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ADDENDUM 2

(includes Addendum 1, issued September 2014)

Page 20, **Section 7.6 TENSIONER FOUNDATIONS,** *replace:*

> Design loads of all tensioner foundations and all sheave foundations shall be based on the minimum breaking strength of the wire rope, plus the weight of the device and its contents. The foundation shall be designed according to AISC or other nationally or internationally recognized standard. The manufacturer shall provide the mounting and installation information to designer/purchasers, including design load, orientation, alignment, allowable fleet angle, and minimum clearances.

with

> The manufacturer shall provide the mounting and installation information to the designer/purchaser, including design load, orientation, alignment, allowable fleet angle, and minimum clearances.

Page 32, **Section 14**, *replace the entire section as follows:*

14 Riser Running and Handling Equipment

14.1 INTRODUCTION

14.1.1 General

Handling tools for the riser and the diverter, if used to support the riser and the BOP stack, shall be designed for hoisting and lowering the riser system through the riser spider and rotary table, and be designed and rated in accordance with Section 14.2 of this specification.

Riser hang-off spiders shall be rated to support the riser system and BOP stack at the drill floor level. The riser spider and gimbal/shock absorber, if applicable, shall be designed and rated in accordance with Section 14.2 of this specification.

Testing of the riser handling tools, riser spider, and gimbal/shock absorber shall follow the requirements of Section 14.3 of this specification.

14.1.2 Coverage

This section provides the requirements for the following riser running and handling equipment:

a. Manual riser running tools.
b. Hydraulic riser running tools.
c. Riser spiders.
d. Riser gimbals.
e. Equipment used to lift, run, retrieve, or support the riser string and BOP stack.

14.2 DESIGN

14.2.1 Loading

Equipment in Section 14.1.1 shall be designed considering the following loads:

a. Maximum rated static load capacity.
b. Angular capacity of gimbal—maximum rated static load capacity at maximum angular capacity shall be reported.
c. Bending loads (during handling).
d. Loads due to pressure.

14.2.2 Strength Analysis

14.2.2.1 General

The equipment design analysis shall address yielding, buckling, deflection, and rupture as possible modes of failure.

Finite element analysis, in conjunction with closed form analytical solutions, may be used. All forces that may govern the design shall be taken into account. For each cross section to be considered, the most unfavorable combination, position and direction of forces shall be used.

14.2.2.2 Design Safety Factor

The design factor for all equipment referenced in Section 14.1.1 shall be as stated below.

The design safety factor is intended as a design criterion and shall not under any circumstances be construed as allowing loads on the equipment in excess of the load rating.

The design safety factor, SF_D, shall equal 2.25.

14.2.2.3 Allowable Stress

Linear elastic theory shall be employed for the determination of stress distributions within components. Equivalent stress shall be determined based on the Von-Mises Hencky theory as provided in Annex B.

Linearized primary membrane stresses caused by the rated load shall not exceed the maximum allowable stress, $\sigma_{allow,m}$, as calculated by equation (1).

$$\sigma_{allow,m} = \frac{\sigma_{ys}}{SF_D} \tag{1}$$

Linearized primary membrane plus primary bending stresses caused by the rated load shall not exceed the maximum allowable stress, $\sigma_{allow,m+b}$, as calculated by equation (2).

$$\sigma_{allow,m+b} = \frac{1.5 \times \sigma_{ys}}{SF_D} \tag{2}$$

Linearized membrane plus bending secondary stresses caused by the rated load shall not exceed the maximum allowable stress, $\sigma_{allow,s}$, as calculated by equation (3).

$$\sigma_{allow,s} = \frac{3.0 \times \sigma_{ys}}{SF_D} \tag{3}$$

Bearing stresses are allowed to exceed the yield strength of the material provided that the shear and tensile stresses in the vicinity of the bearing load are within acceptable limits. When bearing loads are applied to parts having free edges, the possibility of a shear failure shall be considered.

Where σ_{ys} is the material minimum yield strength per ASTM A370.

14.2.2.4 Shear Strength

For purposes of design calculations involving shear (primary stress), the ratio of yield strength in shear to yield strength in tension shall be 0.58. The design safety factor is to be applied in accordance with Section 14.2.2.3.

