



GUIDE FOR CERTIFICATION OF LIFTING APPLIANCES

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**American Bureau of Shipping
Incorporated by Act of Legislature of
the State of New York 1862**

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Foreword (2018)

The 2018 edition of the *Guide for Certification of Lifting Appliances* is an updated version of the 2016 edition of the subject Guide. Individual chapters of the Guide have been updated in accordance with the latest industry standards as well as ABS plan review and survey practice. The particular changes made to the Guide are as follows:

- **Chapter 2, Guide for Certification of Cranes:**
 - i) 2-2/5.15 – Aligned the Guide requirements for the allowable stresses for pedestals in extreme conditions of seismic loads or extreme winds with API Specification 2C.
 - ii) 2-2/5.23 – Limited the applicability of the requirement to offshore cranes, in line with API Sec.2C/6.4.
 - iii) 2-3/11 – Clarified the correct application of the use of “Z” grade steel, in line with Part 5A, Pt 1, Ch 3, Sec 1, [2.5.1] of the *ABS Rules for Building and Classing Steel Vessels* (CSR for Bulk Carrier and Oil Carriers).
 - iv) 2-4/1 – Allowed the use of the rotation resistant and fiber core ropes for boom hoisting on shipboard cranes, in line with API 9A.
 - v) 2-5/1.1 – Clarified the proof load test requirements for hooks and blocks. Referred to the *ABS Guide for the Certification of Offshore Containers* for structure, loose gear, and/or containers used solely for shipping or transferring equipment to offshore units.
 - vi) 2-5/1.5 – Required that hook curves be provided.
 - vii) 2-7/5.3 – Modified testing requirements for cranes that can only lift the proof test load by luffing the boom, cranes that are not designed to slew the proof test load, and large cranes limited on movement based on stability restrictions. Allowed reduction in minimum number of lifts for cranes that have ABS approved test procedures.
- **Chapter 5, Guide for Certification of Shipboard Elevators:**
 - i) 5-4/5.1 – Clarified that three panel hoistway doors are acceptable, in line with ASME A17.1-2013 Part 1, Section 1.3.
 - ii) 5-4/5.9 – Accepted alternative arrangements considered equivalent to the current requirement.
 - iii) 5-4/5.15 – Accepted alternative arrangements considered equivalent to the current requirement.
 - iv) 5-5/17.11 – Incorporated requirements of ASME A17.1-2013 2.14.1.5.1(f) & 5.8.1.5 and ISO 8383-1985 10.5 & 10.6 with consideration of additional safety factors.

This Guide will become effective on 1 January 2018 and supersedes the existing Guide.

Users are advised to check periodically on the ABS website www.eagle.org to verify that this version of this Guide is the most current.

We welcome your feedback. Comments or suggestions can be sent electronically by email to rsd@eagle.org.



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CHAPTER 1 Scope and Conditions of Certification

SECTION 1 Certification

1 Process

The term certification, as used herein, indicates that a lifting appliance and its equipment have been designed, constructed, installed and surveyed in compliance with this Guide, existing Rules and Guides or other acceptable standards.

The continuance of certification is dependent on the fulfillment of requirements for surveys after construction.

The certification process consists of:

- a) The development of Rules, Guides, standards and other criteria for the design, construction, installation and maintenance of lifting appliances and their equipment;
- b) The review of the design and survey during and after construction to verify compliance with such Rules, Guides, standards or other criteria;
- c) The assignment and registration of certification when such compliance has been verified, and;
- d) The issuance of a renewable certificate, with annual endorsements, valid for five years.

The Rules, Guides and standards are developed by the ABS staff and passed upon by committees made up of naval architects, ocean and marine engineers, shipbuilders, engine builders, steel makers, process engineers and by other technical, operating and scientific personnel associated with the worldwide maritime industry. Theoretical research and development, established engineering disciplines, as well as satisfactory service experience are utilized in their development and promulgation. ABS and its committees can act only upon such theoretical and practical considerations in developing Rules and standards.

For Certification, the lifting appliance and its equipment are to comply with the applicable requirements of this Guide and all applicable Rules.

3 Certificates and Reports

Review of design documentation and surveys during and after construction are conducted by ABS to verify to itself and its committees that an item of material, equipment or machinery is in compliance with this Guide and is to the satisfaction of the attending Surveyor. All reports and certificates are issued solely for the use of ABS, its committees, its clients and other authorized entities.

5 Representations as to Certification

Certification is a representation by ABS as to the structural and mechanical fitness for a particular use or service, in accordance with its Rules, Guides and standards. The Rules and Guides of the American Bureau of Shipping are not meant as a substitute for the independent judgment of professional designers, naval architects, marine engineers, owners, operators, masters and crew, nor as a substitute for the quality control procedures of ship and platform builders, engine builders, steel makers, suppliers, manufacturers and sellers of marine vessels, materials, system components, machinery or equipment. ABS, being a technical society, can only act through Surveyors or others who are believed by it to be skilled and competent.

ABS represents solely to the Lifting Appliance manufacturer or other clients of ABS that when certifying, it will use due diligence in the development of Rules, Guides and standards, and in using normally applied testing standards, procedures and techniques as called for by the Rules, Guides, standards or other criteria of ABS. ABS further represents to the Owner or other Clients of ABS that its certificates and reports evidence compliance only with one or more of the Rules, Guides, standards or other criteria of ABS, in accordance with the terms of such certificate or report. Under no circumstances whatsoever are these representations to be deemed to relate to any third party.

The user of this document is responsible for ensuring compliance with all applicable laws, regulations and other governmental directives and orders related to a vessel, its machinery and equipment, or their operation. Nothing contained in any Rule, Guide, standard, certificate or report issued by ABS shall be deemed to relieve any other entity of its duty or responsibility to comply with all applicable laws, including those related to the environment.

7 Scope of Certification

Nothing contained in any certificate or report is to be deemed to relieve any designer, builder, owner, manufacturer, seller, supplier, repairer, operator, other entity or person of any duty to inspect or any other duty or warranty expressed or implied. Any certificate or report evidences compliance only with one or more of the Rules, Guides, standards or other criteria of the American Bureau of Shipping, and is issued solely for the use of ABS, its Committees, its clients or other authorized entities. Nothing contained in any certificate, report, plan or document review or approval is to be deemed to be in any way a representation or statement beyond those contained in 1-1/5. ABS is not an insurer or guarantor of the integrity or safety of a vessel or of any of its equipment or machinery. The validity, applicability and interpretation of any certificate, report, plan or document review or approval are governed by the Rules, Guides and standards of the American Bureau of Shipping, who shall remain the sole judge thereof. ABS is not responsible for the consequences arising from the use by other parties of the Rules, Guides, standards or other criteria of the American Bureau of Shipping, without review, plan approval and survey by ABS.

The term “approved” is to be interpreted to mean that the plans, reports or documents have been reviewed for compliance with one or more of the Rules, Guides, standards or other criteria acceptable to ABS.

This Guide is published with the understanding that responsibility for reasonable handling and loading operations, beyond the limit specified in the lifting appliance design basis, does not rest upon the Committee.

9 Class Notations (1 July 2016)

9.1 CRC (Crane and Lifting Appliances Register Certificate) Notation

A vessel or unit classed by ABS for which an ABS Register of Lifting Appliances is issued under the provisions of this Guide will be distinguished by the additional class notation **CRC(SC, OC, HC, SP, MRW, RMP)**, as follows:

- SC** signifies that the vessel or unit has an installed Shipboard crane designed, constructed and tested in accordance with the respective requirements of this Guide
- OC** signifies that the vessel or unit has an installed Offshore crane designed, constructed and tested in accordance with the respective requirements of this Guide
- HC** signifies that the vessel or unit has an installed Heavy Lift crane designed, constructed and tested in accordance with the respective requirements of this Guide
- SP** signifies that the vessel or unit has an installed Special Purpose crane (i.e., a davit, monorail hoist/ engine room overhead crane, provision crane, or union purchase) designed, constructed and tested in accordance with the respective requirements of this Guide
- MRW** signifies that the vessel or unit has an installed base-mounted Man Riding Winch designed, constructed and tested in accordance with the respective requirements of this Guide
- RMP** signifies that the vessel's or unit's installed stern, bow and sideport ramps and moveable platforms (decks) are designed, constructed and tested in accordance with the respective requirements of this Guide

For personnel lifting, the above notations may be supplemented with the **PL**, **PL+**, or **PL++** notations (e.g., **CRC(SC-PL)**, **CRC(OC-PL+)**, **CRC(SC-PL++, HC-PL+)**, etc.), as follows:

- PL** signifies that the vessel or unit has an installed crane that is intended to be used for personnel lifting that is designed, constructed and tested in accordance with the provisions of this Guide including the respective requirements for personnel lifting, and is fitted with an Emergency Recovery System in compliance with 2-9/13.3 of this Guide.
- PL+** signifies that the vessel or unit has an installed crane that is intended to be used for personnel lifting that is designed, constructed and tested in accordance with the provisions of this Guide including the respective requirements for personnel lifting, and is fitted with an Emergency Recovery System in compliance with 2-9/13.5 of this Guide.
- PL++** signifies that the vessel or unit has an installed crane that is intended to be used for personnel lifting that is designed, constructed and tested in accordance with the provisions of this Guide including the respective requirements for personnel lifting, and is fitted with an Emergency Recovery System in compliance with 2-9/13.7 of this Guide.

For subsea lifting, notations **OC** and **HC** may also be supplemented with the **Subsea** notation (e.g., **CRC(OC- PL++-Subsea)**, **CRC(HC-Subsea)**, etc.).

9.3 CGSU (Cargo Gear Self Unloading) Notation

A vessel or unit classed by ABS for which an ABS Register of Cargo Gear for Great Lakes Vessels is issued under the provisions of this Guide will be distinguished by the additional class notation **CGSU** (Cargo Gear Self Unloading).

9.5 SElev (Shipboard Elevator) Notation

A vessel or unit classed by ABS having an installed shipboard elevator certified by ABS in accordance with Chapter 5 of this Guide, will be distinguished by the additional class notation **SElev** (Shipboard Elevator).

11 Existing Lifting Appliances (1 July 2016)

11.1 Existing Lifting Appliances without Register

For existing lifting appliances that do not have a Register issued by a recognized classification society, or a recognized cargo gear organization, submission of information as required in the respective chapters of this Guide, with verification of material, is required.

Existing lifting appliances may be certified subject to satisfactory plan review, conditional survey, operational tests including luffing, slewing, test of safety devices, and proof testing of the lifting appliances as units as required in the respective chapters of this Guide. The conditional survey shall include inspection for excessive wear, damage, corrosion, and fractures. Nondestructive testing or verification of materials may be required at the discretion of the Surveyor. In addition, all crane hooks are to be examined using magnetic particle or other suitable crack detecting inspection methods to the satisfaction of the attending Surveyor. All mechanical, electrical and piping systems and components are to be examined as deemed necessary by the attending Surveyor.

11.3 Existing Lifting Appliances with Register

For lifting appliances having a Register issued by a recognized classification society or a recognized cargo gear organization, evidence of previous design approval and survey under construction is to be submitted. Suitable evidence of the design approval would be drawings of the arrangement and details which bear the approval stamp of the losing authority or which are specifically covered by an approval letter from the authority issuing the previous register or the previous register itself. An ABS Register of Lifting Appliance may be issued after review of above data and a proof test and examination in accordance with the requirements of the respective chapters of this Guide.



CHAPTER 1 Scope and Conditions of Certification

SECTION 2 Suspension and Termination of Certification

1 Suspension of Certification (*1 July 2016*)

Certification will be suspended and the Certificate of Lifting Appliance will become invalid from the date of any use, operation or other application of any lifting appliance and its equipment for which it has not been approved and which affects or may affect certification or the structural integrity, quality or fitness for a particular use or service.

