ISO 6507-1, Metallic materials, Vickers hardness test, Part 1: Test method

ISO 6508 All parts, Metallic materials, Rockwell hardness test

ISO 9712, International Standard for Nondestructive Testing Personnel Qualification and Certification

CSWIP, Requirements for the Certification of Visual Welding Inspectors (Level 1), Welding Inspectors (Level 2) and Senior Welding Inspectors (Level 3) (fusion welding) in accordance with the requirements of BS EN ISO 176371:2011

ISO 15156, Materials for use in H2S-containing environments in oil and gas production, all parts

NACE

NACE MR0175, Sulfide Stress Cracking Resistant Metallic Materials for Oilfield Equipment

Footnote:
1) American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990, USA.
2) American Society for Nondestructive Testing, 4153 Arlingate Plaza, Columbus, OH 43228-0518, USA.
3) American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA.
4) International Organization for Standardization, 1, ch. de la Voie-Creuse, Case postale 56, CH-1211 Geneva 20, Switzerland, www.iso.org.
5) NACE International, 1440 South Creek Drive, Houston, Texas 77084-4906, www.nace.org.
6) SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, USA.
7) American Welding Society, 8669 NW 36 Street, # 130, Miami, Florida 33166-6672, USA.

3 Terms, Definitions, and Abbreviations

3.1 Terms and Definitions

For the purposes of this standard, the following terms and definitions apply.

3.1.1
acceptance criteria
Defined limits placed on characteristics of materials, equipment, processes or service.

3.1.2
body
Any portion of equipment between end connections, with or without internal parts, which contains wellbore pressure.

3.1.3
bolting
All threaded fasteners, tap-end studs, double-ended studs, headed bolts, cap screws, screws, and nuts.

3.1.4
calibration
Comparison to a standard of known accuracy and making any needed adjustment(s).

3.1.5
Certificate of Conformance
COC
Document in which the manufacturer, remanufacturer, or technical authority certifies that the assembly or part is in conformance to the mentioned standard(s), specifications and guidelines in accordance with the original or current product definition.

3.1.6
Certificate of Service
COS
Document in which the equipment manufacturer, remanufacturer, technical authority / owner or operator certifies that the equipment has been inspected and successfully tested in accordance with the applicable equipment owner's maintenance program and/or manufacturer's guidelines.

3.1.7
chemical analysis
Determination of the chemical composition of material.

3.1.8
clamp *(noun)*
Device with internal angled shoulders used to fasten mating sealing hubs.

3.1.9
conformance
Satisfying all of the specified requirements of the referenced specification, specification section or document.

3.1.10
critical dimension
Dimension(s) identified by the manufacturer as requiring verification and documentation.

3.1.11
critical cross-section
A section(s) in a part or component identified by technical assessment (i.e. stress calculations or analysis) as a location(s) where mechanical properties are to be evaluated to establish compliance with design and material specification of the OEM/CEM

3.1.12
Current Equipment Manufacturer
CEM
Design owner or remanufacturer of the traceable current assembled equipment, single equipment unit, or component part responsible for the current product definition.

NOTE The OEM can be the CEM as long as they own the CPD that is active for the equipment.

3.1.13
current product definition
CPD
Complete design verified and validated definition of the requirements for the current assembled product, single equipment unit or component part, including specified limits, tolerances, health requirements, safety requirements, environmental requirements, limitations of use, customer specific requirements, design acceptance criteria, materials of construction, materials processing requirements, physical properties, physical dimensions, requirements for manufacturing process controls, inspection, assembly, testing, marking, handling, storage, maintenance, service and records requirements.

3.1.14
Dehydrogenation heat treatment
DHT
Activity carried out to diffuse hydrogen and minimize the risk of hydrogen cold cracking in completed or partially completed weld joints prior to the weld joint cooling to ambient temperature.

3.1.15
design status
Status of a product managed under the requirements of this standard, with regard to changes to elements of the Original Product Definition (OPD) as well as improvements to the OPD or obsolescence of the product.

3.1.16
end connection
Integral male or female thread, clamp hub end connector; flange, studded or through-bolted, or any other means used to join together equipment that contains or controls pressure.

3.1.17
equipment
Components or assemblies to which this specification is applicable.

3.1.18
equipment owner
Owner of the equipment repaired or remanufactured in conformance with this document.

3.1.19

fabrication weld
Weld that joins two or more parts.

3.1.20
flange
Protruding rim, with holes to accept bolts and having a sealing mechanism, used to join pressure-containing equipment with dimensions specified in this standard.

3.1.21
forging *(noun)*
Shaped metal part formed by the forging method.

3.1.22
full-penetration weld
Weld that extends throughout the complete wall section of the parts joined.

3.1.23
heat
Cast lot material originating from a final melt.

NOTE For remelted alloys, a heat is defined as the raw material originating from a single remelted ingot.

3.1.24
heat-affected zone
HAZ
Portion of the base metal which has not been melted, but whose mechanical properties or microstructure has been altered by the heat of welding or cutting.

3.1.25
heat treatment
heat treating
Specified, timed sequence of controlled heating and cooling of materials for the purpose of changing physical or mechanical properties.

3.1.26
hot-work *(verb)*
Deform metal plastically at a temperature above the recrystallization temperature.

3.1.27
hub
Protruding rim with an external angled shoulder and a sealing mechanism used to join pressure-containing equipment.

3.1.28
indication
Visual sign of cracks, pits or other abnormalities found during non-destructive examination.

3.1.29
integral *(adjective)*
Parts joined by the forging, casting or welding process.

3.1.30
Intermediate Stress Relief
ISR
Activity carried out to reduce residual stresses and diffuse hydrogen from completed highly stressed weld joints so that the risk of cracking is minimized upon the weld joint cooling to ambient temperature

NOTE ISR may be used to reduce the risk of decreasing the base material properties when multiple welding operations are performed on a component. For example, a flange may receive an ISR after the seal groove inlay, then receive the final PWHT after the flange has been circumferentially welded to its mating component.

3.1.31
maintenance
Upkeep of well control equipment which is performed in accordance with the equipment owner's PM program and the manufacturer's guidelines.

NOTE These procedures may include but are not limited to: inspections, cleaning, polishing, function testing, pressure testing, non-destructive examination, and change out of sealing parts and those parts defined in the PM program to be changed either periodically or on a cycle basis.

3.1.32
major repair weld
Weld whose depth that is greater than 25% of the original wall thickness or 25.4 mm (1 in.), whichever is less.

3.1.33
manufacturer
OEM or CEM of the product or part.

3.1.34
manufacturing data book
MDB
Composite file of records from a traceable API product which includes all records associated with the original API product manufacturing including certification records as required by this standard.

3.1.35
material traceability level
MTL
The extent of traceability that a part or component has available for a repair and/or remanufacture. This level is determined by the material composition and mechanical properties of the base material.

3.1.36
other end connection
OEC
Connection which is not specified in an API specification or standard.

NOTE: This includes API flanges and hubs with non-API gasket preparations and manufacturer's proprietary connections.

3.1.37
original equipment manufacturer
OEM
Design owner or manufacturer of the traceable assembled equipment, single equipment unit, or component part.

3.1.38
original product definition
OPD

Complete design verified and validated definition of the requirements for the original assembled product, single equipment unit or component part, including specified limits, tolerances, health requirements, safety requirements, environmental requirements, limitations of use, customer specific requirements, design acceptance criteria, materials of construction, materials processing requirements, physical properties, physical dimensions, requirements for manufacturing process controls, inspection, assembly, testing, marking, handling, storage, maintenance, service and records requirements.

3.1.39
part
Individual piece used in the assembly of a single unit of equipment.

3.1.40
post-weld heat treatment
PWHT
Controlled heat treatment subsequent to welding, including stress relief to obtain desired material properties.

3.1.41
pressure-containing component
Component whose failure to function as intended would cause a release of pressurized fluid to the environment.

3.1.42
pressure-containing weld
Weld whose absence or failure will reduce or compromise the pressure-containing integrity of the component.

3.1.43
procedure qualification record
PQR
Record of the welding data used to make the test weldment containing the actual values or ranges of the essential and supplementary essential variables used in preparing the test weldments, including the test results.

3.1.44
product history file
PHF
Composite file of records from a traceable API product which includes all records associated with the API product repair and remanufacturing, including certification records required by this standard.

3.1.45
rated working pressure
Maximum internal pressure that the equipment is designed to contain and/or control.

3.1.46
record *(noun)*
Document or dataset created and maintained that provides objective evidence of activities performed, results achieved or statements made.

3.1.47
relevant indication
Any indication (liquid penetrant or magnetic particle examination) with a major dimension greater than 1.6 mm (0.062 in).

NOTE: Inherent indications not associated with a surface rupture are considered non-relevant indications.

3.1.48

remanufacture
Process of disassembly, reassembly and testing of drill-through equipment, with or without the replacement of parts, in which machining, welding, heat treatment, or other manufacturing operation is employed.

3.1.49
remanufacturer
Organization that performs the repair or remanufacturing work.

3.1.50
repair
Process of disassembly, inspection, reassembly and testing of drill-through equipment, with or without the replacement of parts in order to correct failed or worn components

NOTE Repair does not include machining, welding, heat treating or other manufacturing operations of component parts.

3.1.51
repair weld
Welding performed to correct a nonconformance.

3.1.52
serialization
Assignment of a unique code to individual parts and/or pieces of equipment to maintain records.

3.1.53
skim cut
Re-facing of a machined surface within allowable tolerances and surface finish of the current product definition or API specification.

3.1.54
Statement of Compatibility
Document in which a manufacturer, remanufacturer, or recognized technical authority states that an assembly or component-part meets or exceeds the product performance requirements as defined in API 16A and is compatible with the assembly for which it is intended.

3.1.55
Statement of Fact
SOF
Document in which the manufacturer, remanufacturer, or technical authority certifies that the repair or activity performed was made with in accordance with the scope defined by the owner.

NOTE A Statement of Fact does not fulfil the requirements of a Certificate of Conformance or other documentation verifying product design.

3.1.56
stress relief
Controlled heating of material to a predetermined temperature for the purpose of reducing any residual stresses.

3.1.57
Technical Authority
Competent and technically qualified person or organization with evidence to demonstrate the expertise, skills, and experience regarding design, quality, and manufacturing processes necessary to perform the required verification(s).

3.1.58

utility bolting
All bolting that is required to mount equipment and accessories to the drill through equipment that is not closure bolting, pressure retaining, or pressure controlling.

NOTE Examples: bolting on lifting eye, pad eye (non-welded), wear bushing, name plate, clamps for tubing, guards.

3.1.59
visual examination
Examination of parts and equipment for visible defects in material and workmanship.

3.1.60
weld *(verb)*
Act of fusing materials, with or without the addition of filler materials.

3.1.61
welding
Application of any one of a group of welding processes, which applies heat energy sufficient to melt and join one or more pieces of metal through localized fusion and coalescence.

3.1.62
welding procedure specification
WPS
Written welding procedure that is qualified to provide direction for welding in accordance with requirements of this standard and describing the specific essential, nonessential, and supplementary essential variables required for each welding process.

NOTE These variables and their meanings are defined in ASME Boiler & Pressure Vessel Code Section IX, Article II and Article IV.

3.1.63
weldment
Portion or area of a component on which welding has been performed.

NOTE A weldment includes the weld metal, the heat-affected zone (HAZ), and the base metal unaffected by the heat of welding.

3.1.64
yield strength
Stress level, measured at room temperature, at which material plastically deforms and will not return to its original dimensions when the stress is released.

NOTE 1 The term is expressed in Newton's per square millimeter (pounds per square inch) of loaded area.

3.2 Abbreviations

For the purposes of this document, the following abbreviations apply.

AE	acoustic emission
ANSI	American National Standards Institute
API	American Petroleum Institute
AQL	acceptance quality level
ASME	American Society of Mechanical Engineers
ASNT	American Society for Nondestructive Testing
ASTM	American Society for Testing and Materials
AWS	American Welding Society
BM	base metal
BPVC	Boiler and Pressure Vessel Code
CE	carbon equivalent
CEM	current equipment manufacturer
CPD	current product definition
COC	certificate of conformance
COS	certificate of service
CRA	corrosion resistant alloy
CSWIP	certification scheme for welding and inspection personnel
DAC	distance amplitude curve
DHT	dehydrogenation heat treatment
DPI	dye penetrant inspection
ER	equivalent round
EP	equivalent P-number

FAT	Factory Acceptance Test
Fe	Iron
FL	fusion line
HAZ	heat-affected zone
HBW	hardness Brinell
ID	inside diameter
ITP	inspection test plan
LP	liquid penetrant
MDB	manufacturing data book
MP	magnetic particle
MPI	magnetic particle inspection
MTR	material test record
NACE	National Association of Corrosion Engineers
NDE	nondestructive examination
OD	outside diameter
OEC	other end connection
OEM	original equipment manufacturer
OPD	original product definition
PHF	product history file
PM	preventive maintenance
PMI	positive material identification
PQR	procedure qualification record
PWHT	post-weld heat treatment
QMS	quality management system
Q&T	quenched and tempered

QTC	qualification test coupon
SMYS	specified minimum yield strength
SOF	statement of fact
SSC	sulfide stress cracking
SST	stainless steel
TPI	third party inspection
UNS	unified numbering system
UT	ultrasonic testing
UTS	ultimate tensile strength
VBR	variable-bore ram
WPS	welding procedure specification
YS	yield strength

4 Responsibilities

4.1 General

An assembly can have more than one Certificate of Conformance for its various components that can coexist together to provide certification for the entire assemblies. Similarly, an assembly can have more than one CEM or OEM.