14.2.2.5 Contact Stresses and Geometric Discontinuities (Secondary Stresses)

The method of Section 14.2.2.6 may be performed for any one of the following conditions:

a. For contact areas and bearing loads exceeding yield;
b. For areas of highly localized stress concentrations caused by part geometry exceeding the requirements of Section 14.2.2.3.

For these areas the primary membrane stress in the section must meet the requirements of Section 14.2.2.3.

14.2.2.6 Ultimate Strength (Plastic) Analysis

The lower bound true stress-true strain curve, with strain hardening and change in geometry can be used for determining the rated load, local strain, and shakedown. Using this method does not require satisfying the limits on primary and secondary stress in Section 14.2.2.3. The curve has to be based on the specified minimum yield stress. The material model for this type of analysis must be defined by the following:

1. The yield surface defining when plastic strains are generated must be modeled using von Mises plasticity.
2. kinematic hardening model defining how the yield surface changes for plastic strains or a combination of both.

The load is increased incrementally in the FEA model of the structure until the model fails to converge, or the deformation is large enough such that the structure no longer serves its purpose per the functional requirements. This is the lower bound load. The rated load is the lower bound load divided by the safety factor in Section 14.2.2.2.

The use of the method in this section requires local strains to be analyzed for a few cycles of the rated load to determine if shakedown occurs, i.e. no progressive distortion or stress ratcheting.

14.2.2.7 Limit Analysis (Elastic-Perfectly Plastic Analysis) (Alternate Method)

Nonlinear analysis may be conducted with a material model that defines yielding using bilinear von Mises plasticity typically based on small displacement analysis. For this method, stress less than the yield strength has a slope equal to the elastic modulus of the material, above yield the slope is as near zero as practical.

The model shall be loaded until the lower bound collapse load is identified by failure of the model to converge. This is the limit load. The rated load is the limit load divided by the safety factor in Section 14.2.2.2.

The results of the limit analysis may be used to justify primary stresses exceeding the stress allowables in Section 14.2.2.3, but not secondary stresses.

The method in Section 14.2.2.6 may be used to justify secondary stresses. The rated load determined using the method in Section 14.2.2.6 must be greater than the rated load determined using the limit analysis method to justify the secondary stresses.

14.2.2.8 Bolted Connections

Bolts subject to the primary load shall meet the requirements of equations (5) and (6) below:

$$\frac{2.25 \times Rated\ Load}{A_{bolt}} \leq \sigma_{ys} \tag{5}$$

$$\frac{Preload \times Rated\ Load}{A_{bolt}} \leq 0.83\sigma_{ys} \tag{6}$$

where

A_{bolt} is the minimum cross section of the bolt being considered.

Equation (6) considers the effective joint stiffness, i.e. bolt stiffness plus the clamped components stiffness. Both equations (5) and (6) consider only the membrane stresses through the bolt section and do not account for secondary and bending effects.

14.2.2.9 Pressure Containing Components

Pressure containing components shall be designed using the design methodology and stress allowables described in Annex B.

14.2.3 Design Verification

The design shall be verified using an independent source outside of the design process plus prototype testing.

14.3 TESTING

14.3.1 Prototype Testing

Prototype testing shall be performed for design validation. Prototype testing shall be used to verify the strength analyses conducted by either of the methods described in Section 14.2.2. The component rated load shall be applied to verify any assumptions made.

Strain measurements must be determined as near as physically possible to at least five of the highly stressed locations and five locations away from stress concentrations as predicted by the methods in Section 14.2.2. The measurements shall correlate to the design methodology used to within manufacturer's acceptance criteria.

14.3.2 Production Testing

14.3.2.1 Proof Load Test

To ensure conformity with specified requirements the design shall be validated using test of production products to a minimum load of 1.5 times the rated load capacity of the component. Gimbals need only be loaded in the axial direction.

The equipment shall be mounted in a test fixture capable of loading the equipment in essentially the same manner as in actual service and with essentially the same areas of contact on the load-bearing surfaces.

The test load, equal to 1.5 times the rated load, shall be applied for a period not less than 5 minutes.

All primary-load-carrying components shall be inspected in accordance with Section 14.6 after the production load test.

14.3.2.2 Functional Test

Functional test shall be performed to ensure proper operation of the components. The function test shall be performed after the completion of the production load test and inspection in accordance with Section 14.6.6.

