API Spec 7K, 6th Edition – WI 9202 BOP Handling Systems and Equipment

9.12 BOP Handling Systems and Equipment

9.12.1 Applicability of the Requirements in Section 1 Through Section 8

9.12.1.1 Sections 4.1, 4.5, 4.6 and 8.6 covering design requirements, DSFs and Proof Load Testing shall not apply to this equipment. Such requirements for this equipment shall be in accordance with 9.12.3, 9.12.4, 9.12.5 and 9.12.6.

9.12.1.2 Section 4.2.7 regarding fatigue life shall apply to this equipment, or as specified by the manufacturer in accordance with 9.12.8.

9.12.1.3 Section 4.4.1 covering rotary tables, spiders, and manual tongs shall not apply to this equipment.

9.12.1.4 Section 4.4.3 covering torque ratings for manual tongs shall not apply to this equipment.

9.12.2 Requirements for Information and Specifications for BOP Handling Systems

9.12.2.1 General

The requirements in 9.12.2.2 and 9.12.2.3 shall be considered in design, and design limits shall be specified in the documentation.

9.12.2.2 Control System Features

Control systems shall be designed so as to prevent unexpected movement of the system when power is interrupted, and when power (e.g. electrical, pneumatic, and hydraulic) is restored after interruption. The controls shall be designed to prevent unexpected movement regardless of whether one source or multiple sources of power are interrupted and subsequently restored. The purchaser may specify any additional control system features.

9.12.2.3 Ambient Conditions

The purchaser shall specify the environment in which the system is anticipated to operate in terms of maximum and minimum temperatures and humidity levels; the corrosiveness of the atmosphere, such as whether the system will be used offshore or onshore; and any other ambient conditions that could affect the design or manufacture of the system that would be reasonably anticipated.

9.12.2.4 Other Systems Interface Requirements

9.12.2.4.1 The purchaser shall identify the other systems that the BOP handling system will interface with physically as well as functionally. This type of interface may include but not be limited to rig system control and monitoring systems (including software compatibility), BOP stack storage structure(s), moonpool guidance systems, and/or structural interface required to distribute and support the primary load of the handling system. The latter requirement should include a transmittal of relevant rig structural drawings to the manufacturer needed to design appropriate system structure to interface with the rig structure.

9.12.2.4.2 When it is intended that the system is to receive power supplies from the rig after it is installed, the purchaser shall specify the sources of electrical, hydraulic, and/or pneumatic power that is to be made available to supply power to the system.

9.12.2.4.3 The purchaser shall specify the applicable codes, standards, and regulatory requirements that shall apply to electrical equipment, components, fittings, cabling, and their installation, including applicable requirements for hazardous area or zone classifications in which the BOP handling system is to be installed.

9.12.2.4.4 The purchaser, at his/her option, shall specify the type of third-party certification required for the system.

9.12.2.5 LoadingConditions

9.12.2.5.1 The maximum static load that will be handled by the system shall be specified. This shall include the entire BOP stack and all its attachments.

9.12.2.5.2 The dynamic loads that the system will be exposed to shall be specified, including, but not limited to, maximum wind velocity, accelerations caused during transportation if the system is portable, accelerations caused by offshore vessel motion criteria, side loading and/or operation requirements at angles misaligned with the normal load path, and/or other dynamic forces that would be anticipated during system operation.

9.12.2.5.3 The purchaser shall specify wave slamming loads if this needs to be considered by the equipment designer.

9.12.2.5.4 The purchaser shall specify load response from riser hang-off if this needs to be considered by the equipment designer.

9.12.3 Subsystem Design Requirements

9.12.3.1 General

Design requirements and specifications of subsystems and/or system components are specified as follows.