Certification will be suspended and the Certificate of Lifting Appliance will become invalid in any of the following circumstances:

- i) If recommendations issued by the Surveyor are not carried out by their due dates and no extension has been granted,
- ii) If the periodical surveys required for maintenance of certification, other than Annual, Quadrennial or Retesting Surveys, are not carried out by the due date and no Rule-allowed extension has been granted, or
- iii) If any damage, failure or deterioration repair has not been completed as recommended.

Certification may be suspended, in which case the Certificate of Lifting Appliance will become invalid, if proposed repairs have not been submitted to ABS and agreed upon prior to commencement.

Certification is automatically suspended and the Certificate of Lifting Appliance is invalid in any of the following circumstances:

- i) If the Annual Survey is not completed by the due date,
- ii) If the Quadrennial or Retesting Survey is not completed by the due date.

Any damage, failure, deterioration, or repair to lifting appliances covered by this Guide, which affects or may affect the certification, is to be submitted by the Owners or their representatives for examination by a Surveyor at first opportunity. All repairs found necessary by the Surveyor are to be carried out to the Surveyor's satisfaction.

3 Lifting of Suspension (*1 July 2016*)

Certification will be reinstated after suspension for overdue surveys upon satisfactory completion of the overdue surveys. If the survey becomes overdue by three months or more, a retesting survey will be required, in addition to the other Cargo Gear surveys that are overdue, to reinstate Certification. Such surveys will be credited as of the original due date or a new cycle can be started upon completion of a Renewal Survey. Certification will be reinstated after suspension for overdue recommendations, upon satisfactory completion of the overdue recommendations.

5 Termination of Certification

The continuance of the Certification of the Lifting Appliance and its equipment is conditional upon the Guide requirements for periodical, damage and other surveys being duly carried out. ABS reserves the right to reconsider, withhold, suspend or terminate the certificate of any lifting appliance and its equipment for non-compliance with the Guide and Rules, for defects reported by the Surveyors which have not been rectified in accordance with their recommendations or for nonpayment of fees which are due on account of Lifting Appliances Surveys. Suspension or termination of certification may take effect immediately or after a specified period of time.

7 Notice of Surveys

It is the responsibility of the Owner to ensure that all surveys necessary for the maintenance of certification are carried out at the proper time. ABS will give proper notice to an Owner of upcoming surveys. This may be done by means of a letter, a quarterly status report or other communication. The non-receipt of such notice, however, does not absolve the Owner from his responsibility to comply with survey requirements for maintenance of certification.



CHAPTER 1 Scope and Conditions of Certification

SECTION 3 Requirements for Certification

1 Applications (1 July 2016)

This Guide contains provisions for the certification of lifting appliances installed aboard vessels and/or offshore floating/fixed units classed by ABS.

If specifically requested by the Owner, this Guide can also be used as a basis for acceptance or certification under the requirements of Administrations. Owners who desire to have a lifting appliance evaluated for compliance with National Regulations should contact ABS.

3 Scope (1 July 2016)

This Guide provides requirements for certification of lifting appliances installed on vessels and offshore floating and/or fixed units classed by ABS, including but not limited to:

- Pedestal and tub mounted rotating heavy lift, gantry, shearleg, stiffleg and “A” frame type cranes operating in harbors and offshore
- Base-mounted manriding winches
- Shipboard personnel and passenger elevators, including their systems, of traction and winding drum type driven by electric or hydraulic motors, direct-plunger hydraulic type, roped hydraulic type and rack and pinion type.
- Self-unloading cargo gear on Great Lakes Vessels
- Stern, bow and sideport ramps and moveable platforms

5 Alternatives

The Committee is at all times ready to consider alternative arrangements and designs which can be shown, through either satisfactory service experience or a systematic analysis based on sound engineering principles, to meet the overall safety, serviceability and strength standards of the applicable Rules and Guides.

The Committee will consider special arrangements or design for details of lifting appliances and their equipment which can be shown to comply with standards recognized in the country in which the lifting appliance and its equipment are designed or built, provided these are not less effective than the requirements contained in this Guide.

7 Effective Date of Change of Requirement

7.1 Effective Date (1 May 2017)

This Guide and subsequent changes to this Guide are to become effective on the date specified by ABS.

7.3 Implementation of Rule Changes

In general, until the effective date, plan approval for designs will follow prior practice, unless review under the latest Guide is specifically requested by the party signatory to the application for certification. If one or more systems are to be constructed from plans previously approved, no retroactive application of the subsequent Rule changes will be required, except as may be necessary or appropriate for all contemplated construction.

9 ABS Type Approval Program (1 July 2016)

9.1 Type Approval (1 July 2016)

Products that are used as components for lifting appliances and can be consistently manufactured to the same design and specification may be Type Approved under the ABS Type Approval Program. The ABS Type Approval Program is a voluntary option for the demonstration of compliance of a system or product with the Rules, Guides or other recognized standards. It may be applied at the request of the designer or manufacturer.

Specific requirements and details regarding the ABS Type Approval Program can be found in 1-1-4/7.7 and Appendix 1-1-A3 of the *ABS Rules for Conditions of Classification (Part 1)*.

9.3 Unit-Certification

Unit-Certification is a review of individual materials, components, products and systems for compliance with ABS Rules, Guides or other recognized standards. This allows these items to be placed on a vessel, marine structure or system to become eligible for classification. Certification is a “one-time” review. The process is:

- i) A technical evaluation of drawings or prototype tests of a material, component, product or system for compliance with the ABS Rules, Guides or other recognized standards.
- ii) A survey during manufacture for compliance with the ABS Rules, Guides or other recognized standards and results of the technical evaluation.
- iii) Alternatively, a certificate of type approval will expedite the requirements of i) and ii) above.
- iv) Products found in compliance are issued “Individual Unit Certification”.
- v) There is no requirement for subsequent reviews or surveys.

11 Other Regulations

11.1 International and Other Regulations

While this Guide covers the requirements for the certification of lifting appliances and their equipment, the attention of Owners, designers and builders is directed to the regulations of international, governmental and other authorities dealing with those requirements in addition to or over and above the classification requirements.

Where authorized by the Administration of a country signatory thereto and upon request of the Owners of a certified lifting appliance or one intended to be certified, ABS will survey for compliance with the provision of International and Governmental Conventions and Codes, as applicable.

11.3 Governmental Regulations

Where authorized by a government agency and upon request of the Owners of a new or existing lifting appliance, ABS will survey and certify a classed lifting appliance or one intended to be classed for compliance with particular regulations of that government on their behalf.

11.5 Other Rules

Where the vessel on which the lifting appliances are installed is built in accordance with 1-1-4/7.5 of the *Rules for Conditions of Classification (Part 1)*, ABS will consider the lifting appliances constructed to the satisfaction of the ABS Surveyors in accordance with the plans that have been approved to the Rules/Guides of another recognized classification society with verification of compliance by ABS.

13 Submission of Plans

Each Chapter of this Guide identifies a list of lifting appliance components that are required for the certification of lifting appliance. In most cases, manufacturer's component and system related drawings, calculations and documentation are required to be submitted to substantiate the design of the system or component. In these cases, upon satisfactory completion of ABS review of the manufacturer's submittal, ABS Engineers will issue a review letter. This letter, in conjunction with the submitted package, will be used and referenced during surveys and subsequently issued reports by attending ABS Surveyors.

Upon satisfactory completion of all of the required engineering and survey processes, ABS will issue the Certificate to the lifting appliance.

15 Notification and Availability for Survey

The Surveyors are to have access to certified lifting appliances and their equipment at all reasonable times. For the purpose of Surveyor monitoring, monitoring Surveyors are also to have access to certified lifting appliances and their equipment at all reasonable times. Such access may include attendance at the same time as the assigned Surveyor or during a subsequent visit without the assigned Surveyor. The Owners or their representatives are to notify the Surveyors for inspection on occasions when the vessels/units on which the lifting appliances are installed are in dry dock or on a slipway.

The Surveyors are to undertake all surveys on certified lifting appliances and their equipment upon request, with adequate notification, of the Owners or their representatives, and are to report thereon to the Committee. Should the Surveyors find occasion during any survey to recommend repairs or further examination, notification is to be given immediately to the Owners or their representatives so that appropriate action may be taken. The Surveyors are to avail themselves of every convenient opportunity for carrying out periodical surveys in conjunction with surveys of damages and repairs in order to avoid duplication of work.

17 Units

This Guide is written in three systems of units: SI units, MKS units and US customary units. Each system is to be used independently of any other system. Unless indicated otherwise, the format of presentation of the three systems of units in this Guide is as follows:

SI units (MKS units, US customary units)

19 Fees

Fees in accordance with normal ABS practice will be charged for all services rendered by ABS. Expenses incurred by ABS in connection with these services will be charged in addition to the fees. Fees and expenses will be billed to the party requesting that particular service.

21 Disagreement

21.1 Rules and Guides

Any disagreement regarding either the proper interpretation of Rules and Guides or the translation of Rules and Guides from the English language edition is to be referred to ABS for resolution.

21.3 Surveyor

In case of disagreement between the Owners or builders and the Surveyors regarding the material, workmanship, extent of repairs or application of the Rules and Guides relating to any system classed or proposed to be classed by ABS, an appeal may be made in writing to the Committee, who will order a special survey to be held. Should the opinion of the Surveyor be confirmed, expense of this special survey is to be paid by the party appealing.

23 Limitation of Liability

The combined liability of the American Bureau of Shipping, its committees, officers, employees, agents or subcontractors for any loss, claim or damage arising from its negligent performance or nonperformance of any of its services or from breach of any implied or express warranty of workmanlike performance in connection with those services, or from any other reason, to any person, corporation, partnership, business entity, sovereign, country or nation, will be limited to the greater of a) \$100,000 or b) an amount equal to ten times the sum actually paid for the services alleged to be deficient.

The limitation of liability may be increased, up to an amount twenty-five times the sum paid for services, upon receipt of Client's written request at or before the time of performance of services, and upon payment by Client of an additional fee of \$10.00 for every \$1,000.00 increase in the limitation.

Under no circumstances shall American Bureau of Shipping be liable for indirect or consequential loss or damage (including, but without limitation, loss of profit, loss of contract, or loss of use) suffered by any person as a result of any failure by ABS in the performance of its obligations under these Rules. Under no circumstances whatsoever shall any individual who may have personally caused the loss, damage or expense be held personally liable.

25 Hold Harmless

The party requesting services hereunder, or his assignee or successor in interest, agrees to release ABS and to indemnify and hold harmless ABS from and against any and all claims, demands, lawsuits or actions for damages, including legal fees, to persons and/or property, tangible, intangible or otherwise which may be brought against ABS incidental to, arising out of or in connection with this Agreement, the work to be done, services to be performed or material to be furnished hereunder, except for those claims caused solely and completely by the negligence of ABS, its agents, employees, officers, directors or subcontractors. The parties agree that for the purposes of the Convention on Limitation of Liability for Maritime Claims, 1976, ABS is a person for whose acts the shipowner is responsible.

Any other individual, corporation, partnership or other entity who is a party hereto or who in any way participates in, is engaged in connection with or is a beneficiary of, any portion of the services described herein shall also release ABS and shall indemnify and hold ABS harmless from and against all claims, demands, lawsuits or actions for damages, including legal fees, to persons and/or property, tangible, intangible or otherwise, which may be brought against ABS by any person or entity as a result of the services performed pursuant to this Agreement, except for those claims caused solely and completely by the negligence of ABS, its agents, employees, officers, directors or subcontractors.