Replacement parts and components shall conform to the API 16F edition at the date of manufacture or if the component was not manufactured to API 16F, the component shall meet the requirements of API 16F 1st edition

4.2 Manufacturer

New components shall conform to the following:

API 16F edition to which the component was manufactured, or if the component was not manufactured to API 16F, the component shall meet the requirements of API 16F 1st edition.

4.3 Remanufacturer

Remanufactured components shall conform to the following:

— API 16F edition to which the component was manufactured, or if the component was not manufactured to API 16F, the component shall meet the requirements of API 16F 1st edition.

— The CEM shall ensure the remanufactured component(s) meets or exceeds the design and functional requirements of the assembly.

4.4 Equipment Owner

The equipment owner shall be responsible for:

— Ensuring the remanufactured condition of the component or assembly is fit for its intended use.

— Maintaining an up to date MDB and PHF (Annex A and Annex B);

— Maintaining equipment certification records;

— Documenting the requirements for the MDB and PHF in the purchase order for repair and / or remanufacturing;

— Listing the TPI requirements in the purchase order for repair and / or remanufacturing;

— Ensuring a compatibility study has been conducted between the differing CEM components or between the CEM design and the OEM design.

5 General Requirements

5.1 General

Quality control requirements for specific equipment and parts as documented in clause 4.1, 4.2, 4.3 shall meet or exceed the API 16F edition the riser was manufactured to, or at least to the API 16F 1st edition.

Parts that do not meet the minimum of API 16 F quality requirements defined in 4.1 are not considered to be in conformance with this standard.

5.2 Inspection – Pre-remanufacturing

Any initial inspection required shall be defined by the product owner

5.3 Inspection of Class 2 of Class 3 Bolting

If Class 2 or Class 3 bolting are intended for reuse, they shall undergo a thorough inspection which includes:

— Wet particle MPI or DPI of the threads and non-threaded areas of the part;

— Hardness measurements on bolts & nuts;

— Threads (internal / external) inspection for wear and stretch;

— Bolt holes threads inspected for wear and stretch;

— Full dimensional inspection of the Class 2 or Class 3 bolting.

5.4 Replacement Parts

Replacement parts shall be documented in the PHF. Unique markings of the part shall provide the traceability that allows verification of the part design status.

Equipment shall be reassembled in accordance with documented specifications of the manufacturer.

5.4.1 Elastomeric Seal Requirements

All elastomer components used shall be in conformance with the requirements of API 16F.

5.4.2 Visual Inspection

After final acceptance testing equipment shall be visually inspected for wear or damage and results shall be recorded.

5.5 Documentation

Repair and remanufacturing activities performed on the product shall be fully documented, supported by the required certification and added to the PHF as defined in Annex B.

Documentation shall provide traceability as required under API 16F.

6 Quality Control Requirements

6.1 General

This clause specifies the quality control requirements for equipment repaired and remanufactured to meet this standard.

6.2 Measuring and Testing Equipment

6.2.1 General

Equipment used to inspect, test or examine material or other equipment shall be identified, controlled, calibrated and adjusted at specified intervals in accordance with documented manufacturer requirements, and consistent with recognized standards specified by the manufacturer / remanufacturer, to maintain the accuracy required by this standard.

6.2.2 Pressure-measuring Devices

6.2.2.1 Type and Accuracy

Test pressure-measuring devices shall be accurate in accordance with 16F.

Test pressure-measuring devices shall be either pressure gauges or pressure transducers and shall be accurate to at least □1.0 % of full-scale range.

If pressure gauges are used in lieu of pressure transducers, they shall be selected such that the test pressure is indicated within 20 % and 80 % of the full-scale value.

Pressure tests shall be documented in a chart (linear or circular) in the Product History File (PHF) and Manufacturing Data Book (MDB).

The record shall identify the recording device, calibration due date and shall be dated and signed.

6.2.2.2 Calibration Procedure
Pressure-measuring devices shall be periodically recalibrated with a master pressure-measuring device or a deadweight tester to at least three equidistant points of full scale (excluding zero and full scale as required points of calibration).

6.2.2.3 Calibration Intervals
Intervals shall be established for calibrations based on repeatability and degree of usage.

Calibration intervals shall be a maximum of three months until recorded calibration history can be established by the manufacturer / remanufacturer and new intervals established demonstrating the ability to retain accuracy after a period of time and after repeated use.

The increased calibration intervals shall not exceed one year.

The date of the last test may be noted on the front of the gauge.

6.3 Quality Control Personnel Qualifications

6.3.1 Non-destructive Examination (NDE) Personnel
Personnel performing NDE shall be qualified in accordance with the manufacturer's or remanufacturer's documented training program that conforms to the requirements specified in ISO 9712 or ASNT SNT-TC-1A.

6.3.2 Visual and Dimensional Examination Personnel
Personnel performing visual and dimensional examinations, including welders, shall take and pass an annual vision examination in accordance with the manufacturer's or remanufacturer's documented procedures that conforms to the applicable requirements of ISO 9712 or ASNT SNT-TC-1A.

6.3.3 Welding Inspectors
Personnel performing visual inspection of welding operations and completed welds shall be qualified to one of the following:

- AWS Senior Certified Welding Inspector (SCWI) in conformance with the provisions of AWS QC1;
- AWS Certified Welding Inspector (CWI) in conformance with the provisions of AWS QC1;
- AWS Certified Associate Welding Inspector (CAWI) in conformance with the provisions of AWS QC1 and under the supervision of an AWS SCWI or AWS CWI.
- CSWIP Certified Visual Welding Inspectors (Level 1);
- CSWIP Certified Welding Inspectors (Level 2);
- CSWIP Certified Senior Welding Inspectors (Level 3);
- Welding inspector certified by the OEM/CEM documented training program.

The OEM/CEM shall have written procedures:

- Defining the In-house welding inspector certification program including training syllabus, Instructor qualification requirements, length of certification and renewal requirements;
- Defining the roles, responsibilities, authority and accountability of a welding inspector;
- Defining essential welding variables and equipment monitoring;

6.3.4 Third-Party Inspection

If Third-Party Inspection is used, the following shall apply:

- Third Party Inspectors (TPI) shall be competent based on the appropriate education, training, skills and experience needed to perform the inspection service and certification related product requirements defined in the inspection scope;
- Evidence of the determination of competence of TPI personnel shall be recorded and maintained by the TPI company in accordance with their QMS documented procedures and requirements for competence
- The TPI scope shall be clearly defined in the purchase order by the equipment owner;
- The TPI requirements defined in the purchase order shall be included in the Inspection Test Plan for the product.

6.3.5 Equipment Certification

Equipment certification shall be approved by a manufacturer, remanufacturer, or Technical Authority.

6.3.6 Other Personnel

All other personnel performing measurements, inspections, tests or other quality control activities for acceptance shall be qualified and competent in accordance with the manufacture's or remanufacturer's quality management systems documented procedures and requirements, that meet the requirements of API Q1 or equivalent internationally recognized standard.

6.4 Quality Control Requirements for Equipment and Parts

6.4.1 General

All pressure-containing components exposed to wellbore fluid shall be in conformance with the requirements of NACE MR0175 / ISO 15156 (all parts).

All equipment and parts that are to be repaired/remanufactured under this standard shall be reviewed and confirmed to meet the requirements in this standard.

The MDB and PHF shall be updated in accordance to these requirements.

6.4.2 Material Requirements

Material used for parts or members shall conform to the requirements of API 16F with the exceptions noted in Section 8.

6.4.3 Quality Control Instructions

All quality control work shall be controlled by the OEM/CEM documented instructions, which includes an appropriate Inspection Test Plan (ITP) or other methodology that provides an auditable tracking document with quantitative and qualitative acceptance criteria.

6.4.4 Non-destructive Examination (NDE)

The following are considered NDE operations requiring validation:

6.4.4.1 NDE Instructions

NDE instructions shall be detailed regarding the requirements of this standard and those of all applicable nationally or internationally recognized standards specified by the manufacturer or remanufacturer. All NDE instructions shall be approved by a NDE Level III examiner.

NOTE: This requirement is not applicable to hardness testing and visual examination procedures.

6.4.4.2 NDE Qualification Levels

NDE personnel shall be qualified in accordance with requirements specified in ISO 9712 or ASNT SNT-TC-1A.

Be qualified in accordance with requirements specified in ISO 9712 or ASNT SNT-TC-1A.

6.4.5 Acceptance Status

The acceptance status of all equipment, parts, and materials shall be indicated either on the equipment, parts or materials or in the records traceable to the equipment, parts or materials.

6.5 Quality Control Requirements for Specific Equipment and Parts

6.5.1 General

Unless specified differently in this standard, quality control requirements for specific equipment and parts under this standard shall be in conformance with API 16F under which it was manufactured.

All new manufactured or replacement parts shall be in full conformance to the edition of API 16F under which it was manufactured, including design verification and validation. At a minimum, all remanufactured equipment for equipment manufactured prior to API 16F 1st Edition shall be in full conformance to API 16F 1st Edition. Repaired equipment or new components can meet the requirements of the original design requirements.

All new manufactured, remanufactured or replacement parts shall be in conformance with an actual product definition (OPD or CPD).

Quality control records and marking for specific equipment and parts shall be in conformance with API 16F.

6.5.2 Hardness Testing

Hardness testing requirements shall meet the following:

- Hardness testing methods shall be in accordance with ASTM E10, ASTM E18, ASTM E110, ASTM E384, ISO 6506-1, ISO 6507-1 or ISO 6508-1, as appropriate;
- Vickers hardness testing is permissible only for weld qualification.

- At least one hardness test (consisting of at least two indentations) shall be performed on each part tested, at a location determined by the manufacturer's or remanufacturer's specifications;
- For all pressure-containing and primary-load-path welds shall be hardness tested. At least one hardness test shall be performed in both the weld and in the adjacent unaffected base metal after all heat treatment and machining operations. Hardness values shall meet the requirements of the OEM/CEM written specification.
- Locations deemed inaccessible by the OEM/CEM for hardness testing shall be identified and recorded.
- The hardness testing used to qualify each part shall be performed after the last heat-treatment cycle (including all stress-relieving heat-treatment cycles) and after all exterior machining operations;
- The average value of the hardness test shall be stamped on the part adjacent to the test location. It is permissible for the hardness marking to be covered by other components after assembly;
- Hardness measurements for components where NACE MR0175 shall be required per API 16F, applicable limits shall be specified by NACE MR0175.
- Hardness measurement results shall be added to the MDB and PHF.

6.5.3 Critical Dimensions

6.5.3.1 Critical Dimensions and Critical Areas
Critical dimension requirements shall meet the following.

- Critical dimensions, as defined by the OEM or CEM, shall be documented and recorded for each part, and such documentation shall be retained by the OEM or CEM in accordance with the quality control requirements of Section 13.2 and 14.5.1.
- Critical dimensions, as defined by the OEM or CEM, shall be within the tolerances specified in the CPD.
- Critical areas, as defined by the OEM or CEM, shall be in conformance with the CPD.
- The OEM or CEM shall define and document the extent to which dimensions shall be verified and recorded.

6.5.4 Traceability

Traceability requirements shall meet the following:

- Parts and material shall be traceable in accordance with Annex A and Annex B;
- Identification shall be maintained on materials and parts, to facilitate traceability, as required by documented manufacturer requirements;
- OEM/CEM documented traceability requirements shall include provisions for maintenance or replacement of identification marks and identification control records;

— Welds without sufficient documentation / traceability in the PHF to meet the design specification of the manufacturer shall be removed.

At any time when traceability markings are still present, these markings may be reapplied as per API Q1.

6.5.5 Chemical Analysis

Chemical analysis shall be required for the base metal and filler material of remanufactured primary-load-carrying components or pressure containing components.

— Chemical analysis shall be performed when an MTR is not available;

— Chemical analysis shall be performed in accordance with the remanufacturers written procedure;

— The chemical composition shall be in conformance with the requirements of API 16F.

6.5.6 Visual Examination

Visual examination requirements shall meet the following:

— Areas, parts, or components as identified by the scope of work shall be 100% visually examined.

— Areas or parts nearby a repair/remanufacture that may have been affected by the repair or remanufacture process shall also be visually inspected.

— Visual examination of castings and forgings shall be performed in accordance with the OEM/CEM written specification;

— Acceptance criteria shall be in accordance with manufacturer's written specifications;

— Non-well fluid-wetted and non-sealing surfaces shall be examined in accordance with OEM/CEM written specifications.