9.12.3.2 Piping Systems

Valve DSFs shall meet or exceed those required by ASME B16.34 and NFPA T2.12.10 R1 or other recognized international standard for this type of application. For piping systems, safety factors shall meet or exceed the requirements specified in ASME B31.3, hydraulic circuit design shall incorporate features that will allow isolation of components such as pressure relief, pressure regulating, and counter-balance valves for replacement and maintenance without having to drain the system of hydraulic fluid. Functional redundancy and bypass circuits shall also be employed to increase reliability. Hydraulic hoses shall only be utilized where there is a requirement to address misalignment, relative movement between components, thermal expansion and contraction, and vibration. Otherwise, rigid piping/tubing shall be utilized.

9.12.3.3 Wire Rope

Steel wire rope design factor for running applications shall not be less than 3.

Steel wire rope forming part of sling and for mast stays, pendants and similar standing applications shall have a design factor not less than 5.

Reeving efficiency, end termination efficiency and D/d-ratio (Wire sheave / Rope) shall be considered during selection of wire rope.

9.12.3.4 Slings

Slings made from wire rope, chain, or synthetic materials shall be fabricated and certified per ASME B30.9 or equivalent. Wire rope slings shall incorporate the end termination efficiency and a wire rope design factor of 5 in their rated capacity. The rated capacity of each sling shall be shown on a tag attached to the sling.

9.12.3.5 Off-the-shelf Loose Gear

Off-the-shelf loose gear selected for use in BOP handling systems, such as shackles, hooks, chain, binders, swivels, turnbuckles, sheave blocks, and connecting links, shall have a working load limit published by the manufacturer that equals or exceeds the design load of the load path they are used in.

9.12.3.6 Hydraulic Hoses

9.12.3.6.1 The use of hydraulic hoses shall be kept to an absolute minimum required to compensate for vibration, thermal expansion and contraction, misalignment, or relative movement required between the hydraulic hose end terminations.

9.12.3.6.2 Hydraulic hoses shall meet the requirements of SAE J 517 and shall have a working pressure equal to or exceeding the piping system into which they are installed. The minimum burst pressure of hydraulic hoses shall be a minimum of four times the working pressure of the hose, as specified by the hydraulic hose manufacturer.

9.12.3.6.3 Only hydraulically crimped type hydraulic hose end fittings shall be used. Swivel-type end fittings that are widely available are recommended to be installed at each end of the hydraulic hose to prevent hose twisting during installation and removal. No hot-dip galvanized end fittings shall be used and no PTFE tape shall be applied to any pressure sealing threaded connections, such as national pipe thread (NPT) threads.

9.12.3.6.4 Raw hose body material used to fabricate hydraulic hose assemblies shall not be older than five years from the date of manufacture and shall be suitable and compatible with the media being conveyed.

9.12.3.6.5 The outer cover of the hydraulic hose body of all hydraulic hose assemblies shall not be painted.

9.12.3.6.6 All hydraulic hoses and hose assemblies (i.e. those located on a machine and/or dragchain and jumper/hook-up) shall be internally cleaned after pressure testing to ensure that any contamination inside the hydraulic hose assembly will not adversely affect system operation. Hydraulic hose assemblies shall be capped and sealed after pressure testing and cleaning.

9.12.3.6.7 When installing hydraulic hose assemblies, they shall be routed and secured in such a manner that will avoid kinking or bends in the hydraulic hose body that are less than the published minimum bending radius. Additional protection shall be provided to the outer cover of the hydraulic hose in way of contact with surfaces subject to vibration.

9.12.3.6.8 Each hydraulic hose assembly shall be pressure tested to a minimum of 1.5 times the working pressure of the hydraulic hose body prior to cleaning. Fluid should be used as the pressure testing media.

9.12.3.6.9 A list of all hydraulic hose assemblies utilized in the system shall be provided in an attachment to the system parts manual, which shall specify as a minimum, the equipment manufacturer part number.

9.12.3.7 Mechanical Components

The design of mechanical components including but not limited to shafting, clevis linkages, gears of all types, keyways, splines, etc. shall meet the requirements of 9.12.4 to determine the design load. A DSF shall then be applied in accordance with 9.12.5.