27 Time Bar to Legal Action

Any statutes of limitation notwithstanding, Owner's right to bring or to assert against ABS any and all claims, demands or proceedings whether in arbitration or otherwise shall be waived unless (a) notice is received by ABS within ninety (90) days after Owner had notice of or should reasonably have been expected to have had notice of the basis for such claims; and (b) arbitration or legal proceedings, if any, based on such claims or demands of whatever nature are commenced within one (1) year of the date of such notice to ABS.

29 Arbitration

Any and all differences and disputes of whatsoever nature arising out of services under these Rules shall be put to arbitration in the City of New York pursuant to the laws relating to arbitration there in force, before a board of three persons, consisting of one arbitrator to be appointed by ABS, one by the Client, and one by the two so chosen. The decision of any two of the three on any point or points shall be final. Until such time as the arbitrators finally close the hearings either party shall have the right by written notice served on the arbitrators and on an officer of the other party to specify further disputes or differences under these Rules for hearing and determination. The arbitration is to be conducted in accordance with the rules of the Society of Maritime Arbitrators, Inc. in the English language. The governing law shall be the law of the State of New York, U.S.A. The arbitrators may grant any relief other than punitive damages which they, or a majority of them, deem within the scope of the agreement of the parties, including, but not limited to, specific performance. Awards made in pursuance to this clause may include costs including a reasonable allowance for attorney's fees and judgment may be entered upon any award made hereunder in any court having jurisdiction.

31 ABS Surveyor's Safety and ABS Occupational Health and Safety Management Systems (OHSMS) Manual (1 July 2016)

In addition to 1-1/1 and 1-3/15, it is the responsibility of the shipyard, ship repairer, manufacturer, Owner or their representatives or other client to have established health and safety procedures in accordance with any governmental and/or local regulatory administrations.

ABS Surveyors will conduct surveys, provided that the client's established health and safety procedures are not less effective than those contained in the ABS Occupational Health and Safety Management Systems (OHSMS) Manual and its associated procedures.

If ABS Surveyors encounter conditions or procedures that may compromise the safety of the Surveyors, they may stop their survey immediately until corrective actions are taken.

Nothing in the latest revision of the ABS OHSMS Manual (including its associated procedures) is intended to replace or supersede any governmental or local authority's regulations or requirements for the implementation of or content of a premises safety plan, provided such plan is not less effective than the safety policies contained therein.



CHAPTER 2 Guide for Certification of Cranes

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CHAPTER 2 Guide for Certification of Cranes

SECTION 1 General (1 July 2016)

1 Scope (1 July 2016)

This Guide sets forth requirements for the certification of pedestal mounted rotating, heavy lift, gantry, shear leg, stiffleg and “A”-frame type cranes installed aboard vessels, and/or floating/fixed structures classed by ABS, operating in harbors and offshore.

3 Submission of Plans and Design Data

3.1 General (2011)

Plans showing the arrangements and details of the crane are to be submitted for review before fabrication begins. These plans are to clearly indicate the scantlings, materials, joint details and welding. Plans should generally be submitted electronically to ABS. However, hard copies will also be accepted.

3.3 Information to Be Submitted (1 July 2016)

The following plans and supporting data are to be submitted for review and approval where appropriate.

3.3.1 Crane Structure

- i) General arrangement, assembly plans and description of operating procedures and design service temperature.
- ii) Applicable in-service and out-of-service loads, including dead, live and dynamic loads, environmental loads including the effects of wind, snow and ice, load swing caused by non-vertical lifts, loads due to list and/or trim of the vessel or structure, loads due to vessel's or unit's motions, etc.; along with supporting calculations, including details for crane stiffness, relative velocities and vertical distances from boom tip to the deck of the vessel or unit supporting the lifted load, etc.
- iii) Details and drawings of all primary structural members and crane supporting structure.
- iv) Stress diagram, stress and fatigue analysis and other supporting calculations, suitably referenced. Where computer analysis is used for the determination of scantlings, details of the programs describing input and output data and procedures are to be included together with the basic design criteria.
- v) Wire rope specifications.
- vi) General arrangement drawings and specifications for sheaves.
- vii) List of the assembled loose gear specifying the Safe Working Load for each component.
- viii) Material specifications.
- ix) Welding details and a plan indicating extent and locations of nondestructive inspection of welds for crane structure, pedestal and foundation.
- x) Crane capacity rating charts (load charts) and corresponding wire rope reeving diagrams.
- xi) Crane pedestal and foundation (where required as per 2-2/5.15) drawings together with calculations indicating the maximum reactions and overturning moments, identifying the portions of each coming from the hoisted load and counterweight if fitted.

- xii) Swing circle assembly drawings and details, including, as applicable:
 - a) Hold down bolt size with calculations, arrangement of bolts, material, grade and pretensioning, together with the method used for pretensioning.
 - b) Slewing ring drawings, along with static strength calculations and details, which are to include material specifications of raceways and rollers or balls, hardness and heat treatment details of raceways and rollers, number and diameter of rollers or balls, raceway static capacity, specified planarity (flatness) tolerances and surface finish of bearing and supporting flanges, bearing wear tolerances.
 - c) Procedure for wear down measurement of slewing ring (“rocking test”).
- xiii) Documentation identifying proof load testing weights, locations and conditions, in accordance with 2-7/5.3.
- xiv) For union purchase conditions, plans are to be submitted showing the configuration of the lifting gear, vang and preventer details and locations, hatch opening, coaming height, deck at side, bulwark height, vessel’s maximum beam and the boom head location over the hatch and over the side of the vessel.

3.3.2 Crane Machinery, Piping and Electric System

- i) Description and general details of safety devices and features, such as limit switches, anti-two blocks, etc.
- ii) Detailed diagrammatic plans of piping system accompanied by lists of materials, giving size, wall thickness, maximum working pressure and material (including mechanical properties) of all pipes and the type, size, pressure rating and material of pumps, hoses, manifolds, valves and fittings.
- iii) Detailed diagrammatic plans of electrical wiring systems including complete feeder lists, type of wire or cable, rating or setting of circuit breakers, rating of fuses and switches, interrupting capacity of circuit breakers and fuses.
- iv) Documentation for computer-based systems, as per 4-9-1/7 of the *ABS Rules for Building and Classing Steel Vessels (Steel Vessel Rules)*, as applicable by other sections of this Guide.
- v) Details of accumulators, heat exchangers and lift and telescoping cylinders indicating shell, heads, pistons, piston rods, lug attachments, tie rod dimensions and threading details, as applicable with material specifications (including mechanical properties).
- vi) Details of swing circle mechanism and luffing and hoisting winches, including all torque-transmitting components such as drums, brakes, clutches, shafts, reduction gears and coupling bolts and foundation arrangements, as applicable.
- vii) Design justification including component strength calculations, stress analysis, material specifications, weld procedure specifications and the extent of nondestructive examination as considered necessary are to be submitted for items 2-1/3.3.2v) and 2-1/3.3.2vi) above.
- viii) Details of all prime movers such as diesel engines, motors and generators.
- ix) A list/booklet identifying all equipment of the crane in hazardous areas and the particulars of the equipment, including manufacturers’ names, model designations, rating (flammable gas group and temperature class), the method of protection (flameproof, intrinsically safe, etc.), any restrictions in their use, and document of certification.
- x) A declaration for the absence of Asbestos in the manufacture or packaging of all materials, components, equipment, machinery, piping systems and electrical installations.
- xi) Personnel lifting and personnel emergency recovery operational procedures, including conditions, precautions and limitations for lifting of personnel.

The above items 2-1/3.3.2i) through 2-1/3.3.2viii) need not be submitted for small davits/cranes, including Monorail Hoists/Engine Room Overhead Cranes, with SWL of less than 98 kN (10 tf, 22050 lbf) and without powered slewing systems or powered luffing systems.

5 Loading, Handling and Securing

This Guide is published on the understanding that responsibility for control of Safe Working Loads, crane handling during lifting and setting loads, avoidance of improper weight distributions while lifting a load, securing of the crane on the vessel or unit when not in use, maintenance of the crane, and handling and stability of the vessel or unit during operation of the crane, rest with the Operator/Owner.

7 Definitions

7.1 Active Heave Compensation System (1 July 2016)

A system that uses motion sensors and external energy in order to maintain the vertical position of the live load at a predetermined location within a fixed frame of reference.

7.3 Active Rope Tensioning System (1 July 2016)

A system that uses tension measurement devices and external energy in order to maintain the tension on the load hoisting rope at a preset value.

7.5 Boom (1 July 2016)

An arm used for supporting the hoisting tackle at the required outreach.

7.7 Boom Angle (1 September 2012)

The angle to the horizontal of the longitudinal axis of the boom base section.

7.9 Boom Foot Pin (Heel Pin) (1 July 2016)

The pin supporting the boom at its pivot point.

7.11 Boom Head (1 September 2012)

The outer end of the top section of the boom.

7.13 Boom (Luffing) Hoist (1 September 2012)

A hoist drum and rope reeving system used to raise and lower the boom.

7.15 Computer-Based System (1 July 2016)

A computer-based system is a system of one or more microprocessors, associated software, peripherals and interfaces. Programmable Logic Controllers (PLC), Distributed Control Systems (DCS), PC or server-based computation systems are examples of computer-based systems.

7.17 Control System (1 July 2016)

An assembly of devices interconnected or otherwise coordinated to convey the command or order.

7.19 Dead Load

Dead Load is the weight of the crane components not included in the live load.

7.21 Design Service Temperature (DST) (1 July 2016)

The *Design Service Temperature (DST)* is the minimum anticipated temperature at which the crane will operate, as specified by the Owner, crane manufacturer or builder.

7.23 Drum (1 September 2012)

A cylindrical member around which a rope is wound for lifting and lowering the load or boom.

7.25 Dynamic Loads (1 September 2012)

Loads introduced into the crane or its components by forces in motion.

7.27 Fail-safe Arrangement

A system is considered to be arranged as fail-safe if failure of a mechanical component will result in the braking or slowing and controlled release of the load. A fail-safe device is a device fitted for such purposes.

7.29 Gantry, Mast or "A-frame" (1 September 2012)

A structural frame, extending above the revolving upper structure to which the boom support ropes are reeved.

7.31 Heavy Lift Cranes (1 July 2016)

In general, *Heavy Lift Cranes* are lifting appliances mounted on barges, semi-submersibles or other vessels, used for lifting and moving loads of not less than 1570 kN (160 tf, 352800 lbf) in operations such as for construction, shipbuilding, or salvage operations within a harbor or sheltered area or at open sea in very mild environmental conditions; or other environmental conditions specified by the designer. Refer to 2-2/11. See also 2-1/Figures 1, 2, 3, 4, 5 and 6 for sketches of typical heavy lift cranes.

7.33 Hoist Mechanism (1 September 2012)

A hoist drum and rope reeving system used for lifting and lowering loads.

7.35 Hook, Latch-type (1 September 2012)

A type of hook with a mechanical device to close the throat opening of the hook.

7.37 Jib (1 September 2012)

An extension attached to the boom head to provide added boom length for lifting specified loads. The jib may be in line with the boom or offset at various angles to the boom.

7.39 Kingpost (1 July 2016)

A vertical post that acts as a centerline of rotation for the revolving upper structure and as the connective member to the platform.

7.41 Live Load (LL) (1 July 2016)

Live Load is the load that is suspended from the boom head, i.e., the sum of the SWL, the weight of the gear (hook, block, wire, etc.) and any other connected component undergoing the same motion as the hook load.

7.43 Load Block, Lower (1 September 2012)

The assembly of hook or shackle, swivel, sheaves, pins, and frame suspended by the hoisting ropes.

7.45 Load Block, Upper (1 September 2012)

The assembly of sheaves, pins and frame at the boom head.

7.47 Lock Valve (1 July 2016)

A valve, such as a counter-balance valve, capable of holding pressure and requiring positive pressure in order to release.