6.5.7 Surface NDE

Surface NDE requirements shall meet the following:

— For Surface NDE of ferromagnetic materials, all accessible surfaces of each finished part shall be inspected after final heat treatment and final machining operations by either magnetic particle (MP) or liquid penetrant (LP) methods;

— For Surface NDE of non-ferromagnetic materials, all accessible surfaces of each finished part shall be inspected after final heat treatment and after final machining operations by the LP method;

- For Surface NDE of overlay cladding, all accessible surfaces of each finished part shall be inspected after final PWHT. If the cladding is to remain as-welded and not machined, no additional surface inspection shall be required after subsequent heat treat cycles. If the cladding is to be final machined, then the newly machined surface shall require surface inspection by the LP method.

- LP examination shall be in accordance with procedures specified in ASTM E165;

- MP examination shall be in accordance with procedures specified in ASTM E709. Prods are not permitted on well fluid-wetted surfaces or sealing surfaces.

6.5.8 Acceptance Criteria for MP and LP

6.5.8.1 General
Inherent indications not associated with a surface rupture (i.e. magnetic permeability variations, non-metallic stringer, etc.) are not considered relevant indications.

6.5.8.2 Acceptance Criteria for Surfaces Other than Pressure Contact (Metal-to-Metal) Sealing Surfaces
Inherent indications not associated with a surface rupture (i.e. magnetic permeability variations, non-metallic stringer, etc.) are not considered relevant indications.

- No relevant indications interpreted as a crack;

- No relevant indication with a major dimension equal to or greater than 5 mm (0.2 in);

- No more than ten relevant indications in any continuous 10 cm2 (2.5 in2) area;

- Four or more relevant indications in a line separated by less than 1.6 mm (0.062 in) (edge to edge) are unacceptable.

6.5.8.3 Acceptance Criteria for Pressure Contact (Metal-to-Metal) Sealing Surface
There shall be no relevant indications in the pressure-contact (metal-to-metal) sealing surfaces.

6.5.9 Weld NDE
All welds shall be surface NDE and visual inspected.

Weld NDE requirements shall meet the following:

- Essential welding variables and equipment shall be monitored and completed weldments and the entire accessible weld shall be examined in accordance with the methods and acceptance criteria of this standard;

- 100% of all surfaces prepared for welding shall be visually examined prior to initiating welding;

- All fabrication welds shall be visually examined in accordance with ASME BPVC (2010), Section V, Subsection A, Article 9. Undercuts shall not reduce the thickness in the affected area to below the design thickness and shall be ground to blend smoothly with the surrounding material.

- Examinations shall include a minimum of 13 mm (0.5 in) of adjacent base metal on both sides of the weld;

- Weld NDE surface preparation acceptance shall be in accordance with the manufacturer's/remanufacturer's written specification;
- All welds shall be examined according to manufacturer's/remanufacturer's written specification;
- Any undercut detected by visual examination shall be evaluated in accordance with the manufacturer's/remanufacturer's written specification;
- Surface porosity and exposed slag are not permitted on or within 3 mm (0.125 in) of sealing surfaces.
- NDE shall be carried out after final PWHT.

6.5.10 Weld NDE - Surface Examination (Other than Visual)

Weld NDE surface examination requirements shall meet the following:

- 100% of all primary load carrying and pressure-containing repair welds, weld metal overlay welds and repaired fabrication welds shall be examined by either MP or LP methods after all welding, post-weld heat treatment and machining operations are completed;
- The examination shall include 13 mm (0.5 in) of adjacent base material on both sides of the weld;
- The test method and acceptance criteria for Surface NDE shall be in conformance with API 16Ft

6.5.11 Repair Welds

Repair weld requirements shall meet the following:

- All repair welds shall be examined using the same methods and acceptance criteria used in examining the base metal;
- The examination shall include 13 mm (0.5 in) of adjacent base material on both sides of the weld;
- Surfaces of ground-out areas for repair welds shall be examined prior to welding to ensure defect removal using the acceptance criteria for fabrication welds.

6.5.12 Weld NDE — Volumetric Examination of Weld

6.5.12.1 Sampling

Sampling requirements shall meet the following:

- 100% of full-penetration pressure-containing welds and full-penetration welds in the primary load path shall be examined by either radiography or ultrasonic after all welding, PWHT, and machining operations.
- All repair welds for which the repair is greater than 25 % of the original wall thickness or 25.4 mm (1 inch) (whichever is less) shall be examined by either radiography, ultrasonic or acoustic emission methods after all welding and post-weld heat treatment;
- Examinations shall include at least 12.7 mm (0.5 in) of adjacent base metal on all sides of the weld;

— Equipment with untraceable pressure containing welds that are not subjected to 100% volumetric NDE are classified as RSL 1 product.

6.5.12.2 Radiography Examination

Radiography examination requirements shall meet the following:

— Radiographic examinations shall be performed in accordance with procedures specified in ASTM E94, to a minimum equivalent sensitivity of 2% and a 2-2T quality level;

— Both X ray and gamma ray radiation sources are acceptable within the inherent thickness range limitation of each;

— Real-time imaging and recording/enhancement methods may be used when the manufacturer or remanufacturer has documented proof that the methods will result in a minimum equivalent sensitivity of 2% and a 2-2T quality level;

— Wire-type image quality indicators are acceptable for use in accordance with ASTM E747.

6.5.12.3 Radiography Examination Acceptance Criteria

The following shall not be accepted:

— any type of crack, zone of incomplete fusion or penetration;

— any elongated slag inclusion that has a length equal to or greater than specified in Table 1;

— any group of slag inclusions in a line having an aggregate length greater than the weld thickness, t, in any total weld length 12t, except when the distance between successive inclusions exceeds six times the length of the longest inclusion;

— any rounded indications in excess of that specified in ASME Boiler and Pressure Vessel Code, Section VIII, Division I.;

Table 1: Weld Inclusion Criteria

Weld thickness *t*		**Inclusion length**	
mm	(in)	mm	(in)
< 19	< 0.76	6.4	0.25
$19 \leq t \leq 57$	$0.76 \leq t \leq 2.25$	0.33 *t*	0.33 *t*
> 57	> 2.25	19.0	0.75

6.5.12.4 Ultrasonic Examination

Ultrasonic examinations shall be performed in accordance with procedures specified in ASME Boiler and Pressure Vessel Code, Section V, Article 4.

6.5.12.5 Ultrasonic Examination Acceptance Criteria

The following shall not be accepted:

- any indication whose signal amplitude exceeds the reference level;
- any linear indication interpreted as a crack, incomplete joint penetration or incomplete fusion;
- any slag indication with amplitude exceeding the reference level whose length exceeds that specified in Table 1.

NOTE If a weld joins two members having different thicknesses at the weld, t is taken as the thinner of the two thicknesses.

6.5.12.6 Weld NDE – Hardness Testing
Weld NDE harness testing requirements shall meet the following:

- All accessible pressure-containing welds, primary-load path welds, and major repair welds (including structural welds) shall be hardness tested;
- At least one hardness test shall be performed in both the weld and in the adjacent unaffected base metal after all heat treatment and machining operations;
- The hardness recorded in the PQR shall be the basis for acceptance if the weld is not accessible for hardness testing;
- Hardness testing shall be performed in accordance with one of the following:
- those procedures specified in ASTM E18, ASTM E110 (Rockwell) or ISO 6506-1;
- those procedures specified in ASTM E10, ASTM E110 (Brinell) or ISO 6508-1;
- The value of the hardness test shall be stamped on the part adjacent to the test location as per 7.5.2. It is permissible for hardness marking to be covered by other components after assembly.

6.5.12.7 Hardness Examination Acceptance Criteria
Hardness values shall meet the requirements of the manufacturer's/remanufacturer's written specification.

6.5.13 Volumetrics NDE Parts

6.5.13.1 Sampling
Sampling requirements shall meet the following:

- For quench-and-tempered remanufactured or replacement products, the volumetric inspection shall be performed after heat treatment for mechanical properties exclusive of stress-relief treatments or re-tempering to reduce hardness;
- As far as practical the entire volume of each part shall be volumetrically inspected (radiography or ultrasonic) after heat treatment for mechanical properties and prior to machining operations that limit effective interpretation of the results of the examination.

6.5.13.2 Ultrasonic Examination
Ultrasonic examination requirements shall meet the following:

- Remanufactured parts: Ultrasonic examination of remanufactured parts shall be performed in accordance with the flat-bottom-hole procedures specified in ASTM A388 (except immersion method may be used) and ASTM E428;

- Calibration: Distance amplitude curve (DAC) shall be based on 1.6 mm (0.062 in) flat-bottom hole for metal thicknesses through 38.1 mm (1.5 in), on 3.2 mm (0.125 in) flat-bottom hole for metal thicknesses from 38.1 mm (1.5 in) through 152 mm (6 in), and on 6.4 mm (0.25 in) flat-bottom hole for metal thicknesses exceeding 152 mm (6 in).

6.5.13.3 Acceptance Criteria Ultrasonic Examination

The following acceptance criteria apply:

- no single indications exceeding reference distance amplitude curve;

- no multiple indications exceeding 50 % of reference distance amplitude curve.

Multiple indications are defined as two or more indications (each exceeding 50 % of the reference distance amplitude curve) within 13 mm (0.5 in) of each other in any direction.

6.5.13.4 Radiographic Examination

Radiographic examination of parts shall be performed in accordance with methods specified in 6.5.13.2.

6.5.14 Acceptance Criteria Radiographic Examination

The following acceptance criteria apply to parts:

- no cracks, laps, or bursts;

- no group of indication in a line that have an aggregate length greather than “t” in a length of 12t;

- no elongated indications with length greater than specified in 6.5.13.3 Table 1.

6.5.15 Non-Metallic Parts

Inspection of Non-metallic parts shall be in conformance with API 16F.

6.5.15.1 Other End Connections (OEC)

The design and configuration of OECs shall conform to API 16F. The OEM product definition requirements shall be met.

6.5.16 Bolting Specification

All replacement class 3 and/or class 2 bolting shall meet the requirements per API 16F 2nd Edition at a minimum.

UTILITY BOLTING?

Applicable traceability of bolting as noted in API 16F 2nd Edition (at a minimum) shall be documented in the PHF.

6.5.17 Assembled Equipment

Assembled equipment shall meet the requirements as specified in the Product Specific Sections.

- The quality control requirements shall include pressure tests and hydraulic operating system tests, for each assembled equipment unit in conformance with 13.7;
- Serialization shall be recorded on all assembled equipment and shall be carried out in accordance with the CEM written specification;
- A report shall be prepared in which all serialized and individual-heat-traceable parts are listed as traceable to the assembly (e.g., assembly part number, serial number);
- The hydrostatic proof or shell test pressure shall be determined by the rated working pressure for the equipment and be in conformance with 13.7.

6.6 Quality Control Records

6.6.1 General

The quality control records required by this Standard are those documents and records necessary to substantiate that all materials and equipment made to this Standard do conform to the specified requirements.

6.6.2 NACE Records Requirements

Records required to demonstrate conformance of equipment to NACE MR0175 / ISO 15156 (all parts) requirements shall be in addition to those described in other clauses of this standard, unless the records required by this standard also satisfy the NACE MR0175 / ISO 15156 (all parts) requirements.

6.6.3 Records Control

The organization shall maintain a documented procedure to define the controls and responsibilities needed for the initiation, identification, collection, storage, protection, retrieval, retention time, and disposition of records.

Records, including those from outsourced activities, shall be established and controlled to provide evidence of conformity to requirements and of the effective operation of the quality management system.

Records shall be retained for a minimum of ten years following the date the equipment was received by the service provider, or as required by customer, legal and other applicable requirements, whichever is longer.

All records required by this Standard shall be signed and dated.

Records shall be legible, identifiable, retrievable and protected from damage, deterioration or loss.

Records can be hard copies and/or computer-stored as defined in the organization records control system procedure.

6.6.4 Records Maintained by Remanufacturer

6.6.4.1 General

The remanufacturer shall retain all documents and records as required in clause 7.2.

In addition, the remanufacturer shall provide PHF records in conformance with Annex B to their equipment owner in either electronic format, hard copy or both, as specified in the purchase order by the equipment owner.

6.6.4.2 Parts or Components Covered in API 16F

The following records shall be retained:

1. Procedure Qualification Record (PQR);
2. Welder performance qualification record;
3. Welding equipment records:
   - calibration tests;
   - certification documentation;
4. Material test records:
   - chemical analysis;
   - tensile tests (QTC);
   - impact tests (QTC, as required);
   - hardness tests (QTC);
5. NDE personnel qualification records;
6. NDE records:
   - visual/optical NDE records;
   - surface NDE records;
   - full penetration fabrication;
   - weld volumetric NDE records;
   - repair weld NDE records;
7. Hardness test records;
8. Welding process records (Weld Map):
   - welder identification;
   - Welding Procedure Specification (WPS);
   - filler material heat/lot number;
   - weld location

- post-weld heat treatments and Dehydrogenation Heat Treatments (DHT);

9. Heat treatment records:
   - actual temperature;
   - actual times at temperature;
10. Volumetric NDE records;
11. Test records for any testing as required by individual equipment sections;
12. Critical dimensions as defined by the remanufacturer in the OPD/CPD as applicable.

7 Quality Management System Requirements

7.1 General

The organization shall establish, document, implement, and maintain a management system that conforms to an internationally recognized quality management standard for all products and services provided per API 16AR.