9.12.3.8 Attachments to Rig Structure

The manufacturer shall provide reaction loads for each interface to the rig structure that is necessary for the purchaser to be able to design supporting structure for mounting and/or founding the system on the rig.

9.12.3.9 Electrical Power and Control System Components

The specifications for electrical power and control system components such as AC or DC motors, variable frequency drives, electrical enclosures, switches, relays, circuit breakers, and other components, as well as electrical cabling, etc., and the suitability of such components for installation in hazardous areas or zones shall meet the requirements of all applicable requirements specified in the purchase agreement.

9.12.3.10 BOP Stack Storage Structures

The design of BOP stack storage structures shall be based on the governing static and dynamic loads for storage of the BOP Stack.

9.12.3.11 BOP Stack Lifting Attachment Points

BOP attachment points for lifting BOPs and/or BOP stacks should be specified by the original equipment manufacturer including any limitations.

9.12.3.12 Control System Features

Controls for raising, lowering, and transporting the load shall be designed such that they will return to neutral when the operator releases the control, which shall cause the brakes and/or load-holding device to be set automatically. Controls for the brakes and/or load-holding devices shall be designed such that they shall not disengage until the operator of the system activates the function on which the brake and/or load-holding device is engaged. If the load-holding device is activated as a result of a power loss, the control system shall be designed to ensure that it shall remain engaged when power is restored.

9.12.3.13 Sheave/Winch Drum Diameter to Wire Rope Diameter Ratios

The ratio of wire rope sheave diameter to the wire rope diameter used with the sheave shall be a minimum of 18-to-1. The drum pitch diameter to the wire rope diameter wrapped on a drum that is part of a BOP handling system shall be a minimum of 18-to-1. Exception to these requirements may be taken when space constraints and other circumstances dictate smaller ratios. In these cases, sheaves and/or drums should be provided that have the largest ratio that can be installed, operated, and maintained in the space provided. For systems that are supplied with sheaves and/or drums having smaller ratios than 18-to-1, the manufacturer shall include a statement in the system operating and maintenance manual to the effect that the purchaser should be aware of the reduced fatigue life of the wire rope utilized with such sheaves and/or drums.

The strength of a wire rope assembly shall be derated for end connection efficiencies and for D/d ratios less than 18 in accordance with API RP 9B.

9.12.3.14 Wire Rope Hoist Features

Wire rope hoists shall incorporate a brake and/or load holding device as described in 9.12.3.20. Level-wind devices shall be considered when wire rope to drum fleet angles exceed 2 degrees.

9.12.3.15 Maximum Beam Deflection

The maximum vertical deflection of a beam or girder produced by the design load on such girders or beams should not exceed $^{1}/_{250}$ of the span. Inertial forces caused by dynamics shall not be considered in determining deflection.

9.12.3.16 Wear and Corrosion Allowances

An allowance for wear and corrosion shall be accounted for in determining the maximum allowable stress in primary load-carrying components in applications where wear and corrosive ambient conditions will most likely prevail and act to increase the unit stress above maximum allowable limits within the life expectancy of the system as specified by the manufacturer. In this regard, the manufacturer shall specify the maximum loss of material due to wear and/or corrosion that is allowed in measurable terms to provide a means for the user for accepting or rejecting such components from further service as a result of measurements taken during routine inspections. In lieu of providing a corrosion allowance, the manufacturer may opt to incorporate corrosion-resistant materials or offer other means of corrosion prevention in the form of coating systems or cathodic protection, as appropriate. The maintenance requirements of such coating systems and/or cathodic protection systems shall be prescribed by the manufacturer in the recommended maintenance requirements published in the operation and maintenance manuals to be provided with the BOP handling systems upon delivery to the purchaser.

9.12.3.17 Side Loading

Load path design shall accommodate whatever side loading that is likely to occur as determined by the designer or as specified by the purchaser, whichever case is the most severe during system operation for a given installation. The combined loads shall not result in exceeding the maximum allowable stress in the component.