7.49 Loose Gear (1 July 2016)

Any gear by means of which a load can be attached to a lifting appliance, but which does not form an integral part of the lifting appliance or the load.

7.51 Offboard Lift (1 September 2012)

A lift by a crane from, or to, anywhere not on the vessel/unit upon which the crane is mounted.

7.53 Offshore Cranes (1 July 2016)

In general, *Offshore Cranes* are lifting appliances mounted on a bottom-supported or floating unit or vessel, used in oil drilling and production operations, as well as for lifting and moving cargo, equipment, supplies and other loads under the environmental conditions specified by the designer while the vessel or unit is at open sea and/or when there may be motion relative to the other vessel or unit during crane operations. Refer to 2-2/9. See also 2-1/Figure 1, for sketches of typical offshore cranes.

7.55 Onboard Lift (1 September 2012)

A lift by a crane from, or to, a deck of the vessel/unit upon which the crane is mounted.

7.57 Passive Heave Compensation System (1 July 2016)

A system that uses stored energy in order to maintain the vertical position of the live load within a preset range.

7.59 Passive Rope Tensioning System (1 July 2016)

A system that uses stored energy in order to maintain the tension on the load hoisting rope within a preset range.

7.61 Pedestal (1 September 2012)

The supporting structure above which the swing circle mechanism and the revolving upper structure are mounted.

7.63 Pitch Diameter (1 September 2012)

The diameter of a sheave or rope drum measured center to center of the rope (i.e., root diameter of sheave/drum plus diameter of the rope).

7.65 Primary Member or Critical Component (1 July 2016)

A member or component whose failure would impair the structural integrity of the crane and/or result in loss of control of the load. See 2-1/Tables 1 and 2 for examples.

7.67 Provision Crane (1 July 2016)

A crane that is used for loading and unloading provisions (groceries, housekeeping supplies, etc.) on a vessel/unit.

7.69 Radius (Outreach) (1 September 2012)

The horizontal distance from the axis of rotation to the center of the hoist line(s).

7.71 Reeving Diagram (1 September 2012)

A wire rope system where the rope travels around sheaves and drums (main and auxiliary).

7.73 Safe Working Load (SWL) (1 August 2014)

The *Safe Working Load* is the load that each complete crane assembly is approved to lift on the cargo hook, excluding the weight of the gear (hook, block, wire, etc.).

7.75 Shipboard Cranes (1 July 2016)

In general, *Shipboard Cranes* are lifting appliances mounted on surface-type vessels, used for lifting and moving loads of less than 1570 kN (160 tf, 352800 lbf) such as cargo, containers, equipment and other loads; or for handling hoses, while the vessel is within a harbor or sheltered area under mild environmental conditions; or under other environmental conditions specified by the designer. Refer to 2-2/7. See also 2-1/Figure 1 and 2-1/Figure 2, for sketches of typical shipboard cranes.

7.77 Special Components (1 July 2016)

Components of special nature, such as hook blocks and sheaves, together with their connecting components, special lifting devices and components built into or for cranes, heavy lift gear, crane hooks or hoisting machinery which are specially designed for use with a particular lifting unit, the designs of which are submitted for approval as steel structural parts.

7.79 Standing Rope (Pendant) (1 September 2012)

A supporting rope that maintains a constant distance between the two components connected by the rope.

7.81 Subsea Lifting (1 July 2016)

Subsea lifting refers to the operation of a crane in which a load is lowered through the splash zone into the water column and is either held at an intermediate level, lowered to or released on the seabed, or is retrieved back to the vessel.

7.83 Swing (1 September 2012)

Rotation of the revolving upper structure for movement of loads in a horizontal direction about the axis of rotation.

7.85 Swing Circle (Slewing Ring) Assembly (Pedestal Mounted Cranes) (1 July 2016)

Swing Circle (Slewing Ring) Assembly is the connection component between the crane revolving upper structure and the pedestal. This component allows crane rotation and sustains the moment, radial and axial loads imposed by the crane operations.

7.87 Swing (Slewing) Mechanism (1 July 2016)

The machinery involved in providing rotation of the cranes' revolving upper structure.

7.89 Swinging Loads (1 July 2016)

Swinging Loads refers to the use of a single boom to lift a load, with arrangements for changing the position of the boom while supporting the load.

7.91 Union Purchase (1 July 2016)

Union Purchase means an arrangement in which a pair of booms is used in combination, the booms being fixed and the cargo runners coupled. Such an arrangement is also known as "coupled derricks", "married falls", or "burtoning".

7.93 Vertical Amplification Factor (VAF) (1 July 2016)

Vertical Amplification Factor is a factor calculated in accordance with 2-2/7, 2-2/9 or 2-2/11 in order to address the dynamic and impact effects on the lifted load.

7.95 Whipline (Auxiliary Line) (1 September 2012)

A secondary hoist rope system usually of a lighter load capacity than provided by the main hoist.

TABLE 1
Examples of Primary Structural Members (1 July 2016)

No.	Member
1	Boom or jib, including upper, lower and insert sections, chord members and lacings ⁽¹⁾
2	Center post, gantry, mast or "A"-frame, including chord members and other primary load carrying members
3	Crane base (revolving frame and tub-structure), slew column
4	Load carrying beams
5	Eye plates, lugs and brackets
6	Swing circle assembly and hold down bolts
7	Pins and shafts
8	Crane foundation, pedestal, and kingpost
9	Fasteners loaded in tension in the load path of all primary structural members
10	Hook blocks ⁽²⁾

Notes:

- 1 Lacings are considered as primary structural members, unless demonstrated by the designer that failure of one lacing would not impair the structural integrity of the crane boom.
- 2 Applicable only when treated as special component. See 2-5/1.5 and 2-5/5.

TABLE 2
Examples of Critical Machinery Components (1 July 2016)

No.	Component
1	Torque transmitting components of hoisting, luffing, and slewing mechanisms, such as drums, shafts, gears, couplings, and brakes
2	Winch supports and foundations
3	Luffing, folding, and telescoping hydraulic cylinders

9 Certification of Components (1 July 2016)

Crane components are to be certified in accordance with 2-1/Table 3. For the applicable requirements for each component, refer to the respective sections of this Guide.

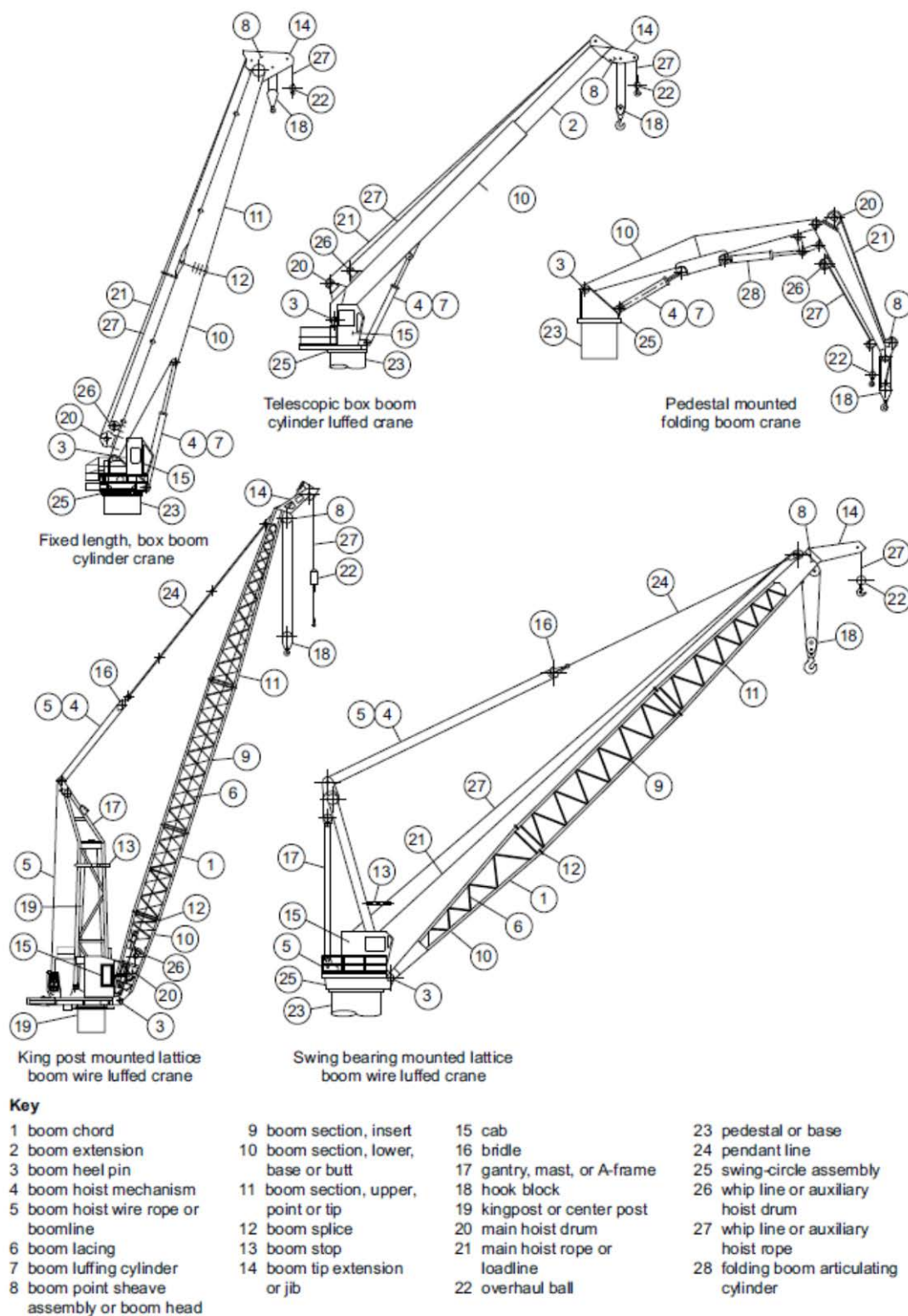
TABLE 3
Crane Components Certification (1 July 2016)

Component ⁽²⁾		ABS Design Review	ABS Unit Certification	Additional Notes
1	Certified Safe Electrical Equipment			Type-tested and certified by a competent, independent testing laboratory for compliance with IEC Publication 60079 or equivalent or ABS Type Approved.
2	Electric Cables			Testing by the manufacturers in accordance with the standards of compliance and records of test to be maintained and submitted upon request by ABS. Construction to be in accordance with the standards specified in 4-8-3/9 of the <i>Steel Vessel Rules</i> or ABS Type Approved.
3	Electric Motors ≥ 100 kW ⁽³⁾	X	X	
4	Electric Motors < 100 kW ⁽³⁾	X		Test certificate furnished by the manufacturer. Testing witnessed by the Surveyor after installation of the crane.
5	Flexible Hoses and Hose End Fittings	X		Design approved by ABS or; alternatively ABS Design Assessment Certificate (PDA)
6	Hoisting, Slewing, Luffing Winches/Gears ≥ 100 kW	X	X	
7	Hoisting, Slewing, Luffing Winches/Gears < 100 kW	X		Integrated gear boxes are to be design verified if located between the braking safety device and the load.
8	Hook Blocks ⁽⁵⁾	X	X	For mass produced hook blocks, acceptance may be based on satisfactory ABS design review and manufacturer's loose gear test certificate
9	Critical Hydraulic Cylinders (including Piston Rods) ⁽³⁾	X	X	
10	All other Hydraulic Cylinders (including Piston Rods)	X		Design review in accordance with 4-6-7/3.5.5 of the <i>Steel Vessel Rules</i>
11	Internal Combustion Engines			Manufacturer's affidavit for compliance with good commercial and marine practice and the requirements of 2-6/11, as applicable.
12	Loose Gear			Testing as per Chapter 2, Section 5 and certificate furnished by the manufacturer, as per 2-5/1.3. For special components, as per 2-5/1.5 is requested, ABS design review and unit certification is required.
13	Pressure Vessels and Heat Exchangers of 150 mm (6 in.) in diameter and over and Accumulators, regardless of their diameter ⁽⁴⁾	X	X	Certification in accordance with Section 4-4-1 of the <i>Steel Vessel Rules</i>
14	Pressure Vessels and Heat Exchangers under 150 mm (6 in.) in diameter			Acceptance based on manufacturer's guarantee of physical properties and suitability for the intended service, provided the installation is carried out to the satisfaction of the Surveyor.
15	Sheaves	X		Materials to be as per Chapter 2, Section 3. If not built into the structure they are to be treated as loose gear.
16	Swing Circle (Slewing Ring)	X	X	
17	Wire Ropes			Certificate of test furnished by the manufacturer, as per 2-4/5.