The organization shall continually improve the effectiveness of the quality management system through the use of the quality policy, quality objectives, audit results, analysis of data, corrective and preventive actions, and management review.

7.2 Control of Documents

The quality management system documentation shall include:

- Statements of quality policy and quality objectives;
- A quality manual that addresses each requirement of this standard and includes:
  - the scope of the quality management system, including justification for any exclusions to specific quality management system elements;
  - a description of the sequence and interaction between the processes of the quality management system;
  - identification of processes that require validation;
  - reference to documented procedures that control the quality management system processes;
  - documented procedures established for the quality management system;
  - documents and records to ensure the effective planning, operation, and control of its processes and compliance with specified requirements;
  - a documented procedure for the identification, distribution, and control of documents required by the quality management system, including required documents of an origin external to the organization;

— a method for control of procedures, work instructions and forms required by the quality management system;

— a documented procedure for inspection and testing to verify that product requirements have been met.

7.3 Training and Awareness

The organization shall:

— Provide Quality Management System training to the organization's personnel and contractors who affect the execution of services or provision of service-related products;

— Ensure that customer-specified training and/or customer-provided training, if required, is included in the training program;

— Maintain appropriate personnel records on education, training, skills, experience and other competencies needed for the function;

— Define responsibilities, authorities, and accountabilities of personnel throughout the organization;

7.4 Control of Testing, Measuring, Monitoring Equipment

The remanufacturer shall maintain a documented procedure which defines the required testing, measurement, monitoring, and detection equipment to be controlled and necessary to provide evidence that service or service-related product meets specified requirements.

The procedure shall address equipment traceability, frequency of calibration, calibration method, acceptance criteria, suitable environmental conditions, storage and handling.

The procedure shall identify required assessments and maintain records when the validity of the previous testing, measuring, monitoring, or detection results are found not to conform to calibration requirements. The organization shall take appropriate action on the equipment and any service affected.

Testing, measuring, monitoring and detection equipment shall have unique identification.

When the equipment is externally provided, the organization shall verify that the equipment is suitable to provide evidence of conformity of service or service-related product to specified requirements.

7.5 Contract Review

7.5.1 General

The organization shall maintain a documented procedure for the review of contract requirements related to the execution of services or provision of service-related products.

7.5.2 Determination of Requirements

The organization shall determine:

— Requirements specified by the customer, including the requirements for service planning, execution, and evaluation;

— Requirements not stated by the customer but considered necessary by the organization or industry recognized Standards for the execution of service and provision of service related product;

— Documentation requirements pertaining to the certificate of compliance/conformance, MDB, PHF, and any other required traceable documents.

Where the customer has provided incomplete, incorrect or unachievable requirements in the purchase order, the customer shall be informed and a resolution shall be documented on the purchase order.

7.6 Purchase Control

The organization shall maintain a documented procedure and qualification of outsourced services to ensure that purchased or outsourced services and service-related products conform to specified requirements.

A list of approved suppliers and their approved scope shall be documented and maintained.

Selection of outsourced service suppliers by the remanufacturer shall include the following prior to initiation of the purchase agreement:

— Assessment of the supplier at supplier's facility to meet the organization's purchasing requirements; and

— Verification that the supplier's quality management system conforms to the quality system requirements specified for suppliers by the organization.

7.7 Design and Development

7.7.1 Design and Development Planning

The manufacturer shall maintain a documented procedure to plan and control the design and development of the product, including the use of service-related products.

The procedure shall identify:

— the design and development stages;

— the activities required for completion, review, and verification of each stage;

— the interfaces between different groups involved in design and development; and

— the responsibilities and authorities for the design and development activities.

The manufacturer shall manage the interfaces between different groups involved in design and development to ensure effective communication and clear assignment of responsibilities.

When design and development are outsourced, the manufacturer shall ensure the supplier meets the requirements of clause 7.7 and provide objective evidence that the supplier has met these requirements.

7.7.2 Design Documentation

Design documentation shall include the methods, assumptions, formulas and calculations.

7.7.3 Design and Development Inputs

Inputs relating to design of the product shall be determined and records maintained.

These inputs shall include:

— customer-specified requirements;

— environmental and operational conditions;

— methodology, assumptions, and formula documentation;

— historical performance and other information derived from previous similar designs;

— other applicable requirements including:

  — requirements provided from an external source;

  — requirements for products and service-related products, including its functional and technical requirements.

7.7.4 Design Verification

The design and development requirements are to be examined and confirmed to be in conformance with specified requirements of the purchase order and API 16F edition the riser was manufactured to, or at least to the API 16F 1st edition.

Design verification activities may include one or more of the following:

1) Confirming the accuracy of design results through the performance of alternative calculations;

2) Review of design output documents independent of activities of design and development;

3) Comparing new designs to similar proven designs.

7.7.5 Design Validation

Design and development validation shall be performed in accordance with planned arrangements (see 0) to ensure that the resulting product is capable of meeting the requirements for the specified application or intended use, where known.

Wherever practicable, validation shall be completed prior to the delivery or implementation of the product.

The completed design shall be approved after validation. Competent individual(s) other than the person or persons who developed the design shall approve the final design.

Records of the results of validation and any necessary actions shall be maintained.

Parts that do not have existing validation records within an assembly covered under the current product definition shall require the API 16F validation testing that loads the part according to the design verification calculations.

7.7.6 Control of Design and Development Changes

Design and development changes shall be identified and records maintained by the manufacturer. The changes shall be reviewed, verified and validated, as appropriate, and approved before implementation. The review of design and development changes shall include evaluation of the effect of the changes on constituent parts and product already delivered. Records of the results of the review of changes and any necessary actions shall be maintained.

7.8 Control of Nonconforming Product

7.8.1 General

The organization shall ensure that product which does not conform to product requirements is identified and controlled to prevent its unintended use or delivery. A documented procedure shall be established to define the controls and related responsibilities and authorities for dealing with nonconforming product.

When nonconforming product is corrected it shall be subject to inspection to demonstrate conformity to the requirements.

All nonconformances dispositioned as acceptable shall be approved by a design engineer competent person that has the appropriate education, training, skills and experience needed to make the verifications.

Records of inspection and conformance with acceptance criteria shall be maintained.

7.8.2 Field Nonconformity Analysis

The documented procedure for nonconforming product shall include requirements for identifying, documenting and reporting incidents of field nonconformities or product failures. The documented procedure shall ensure the analysis of field nonconformities, provided the product or documented evidence supporting the nonconformity is available to facilitate the determination of the cause taking action appropriate to the effects or potential effects of the non-conformance.

Records of the nature of nonconformities and any subsequent actions taken, shall be maintained.

8 Materials

8.1 General

Section 9 is only applicable to primary-load-carrying and pressure-containing components as defined in API 16F.

All repaired/remanufactured parts shall satisfy the OPD or CPD design requirements for the product repaired and /or remanufactured under this standard.

Metallic materials shall meet the design requirements of NACE MR0175 / ISO 15156 as required by API16F (applicable edition).

8.2 Material Traceability Level

The traceability of the material shall be designated by a Material Traceability Level (MTL). In the event traceability is lost, this document will provide requirements and guidance needed to obtain the proper documentation for meeting the necessary Material Traceability Level (MTL).

8.3 Metallic Parts

A written material specification shall be required for all metallic repair parts, or metallic parts added during remanufacturing to a component or an assembly.

The remanufacturer shall meet or exceed the material specifications for the product as listed in the OPD or CPD. The OPD or CPD shall contain the following information:

— acceptance and/or rejection criteria;

— material composition with tolerance;

— material qualification;

— allowable melting practice(s);

— forming practice(s);

— heat treatment procedure, including cycle time and temperature with tolerances, heat treating equipment and cooling media;

— NDE requirements;

— Mechanical property requirements.

NOTE For existing parts remanufactured to MTL-1 or MTL-2, it is recognized some of this information may not be available.

8.4 Metallic Material Traceability

8.4.1 General

To start the remanufacturing process, material composition and mechanical properties for the base material shall be demonstrated or established.

8.4.2 Materials Traceability Levels (MTL)

MTL-1: For materials, when traceability has been lost for a component, the material shall be designated as MTL-1.

MTL-2: For materials, when traceability has been lost, however some but not all of the properties have been re-established by testing the material shall be designated as MTL-2,

MTL-3: For materials, when traceability has full documentation or properties have been fully established by testing, the material shall be designated as MTL-3.

When a component has different traceability levels, the lowest MTL-of the component shall be used to describe it. The minimum required MTL-for a component should be set forth by the equipment owner before the beginning of repair or remanufacture.

8.5 Material Test Reports (MTRs)

When MTR's and traceability are available, and they show compliance to API 16F (As specified in Section 9.1), as well as compliance to the minimum properties needed for the design; then the material shall be considered as meeting MTL-3.

When traceability to the original MTR is lost, the material shall be MTL-1, unless the properties needed for the design are reestablished as required in this section.

8.5.1 Reestablishing Tensile Properties

When tensile properties of a component are unknown, but there is enough traceability to support that other components have been made with the same heat of material, and heat treatment, a component may be used as a sacrificial part to be tensile tested through the critical cross-section in order to obtain and verify the tensile properties of a component. Ensure this sacrificial part meets the properties and all minimum design requirements of the OEM/CEM written material specification. Tensile properties reestablished in this fashion are grounds to maintain the tensile requirements for MTL-3.

Alternatively; if a sacrificial part cannot be used, an MTL-2 for the component may be obtained via hardness testing. The ultimate tensile strength (UTS) of non-austenitic steels (including ferritic and martensitic stainless) may be reestablished by hardness testing as described here in, and the approximation to tensile strength shall be in accordance with ASTM A370. If the material specification the component was originally manufactured to is available, and the specification establishes a hardness range intended for the tensile properties such as yield and tensile strength, and the hardness of the component is within that range, then the yield strength based shall be considered to be the same as the minimum on the specification, regardless of approximated actual UTS.

To reestablish the tensile properties via hardness testing for MTL-2 of other materials not described in the previous paragraph, the hardness test shall be as specified here in, however, the original material specification to which the part was produced, and which describes minimum tensile properties and gives a hardness range is required to be available. In this case, if the material hardness is within hardness range, then the yield and tensile strength shall be considered as the minimum on the material specification.

Hardness testing shall be performed in accordance with ASTM E10, ASTM E110, ISO 6506-1, ASTM E18, or ISO 6508-1.

When hardness conversion is needed, it shall be done in accordance with ASTM E140.

NOTE The hardness of a material is in principle related to the Ultimate Tensile Strength (UTS) and not to the Yield Strength (YS). UTS and YS show a linear correlation with hardness for most steels. However, for steel that shows evidence of strain hardening, a lower strength can be measured for a given hardness. There can be a non-linear relation between strength and hardness.

An MTL-2 for a component may be obtained by testing a QTC of the same alloy composition and similar heat treatment. The QTC shall be heat treated to be within +/- 2 HRC of the actual component's hardness. The size of the QTC and specimen location and orientation shall be in accordance with latest requirements of API 16F. The acceptance criteria shall be established by using the minimum requirements of the original design. If the original design is not available, then new requirements may be established by stress calculations or FEA analysis.

8.5.2 Reestablishing Chemical Composition

When a component has full traceability to an MTR with chemical composition or to a Mill Certificate, the component shall be considered as meeting composition requirements for MTL-3.

In the absence of traceability to chemical composition. To obtain MTL-3 for the component, composition shall be reestablished to the original material specification and original design requirements (Such as NACE MR0175) via testing by Optical Emission Spectroscopy (OES). Since this is a product analysis, permissible variations may be established in accordance with industry standards such as ASTM A788.

When composition is unknown, and the original material specification requirements are unknown, an MTL-2 may be obtained by performing Positive Material Identification (PMI), provided the component will not undergo any welding processes as described in section 9.

MTL-2 of components to be welded shall be established by product check analysis. The analysis shall be performed by OES for carbon and low alloy steels, and PMI is acceptable for other materials provided PMI is capable of properly identifying the alloy for use in combination with weld procedure specification. The chemical composition of the alloys shall meet applicable design requirements such as limits in NACE MR0175.

The chemical composition obtained by OES for carbon and low alloy steels shall include all alloying elements, carbon, and all elements needed to determine Carbon Equivalency per the below formula.

$$C.E. = C\% + Mn\%/6 + (Cr\%+Mo\%+V\%)/5 + (Ni\%+Cu\%)/15$$

8.5.3 Reestablishing Impact Values

When impact properties are required by API 16F (Applicable edition per Section 9.1) for a particular component, and there is traceability to the MTR, then the component shall be considered to meet impact properties of MTL-3

When impact properties of a component are unknown, but there is enough traceability to support that other components have been made with the same heat of material, and heat treatment, a component may be used as a sacrificial part to be impact tested through the critical cross-section in order to obtain and verify the impact properties of a component. Ensure this sacrificial part meets API 16F (as described in section 9.1) and all minimum design requirements. Impact properties reestablished in this fashion are grounds to maintain the impact requirements for MTL-3.

Impact testing, or traceability to impact values for austenitic stainless steel is not required; thus, for components made with these materials MTL-3 shall be maintained regardless of available documentation.