9.12.3.18 Accelerations Caused by System Operation

System design shall incorporate a means of minimizing the forces created by accelerations induced by stopping and starting the lifting, lowering, and transporting functions to ensure that the maximum allowable stress of any component in the load path is not exceeded. This may be accomplished with devices to limit the speed of lifting, lowering, or transporting the BOP stack and/or mitigating acceleration and decelerations with step-down transformers, ramping software controls, fluid cushions, surge accumulators, springs, elastomer bumpers, orifice valves, etc. The inherent regenerative controlled braking means of a squirrel cage motor may be used if the holding brake is designed to meet the additional requirement of retarding a descending load upon the loss of power.

9.12.3.19 Load Transfer Between One Load Path and Another

For systems where the load is transferred from one load path to another, the design shall incorporate functionality such that the transfer is made reliably and seamlessly while under full control.

9.12.3.20 Fail-safe Load-holding Devices

9.12.3.20.1 At least one brake and/or mechanical device that is capable of stopping and holding the maximum rated load of the system shall be fail-safe in design such that whenever power is lost or when the controls for raising, lowering, and transporting the load are let go by the operator and return to neutral, or when the fail-safe load-limiting device specified in 9.12.3.21 is activated, the brake and/or device provided shall engage automatically. Such device shall be located in the load path in such a way as to isolate the transmission and prime-mover from the load when the brake or device is activated. Brake release hydraulic or compressed air piping, valves, and appurtenances shall not be configured in a manner such that hydraulic or pneumatic pressure is trapped to prevent or inhibit the setting of the brake. If chain hoists are utilized in a BOP handling system, they must be fitted with a fail-safe load-holding device as defined in this standard. The following types of system designs and/or features are exempted from the fail-safe load-holding device requirement as detailed below.

9.12.3.20.2 Fluid power cylinders incorporated in the primary load path shall have a maximum allowable working pressure that is at least 10 % above the pressure created when the system is a full-rated load. Devices designed to hold the load, such as counter-balance valves, check valves, etc., shall be provided to activate automatically to stop uncontrolled movement of the cylinder at loads up to and including the design load if the hydraulic pumps that provide hydraulic pressure to such cylinders should fail or power is lost. To account for loads induced into the system that exceed the rated load that could cause an increase in cylinder pressure beyond the maximum allowable working pressure, a pressure-relieving device shall be fitted between each cylinder and the counter-balance valves or check valves employed to hold the load. The pressure-relief devices should be set to relieve pressure at 30% above the maximum allowable working pressure. Fluid emitted from such pressure-relieving devices shall be piped back to the system fluid reservoir. Hydraulic hoses shall not be installed between the cylinder(s) and the counter-balance or load-holding valves and pressure-relieving devices described above.

9.12.3.20.3 When rack and pinion drives are incorporated in the primary load path such that sufficient redundancy in the form of multiple rack and pinion drives is not provided to support the load if one pinion drive should fail, then mechanical devices incorporating a separate load path shall be provided that will activate automatically to stop and hold the load at the rated load of the system.

9.12.3.21 Fail-safe Load-limiting Devices

Load-limiting, fail-safe devices such as circuit breakers, relief valves, pressure regulating valves, etc., shall be

provided such that the load on the system shall not exceed 110 % of the design load of the system. Anti-tampering devices shall be employed to mitigate the manual detention of such load-limiting and fail-safe devices, except for the purpose of load testing when the loads intended to be applied to the primary load path exceed 110 % of the design load of the system.

9.12.3.22 Load-monitoring Devices

Load-indicating systems shall be made available as an optional feature by the manufacturer. When specified in the purchase agreement, such load-indicating systems shall, at a minimum, display the amount of the load being handled by the system. Additional options may include a data logger to record operational and/or load information, audio/ visual alarms to indicate when a certain percentage of the load has been reached, or automatic shut-downs activated by the load-monitoring system when certain load values are reached to prevent system overloading in addition to that which is required by this standard.