Notes:

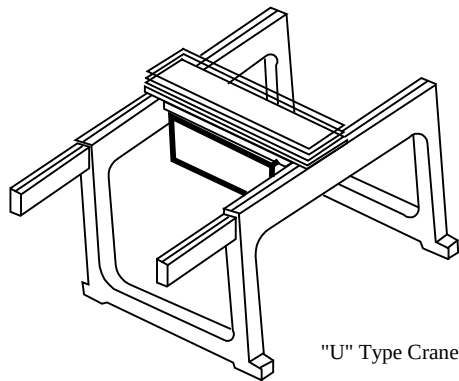
- For materials' certification, refer to Chapter 2, Section 3.
- For components not covered by this table, refer to the appropriate sections of this Guide.
- (1 July 2016) Applicable only for critical components. Refer to 2-1/7.65.
- (1 July 2016) Applicable only for pressure vessels and heat exchangers having design pressure, temperature and volume as defined in 4-4-1/Table 1 of the *Steel Vessel Rules*.
- (1 July 2016) Applicable only when treated as special component. Refer to 2-5/1.5 and 2-5/5.

FIGURE 1
Pedestal Mounted Rotating Cranes (1 July 2016)

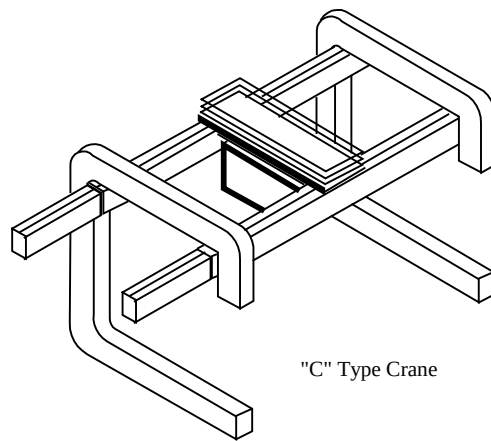


2-1/Figure 1 is taken from API Specification 2C, *Offshore Pedestal-mounted Cranes*, Seventh Edition, March 2012. Reproduced courtesy of the American Petroleum Institute.

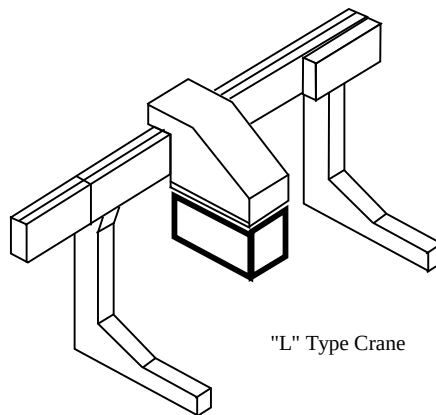
FIGURE 2
Gantry Cranes



"U" Type Crane



"C" Type Crane



"L" Type Crane

FIGURE 3
Tub Mounted Rotating Crane

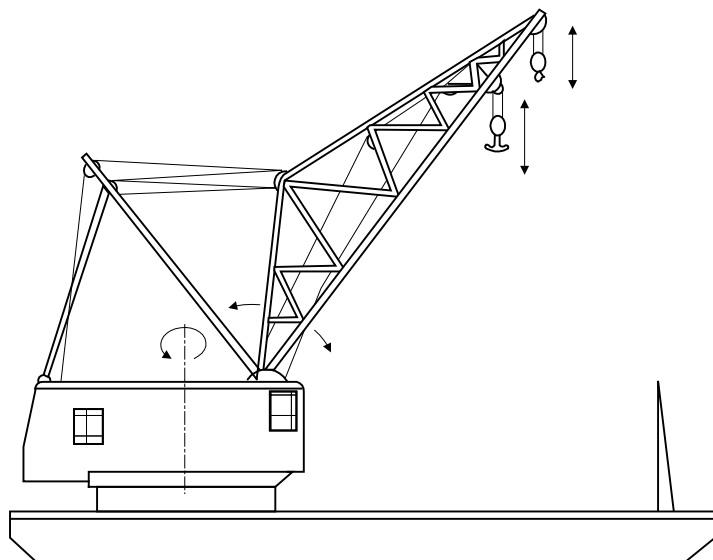


FIGURE 4
Shear Leg Crane

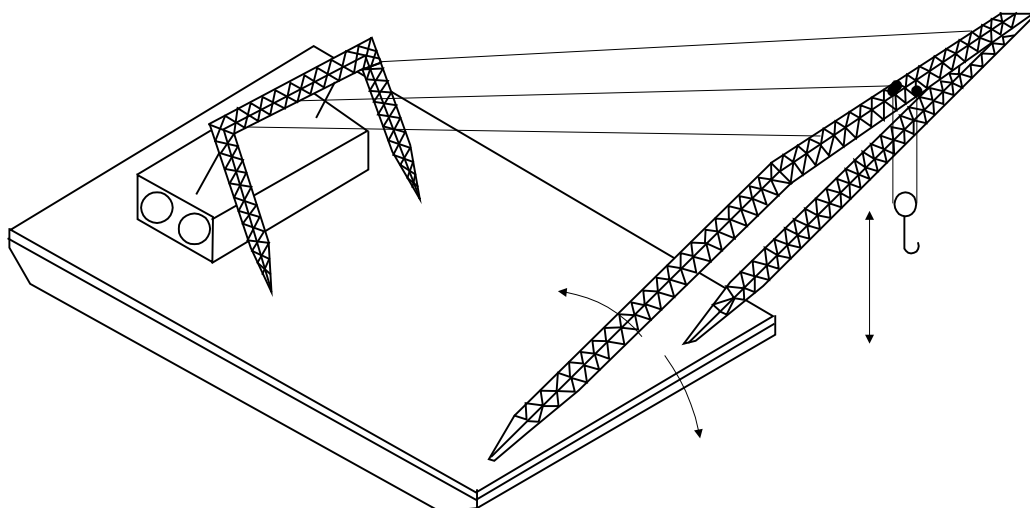


FIGURE 5
Stiffleg Derrick Crane

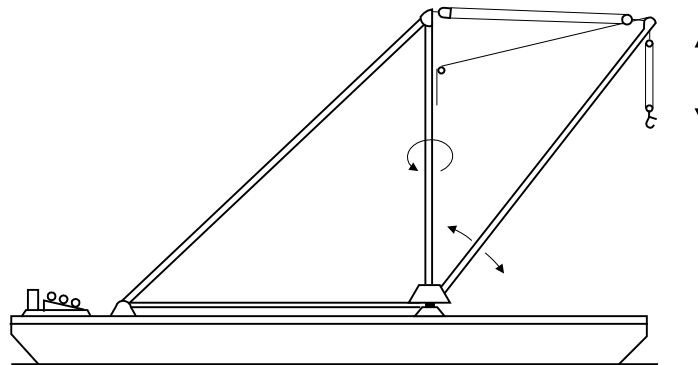
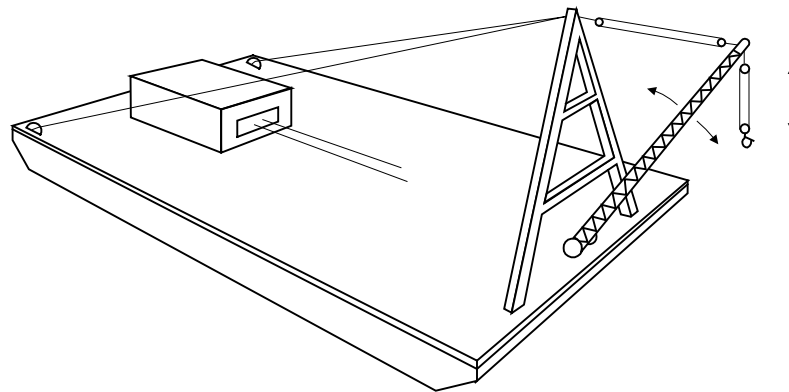


FIGURE 6
"A"-Frame Derrick Crane





CHAPTER 2 Guide for Certification of Cranes

SECTION 2 Structural Requirements (1 July 2016)

1 General (1 July 2016)

1.1 Cranes

These requirements are applicable to pedestal and tub mounted rotating, gantry, shear leg, stiffleg, “A”-frame type and overhead (bridge) cranes, as defined in 2-1/7.31, 2-1/7.53 and 2-1/7.75. Other types of cranes will be considered on an individual basis. Except where indicated otherwise, 2-2/3 and 2-2/5 are general requirements which apply to the cranes specified in 2-2/7, 2-2/9 and 2-2/11.

The design service temperature (DST) is to be indicated at an appropriate place for the crane operator’s information. For lifting appliances approved for varying capacities, it is to be indicated on the crane capacity rating chart (see 2-2/1.5).

1.3 Conditions for Strength Assessment

Crane primary structural members are to be designed for full compliance with the requirements in this Section. The following three conditions are to be considered in application of these strength criteria:

- i) Crane in-service; crane suspends a load from the cargo hook,
- ii) Crane out-of-service; the boom not stowed on boom rest or on other stowage arrangement,
- iii) Crane out-of-service, the boom stowed on boom rest or other stowage arrangement

1.5 Crane Capacity Rating Charts (Load Charts)

For cranes approved for varying capacities and/or environmental conditions, crane capacity rating charts (load charts) are to be provided, which are to include the following information:

- i) Safe Working Load ratings for operating radii increments not exceeding 1.5 m (5 ft), or corresponding boom angles for the specified boom and jib length
- ii) Corresponding environmental conditions, such as significant wave height and wind speed, and vessel inclinations (list and trim)
- iii) Corresponding rating conditions, such as onboard or offboard lifting, as applicable
- iv) Design Service Temperature (DST) of the crane
- v) Corresponding number of wire rope line parts (falls) and/or reference to corresponding wire rope reeving diagrams, as applicable
- vi) Weight of the hook, hook block, etc.
- vii) The name of the vessel or unit the chart is applicable to, the crane’s serial number and manufacturer

An approved copy of the crane capacity rating chart will be included in the Register of Lifting Appliances and is to be furnished to the Owner for use by crane personnel. See 2-7/5.11.

For capacity rating chart requirements of cranes used for personnel lifting, see Chapter 2, Section 9.

3 Materials

3.1 Material Selection Requirements

Material for structural members and components is to be as required in Chapter 2, Section 3.

3.3 Minimum Thickness of Structural Members

Crane boom chords and other members considered to be critically stressed are to have the following minimum thickness:

Solid Sections: 6 mm (0.24 inch) thick

Hollow Sections (e.g., truss boom lacings): 4 mm (0.16 inch) thick

For less stressed members, a minimum thickness of 4 mm (0.16 in.) is to be provided.

Interior of hollow sections is to be either coated or is shown to be tight to the attending Surveyor.