NOTE There is no way to establish MTL-2 when impact testing is required, and documentation is not available; thus, missing the documentation will result in MTL-1, or MTL-3 if the properties are reestablished per this section or if the component is replaced.

8.5.4 Reestablishing Hardness Values

When hardness testing is required by API 16F or by design considerations at the time the component was produced, hardness testing shall be performed in accordance with ASTM E10, ASTM E110, ISO 6506-1, ASTM E18, or ISO 6508-1. The acceptance criteria shall be as required by the OPD. If design parameters are unknown, calculations or FEA may be used to propose a new hardness range for the component. Hardness values established this way shall be considered as complying with the hardness requirements for MTL-3.

If a component has undergone a surface heat treatment process, or a hard-facing process which does not allow for hardness testing of the unaffected base metal, then the component shall be considered MTL-1 unless the base metal properties can be verified in the documentation.

Reestablishing hardness values for components with hard-facing, plating, case hardening or other manufacturing processes resulting in a hardened surface, the testing shall be performed in accordance with ASTM A384, ISO

6507-1 or as required in the original design specifications if available. To reestablish surface hardness to obtain MTL-3, the hardness shall comply with the requirements of the specifications at time of original manufacture. If the original hardness range is not available, a new range shall be established prior to inspection in order to meet MTL-2 hardness requirements for the component.

8.5.5 Reestablishing Product Form (Cast vs. Wrought)

When the product is not known to be a casting or a wrought, and this is part of the acceptance criteria or necessary to establish proper welding procedures, the material shall be metallographically inspected to determine whether it has a wrought structure or a cast structure. The metallography may be performed at a lab or in-situ depending on accessibility of the component. Wrought products shall be free from dendritic structures on the base metal.

NOTE If a component is known to have been previously welded or weld repaired, it is important to perform more than one metallography, to avoid confusing the cast structure from a weld with the base metal structure.

Product(s) in compliance with API 16F and original design specifications shall be considered to be MTL-3. Product(s) in compliance with API 16F only, but not the original design requirements shall be considered to be MTL-2, provided no welding is required, or product form is not essential to establishing adequate weld procedures

8.6 Tubular Components

8.6.1 Base Metal Repair of Tubular Components

Weld repair of tubular components shall be strictly prohibited. The repair of tubular components shall be performed by replacing the damaged area with a new section of material which meets or exceeds the original design requirements, and the joining of the component's new section shall be performed with Fan appropriate and qualified weld procedure specification as described in Section 9.

8.6.2 Repair/Remanufacture of Base Metal (excluding tubulars)

Repair of base metal shall be performed in accordance with API 16F current edition.

8.6.3 Non-Metallic Components

Non-metallic component shall be in accordance with API 16F.

9 GENERAL WELDING REQUIREMENTS

9.1 Primary-load-carrying and Pressure-containing Weldments

All welding procedures, welders and welding operators shall be qualified in accordance with ASME BPVC, Section IX and API 16F. NACE MR0175/ISO 15156 requirements shall be applicable to weldments and weld procedure qualifications intended for sour service environment. Other recognized industry standards may be used for weld procedure qualifications when approved by the purchaser. All welding procedures shall be qualified to meet the design requirements. Additional welding requirements or codes and standard may apply as agreed upon by the purchaser and the remanufacturer. Other sections of this standard may have additional requirements based on the CPD and/or CEM.

9.1.1 Weld procedure qualification and welding practices should be supplemented with requirements necessary for the prevention of hydrogen delayed cracking of welds for alloys with high hardenability e.g., low alloy steels.

9.1.2 When PWHT is required, test coupons which include weld material shall be post-weld heat treated with the nominal temperature at minimum and maximum cumulative time at temperature to be used in production. Mechanical property and other testing required by this specification, governing welding code, and design requirements shall be completed at minimum and maximum PWHT times allowed by WPS.

NOTE: Maximum PWHT time allowed may be what is recorded on the PQR or 25% more as permitted by ASME Section IX.

9.1.3 Welding shall be considered as a repair if performed after PWHT; or if no PWHT is required, after final NDE of the weldment. NDE of the repair shall be equivalent to that of the original weld.

9.1.4 Butter welds, as defined in ASME BPVC, Section IX, shall be approved by the purchaser. Butter weld joints and joining welds shall require procedure qualification records (PQRs) for the buttering weld process and for the joining weld process. A welding procedure specification (WPS) shall be required for the entire completed weldment joint.

9.1.5 When design requirements specify impact testing, the WPS shall be qualified with impact testing at or below the minimum temperature specified. Notch toughness shall be taken in the weld metal (WM) heat affected zone (HAZ), and base metal (BM). In case of WPSs with no PWHT BM impact testing is not required. For procedure qualification tests joining dissimilar materials, HAZ and BM shall be tested for both base metals.

9.1.6 The WPS shall describe all the essential, non-essential and supplementary essential variables in conformance with the applicable Codes and Standards.

9.1.7 The WPSs, PQRs and all supporting data, viz., weld test history, base metal MTRs, consumable certificates, PWHT charts and lab test reports etc., shall be maintained as records in accordance with the quality control record requirements from section 6.6.

9.1.8 All pressure-containing and primary-load-carrying welds and the adjacent unaffected base material welds shall undergo a hardness test where accessible after final PWHT and shall meet the hardness requirements of the base material per the OPD/CPD as applicable.

9.1.9 The remanufacturer shall have a written procedure for storage, handling and control of welding consumables. Materials of low-hydrogen type shall be stored and used as recommended by the consumable manufacturer to retain their original low-hydrogen properties. Any

reconditioning of fluxes and SMAW electrodes shall be carried out in accordance with the manufacturer's recommended practice.

9.2 Structural Welding Procedure and Welder Performance

Structural weld procedures and welder/operator performance shall be qualified in accordance with the requirements of AWS D1.1, ASME BPVC Section IX, or other recognized industry structural welding specification.

9.2.1 All welding procedures shall be qualified to meet the design requirements. When impact and/or hardness testing is required by design, the specimens shall be taken from the welded coupon in accordance with the requirements of API 16F.

9.3 Noncritical Welding

Welding of noncritical components shall be in accordance with manufacturer's written procedures/specifications or a manufacturer-approved written procedures/specifications. WPS may or may not comply with any welding codes and standards. Noncritical welding shall not be allowed on the following: sour service applications, pressure-containing, hoisting equipment, primary-load-carrying members, and/or lifting devices

9.4 Preheating

Preheating of assemblies or parts, when required, shall be performed in accordance with the remanufacturer written procedures (e.g. requirements for ensuring suitable/capable preheat/interpass temperature control that includes heating methods, distance-set-off, for torch heating, neutral flame, etc.).

9.5 Dehydrogenation Heat Treatment

Any heat treatment performed prior to final PWHT, such as Dehydrogenation Heat Treatment (DHT) or Intermediate Stress Relief (ISR), shall be included as part of the welding procedure qualification if performed within 175 °F (79 °C) of the nominal final PWHT temperature. Remanufacturer shall have written procedures for DHT.

9.5.1 Welds (excluding overlay) made on low alloy steels with the SMAW, SAW, or FCAW processes when must be allowed to cool below the minimum preheat temperature, prior to PWHT, shall be subjected to a DHT immediately after completion of welding. The weldment shall be held at a maximum of 700 °F (370 °C) and shall not exceed the maximum interpass temperature of the applicable WPS, for 2 hours minimum prior to slow cooling under insulation or in still air.

NOTE This dehydrogenation heat treatment may be omitted, provided the electrode used is classified by the filler metal manufacturer with a diffusible-hydrogen designator of H4 (e.g., E7018-H4).

9.6 Post Weld Heat Treatment (PWHT)

PWHT shall be in accordance with the manufacturer's/remanufacturer's written procedures. The written procedures approved by the remanufacturer shall include:

- Method of temperature control (including ramp rates) and control of cooling rate to ambient temperature. The procedure shall include control methodology for fans, winds, or other environmental conditions that can affect the cooling rate.
- Location of controlling and monitoring thermocouples. A sketch shall be included in the routing or traveler to depict the location of the part thermocouples.
- Identification of part loading supporting equipment (racks or baskets) required and a sketch showing the location of parts in the furnace's qualified heating zone.
- Area to receive the source of heating for local heat treatments, the type and amount of insulation the methods to control the heating gradient outside of the local heating area.
- Method and control of intermediate stress reliefs (ISRs) performed as an intermediate heat treat to allow further processing of the part prior to the final PWHT, such as a Larsen-Miller Parameter (LMP), in order to estimate the effect of ISR on the material when performing an ISR

9.6.1 All PWHT temperatures shall not exceed the manufacturer's stated minimum specified tempering temperature. WPS PWHT median temperature shall be at least 14 °C (25 °F) below the minimum specified or actual tempering temperature of the raw forging.

9.6.2 Furnace post-weld heat treatment shall be performed in equipment meeting the requirements of API 16A, Annex B.

9.6.3 Local post-weld heat treatment shall be carried out in accordance to a written procedure consisting of heating a band around the weld at a temperature within the range specified in the qualified WPS. The minimum width of the controlled band adjacent to the weld, on the face of the greatest weld width, shall be the thickness of the weld or 2 in. (50 mm), whichever is less. Gas heated infrared heaters may be used. Open flame PWHT is not permitted.

9.6.3.1 A sketch of local PWHT heater size location and thermocouples location shall be provided in the PHF (product history file).

9.6.4 All WPS's and/or additional associated procedures shall specify the following if PWHT or additional heat treatment is required:

- **A procedure for attaching thermocouples to the weldment.**
- **Holding temperature range.**
- **Holding time.**
- **Heating method.**
- **Insulation.**
- **Temperature control devices.**
- **Recording equipment.**
- **Maximum heating rate.**
- **Maximum cooling rate.**
- **Temperature gradients.**

9.6.5 The heating and cooling rates shall be specified on the WPS or in a separate written procedure.

9.6.6 Perform new PQR(s) with extended PWHT time to qualify previously used WPS(s) for enough cumulative time to permit a repair. The new PQR/WPS may be a standalone document and from a different company than previously used WPS if all essential variables of previously used WPS are identical with additional PWHT time at temperature.

9.6.7 Remove all weld metal and HAZ(s) (at least 1/8 inch additional material from weld toe) prior to weld repair provided there is documented PQR or simulated PWHT evidence that base metal properties will meet minimum mechanical property requirements. This assessment of base metal properties shall be made taking into consideration all cumulative time at temperature the component has been subject to prior to the current repair.

9.6.8 For welds originally processed with local PWHT, the weld, HAZ, and base metal(s) near the welds subjected to PWHT shall be removed prior to repair and no further consideration of PWHT history and previously used WPS(s) is required. The remanufacturer shall determine the amount of base metal that was subject to PWHT and requiring removal.

9.6.9 For base metal repairs/buildups of parts with one or more types of welds/weld repairs, if local PWHT of the repair weld will not subject any of the previous welds/HAZ(s) to PWHT then consideration of the previously used WPS PWHT history is not required provided the base metal property considerations of Clause 1.10.18.2 are satisfied.

9.7 Repair of Welds

9.7.1 Welding shall be considered as a repair if performed after PWHT, or if no PWHT is required, after final NDE of the weldment.

NOTE In-process weld repair prior to PWHT (if applicable) is not addressed by this paragraph.

9.7.2 NDE of weld defect repairs shall be equivalent to that of the original weld.

9.7.3 All major repair of welds to pressure-containing members, where failure would result in release of wellbore fluid to the environment, and to primary-load-carrying members performed after original PWHT shall be mapped. At minimum, this shall include:

- **Part Sketch denoting new weld/repair Area**
- **Part Number**
- **Serial number**
- **Welder's stamp or ID number**
- **PT / MT Report Number of verification of Defect Removal**
- **WPS used**
- **Filler Material Heat/Batch/Lot**
- **Weld Flux Heat/Batch/Lot, if used**
- **Number PWHT hours per weld used for this remanufacturing cycle**
- **Accumulation of all PWHT hours per weld, if applicable**
- **Number PWHT hours for base material, if applicable**

9.7.4 Surface examination shall be performed on all excavations for weld repairs, with the method and acceptance criteria as specified in Section 6.5.9.

9.7.5 **Total PWHT time at temperature after the repair(s) shall not exceed the maximum time qualified and recorded on the WPS. If a weld is to be repaired after PWHT, both the original and the repair WPS shall have additional PWHT time to ensure that the total cumulative time at temperature does not exceed the time qualified for both the WPSs. All PWHT cycles shall be recorded on a furnace chart or digital file.**

9.8 Repair Welding of Base Metals

9.8.1 **There shall be adequate access to evaluate, remove, and inspect the nonconforming condition causing the need for the repair. The nonconforming condition causing the need for repair shall be removed and evaluated by NDE prior to the repair.**

9.8.2 **The WPS and the available access for repair shall ensure complete fusion of the weld with the base material.**

9.8.3 **The repair welds on pressure-containing and primary-load-carrying components shall conform to all NDE requirements and acceptance criteria for the components.**

9.8.4 **All repair welding shall be performed in accordance with the manufacturer's WPSs and inspected to manufacturer's written specifications. WPSs shall be documented and shall be supplied at the purchaser's request.**

9.8.5 **Prior to any repair, the manufacturer shall document the following criteria for permitted repairs:**

- **— defect type,**
- **— defect size limits,**
- **— definition of major/minor repairs.**

9.8.6 **All excavations, prior to repair and the subsequent weld repair, shall meet the quality control requirements specified in Section 6.5.7.**

9.8.7 For major repair welds, the manufacturer shall also produce a weld map of the area to be repaired and the repair sequence. Documentation of repairs shall be maintained in accordance with requirements of Section 6.6.4.