9.12.4 Determination of Design or Rated Load

9.12.4.1 The design or rated load as defined in Section 3 shall be determined by multiplying the static load by the dynamic factor, which is determined with information provided by the purchaser. If such information is not available from the purchaser, then a dynamic factor according to FEM 1.001 “Rules for the design of hoisting appliances”, API 2C “Specification for Offshore Pedestal Mounted Cranes or other recognized standard shall be used in addition to inertia forces, as applicable (e.g. for floating installations).

9.12.4.2 Apply an additional design factor to accommodate side loading as specified in 9.12.3.17 if it is in addition to the dynamic factors specified in 9.12.4.1, depending on the specific application.

9.12.4.3 Apply an additional design factor to accommodate dynamic forces induced by system operation as specified in 9.12.3.18 if it is in addition to the dynamic factors specified in 9.12.4.1, depending on the specific application.

9.12.5 Required Minimum Design Safety Factor (DSF)

Minimum DSFs, according to FEM 1.001 “Rules for the design of hoisting appliances”, API 2C “Specification for Offshore Pedestal Mounted Cranes, AISC 360-16 “Specification for Structural Steel Buildings” or other recognized standard shall be used for the relevant environmental conditions. All relevant environmental conditions (i.e. Still water, Operation, Survival, Transit and Accidental) shall be considered using appropriate DSFs from chosen recognized standard.

9.12.6 Testing Requirements

9.12.6.1 A load test shall be carried out for equipment intended for lifting when the purchaser specify supplementary requirement SR-6, see Annex A Chapter A.9.

9.12.6.2 A specific test of the fail-safe load-holding device specified in 9.12.3.20 shall be performed during testing at the full rated load prior to regular operation of the system.

9.12.6.3 Function testing of the fail-safe load-limiting device specified in 9.12.3.21 shall be performed prior to regular operation of the system.

9.12.7 Requirements for Failure Modes and Effects Analysis (FMEA), and Hazard and Operability Studies (HAZOP) Analysis

The manufacturer shall conduct FMEA, HAZOP, or other recognized analyzes techniques of each system design family to determine single-point failure modes. Such analyses shall also be used to determine control system functionality, displays, detents, interlocks, defaults, overrides, fail-safe shutdown triggers, and other similar types of features.

9.12.8 Fatigue Life

The life expectancy of the system shall be in accordance with 4.2.7 or as determined and specified by the manufacturer based on normal and expected service conditions.

9.12.9 Marking

BOP handling systems shall be marked in accordance with the requirements of Section 10 and with safe working load of the system (i.e. SWL), expressed in USC or SI units.

9.12.10 Third-party Certification

When specified by the purchaser in the purchase agreement, the manufacturer shall ensure that a third party is employed to provide third-party certification to ensure that the system delivered under the purchase agreement complies with the requirements of this standard as well as other applicable regulatory or classification rules specified by the purchaser in the purchase agreement.

9.12.11 BOP Handling System Manual

The manufacturer of the BOP handling system shall provide a system manual upon delivery of the system to the purchaser in accordance with 11.3. In addition to the requirements of 11.3, all of the purchaser defined requirements specified in 9.12.2 shall be included, as well as all other information specified in this standard.

Annex A
(normative)

Supplementary Requirements

A.1 Introduction

If specified in the purchase order, one or more of the following supplementary requirements shall apply.

A.2 SR1—Proof Load Testing

The equipment shall be proof load-tested and subsequently examined in accordance with the requirements of 8.6.

The equipment shall be marked "SR1" by means of low-stress hard-die stamping near the load rating identification.

Marking "SR1" is not required on equipment for which proof load testing is normally required under Clause 8 or Clause 9.

A.3 SR2—Low-temperature Testing (Metallic Components Only)

The maximum impact-test temperature for materials used in primary load-carrying components of covered equipment with a required minimum operating temperature below that specified in 4.1 shall be specified by the purchaser.