14.3.2.3 Pressure Test

Pressure containing systems shall be pressure tested to 1.5 times the maximum rated pressure of that system for a period not less than 5 minutes after stabilization with no detectable leaks. The pressure test shall be performed after the production load test and inspection in accordance with Section 14.6.

14.4 MATERIAL

14.4.1 General

All materials shall be suitable for the intended service.

The remainder of Section 14.4 describes the various material qualification, property and processing requirements for primary-load-carrying components and pressure-containing components unless otherwise specified.

14.4.2 Written Specification

Written specifications of materials used for riser running equipment shall follow the requirements of Section 6.3.

14.4.3 Mechanical Properties

Materials shall meet the property requirements specified in the manufacturer's material specification.

The impact toughness shall be determined from the average of three tests, using full sized test pieces if the size of the component permits. If it is necessary for sub-size impact test pieces to be used, the acceptance criteria for impact values shall be those stated below but multiplied by the appropriate adjustment factor listed in Table 14.2. Sub-size test pieces of width less than 5 mm shall not be used.

For materials of a specified minimum yield strength of at least 310 MPa (45 ksi), the average impact toughness shall be 42 J (31ft-lb) at –20°C (–4°F) with no individual value less than 32 J (24 ft-lb).

For materials with a minimum specified yield strength of less than 310 MPa (45 ksi), the average impact toughness shall be 27 J (20ft-lb) at –20°C (–4°F) with no individual value less than 20 J (15 ft-lb).

For design temperatures below –20°C (–4°F) (e.g. arctic service), the following supplementary impact toughness requirements shall apply:

1. The maximum impact test temperature for materials used in primary-load-carrying components with a required minimum operating temperature below –20°C (–4°F) shall be specified by the purchaser.
2. Impact testing shall be performed in accordance with this section and ASTM A370. The minimum average Charpy impact energy of three full-size test pieces, tested at the specified (or lower) temperature, shall be 27 J (20 ft-lb) with no individual value less than 20 J (15 ft-lb).

3. Each primary-load-carrying component shall be marked "LTT" to indicate that low temperature testing has been performed using low-stress, hard die-stamps near the load rating identification. Each primary-load-carrying component shall also be marked to show the actual design and test temperature in degrees Celsius.

Where the design requires through-thickness properties, materials shall be tested for reduction of area in the through-thickness direction in accordance with ASTM A770. The minimum shall be 25%.

Components shall be fabricated from materials meeting the applicable requirements for ductility specified in Table 14.1 and Table 14.2.

Table 14.1—Elongation Requirements

Yield Strength		Elongation, minimum %	
MPa	**ksi**	$L_0 = 4d$[a]	$L_0 = 5d$[a]
Less than 310	Less than 45	23	20
310 to 517	45 to 75	20	18
Over 517 to 758	Over 75 to 110	17	15
Over 758	Over 110	14	12

a) Where L_0 is the gauge length and d is the diameter.

Table 14.2—Adjustment Factors for Sub-size Impact Specimens

Specimen Dimensions (mm)	Adjustment Factor
10.0 × 7.5	0.833
10.0 × 5.00	0.667

14.4.4 Material Qualification

The manufacturer shall perform the mechanical tests on qualification test-coupons representing the heat and heat treatment lot used in the manufacture of the component. Tests shall be performed in accordance with ASTM A370, or equivalent standards, using material in the final heat treated condition. For the purposes of material qualification testing, PWHT is not considered heat treatment, provided that the PWHT temperature is below that which changes the heat treatment condition of the base material.

Qualification test coupon size shall be determined per Section 6.7.

Test specimens shall be removed from integral or separate qualification test-coupons so that their longitudinal centerline axis is entirely within the center core 1/4-thickness envelope for a solid test-coupon or within 3 mm (1/8 in.) of the mid-thickness of the thickest section of a hollow test-coupon. The gauge length on a tensile specimen or the notch of an impact specimen shall be at least 1/4 thickness from the ends of the test-coupon.

Test specimens taken from sacrificed production parts shall be removed from the center core 1/4-thickness envelope location of the thickest section of the part.

Testing of QTC shall be performed per Section 6.8 considering the requirements of Section 14.4.3 above.

14.4.5 Manufacture

The manufacturing process shall ensure repeatability in producing components that meet all the requirements of this Standard.