9.8.8 Riser Main Tube

Wrought tubular products shall not be spot repair welded.

9.8.9 For situations when a base metal, weld, or overlay needs to be repaired with PWHT and there is insufficient PWHT soak time qualified for previously used WPS(s), the following repair options are permitted.

10 Marking Requirements

10.1 General

Parts which are repaired or remanufactured shall be marked. The repair or remanufacture marking requirements are in addition to and do not replace original marking requirements of API 16F.

Location of marking for metallic equipment which is repaired or remanufactured shall be in accordance with API 16F.

The following marking shall be added to the parts:

— “RMFR” for remanufacture or “RPR” for repair;

— remanufacturer's name or mark;

— date of repair or remanufacture (month and year) e.g. March 2016 is coded as 0316.

Original markings lost before remanufacturing must be replaced by markings in conformance with API 16F, containing the details from the OEM or CEM.

Product changes as result of repair or remanufacturing that affect current API 16F identification stamping shall be updated to indicate the current equipment specification as per API 16F.

Parts or assemblies that do not conform to the OPD shall have a unique identifier.

10.2 Low-stress Area Marking

For identification on low-stress areas (such as nameplates, outside diameters of flanges, etc.), the use of sharp “V” stamping shall be acceptable.

10.3 High-Stress Area Marking

For identification on high-stress areas, dot, vibration or round "V" stamping shall be acceptable. Sharp "V" stamping shall be acceptable in high-stress areas only if subsequent stress-relieving is performed to the component.

10.4 Specific Codification Requirements of Equipment

In addition, the remanufacturer's part number shall be marked on the component.

11 Storing and Shipping

11.1 Storage and Shipping

All equipment shall be stored and shipped in accordance with API 16F.

12 Certification

12.1 General

Certificate records shall be added to the equipment Product History File (PHF) to support the traceability of the product through equipment life.

Certificates are product status reports on the conformance to specifications at time of issue and do not infer duration of validity.

12.2 Certificate of Conformance

On completion of the repair or remanufacturing of drill through equipment under this standard, a Certificate of Conformance (COC) shall be issued unless otherwise specified by the equipment owner.

If repairs completed only include replacement of parts that have their own COC, the only COC's required for conformance of the assembly / system are the COC's of the new components. In this case, the replaced parts shall be in conformance with the current product definition.

Minimum requirements for the Certificate of Conformance (COC) shall be used to certify repairs and remanufacturing under this standard. The minimum requirements for the COC are listed in Annex E.

12.3 Statement of Compatibility

Replacement assemblies or component-parts other than those supported by the OEM or CEM product definition shall be supported by a Statement of Compatibility (SOC) in the PHF.

Minimum requirements for the SOC shall be used to certify product fitness under this standard. The minimum requirements for the SOC are listed in Annex E.

12.4 Statement of Fact

Inspections and repair performed on a part or system made in accordance with the reduced / limited scope defined by the owner shall be documented by a Statement Of Fact (SOF).

NOTE This record does not fulfil the requirements of a Certificate of Conformance or other documents verifying product design.

12.5 Certificate of Service

Equipment inspection, service and maintenance performed should be documented by Certificate Of Service (COS) in the PHF.

13 Choke, Kill, and Auxiliary Lines

13.1 General

Riser Joint repair and remanufacture shall consider service classification with respect to load-sharing or non-load-sharing designation.

Choke, kill and auxiliary lines shall be repaired and remanufactured per Section 13.

Buoyancy equipment shall be repaired and remanufactured per Section 15.

13.2 Dimensional Check

For repair and remanufacturing the sealing dimensions shall be within product definition (OPD / CPD) tolerances.

Wear tolerances defined in the product definition (OPD or CPD), shall be used to verify if the part is suitable for service.

In addition to those required in the product specific sections, dimensional checks shall include the following as a minimum:

— Wear of all critical sealing surfaces as defined in the product definition;

— Pressure containing Components;

— Any Critical Areas per the Product Definition.

Dimensions shall be documented in accordance with the established QMS.

13.3 NDE – Initial Inspection

The following inspections shall be

— All parts that require remanufacturing or any pressure containing and pressure controlling parts with unknown hardness values shall be hardness tested per 8.5.4

— All primary load bearing, critical components, and critical sealing surfaces shall be MPI or DPI inspected;

— All welds shall be MPI or DPI inspected;

— External surfaces shall be 100% visually inspected and any anomalies further investigated with MPI or DPI;

— Unacceptable indications per 6.5.8, found with MPI or DPI shall be removed.

If full weld records are not available, all machined surfaces of the components with missing records shall be acid etched to determine the location of previous welds.

13.4 Visual Inspection at Disassembly

All parts shall be 100% visually inspected as defined by the scope of work and includes but is not limited to:

— Critical wear areas and body structure;

— All threaded lifting bolt holes;

— Sealing surfaces;

— Running and handling surfaces;

— Corrosion / pitting.

13.5 Replacement Parts

All replacement parts shall be designed and manufactured to meet or exceed the requirements of Section 4, 5.4 and Annex B and API 16F design edition.

Replacement parts shall be documented in the PHF. Unique markings of the part shall provide the traceability that allows verification of the part design status.

Equipment shall be reassembled in accordance with documented specifications of the manufacturer.

13.6 Preforming repair and remanufacturing

13.6.1 Skim cutting

Skim cut may be performed to remove defects or restore surface finish on box and pin sealing areas in order to reestablish surface datum.

If skim cut is within the CPD tolerance then it shall be considered a repair.

13.6.2 Remanufacture by Welding

Welding shall be performed in accordance with the requirements of General Welding Section. Additional requirements and exceptions are specified here in.

13.6.2.1 Boost Lines

Remanufacture by welding of pins and boxes by welding outside the overlay areas shall be prohibited.

Remanufacture by welding of CRO shall meet the general requirements of Section 9. The CRO procedure may include PWHT or may be welded without PWHT if the weld and its associated HAZ are outside the base material. For build up using CRO, the WPS shall be qualified to meet the design criteria.

Remanufacture by welding of HFO shall meet the requirements of general welding section (Reference the section number). The HFO procedure should include PWHT.

Remanufacture of thermal spray and fused components may be performed by removing the thermal spray and replacing with qualified overlay welding procedure. Remanufacture by thermal spray shall be prohibited.

Remanufacture by welding of tubular components shall not be permitted. In order to repair damaged tube, a pup piece shall be used. The weld metal and corresponding HAZ's shall be removed (The HAZ is typically between 1/8" and ¼" from the toe of the cap and can vary by weld process). After removing the HAZ, length shall be made up by adding a pup piece, the length between the two weld joints shall be as defined by written OEM specification, or at a minimum of at least 3 diameters long.

When remanufacturing by welding the joint between pin and tube, or box and tube, if pin/box remains welded to the tube; weld metal repairs shall be performed in accordance with the requirements of the general section. If pin/box is removed, the weld metal and corresponding HAZ's shall be removed (The HAZ is typically between 1/8" and ¼" from the toe of the cap and can vary by weld process). After removing the HAZ, length shall be made up by one of the two described methods:

1. Replacing the original pin/box with a modified pin/box having an integral extension in the area to be welded (e.g. longer weld neck).

2. Addition of a pup piece to the tubular component shall include adding a pup piece, the length between the two weld joints shall be as defined by written OEM specification, or at minimum of at least 3 diameters long.

13.6.2.2 Hydraulic Lines

Welding shall be in accordance with the requirements of the general welding section (write reference). Additional requirements and exceptions are specified herein.

Weld procedure qualification of Austenitic stainless steel components shall be exempt from impact testing requirements.

The microstructure of weld heat-affected zones and ferritic-austenitic weld metal (when ferritic-austenitic weld metal is used) shall have between 30 % and 70 % ferrite.

Remanufacture by welding of hydraulic pins or hydraulic boxes shall be prohibited.

Remanufacture by welding of Ferritic-Austenitic hydraulic tubular components shall not be permitted, remanufacture by welding in accordance with requirements of Section 9 is permitted for 300 series stainless steel. In order to repair damaged tube, a pup piece shall be used. The weld metal and corresponding HAZ's shall be removed (The HAZ is typically between 1/8" and ¼" from the toe of the cap and can vary by weld process). After removing the HAZ, length shall be made up by adding a pup piece, the length between the two weld joints shall be as defined by written OEM specification, or at a minimum of at least 3 diameters long.

When remanufacturing by welding the joint between pin and tube, or box and tube, if pin/box remains welded to the tube; weld metal repairs shall be performed in accordance with the requirements of the general section. If pin/box is removed, the weld metal and corresponding HAZ's shall be removed (The HAZ is typically between 1/8" and ¼" from the toe of the cap and can vary by weld process). After removing the HAZ, length shall be made up by one of the two described methods:

1. Replacing the original pin/box with a modified pin/box having an integral extension in the area to be welded (e.g. longer weld neck).

2. Addition of a pup piece to the tubular component shall include adding a pup piece, the length between the two weld joints shall be as defined by written OEM specification, or at minimum of at least 3 diameters long.

13.6.3 Hydraulic Line Straightening

Stainless steel hydraulic tube may be remanufactured by straightening, and the work shall be carried out in accordance with a written procedure.

The following shall be strictly prohibited:

1. Straightening Ferritic-Austenitic Stainless Steels with the use of external heat sources.

2. Stress relieving of Ferritic-Austenitic Stainless Steels by use of external heat sources.

3. Straightening of sections with creases, gouges or where bending is directly on a weld or its associated HAZ.

13.7 Factory Acceptance Testing

13.7.1 Hydrostatic Testing

Repaired equipment shall be subjected to a leak test of 1.0 times rated working pressure.

If mechanical dressing is performed the tolerances shall remain within OPD/CPD specified limits.

Remanufactured equipment shall be subjected to a hydrostatic test of 1.5 times rated working pressure.

Mechanical Dressing

Removal of material by mechanical process intended to repair surface imperfections.

Note: Mechanical Dressing Examples include: buffing, honing, machining, etc.

Spare Parts

Replacement pins and boxes not welded into the line assembly shall be hydrostatic tested to 1.5 times rated working pressure.

Pressure testing shall be performed per API 16F.

14 Riser Joints

14.1 General

Riser Joint main tube and coupling shall be classified as load-sharing or non-load-sharing.

Choke, kill and auxiliary lines shall be repaired and remanufactured per Section 13.

Buoyancy equipment shall be repaired and remanufactured per Section 15.

14.2 Inspection – Pre-remanufacturing

Any initial inspection required shall be defined by the product owner

14.3 Replacement Parts

All replacement parts shall be designed and manufactured to meet or exceed the requirements of Section 4, 5.4 and Annex B and API 16F design edition.

Replacement parts shall be documented in the PHF. Unique markings of the part shall provide the traceability that allows verification of the part design status.

Equipment shall be reassembled in accordance with documented specifications of the manufacturer.

14.4 Repair and Remanufacture

14.4.1 Remanufacture by Welding

Welding shall be in accordance with the requirements of the general welding section (write reference).

Additional requirements and exceptions are specified herein.

14.4.1.1 Riser Coupling

Remanufacture by welding on riser coupling body outside the sealing area or at the weld joint shall be prohibited.

NOTE welding performed on any other areas of the coupling should require design analysis to be performed which includes the remanufactured material properties (i.e. account for weld metal) and should approved by the equipment owner. This type of remanufacture is not covered under this specification.

Remanufacture by welding of Corrosion resistant overlay shall meet the requirements of general welding section (Reference the section number). The CRO procedure may include PWHT or may be welded without PWHT if the weld and its associated HAZ are outside the base material. For build up using CRO, the WPS shall be qualified to meet the design criteria.

Base metal repair sealing areas may be performed by weld metal build up in accordance with qualified welding procedures that meet base metal mechanical properties. Procedure qualification shall meet the requirements in the general section.

14.4.1.2 Riser Pipe

Repairs involving remanufacture by welding of riser pipe shall not be permitted. In order to repair damage pipe a pup piece shall be used. The weld metal and corresponding HAZ's shall be removed (The HAZ is typically between 1/8" and ¼" from the toe of the cap and can vary by weld process). After removing the HAZ, length shall be made up by one of the two described methods:

1. When adding a pup piece, the length between the two weld joints shall be as defined by written OEM specification, or at least 3 diameters in length.

2. If the pup piece is seamed pipe/tubular, then the pup piece seams shall not be aligned with the seams. The minimum misalignment angle between longitudinal seam welds shall be 45 degrees.

14.4.1.3 Repair of Coupling to Pipe Joints

When coupling remains welded to the pipe; weld metal repairs shall be performed in accordance with the requirements of the general section (Reference number).