3.5 Effective Corrosion Control (1 July 2016)

Special protective coatings are to be applied to those structural members of the crane where the thickness is less than 6 mm (0.24 in.) to the satisfaction of the attending Surveyor.

5 Loads and Stresses (1 July 2016)

5.1 Loading Conditions (1 July 2016)

5.1.1 In-service Loads

Typical loads to be submitted and considered in the analysis of the cranes, as applicable, are:

- i) Dead loads
- ii) Live loads and dynamic loads, including the applicable vertical amplification factors, as per 2-2/7, 2-2/9, or 2-2/11
- iii) Loads due to vessel's or unit's motions, as per 2-2/5.17
- iv) Loads due to wind, as per 2-2/5.19
- v) Loads due to list and/or trim, as per 2-2/5.21
- vi) Load swing caused by non-vertical lift
- vii) Snow and ice

The analysis of the cranes is to be based on the worst combination of the above loads, as applicable.

For additional requirements for Shipboard, Offshore and Heavy Lift Cranes, refer to 2-2/7, 2-2/9, and 2-2/11 respectively.

If the crane is subject to unusual loads and/or unusual operating conditions, these are also to be submitted and are specially considered for each case.

5.1.2 Out-of-service Loads

In addition to the in-service loads, the out-of-service loads are to be submitted and considered in the structural analysis of the crane. The out-of-service loads are to include the loads resulting from the weight of the crane and the following environmental and motion loads:

- i) Environmental forces (wind, snow and ice, etc.)
- ii) Loads due to vessel's or unit's motions
- iii) Loads due to list and trim

In the out-of-service condition no load is to be suspended from the crane's hook.

The designer is to demonstrate, through analysis, that the stresses during out-of-service conditions, with boom stowed and not stowed, do not exceed the allowable stresses given in 2-2/5.5. For extreme conditions of seismic loads or extreme winds, an increase of up to 33% in the allowable stresses may be used.

5.3 Allowable Stress Coefficients

The allowable stress coefficients, S_c , referred to herein are specified in 2-2/Table 1.

TABLE 1
Allowable Stress Coefficient, S_c (1 July 2016)

Type of Stress	Allowable Stress Coefficient, S_c
<i>Tension:</i>	
Non-Pin Connected members (gross area)	0.60
Pin Connected members (net area)	0.45
<i>Shear:</i>	
On the Cross Sectional Area Effective in Resisting Shear	0.40
<i>Bending: (Tension and Compression on Extreme Fibers)</i>	
Solid Round and Square Bars	0.75
Members with Compact Sections ⁽³⁾	0.66
Members with Non-Compact Sections ⁽³⁾	0.60
<i>Bearing Stress:</i>	
On contact area of surfaces and projected area of pins in holes	0.90
<i>Combined Stress:</i>	
Von Mises Stress	0.75
Von Mises Stress using FEM Fine Mesh Analysis with All Loads	0.85

Notes:

- Members subjected to combined stresses are to be proportioned to satisfy requirements of 2-2/5.7.
- For additional guidance, see AISC Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings, June 1, 1989.
- (1 July 2016) For classification of sections as compact or non-compact, refer to 2/1.7 of ABS Guide for Buckling and Ultimate Strength Assessment for Offshore Structures.

5.5 Allowable Stresses (1 July 2016)

Computed tensile, bending and shear stress components and, as applicable, combinations of such stresses, for primary structural members are not to exceed the allowable stress, F , as obtained from the following equation:

$$F = F_y \times S_c$$

For steel booms:

$$F_y = \text{specified minimum yield point of the material}$$

For all other steel structural parts:

$$F_y = \text{minimum yield point. For design purposes, for steels with yield strength not exceeding } 355 \text{ N/mm}^2 \text{ (36 kgf/mm}^2, 51 \text{ ksi)} F_y \text{ is to be considered taken as not greater than 72\% of the minimum ultimate strength of the steel.}$$

$$S_c = \text{specified in 2-2/5.3}$$

5.7 Buckling and Combined Stresses (1 July 2016)

Members subjected to axial compression or combined loads, such as axial compression and bending moment, are to be assessed in accordance with the requirements of *ABS Guide for Buckling and Ultimate Strength Assessment for Offshore Structures*. Assessment performed in accordance with other applicable standards will be subject to special consideration.

For members with non-compact cross sections, as classified in accordance with 2/1.7 of *ABS Guide for Buckling and Ultimate Strength Assessment for Offshore Structures*, the local buckling is to be taken into account and is to be evaluated in accordance with the provisions of *ABS Guide for Buckling and Ultimate Strength Assessment for Offshore Structures*.

Design section properties of tapered members are to be determined in accordance with 2-2/5.9.2.

The effective length of crane booms may be determined in accordance with Appendix C of BS 2573-1:1983 or other recognized standards.

5.9 Design Properties for Structural Members

5.9.1 General (1 July 2016)

The design section properties for a box type boom of lattice construction with tapered ends are specified in 2-2/5.9.2. Other types of members will also be considered.

Built up sections with multiple layered plates of primary structural members will be subject to special consideration.

5.9.2 Tapered Members

The moment of inertia, section modulus and radius of gyration to be used in the design of box-type booms of lattice construction, having tapered ends of similar proportions and constant-size corner members, are to be those of a prismatic member of equivalent stiffness, having ends that are similar, equal and parallel. See 2-2/Figure 1.

The moment of inertia I_z at any cross-section within the tapered portion may be computed as:

$$I_z = I_1(Z/a)^2$$

where I_1 is the moment of inertia at the small end of tapered portion and the distances Z and a are shown in 2-2/Figure 1.

If the moment of inertia I_1 , at the top end of the boom, differs from the bottom end, the smaller of the two values is to be used to find the ratio I_1/I_o .

The moment of inertia I_o at the large end of the tapered portion may be computed as:

$$I_o = I_1(d_o/d_1)^2$$

where d_o and d are, respectively, the out-to-out distance of chord angles at the large and small end of the tapered portion.

The equivalent radius of gyration, r , for use in determining the slenderness ratio of the boom acting as a column, is:

$$r = \sqrt{CI_o / A}$$

where

I_o	=	moment of inertia at any section through length h (prismatic central portion) of the member
C	=	applicable coefficient from 2-2/Table 2.
A	=	area of cross-section at any section through length h (prismatic central portion)
CI_o	=	average moment of inertia

FIGURE 1
Box Type Boom

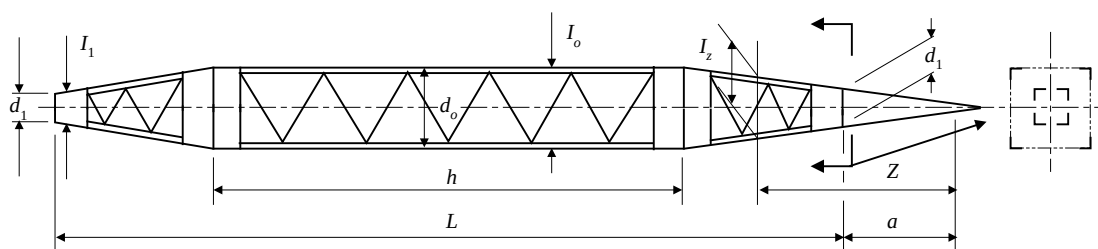


TABLE 2
Coefficients C

I_1/I_0	h/L					
	0	0.2	0.4	0.6	0.8	1.0
0.0	0.101	0.158	0.282	0.633	0.970	1.000
0.01	0.350	0.479	0.667	0.873	0.984	1.000
0.1	0.548	0.675	0.818	0.937	0.993	1.000
0.2	0.645	0.760	0.873	0.957	0.995	1.000
0.4	0.772	0.852	0.929	0.976	0.998	1.000
0.6	0.863	0.916	0.962	0.987	0.999	1.000
0.8	0.937	0.963	0.982	0.995	1.000	1.000
1.0	1.000	1.000	1.000	1.000	1.000	1.000

5.11 Crane Boom and Structural Component Fasteners

Allowable tension and shear stresses for boom and structural component rivets, bolts and thread parts are to be as per AISC Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings, or other recognized standards. For hold-down bolts see 2-2/5.13.

5.13 Swing Circle (Slewing Ring) Assembly (1 July 2016)

The following requirements apply to swing circle assemblies (as defined in 2-1/7.85) for Shipboard, Offshore, and Heavy Lift Pedestal Mounted Cranes.

5.13.1 Loads and Moments

Based on the type of the crane (i.e., Shipboard, Offshore or Heavy Lift), the respective loads and moments from 2-2/5.1 and 2-2/7, 2-2/9, or 2-2/11 are to be considered for the analysis of the swing circle assembly.

5.13.2 Supporting Flanges

The design of flanges and their attachment to the pedestal or other supporting structures is to consider the slew bearing manufacturer's recommendations for maximum permissible flange deflection as well as the degree of flatness of the surface of the flanges that are in contact with the slew bearing.

Where principal loads from either service or weld residual stresses are imposed to the flange through thickness direction, the flanges are to be made of material with improved through thickness properties, as per 2-3/11.

5.13.3 Hold-down Bolts

The bolt load, P_b , on the most heavily loaded slewing ring bolt is to be calculated for the most severe in-service loading conditions by the following equation:

$$P_b = \frac{4M}{ND} - \frac{V}{N}$$

where

- M = design overturning moment, as calculated based on the loads of 2-2/5.1, using 3.75 times the vertical design load (see 2-2/7, 2-2/9, or 2-2/11, as applicable)
- V = vertical load, as calculated based on the loads of 2-2/5.1, using 3.75 times the vertical design load (see 2-2/7, 2-2/9, or 2-2/11, as applicable)
- D = pitch circle diameter of bolts
- N = number of slewing ring bolts in a 360° uniform bolting pattern

The design overturning moment is to be based on a combination of in-plane and side plane loading.

As an alternative to the above, consideration will be given to calculation of the bolt load (P_b) using an independent analysis, which is to be submitted for review.

The maximum calculated bolt tensile stress is not to exceed the minimum specified ultimate tensile strength of the bolt material.

During installation, the bolts are to be pretensioned by controlled means to the satisfaction of the attending Surveyor. Pretensioning, by bolt torque or by hydraulic tensioning device, is to be in accordance with the bearing manufacturer's instructions and is not to exceed 0.7 times the bolt yield strength for bolts pretensioned by torque or 0.9 times the bolt yield strength for bolts pretensioned by axial tension.

Elongation of the bolts is to be measured to verify pretensioning. At least 10 percent of the bolts, randomly selected, are to be measured to the satisfaction of the attending Surveyor.

The material used in hold-down bolts is to be in accordance with 2-3/5.9.

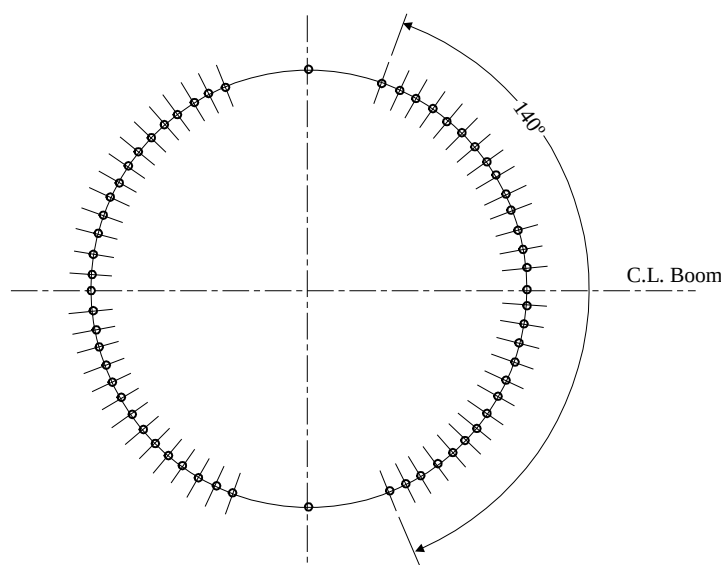
5.13.4 Bolting Arrangement

Where the swing circle assembly utilizes a roller or ball bearing slewing ring, the inner and outer bearing rings are to have a 360-degree uniform bolting pattern.