All wrought materials shall be manufactured using processes which produce a wrought structure throughout the component

All heat treatment operations shall be performed utilizing equipment qualified in accordance with the requirements specified by the manufacturer or processor. The loading of the material within heat treatment furnaces shall be such that the presence of any one part does not adversely affect the heat treatment response of any other part within the heat treatment lot. The temperature and time requirements for heat treatment cycles shall be determined in accordance with the manufacturer's or processor's written specification. Actual heat treatment temperatures and times shall be recorded, and heat treatment records shall be traceable to relevant components.

The manufacturer shall specify the melting, refining, casting, and working practices for all components. The specified practices shall be recorded in the required written material specification.

14.4.6 Chemical Composition

The material composition of each heat shall be analyzed for all elements specified in the manufacturer's written material specification.

The maximum mass fraction of sulfur and phosphorous shall each be 0.025, expressed as a percentage.

14.5 REPAIR WELDING

14.5.1 General

This section describes the requirements for repair welding, where permitted, of primary-load-carrying components and pressure-containing components, including attachment welds. The term "repair," as referred to in Section 14, applies only to the repair of defects in materials during the manufacture of new equipment. Section 6 shall apply in full to primary-load-carrying and pressure-containing weldments except as amended or superseded by Section 14.5

14.5.2 Access

There shall be adequate access to evaluate, remove and inspect the non-conforming condition causing the need for the repair.

14.5.3 Forgings

All repair welding shall be performed in accordance with properly qualified welding procedures.. Welding procedure specifications shall be documented..

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

- Defect type;
- Defect size limits;
- Definition of major/minor repairs.

All excavations, prior to repair and the subsequent weld repair, shall meet the quality control requirements specified in Section 14.6

For major weld repairs as defined by the manufacturer shall also produce a dimensional sketch of the area to be repaired and the repair sequence. Documentation of repairs shall be maintained in accordance with requirements of Section 17.

14.5.4 Heat Treatment

The welding procedure specification used for qualifying a repair shall reflect the actual sequence of weld repair and heat treatment performed on the repaired item.

14.6 QUALITY CONTROL

14.6.1 General

Section 18.1 specifies the quality control requirements for all primary-load-carrying components and/or pressure-containing equipment and components unless otherwise specified below.

14.6.2 Chemical Analysis

Methods and acceptance criteria shall be in accordance with 14.4.6.

14.6.3 Tensile Testing

Methods and acceptance criteria shall be in accordance with 14.4.3 and 14.4.4.

14.6.4 Impact Testing

Methods and acceptance criteria shall be in accordance with 14.4.3 and 14.4.4.

14.6.5 Traceability

Fasteners not in the primary load path and pipe fittings shall be exempt from traceability requirements provided they are marked in accordance with a recognized industry standard.

14.6.6 Surface NDE

14.6.6.1 General

NDE and inspection, in accordance with the below requirements, shall be performed after final heat treatment and final machining operations in welds, primary load path components and high stress regions as determined by Section 14.6.8.

If the equipment is subjected to a load test, the qualifying NDE shall be carried out after the load test. For materials susceptible to delayed cracking, as identified by the manufacturer, NDE shall be done not earlier than 24 h afters the load test. The manufacturer shall establish the critical areas for inspection. Conductive surface coatings shall be removed prior to examination. Non-conductive surface coating shall be removed prior to examination unless it has been demonstrated that the smallest relevant indications defined in 14.6.6.2 can be detected through the maximum applied thickness of the coating.

14.6.6.2 Method

Ferromagnetic materials shall be examined by the magnetic particle method in accordance with ASME BPVC, Section V, Subsection A, Article 7, and Subsection B, Article 25 or ASTM E709. Machined surfaces shall be examined by the wet fluorescent method; other surfaces shall be examined by a wet method or dry method.

Non-ferromagnetic materials shall be examined by the liquid penetrant method in accordance with ASME BPVC, Section V, Subsection A, Article 6, and Subsection B, Article 24 or ASTM E165.

If the use of prods cannot be avoided, all prod burn-marks shall be removed by grinding and the affected areas shall be re-examined by the liquid penetrant method.

14.6.6.3 Evaluation of Indications

Only those indications with major dimensions greater than 2 mm ($^{1}/_{16}$ in.) and associated with surface ruptures shall be considered relevant indications. Inherent indications not associated with a surface rupture (i.e. magnetic permeability variations, non-metallic stringers, etc.) shall be considered non-relevant. If magnetic particle indications greater than 2 mm ($^{1}/_{16}$ in.) are believed to be non-relevant, they shall either be examined by the liquid penetrant method to confirm they are non-relevant or they shall be removed and re-inspected to confirm they are non-relevant.