When coupling is removed. The weld metal and corresponding HAZ's shall be removed (The HAZ is typically between 1/8" and ¼" from the toe of the cap and can vary by weld process). After removing the HAZ, length shall be made up by one of the two described methods:

1. Replacing the original coupling with a modified coupling having an integral extension in the area to be welded (e.g. longer weld neck).
2. Addition of pup piece to a tubular component. When adding a pup piece, the length between the two weld joints shall be as defined by written OEM specification, or at minimum of at least 3 diameters long. If the pup piece is seamed pipe/tubular, then the pup piece seams shall not be aligned with the seams of the original pipe/tubular component. The minimum misalignment angle between longitudinal seam welds shall be 45 degrees.

14.4.1.4 Dressing of Weld cap and Root

Grinding/Dressing shall as minimum satisfy the OPD or CPD design requirements for the product.

14.5 Inspection – Post-remanufacturing

All the following inspection in this section shall be performed on the post re-manufactured components.

Visual Inspection

All remanufactured parts shall be 100% visually inspected as defined by the scope of work and includes, as applicable:

— Critical wear areas and body structure;

— All threaded lifting bolt holes;

— Sealing surfaces;

— Running and handling surfaces;

— Surface condition/ coating.

14.5.1 Dimensional Inspection

The dimensions of the remanufactured sealing surfaces shall be within the limits defined in the product definition.

Tolerances defined in the product definition (OPD or CPD), shall be used to verify if the part is suitable for service.

In addition to those required in the product specific sections, dimensional checks affected by the remanufactured process shall include the following as a minimum:

— All critical sealing surfaces as defined in the product definition;

— Pressure containing Components;

— Any Critical Areas per the Product Definition (note: critical area examples include are running profile, load shoulders, wall thickness, etc).

Dimensions shall be documented in accordance with the established QMS and databook requirements (add reference to QMS and databook reference in this document).

14.5.2 NDE

The following inspections shall be performed prior to proceeding with remanufacturing (applicable when reusing the original parts and not for replacement parts).

— All parts that require remanufacturing with unknown hardness values shall be hardness tested as per 8.5.4.

— All primary load bearing, critical components, and critical sealing surfaces that are to be remanufactured shall be MPI or DPI inspected;

— All welds shall be MPI or DPI inspected;

— External surfaces shall be 100% visually inspected and any anomalies further investigated with MPI or DPI;

Unacceptable indications as per 6.5.8, found with MPI or DPI shall be removed.

If full weld records are not available, all machined surfaces of the components with missing records shall be acid etched to determine the location of previous welds.

Note: Add section for coating

Coating shall be to the OPD/CPD documented requirements. (Dan will work on definition for coating).

14.5.3 Final Assembly Inspection

Gap setting for external lines shall be verified in according with OPD/CPD.

Distance from the riser connector datum to the end of the external lines shall be verified to a OPD/CPD procedure.

Inspection procedure shall be in accordance with OEM/CEM procedures.

14.5.4 Drift Test

NOTE Drifting of riser is not required unless mandated by the purchaser.

If required, the drift requirements shall be clearly documented in the purchase agreement by purchaser and shall specify the following:

— riser components to be drift tested,

— percentage of components to be drift tested,

— minimum drift diameter,

— minimum drift length,

— required markings,

— type and location.

15 Buoyancy Equipment

15.1 General

Repair of riser buoyancy equipment shall conform to the requirements of this specification.

15.2 Inspection – Pre-repair

Any initial inspection and/or pre-repair documentation outside the below requirements shall be defined by the product owner.

Buoyancy modules shall be ensured to be completely dry on the exterior prior to any pre-repair inspection or measurements and prior to repair activities. Inspection shall document the following:

- Module Serial Number
- Module pre-repair weight
- Repair Category

15.3 Classification of Repair

15.3.1 Category 1 – Cosmetic Repair

A Category 1 buoyancy module repair is defined by damage to the exterior skin, covering no more than 25% of the module area and with no damage to the underlying buoyant material.

Materials for Category 1 Repair:

Skin system - The repair skin system shall be one or more layers of suitable formable fabric which restores the outer impact protection of the underlying buoyant material.

Laminating Resin - The laminating resin system shall saturate the skin system fabric and adhere to the underlying buoyant material so as to minimize the risk of delamination post repair in accordance with qualification requirements in Section 15.4

Paint - Any damage to identification marking shall be repaired to show original identification details. Depth break identification coloring shall be restored to original manufacturing specifications.

15.3.2 Category 2 – Medium Sized Repair

A Category 2 buoyancy module repair is defined by damage to the exterior skin, and underlying buoyancy material with a damage depth of no more than 10mm and a surface area no more than 0.10m^2.

Materials for Category 2 Repair:

Repair materials typically included in a Category 2 module repair are as per Category 1 with the following

additions.

Filler Material - Buoyant repair filler material shall bond to the underlying buoyancy material in accordance with qualification requirements in Section 15.4.

15.3.3 Category 3 – Large Sized Repair

A Category 3 buoyancy module repair is defined by damage to the exterior skin, and underlying buoyancy material of a larger volume than a Category 2, without damage to the structural integrity of the buoyancy module. Category 3 repairs typically requires the inclusion of hollow spherical fillers in the repair material matrix.

Materials for Category 3 Repair:

Repair materials typically included in a Category 3 module repair are as per Category 2 with the following additions.

Hollow Spherical Fillers - Hollow spherical fillers shall have a hydrostatic rating suitable for the intended depth in accordance with Section 15.4.

15.3.4 Category 4 – Large Module Crack Repair

A Category 4 buoyancy module repair is defined by damage to the exterior skin, and underlying buoyancy material of a larger volume than a Category 3, with damage to the structural integrity of the buoyancy module. This may include the reattachment of separated pieces no larger than a running length of 500mm. Category 4 repairs typically requires the inclusion of structural support members in the repair material matrix or parent material.

Materials for Category 4 Repair:

Repair materials typically included in a Category 4 module repair are as per Category 3 with the following additions.

Structural support members - Structural support members shall allow for tensile and shear load transfer between the parent material and the members in accordance with Section 15.4.

Bonding Agent - The bonding agent shall provide the bond between the parent material and the structural members for facilitating load transfer between the two components and maintaining a shear and tensile strength in accordance to Section 15.4.

15.3.5 Category 5 – Module Cracked in Half Repair

A Category 5 buoyancy module repair is defined by damage to the exterior skin, and underlying buoyancy material and such that the buoyancy is in multiple large pieces greater than the discrete piece size defined in Category 4.

Materials for Category Repair:

Repair materials typically included in a Category 5 module repair are as per Category 4.

15.4 Composite Repair Material Structure Qualification

The combination of the materials used for the given category of repair shall be confirmed to meet the criteria outlined

in Section 15.4.1 through Section 15.4.4.

These tests shall provide assurance that the composite repair material matrix does not absorb water at an excessive rate while under pressure. The repair facility shall perform tests or produce records of prior tests that confirm the repair material is qualified for rated service depth.

A minimum of two composite repair material matrix samples for each test (crush strength and buoyancy loss) shall be tested. The material test samples shall not have been subjected to prior pressure testing.

Repair facilities shall refer to 16F for hydrostatic test procedures.

In an instance where prequalified repair materials cannot be imported to a particular region, substitute materials may be used so long as they can be proven to be identical based on material properties and chemical makeup. Material equivalency for substitution shall be proven through material data sheets. Data sheets for the originally qualified material and for the substitute material shall be provided to the equipment owner in the final documentation of the repair.

15.4.1 Repair Material Test Samples

Repair material tests samples shall be constructed of all components to be included in the final repair and of an adequate size to accurately represent the buoyancy structure. Composite material test samples shall have a minimum dimension at least 5 times the dimension of the largest macrosphere included in the repair.

Repair material test samples for buoyancy loss shall be at a minimum, large enough to accurately measure buoyancy loss at service depth to confirm the requirements of 15.4.2 are met.

If no macrospheres are included in the repair material the test sample size for hydrostatic crush testing shall be, at a minimum, 25 cubic centimeters.

Repair Material Adhesion Test Samples

Test Sample inclusive of bonding agent:

The adhesion test sample shall be comprised of 2 discrete parts of OEM buoyancy material rated to the maximum depth for which the repair is being qualified and a bonding agent. The 2 parts shall be adhesively bonded together. The test sample shall be of appropriate geometry and size to allow for qualification of the bonding agent between the two parts as identified in 15.4.3.

If structural support members are to be included in the repair than qualification test samples shall include support members.

Test sample exclusive of bonding agent:

The adhesion test sample shall be comprised of 2 parts. One parent material blank which has been fabricated from an OEM buoyancy material, rated to the maximum depth for which the repair is being qualified, and one composite repair material molded to the parent blank without any additional bonding agent. The test sample shall be of appropriate geometry and size to allow for qualification of the adhesion between the two parts as identified in 15.4.3.

If structural support members are to be included in the repair than qualification test samples shall include support members.

NOTE: If no OEM buoyancy material is available, a parent material blank may be fabricated comprised of a compatible composite syntactic foam material. Compatibility between OEM buoyancy material and parent material blanks for qualification testing must be proven.

Note: A qualification program on a material matrix coupon for Category 5 will qualify the constituent lower category systems.

15.4.2 Water Absorption

Acceptance criteria shall be based on the results of a 24-hour test with the last 20 hours of data extrapolated over a 12-month period.

The total buoyancy loss of the repair material shall not exceed

- 4% for composite buoyancy repair material rated to a depth of 6000ft or shallower,
- 5% for composite buoyancy repair material rated to a depth greater than 6000ft.

Compression of material at service depth shall not cause more than 1.50% loss of net volume.

15.4.3 Material Bonding

Acceptance criteria shall be based on the results of a 1-hour continuous test at the service depth.

Adhesion between the OEM parent material blank and the added OEM material or composite repair material shall be maintained after completion of the hydrostatic test. No significant cracking, separation, or deformation between the bonding interface shall be accepted.

Following a passing hydrostatic test at service depth, a flexural test shall be performed on the repair material adhesion test sample with the bending load centered at the location of the bond. The test shall be executed till test sample failure.

If failure of the test sample occurs in the parent OEM material then the bond test shall be considered adequate.

If failure of the test sample occurs at the bonding location, the failure load value shall be included in final qualification documentation.

15.4.4 Hydrostatic Crush Pressure

Crush strength shall be at least 1.25 times the hydrostatic pressure at service depth

15.5 Inspection – Post-repair

15.5.1 Dimensional Inspection

The surface finish of the repair shall be inspected and shown to be free of significant defects that would affect the overall general shape and critical dimensions discussed below.

Overall general shape of the repaired module shall conform to original alignment. Repaired modules shall conform to OEM specified critical dimension tolerances. If no OEM specified critical dimension tolerances are available, the following dimensions on the repaired module shall be compared to an equivalent module that has not been repaired. Discrepancies between the dimensions shall be reported.

- Auxiliary line recesses
- Mux line recesses
- Flex Pads
- Module OD
- Length
- Strap Recesses (if present)
- Bolting locations, through hole and reinforced area (if present)
- Additional geometric features (such as auxiliary fairing equipment grooves or VIV suppression designs, if present)

15.5.2 Weight and Uplift Calculation

Net lift for a module shall be the lift provided by the module calculated using the measured weight of the module post repair, the water weight of the attachment hardware, the original module volume at approximately atmospheric pressure, and the density of seawater with a specific gravity of 1.025. The repair facility shall document the details of the calculation method and data used for the net lift calculations.

Note: If original manufacture issued module documentation is unavailable (original module volume) no post-repair uplift value can be provided to the equipment owner unless a post-repair buoyancy verification test is performed on the module.

15.6 Documentation – Post-repair

An inspection data sheet, containing the following information as a minimum, shall be prepared for each repaired module

a) Level of repair

b) Original module weight from original documentation (if available)

c) Original module volume form original documentation (if available)

d) Original module uplift from original documentation (if available)

e) Serial number and date of repair.

f) Service depth rating.

g) Measured dry weight before repair.

h) Measured dry weight post repair

i) Post repair calculated submerged weight in seawater (SG= 1.025)

j) All critical dimensions

k) Flatness/straightness

In addition to the above module specific information the repair material qualification data and material data sheets if required shall be provided to the equipment owner.

Annex A(Normative)

Manufacturing Data Book Requirements (Change to API 16F)

The below mentioned document contents for the construction of the Manufacturing Data Book (MDB) shall be provided and recorded in order to provide the minimum traceability requirements for maintenance and remanufacturing of marine drilling riser equipment under API 16F.

Manufacturing Data Book (MDB)

Document Contents	*Delivered to equipment owner*	*Maintained by Manufacturer*
Date of manufacturing / assembly	√	√
Purchase order number/sales order number	√	√
Date of Factory Acceptance Testing (FAT)	√	√
Part and Serial Numbers of equipment and location (including elastomers)	√	√
Assembly drawings showing: a) Actual overall package dimensions b) Pressure rating c) End connection/outlet description d) Mass, e) Center of gravity, f) Basic description of the assembly.	√	√
Manufacturer's Certificate of Conformance – include specification to which equipment is certified.	√	√
Design Verification Documentation	~~√~~	√
3rd Party Review Certificate	When in Purchase Order	√
3rd Party Approval Certificate	When in Purchase Order	√
Material Test Records (including the following):		
a) Chemical Analysis	√	√
b) Tensile tests	√	√
c) Impact tests	√	√
d) Hardness tests	√	√
e) NDE Reports	√	√
f) Heat Treatment	√	√

Manufacturing Data Book (MDB) continued.