Consideration will be given to the use of sector bolting arrangement, provided a detailed structural analysis which includes side loading of the race, rings and bolted connection is submitted for review.

Where sector bolting is used, it is not to be less than 140-degree sectors and at least one additional bolt is to be fitted at the mid-point between each 140-degree sector where sectors extend to include a full circle. The center of each 140-degree sector is to be in line with the centerline of the boom. See 2-2/Figure 2.

**FIGURE 2
Sector Bolting**



5.13.5 Slewing Ring

5.13.5(a) Static Capacity of Bearing Raceways. The most severe loading at the slewing ring, based on the loads and moments of 2-2/5.1 and 2-2/7, 2-2/9, or 2-2/11, as applicable, is not to exceed the static capacity of the raceways, as specified by the bearing manufacturer. The design of bearing raceways is to take into consideration the maximum permissible bearing wear over the life of the bearing, as specified by the bearing manufacturer.

5.13.5(b) Lubrication. The slew bearing is to be sealed so as to prevent the ingress of foreign matter and contamination. A greasing nipple is to be provided for lubrication.

Lubrication holes are not to terminate on bearing raceways, except for ball bearings, where they are to be located outside the contact path of the ball bearings. The edges of lubrication holes are to be sloped gently so as to avoid sharp edges.

5.13.5(c) Retaining Components. Retaining components of slewing rings are to be designed for the overturning moments and vertical loads, as calculated based on the loads of 2-2/5.1, using 3.75 times the vertical design load (see 2-2/7, 2-2/9, or 2-2/11, as applicable), of the most severe in-service loading conditions. The overturning moment is to be based on a combination of in-plane and side plane loading.

The calculated stresses are not to exceed the ultimate tensile strength of the respective materials of the retaining components.

5.13.6 Swing Circle Assembly Retainer

An auxiliary device to restrain the upper frame against separation from the pedestal may be supplied at the option of the buyer. When the auxiliary device is supplied, the properties of materials used in its design and manufacture should be selected to resist fracture under impact loading. The maximum calculated stress, based on the loads of 2-2/5.13.5(c), is not to exceed the minimum specified ultimate tensile strength of the material.

5.13.7 Materials

Materials used in the swing circle assembly are to be in accordance with Chapter 2, Section 3.

5.15 Pedestals, Kingposts, Foundations, and Supporting Structure (2018)

Crane pedestals, kingposts, foundations, and supporting structure are to be designed for the maximum reaction forces and moments due to most severe in-service and out-of-service loading conditions, in accordance with 2-2/5.1, where the horizontal and vertical loads due to the live load, including the applicable vertical amplification factors, in accordance with 2-2/7, 2-2/9, or 2-2/11, are to be multiplied by the pedestal factor as obtained from the following equation:

$$PF = 1.56 - \frac{LL}{C}$$

is not to be taken greater than 1.5 for all crane types, and

is not to be taken less than 1.2 for Offshore Cranes or less than 1.0 for Heavy Lift Cranes.

where

PF = pedestal factor

LL = live load, in kN (tf, lbf); See 2-1/7.41

C = 4000 (408, 900000)

No doubler plate is allowed between the pedestal and deck plate where any tension load is anticipated.

Detail drawings of the foundation and supporting structure on which the crane is to be installed are to be submitted and approved prior to certification.

These components are to meet the applicable allowable stresses without the 33% increase for extreme conditions of seismic loads or extreme winds as indicated in 2-2/5.1.2.

5.17 Loads due to Vessel's or Unit's Motions (1 July 2016)

Vertical and horizontal accelerations due to vessel's or unit's motions are to be specified by the manufacturer, are to be determined based on vessel motion analysis and are to be submitted and considered in the analysis of Offshore Cranes, as per 2-2/9, and as applicable of Shipboard and Heavy Lift Cranes, as per 2-2/7 and 2-2/11.

In the absence of specific details, the minimum vertical and horizontal accelerations for vessels and units that are to be taken into consideration in the calculation of loads due to vessel's or unit's motions are to be in accordance with 2-2/Table 3.

The vertical load due to each crane component is to be calculated by the following equation:

$$VL_{DL} = DL (1 + a_v)$$

where

VL_{DL} = vertical load due to dead load, in kN (tf, lbf)

DL = component's dead load, in kN (tf, lbf)

a_v = vertical acceleration, in g

The horizontal load due to each crane component is to be calculated by the following equation:

$$HL_{DL} = DL a_h$$

where

HL_{DL} = horizontal load due to dead load, in kN (tf, lbf)

DL = component's dead load, in kN (tf, lbf)

a_h = horizontal acceleration, in g

The calculated vertical loads (VL_{DL}) and horizontal loads (HL_{DL}) are to be applied at the center of gravity of each crane component.

The horizontal load due to the lifted load is to be calculated by the following equation:

$$HL_{LL} = VDL a_h$$

where

HL_{LL} = horizontal load due to live load, in kN (tf, lbf)

VDL = vertical design load, in kN (tf, lbf); see 2-2/7, 2-2/9, and 2-2/11

a_h = horizontal acceleration, in g

The calculated horizontal load (HL_{LL}) is to be applied at the boom tip.

The angle of application of the horizontal loads is to be taken as such so as to induce the maximum loading on the crane.

TABLE 3
Minimum Accelerations due to Vessel's or Unit's Motions (1 July 2016)

Vessel or Unit Type	Vertical Acceleration (g) a_v	Horizontal Acceleration (g) a_h
Ship/barge in calm water and bottom supported structure	0	0
Tension Leg Platform/Spar	$H_{sig}/101.6$ (H_{sig} in m) $H_{sig}/333$ (H_{sig} in ft) but not less than 0.07	$H_{sig}/43.6$ (H_{sig} in m) $H_{sig}/143$ (H_{sig} in ft) but not less than 0.03
Semi-submersible	$H_{sig}^2/133$ (H_{sig} in m) $H_{sig}^2/1429$ (H_{sig} in ft) but not less than 0.07	
Drillship/FPSO	$H_{sig}^2/77.5$ (H_{sig} in m) $H_{sig}^2/833$ (H_{sig} in ft) but not less than 0.07	$H_{sig}^{1.1}/27$ (H_{sig} in m) $H_{sig}^{1.1}/100$ (H_{sig} in ft) but not less than 0.03

Notes:

- 1 H_{sig} = Significant Wave Height
- 2 For additional guidance, refer to Annex B of API Specification 2C – 7th edition.

5.19 Loads due to Wind (1 July 2016)

5.19.1 General

The wind velocities during in-service and out-of-service conditions are to be specified by the manufacturer, are to include the effects of gusts and vertical distance from the water surface to the crane location and are to be submitted and considered in the analysis of the cranes in accordance with sections 2-2/5.19.2 and 2-2/5.19.3.

In the absence of specific details, the following wind velocities are to be used:

- i) For crane in-service, 10.3 m/s (20 kn)
- ii) For crane out-of-service, boom not stowed, 36 m/s (70 kn)
- iii) For crane out-of-service, boom stowed, 51.5 m/s (100 kn)

5.19.2 Wind Pressure

In the calculation of wind pressure, P , the following equation is to be used.

$$P = \frac{V_k^2 \cdot C_s}{f} \quad \text{kN/m}^2 \text{ (tf/m}^2, \text{ lbf/ft}^2\text{)}$$

where

$$\begin{aligned} f &= 1637 \text{ (16051, 296)} \\ V_k &= \text{wind velocity in m/s (m/s, kn)} \\ C_s &= \text{shape coefficient from 2-2/Table 4} \end{aligned}$$

TABLE 4
Values of C_s (1 July 2016)

Component	C_s
Spherical	0.4
Cylindrical shapes (all sizes)	0.5
Flat surfaces	1.0
Isolated structural shapes (angles, channels, beams, etc.)	1.5
Wires	1.2
Small parts	1.4
Lattice booms and derricks (each face)	1.25

Note: Shapes or combinations of shapes which do not readily fall into the specified categories will be subject to special consideration.

5.19.3 Wind Force

The wind force is to be calculated in accordance with the following equation for the live load and each crane component and the resultant force and point of application is to be determined.

$$HL_{wind} = PA$$

where

$$\begin{aligned} HL_{wind} &= \text{horizontal wind force, in kN (tf, lbf)} \\ P &= \text{wind pressure, in kN/m}^2 \text{ (tf/m}^2, \text{ lbf/ft}^2\text{)} \\ A &= \text{projected area, in m}^2 \text{ (m}^2, \text{ ft}^2\text{), of all exposed surfaces} \end{aligned}$$

In calculating the wind forces, the following procedures are recommended:

- i) The projected area of the live load is to be specified by the manufacturer or calculated in accordance with the following equation:

$$A_{LL} = C LL^{2/3}$$

where

$$\begin{aligned} A_{LL} &= \text{projected area of the lifted load, in m}^2 \text{ (m}^2, \text{ ft}^2\text{)} \\ C &= 0.1215 \text{ (0.5565, 0.03536)} \\ LL &= \text{live load, in kN (tf, lbf)} \end{aligned}$$

- ii) Open truss work commonly used for booms, certain types of masts, etc., may be approximated by taking 30% of the projected block areas of both the front and back sides (i.e., 60% of the projected block area of one side for double sided truss work). The shape coefficient is to be taken in accordance with 2-2/Table 4.
- iii) Wind forces are to be added in the horizontal loads of the live load and each crane component.

5.21 Loads due to List and Trim (1 July 2016)

Loads for each crane component and the lifted load due to the static inclination angles (list and trim) of the vessel or unit are to be applied as horizontal side loads at the center of gravity of each crane component and at the boom tip for the lifted load. The respective horizontal side loads are to be calculated by the following equation:

$$HL_{SIA} = L \times \sin \sqrt{list^2 + trim^2}$$

where

- HL_{SIA} = horizontal side load due to the static inclination angles (list and trim)
- L = dead load including the effect of vertical accelerations, as per 2-2/5.17, as applicable, or live load including the applicable vertical amplification factor, as per 2-2/7, 2-2/9, and 2-2/11

The static inclination angles for vessels and units that are to be taken into consideration in the calculation of loads due to list and trim are to be as follows:

- For in service conditions: as specified by the manufacturer, or in the absence of specific details in accordance with 2-2/Table 5.
- For out-of-service, with boom stowed, conditions: in accordance with 4-1-1/Table 7 of the *Steel Vessel Rules* or 4-1-1/Table 1 of the *MODU Rules*, as applicable.
- For out-of-service, with boom not stowed, conditions: as specified by the manufacturer.

TABLE 5
Minimum Static Inclination Angles for Vessels and Units (1 July 2016)

Vessel or Unit Type	List (degrees)	Trim (degrees)
Ship/barge in calm water	5	2
Bottom supported structure/Tension Leg Platform/Spar	0.5	0.5
Semi-submersible	1.5	1.5
Drillship/FPSO	2.5	1

5.23 Fatigue (2018)

For offshore cranes, fatigue analysis for the life expectancy of the crane, performed in accordance with a recognized method, such as API Spec 2C – 7th edition or F.E.M. 1.001 (3rd edition revised 1998.10.01), is to be submitted for review.

7 Shipboard Cranes (1 July 2016)

7.1 General

These requirements apply to shipboard cranes having Safe Working Loads (SWLs) of less than 1570 kN (160 tf, 352800 lbf). See 2-1/7.75. For additional requirements see 2-2/1, 2-2/3 and 2-2/5.