Relevant indications shall be evaluated in accordance with the acceptance criteria specified in 14.6.6.4.

14.6.6.4 Acceptance Criteria

The following acceptance criteria shall apply for surface NDE of wrought materials:

- No relevant indication with a major dimension equal to or greater than 5 mm ($^{3}/_{16}$ in.);
- No more than ten relevant indications in any continuous 40 cm^2 (6 $in.^2$) area;
- No more than three relevant indications in a line separated by less than 2 mm ($^{1}/_{16}$ in.) edge-to-edge;
- No relevant indications in pressure-sealing areas, in the root area of rotary threads or in stress-relief features of threaded joints.

14.6.7 NDE of Welds

14.6.7.1 General

Essential welding variables and equipment shall be monitored during welding. The entire accessible weld, plus at least 13 mm ($^{1}/_{2}$ in.) or surrounding base metal, shall be examined in accordance with methods and acceptance criteria of 14.6.7.

The NDE required under 14.6.7 shall be carried out after final heat treatment.

14.6.7.2 Fabrication Welding

14.6.7.2.1 Visual Examination

All fabrication welds shall be visually examined in accordance with ASME BPVC, 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.

Surface porosity or exposed slag are not permitted on, or within 3 mm (1/8 in.) of sealing surfaces.

14.6.7.2.2 Surface NDE

All primary-load-carrying and pressure-containing welds and attachment welds to main load bearing and pressure-containing components shall be examined as specified in 14.6.6.2.

The following acceptance criteria shall apply:

- No relevant linear indications (i.e. having a length of at least three times the width);
- No rounded indications with a major dimension greater than 4 mm (1/8 in.), for welds whose depth is 17 mm (5/8 in.) or less;
- No rounded indications with a major dimension greater than 5 mm (3/16 in.) for welds whose depth is greater than 17 mm (5/8 in.);
- No more than three relevant indications in a line separated by less than 2 mm (1/16 in.) edge to edge.

14.6.7.3 Repair Welds

The term "repair," as referred to in Section 14, applies only to the repair of defects in materials during the manufacture of new equipment

14.6.7.3.1 Weld Excavations

Magnetic particle examination shall be performed on all excavations for weld repairs, with the method and acceptance criteria as specified 14.6.6.

14.6.7.3.2 Repair of Welds

NDE of the repairs of weld defects shall be identical to that of the original weld; 14.6.7.2.

14.6.8 Critical Area Maps

The manufacturer shall establish and maintain area drawings, identifying high-stress areas, which shall be used in conjunction with this section. For purposes of this section, critical areas shall be all areas where the stress in the component exceeds the value of:

$$High\ Stress \geq \frac{\sigma_{ys}}{1.33 SF_D} \quad (7)$$

If critical areas are not identified on critical area drawings then all surface areas of the component shall be considered critical.

Areas of components in which the stress is compressive, and/or where the stress level is less than the results of Equation (8), may be considered non critical. The low stress areas, thus defined, may be defined on the critical area map.

$$Low\ Stress \geq \frac{0.1\sigma_{ys}}{SF_D} \quad (8)$$

14.7 DIMENSIONS

Verification of dimensions shall be carried out on a sample basis as defined and documented by the manufacturer.

All main load-bearing and pressure-sealing threads shall be gauged to the requirements of the relevant thread specification(s).

The manufacturer shall specify the maximum diameter of riser string component that can pass through the spider with the dogs or jaws retracted.

The Verification of external interface dimensions shall be carried out on each components and/or assembly as relevant.

14.8 PROCESS CONTROL

It shall be the manufacturer's responsibility to maintain documentation to ensure conformance of the riser running equipment design to this specification.

Additionally, raw material traceability to heat number, including of the chemical, physical, and mechanical properties of primary load bearing and pressure-containing components materials shall be maintained through the complete manufacturing cycle except those components excluded from traceability in Section 14.6.7.

14.9 MARKING

Components designed to Section 14 shall be marked using permanent low-stress, metal impression stampings with the following information:

a. Name of manufacturer;
b. Date of manufacture;
c. Unique serial number;
d. Maximum load rating;
e. API 16F.