Document Contents	*Delivered to equipment owner*	*Maintained by Manufacturer*
Material Specification Number	√	√
WPS/PQR 3rd party customer Review Records	As required on purchase order	√
NDE Records:		
a) Surface NDE Records	√	√
b) Volumetric NDE	√	√
c) Repair Weld NDE records	√	√
d) Final Hardness records	√	√
Inspector Qualification Records	As required on purchase order	√
Welding Process Records:		
a) Welder ID	√	√
b) Filler Metal classification, Heat and/or batch number	√	√
c) Flux type and lot number	√	√
d) WPS number(s)	√	√
e) PWHT charts	√	√
f) Total remaining PWHT time per weld	√	√
g) Weld map	√	√
h) Weld inspection records	√	√
i) Sketch of local PWHT heater size location and thermocouples location.	√	√
Welder Qualification records	As required on purchase order	√
Test Report(s), Pressure Testing and Final Acceptance Testing		
a) Hydrostatic pressure test records	√	√
b) Final Acceptance Testing reports	√	√
Dimensions (as defined by OEM / CEM)		√.
Bolting traceability records as per API 16F	√	√
All remaining documentation required as defined in API 16F are kept at OEM / CEM facility for required retention period.		√

Annex B (Normative)

Product History File Requirements

The below mentioned document contents for the construction of the Product History File (PHF) shall be provided and recorded in order to provide the minimum traceability requirements for maintenance and remanufacturing of marine drilling riser equipment under API 16F.

Traceability shall be provided by the remanufacturer in the PHF for the parts being either remanufactured or replaced parts in accordance with this specification.

Product History File (PHF) Repair Only

Document Contents	*Delivered to equipment owner*	*Maintained by Remanufacturer*
Manufacturing Data Book	√	√
Part and Serial Numbers of equipment and location (including elastomers as applicable)	√	√
Design Verification Report	~~√~~ Available for review at the OEM or CEM	√
Third Party or Class Society Inspection Reports	√	√
Test Report(s), Pressure Testing and Final Acceptance Testing		
a) Volumetric NDE Records / radiographic UT Records	√	√
b) Hydrostatic pressure test records	√ Limited scope and pressure test only	√
c) Critical dimensions (as defined by OEM or CEM)	√ Limited scope and basic dimensions only (height, weight, etc…)	√
Final Acceptance Testing reports	√	√
Certificate of Conformance a) Includes the standard to which equipment is certified to.	√ Conformance to Annex E.	√
Serial Numbers of equipment and location	√	√
Parts traceability records	√	√

Product History File (PHF) Repair and Remanufacturing

Document Contents	*Delivered to equipment owner*	*Maintained by Remanufacturer*
PMI Test	√	√
Material Specification Number	√	√
Welding Process Records (if applicable)		
Weld Data Sheet which includes: • Welder ID • Filler Metal • Welding consumable records • Heat and/or batch number • WPS # • Weld map • Weld inspection records • PWHT records • Sketch of local PWHT heater size location and thermocouples location.	√	√
All remaining documentation required as defined in API 16F are kept at OEM / CEM facility for required length of time	√	√
NDE Records	√	√
Hardness records	√	√
Heat Treatment Records (if applicable)	√	√
Third Party or Class Society Inspection Reports	√	√
Test Report(s), Pressure Testing and Final Acceptance Testing	√	√
a) Volumetric NDE Records / radiographic UT Records	√	√
b) Hydrostatic pressure test records	√ Limited scope and pressure test only	√
c) Critical dimensions (as defined by OEM or CEM)	√ Limited scope and basic dimensions only (height, weight, etc…)	√ Critical dimensions kept by OEM / CEM.
Bolting traceability records as per API 16F	√	√
Statement of Compatibility a) includes the standard to which equipment is certified to	√	√
Statement of Fact which includes: • Description of the work done • Pressure tests records • Disassembly records • Origin & serial numbers of parts replaced	√	√
Certificate of Service which includes: • Description of the work done • Pressure tests records	√	√

• Disassembly records • Origin and serial numbers of parts replaced.		

Annex C (Normative)
Failure Reporting

C.1 Owner Responsibility

The owner of marine drilling riser eqipment shall provide a failure notification to the equipment remanufacturer if equipment failure investigation is required.

The failure report shall include the following:

— the operating conditions that existed at the time of the malfunction or failure;

— a description as possible of the malfunction or failure;

— any operating history of the marine drilling riser equipment leading up to the malfunction or failure (e.g. field repair, modifications made to the marine drilling riser equipment, etc.).

C.2 OEM / CEM Responsibility

C.2.1 OEM / CEM Internal Responsibility

All failures experienced with drill through equipment during the repair and remanufacturing process shall be formally communicated to the individual or group within the OEM or CEM organization responsible for the design and specification documents in accordance with API 16F.

The OEM or CEM shall have a written procedure that describes forms and procedures for making this type of communication, and shall maintain records of progressive design, material changes, or other corrective actions taken for each model and size of marine drilling riser equipment in accordance with API 16F.

C.2.2 OEM / CEM External Responsibility

All failures experienced with marine drilling riser equipment and any design changes resulting from a malfunction or failure history shall be reported in accordance with API 16F.

The OEM or CEM shall communicate any design changes resulting from a malfunction or failure history to every equipment owner using the affected equipment in accordance with API 16F.

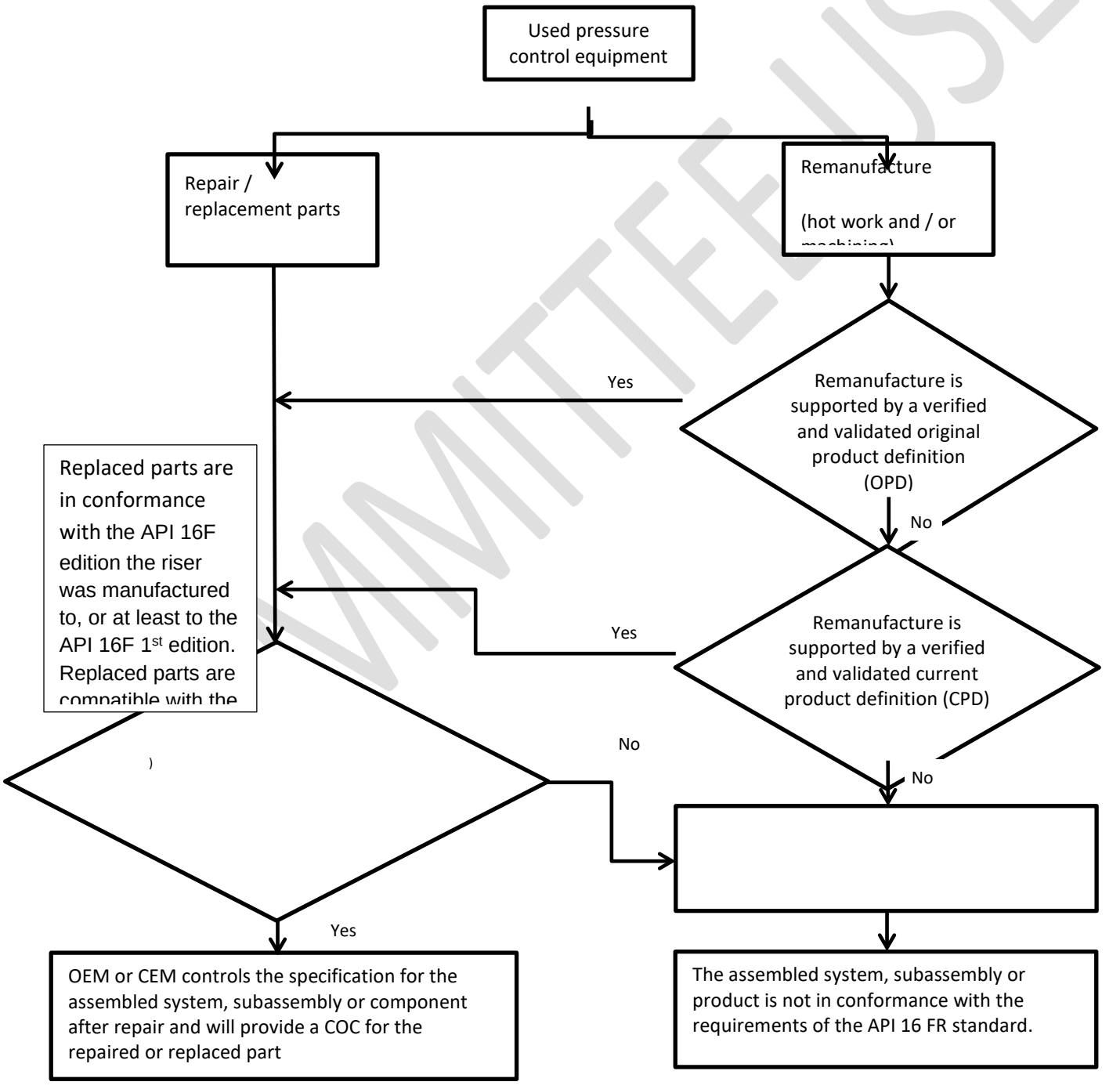
The OEM or CEM shall respond to receiving the failure report and provide a timeline to provide failure resolution.

The OEM / CEM shall, on request of the equipment owner, provide a failure report / of any malfunction or failure.

Annex D (Normative)

Design Ownership

If any alterations to the original design and/or assembled equipment or component part are made by anyone other than the OEM, the assembly, part, or component shall not be considered an OEM product. The party that performs these alterations shall be then designated as the Current Equipment Manufacturer (CEM).



Annex E (Normative)

Minimum Requirements for Certificate of Conformance (COC)

NOTE This example contains the minimum document content requirements for the certificate of conformance in order to provide good traceability of the equipment through field life.

Example

Company Logo	**Company Name** **Company Address**	**QR Code or Bar Code**

Company Certificate No.: ABC-15-0001

CERTIFICATE OF CONFORMANCE

Certificate No. :

Customer :

Customer Reference No.:

Date of Remanufacture:

Customer Purchase Order:

Work Order No.:

A. Assurance:

This is to confirm that the drill through equipment remanufactured per the above purchase order and as listed below have been inspected and/or remanufactured and maintained in accordance with the following:

1. API Spec.16FR "Specification for Marine Drilling Riser Repair and Remanufacture", 1st Edition,
2. Companies current understanding of implementation and interpretation of Jurisdictional regulations listed here:
   a. ……..
   b. ……..

In addition, the following additional standard(s) have been used in support of the repair and remanufacture of the equipment listed on this certificate:

- API Spec16F "Specification for Marine Drilling Riser Equipment", latest Edition
- ……

B. The certification is related to the following operational limitation:

Maximum Working Pressure:

Design Temperature (minimum to maximum):

Sour Service according to NACE MR0175 / ISO 15156: Yes / No

Operation environment (Marine)

Other limitation:

C. List of inspected equipment:

Item	Assembly or Part No.	Qty.	Description	Serial Number(s)
1				
2				
3				

D. Comments:

- It is the responsibility of the owner to ensure that risk analysis is considered and carried out prior to every operation including subject equipment when evaluating the risk situation.
- All documentation in support of the above listed products is retained on file by the Company for a minimum of 10 years for repair / remanufacture.
- All documents and inspection reports to support this certificate of conformance have been verified to the best of my knowledge to be true and correct.
- All documents and inspection reports to support this certificate of conformance have been added to the Product History File.
- All documents and inspection reports to support this certificate of conformance shall be added and maintained by the Owner in the Product History File.

E. Conditions:

- Non-metallic sealing material shall be capable of functioning at specified design temperature, pressure rating, and wellbore fluid /gas composition.

Signature Signature

Name: Name:
Title: Title:

Company disclaimer or Quality disclaimer (if needed).

Bibliography

[1] API Bulletin 6AF, Capabilities of API flanges under combinations of load

[2] API Specification Q2: Specification for Quality Management System Requirements for Service Supply Organizations for the Petroleum, Petrochemical and Natural Gas Industry

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[4] ASME Boiler and Pressure Vessel Code Section VIII, Division 2, Pressure Vessel — Alternate Rules, Appendix 4, Design Based on Stress Analysis

[5] ASME Boiler and Pressure Vessel Code Section VIII, Division 2, Pressure Vessel — Alternate Rules, Appendix 6, Experimental Stress Analysis

[6] ASTM A193, Specification for Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service

[7] ASTM A320, Specification for Alloy Steel Bolting Materials for Low Temperature Service

[8] ASTM A453, Specification for Bolting Materials, High Temperature, 50 to 120 ksi Yield Strength, with Expansion Coefficients Comparable to Austenitic Steels

[9] ASTM E747, Standard Practice for Design, Manufacture, and Material Grouping Classification of Wire Image

[10] AWS QC1 Standard for AWS Certification of Welding Inspectors

[11] ASTM D1418, *Standard Practice for Rubber and Rubber Lattices — Nomenclature*

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