Cranes approved for varying capacities are to be in compliance with the requirements for shipboard cranes, as per 2-2/7, when SWLs are less than 1570 kN (160 tf, 352800 lbf), and in compliance with the requirements for heavy lift cranes, as per 2-2/11, when SWLs are 1570 kN (160 tf, 352800 lbf) or greater, as applicable.

Cranes intended to be operated while the vessel is at open sea, or where there may be motion relative to the other vessel during crane operations, are to meet the requirements for offshore cranes as per 2-2/9.

7.3 Design Considerations

Shipboard cranes are to be designed for the most severe in-service and out-of-service loading conditions as per 2-2/5.1, where the vertical design load due to the lifted load is to be calculated by the following equation:

$$VDL = LL VAF$$

where

VDL = vertical design load, in kN (tf, lbf)

LL = live load, in kN (tf, lbf); see 2-1/7.41

VAF = vertical amplification factor

= 1.3 for $SWL < 392$ kN (40 tf, 88200 lbf)

= $1.366 - \frac{SWL}{C}$ for 392 kN (40 tf, 88200 lbf) $\leq SWL < 1570$ kN (160 tf, 352800 lbf)

SWL = safe working load, in kN (tf, lbf); see 2-1/7.73

C = 5884 (600, 1322774)

The above vertical amplification factors are based on crane operations in mild environmental conditions, where there are no significant accelerations due to vessel's motions. For other environmental conditions, the above vertical amplification factors are to be increased by adding the respective accelerations as specified by the manufacturer and in accordance with 2-2/5.17; but when these accelerations exceed 0.07g, cranes are to meet the requirements for offshore cranes as per 2-2/9.

The total horizontal side load at the boom tip is to be calculated taking into account all applicable side loads in accordance with 2-2/5.1, including the effects of vessel motions, wind and vessel inclinations, as per 2-2/5.17, 2-2/5.19 and 2-2/5.21, but is not to be taken less than $0.02 \times VDL$.

The SWL for grab cranes is not to exceed 80% of the load that each complete crane assembly is approved to lift on the cargo hook. The weight of cargoes lifted by the grab including the weight of the grab and its accessories is not to be greater than the SWL for the grab crane.

9 Offshore Cranes (1 July 2016)

9.1 General

These requirements apply to offshore cranes. Operations may consist of lifting and setting loads on the vessel or structure on which the crane is installed (onboard lifts), or on other structures or vessels (offboard lifts). See 2-1/7.53. For additional requirements see 2-2/1, 2-2/3 and 2-2/5.

9.3 Design Considerations

9.3.1 Onboard Lifts

For onboard lifts, the vertical design load due to the lifted load is to be calculated by the following equation:

$$VDL = LL VAF_{onb}$$

where

VDL = vertical design load, in kN (tf, lbf)

LL = live load, in kN (tf, lbf); see 2-1/7.41

VAF_{onb} = onboard vertical amplification factor

= $1.373 - \frac{LL}{C} + a_v$, but is not to be less than $1.1 + a_v$ or greater than $1.33 + a_v$

C = 5220 (532.5, 1173913)

a_v = vertical acceleration, in g; see 2-2/5.17

The total horizontal side load at the boom tip, taking into account all applicable side loads in accordance with 2-2/5.1, including the effects of vessel motions, wind and vessel inclinations, as per 2-2/5.17, 2-2/5.19, and 2-2/5.21, is not to be less than $0.02 \times VDL$.

9.3.2 Offboard Lifts

For offboard lifts, where there may be motion relative to the other vessel during crane operations, the vertical design load due to the lifted load is to be calculated by the following equation:

$$VDL = LL VAF_{offb}$$

where

VDL	=	vertical design load, in kN (tf, lbf)
LL	=	live load, in kN (tf, lbf); see 2-1/7.41
VAF_{offb}	=	offboard vertical amplification factor; but is not to be less than the onboard vertical amplification factor, VAF_{onb} , as obtained in 2-2/9.3.1
	=	$1 + v_r \times \sqrt{\frac{K}{g \times LL}}$
g	=	acceleration due to gravity
	=	9.81 m/s^2 (32.2 ft/s^2)
K	=	crane stiffness, in kN/m (tf/m, lbf/ft); as specified by the crane manufacturer, where it is to be calculated taking into account all elements from the hook through the pedestal structure.
v_r	=	relative velocity, in m/s (m/s, ft/s)
	=	$v_h + \sqrt{v_d^2 + v_c^2}$
v_h	=	maximum steady hoisting velocity for the live load, in m/s (m/s, ft/s); not to be less than v_{hmin}
v_{hmin}	=	minimum steady hoisting velocity to avoid re-contact of the lifted load with the supply boat m/s (m/s, ft/s)
	=	$0.01 + 0.098 \times H_{sig}$ in m/s; for $H_{sig} \leq 1.8 \text{ m}$
	=	$0.033 + 0.098 \times H_{sig}$ in ft/s; for $H_{sig} \leq 6 \text{ ft}$
	=	$0.067 \times (H_{sig} + 1)$ in m/s; for $H_{sig} > 1.8 \text{ m}$
	=	$0.067 \times (H_{sig} + 3.3)$ in ft/s; for $H_{sig} > 6 \text{ ft}$
H_{sig}	=	significant wave height, in m (m, ft)
v_d	=	vertical velocity of the deck of the vessel or unit supporting the load, in m/s (m/s, ft/s); as specified by the manufacturer; or in the absence of specific details in accordance with 2-2/Table 6
v_c	=	vertical velocity of the crane boom tip due to the motions of the vessel or unit the crane is mounted on, in m/s (m/s, ft/s); as specified by the manufacturer based on motion analysis of the crane and vessel or unit; or in the absence of specific details in accordance 2-2/Table 7

TABLE 6
Vertical Velocity of the Deck Supporting the Load, v_d (1 July 2016)

Lifting from or to:	v_d (m/s)	v_d (ft/s)
Bottom supported structure	0	0
Moving vessel (supply boat), for $H_{sig} < 3$ m (9.8 ft)	$0.6 \times H_{sig}$ (in m)	$0.6 \times H_{sig}$ (in ft)
Moving vessel (supply boat), for $H_{sig} \geq 3$ m (9.8 ft)	$0.9 + 0.3 \times H_{sig}$ (in m)	$5.9 + 0.3 \times (H_{sig} - 9.8)$ (in ft)

Notes:

- 1 H_{sig} = Significant Wave Height
- 2 For additional guidance, refer to Annex B of API Specification 2C – 7th edition.

TABLE 7
Vertical Velocity of the Crane Boom Tip, v_c (1 July 2016)

Lifting from or to:	v_c (m/s)	v_c (ft/s)
Ship/barge in calm water and bottom supported structure	0	0
Tension Leg Platform/Spar	$0.05 \times H_{sig}$ (in m)	$0.05 \times H_{sig}$ (in ft)
Semi-submersible	$0.082 \times H_{sig}^2$ (in m)	$0.025 \times H_{sig}^2$ (in ft)
Drillship/FPSO	$0.164 \times H_{sig}^2$ (in m)	$0.05 \times H_{sig}^2$ (in ft)

Notes:

- 1 H_{sig} = Significant Wave Height
- 2 For additional guidance, refer to Annex B of API Specification 2C – 7th edition.

The horizontal loads due to the motions of the deck of the vessel or unit that is supporting the load are to be taken into account in all offboard lifts.

When specific offlead and sidelead angles are specified by the manufacturer for the horizontal loads at the boom tip due to the motions of the deck of the vessel or unit that is supporting the lifted load, the horizontal radial in-plane (offlead) load and the horizontal side load are to be calculated as follows:

$$HL_{SV.offlead} = VDL \tan(\text{offlead angle})$$

$$HL_{SV.side} = VDL \tan(\text{sidelead angle})$$

where

$HL_{SV.offlead}$ = horizontal radial in-plane (offlead) load due to the motions of the deck of the vessel or unit that is supporting the lifted load, in kN (tf, lbf)

$HL_{SV.side}$ = horizontal side load due to the motions of the deck of the vessel or unit that is supporting the lifted load, in kN (tf, lbf)

In the absence of specific details, the horizontal radial in-plane (offlead) load and the horizontal side load are to be calculated as follows:

$$HL_{SV.offlead} = VDL f_{SV} \quad \text{in kN (tf, lbf)}$$

$$HL_{SV.side} = 0.5 HL_{SV.offlead} \quad \text{in kN (tf, lbf)}$$

where

$$\begin{aligned}
 f_{SV} &= \text{offlead factor; but not greater than 0.30} \\
 &= \frac{2.5 + 1.5 \times H_{sig}}{H_{tip}} \quad \text{for } H_{sig} \text{ and } H_{tip} \text{ in m} \\
 &= \frac{2.5 + 0.457 \times H_{sig}}{0.305 \times H_{tip}} \quad \text{for } H_{sig} \text{ and } H_{tip} \text{ in ft} \\
 H_{sig} &= \text{significant wave height, in m (ft)} \\
 H_{tip} &= \text{vertical distance from boom tip to deck of the vessel or unit supporting the} \\
 &\quad \text{lifted load, in m (ft)}
 \end{aligned}$$

The horizontal loads due to effects on the live load of the vessel's or unit's motions on which the crane is mounted on (refer to 2-2/5.17) and the motions of the deck of the vessel or unit that is supporting the load are to be combined as follows:

$$HL_{comb} = \sqrt{HL_{SV}^2 + HL_{LL}^2}$$

where

$$\begin{aligned}
 HL_{comb} &= \text{combined horizontal load; radial in-plane (offlead) load or side load} \\
 HL_{SV} &= \text{horizontal load due to the motions of the deck of the vessel or unit that is} \\
 &\quad \text{supporting the lifted load; radial in-plane load or side load, respectively} \\
 HL_{LL} &= \text{horizontal load due to the motions of the vessel or unit the crane is mounted} \\
 &\quad \text{on; radial in-plane load or side load, respectively; see 2-2/5.17}
 \end{aligned}$$

The total horizontal side load at the boom tip, taking into account the above combined horizontal side load and all other applicable side loads in accordance with 2-2/5.1, including the effects of wind and vessel inclinations, as per 2-2/5.19 and 2-2/5.21, is not to be less than $0.02 \times VDL$.

11 Heavy Lift Cranes (1 July 2016)

11.1 General (1 July 2016)

These requirements apply to heavy lift cranes having Safe Working Loads (SWLs) of not less than 1570 kN (160 tf, 352800 lbf). See 2-1/7.31. For additional requirements, see 2-2/1, 2-2/3 and 2-2/5.

Cranes approved for varying capacities are to be in compliance with the requirements for shipboard cranes, as per 2-2/7, when SWLs are less than 1570 kN (160 tf, 352800 lbf), and in compliance with the requirements for heavy lift cranes, as per 2-2/11, when SWLs are 1570 kN (160 tf, 352800 lbf) or greater, as applicable.

Cranes intended to be operated while the vessel is at open sea in environmental conditions other than mild, or where there may be motion relative to the other vessel during crane operations, are to meet the requirements for offshore cranes as per 2-2/9.

11.3 Design Considerations (1 July 2016)

Heavy lift cranes are to be designed for the most severe in-service and out-of-service loading conditions as per 2-2/5.1, where the vertical design load due to the lifted load is to be calculated by the following equation:

$$VDL = LL \text{ VAF}$$

where

$$\begin{aligned}
 VDL &= \text{vertical design load, in kN (tf, lbf)} \\
 LL &= \text{live load, in kN (tf, lbf); see 2-1/7.41} \\
 VAF &= \text{vertical amplification factor} \\
 &= 1.1
 \end{aligned}$$