Impact testing shall be performed in accordance with the requirements of 6.3.1.1 and ISO 148 (V-notch Charpy) or ASTM A370 (V-notch Charpy). Except for manual tong hinge pins of wrought material, 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). For manual tong hinge pins of wrought material, the minimum average impact energy of three full-size Charpy impact test pieces, tested at the specified (or lower) temperature, shall be 15 J (11 ft-lb) with no individual value less than 12 J (8.5 ft-lb).

Each primary load-bearing component shall be marked "SR2" to indicate that low-temperature testing has been performed. Each primary load-bearing component shall also be marked to indicate the actual design and test temperature in degrees Celsius.

A.4 SR2A—Additional Low-temperature Testing (Metallic Components Only)

Impact testing shall also be applicable to materials used in the primary load-carrying components of equipment normally exempted from impact testing. The components to which impact testing shall apply shall be determined by mutual agreement of the purchaser and the manufacturer.

Impact testing shall be performed in accordance with the requirements of 6.3.1.1 and ISO 148 or ASTM A370. The maximum impact test temperature and the minimum average and individual values shall be as agreed upon by the purchaser and the manufacturer.

Each covered primary load-carrying component shall be marked "SR2A" to indicate that additional low-temperature testing has been performed. The component shall also be marked with the temperature in degrees Celsius to indicate the actual design and test temperature.

A.5 SR2B—Additional Low-temperature Testing (Non-metallic Components Only)

The maximum test temperature, for materials used in primary load-carrying components of covered equipment with a required minimum operating temperature below that specified in 4.1, shall be specified by the purchaser. Testing shall be performed in accordance with the test requirements of 6.4.6.

Each covered primary load-carrying component shall be marked "SR2B" to indicate that additional low-temperature testing has been performed. The component shall also be marked with the temperature in degrees Celsius to indicate the actual design and test temperature.

A.6 SR3—Data Book

When requested by the purchaser, records shall be prepared, gathered, and properly collated in a data book by the manufacturer. The data book shall include for each unit at least the following information:

a) statement of compliance;

b) equipment designation/serial number;

c) assembly and critical area drawings;

d) wear limits and nominal capacities and ratings;

e) list of components;

f) traceability codes and systems (marking on parts/records on file);

g) steel grades;

h) heat-treatment records;

i) material test reports;

j) NDE records;

k) performance test records, including functional hydrostatic and load test certificates (when applicable);

l) certificates for supplementary requirements, as required;

m) welding procedure specifications (WPSs) and qualification records.

A.7 SR4—Additional Volumetric Examination of Castings

The requirements for SR4 shall be identical to the requirements for 8.4.8, except that all critical areas of each primary load-carrying casting shall be examined.

A.8 SR5—Volumetric Examination of Wrought Material

The entire volume of primary load-carrying wrought components shall be examined by the ultrasonic method. When examination of the entire volume is impossible due to geometric factors, such as radii at section changes, the maximum practical volume shall suffice.

Ultrasonic examination shall be in accordance with ASTM A388 (the immersion method may be used) and ASTM E428. Straight-beam calibration shall be performed using a distance vs. amplitude curve based on a flat-bottomed hole with a diameter of 3.2 mm ($^1/_8$ in.) or smaller.

Wrought components examined by the ultrasonic method shall meet the following acceptance criteria.

a) For both straight and angle beam examination, any discontinuity resulting in an indication that exceeds the calibration reference line is not allowed. Any indication interpreted as a crack or thermal rupture is also not allowed.

b) Multiple indications (i.e. two or more indications), each exceeding 50 % of the reference distance vs amplitude curve and located within 13 mm ($^1/_2$ in.) of one another, are not allowed.

A.9 SR6—Load testing of BOP Handling Equipment Intended For Lifting

When requested by the Purchaser, A load test shall be carried out for equipment intended for lifting, using the factors:

Table A.1 Test Loads for BOP Handling Equipment

Safe working load	**Test load**
≤ 20t	SWL + 25%
>20t ≤ 50t	SWL + 5t
> 50t	SWL + 10%

Load testing at manufacturer's location is not mandatory.