

Jacking Systems for Deck Elevation etc.

Amended Rules and Guidance

Rules for the Survey and Construction of Steel Ships Parts B, O, and P
Guideline for the Survey and Construction of Steel Ships Parts O, and P

Reason for Amendment

General requirements for jacking systems for deck elevation are specified in Chapter 4 of the Code for the Construction and Equipment of Mobile Offshore Drilling Units, 2009 (2009 MODU Code) and these requirements have already been incorporated into the NK Rules.

However, since there are no specific provisions in the 2009 MODU Code for plans to be submitted for verification of the jacking systems, design strength requirements, etc., the Society has been verifying such plans for Society registered ships by applying relevant industry regulations.

In view of the recent increase in the number of ships equipped with the jacking systems due to the spread and evolution of marine development, relevant requirements are amended to clarify the above plans to be submitted, the application of the requirements for branch bilge suction pipes for self-elevating units and some requirements for design loads.

Outline of Amendment

The main contents of this amendment are as follows:

- (1) Amends requirements related to the jacking system plans to be submitted for verification.
- (2) Specifies the hardness tests and non-destructive tests as well as tests related to newly designed rack and pinion jacking systems as the test requirements for jacking systems.
- (3) Specifies the loading conditions required for jacking system designs.
- (4) Adds requirements for the allowable stresses as well as the buckling strength and fatigue strength of jacking system mechanical components.
- (5) Clarifies that requirements for inner diameters of the branch bilge suction pipes of self-elevating units are not subject to Part D of the Rules.
- (6) Amends the formulae for the current and tidal current design loads.

“Rules for the survey and construction of steel ships” has been partly amended as follows:

Part B CLASS SURVEYS

Chapter 12 SURVEYS FOR MOBILE OFFSHORE DRILLING UNITS AND SPECIAL PURPOSE BARGES

12.2 Classification Survey during Construction

Paragraph 12.2.2 has been amended as follows.

12.2.2 Submission of Plans and Documents*

1 Submission of Plans and Documents for Approval

With respect to the Classification Survey during Construction, the following plans and documents are to be submitted to the Society for approval before the work is commenced.

- (1) (Omitted)
- (2) Machinery
 - ((a) and (b) are omitted.)
 - (c) For self-elevating units, ~~construction and control diagrams of the jacking system~~ the plans and documents specified in 11.1.14-1(1), Part P
 - ((d) to (f) are omitted.)
- (3) (Omitted)

2 Submission of Plans and Documents for Reference

With respect to the Classification Survey during Construction, the following plans and documents are to be submitted for reference in addition to the plans and documents specified in -1.

- ((1) to (6) are omitted.)
 - (7) For self-elevating units, the following plans and documents.
 - (a) ~~e~~Calculations substantiating adequacy of the structure to transmit forces between legs and hull through the jacking or other elevating systems.
 - (b) Calculations of the ship's ability to resist overturning.
 - (c) The plans and documents specified in 11.1.14-1(2), Part P.
 - ((8) to (21) are omitted.)
- 3 (Omitted)**

Chapter 15 SURVEYS FOR WORK-SHIPS

15.2 Classification Surveys during Construction

Paragraph 15.2.2 has been amended as follows.

15.2.2 Submission of Plans and Documents*

1 In the Classification Survey during Construction, the following plans and documents in addition to those plans and documents specified in relevant requirements in **2.1.2** are to be submitted to the Society for approval before the work is commenced. The plans and documents may be submitted for examination by the Society prior to making an application for the classification of the ship as stipulated otherwise by the Society.

- (1) Plans for the installations and machinery for the intended work (hereinafter referred to as “work-related installations”).
- (2) Plans for the supporting structures of work-related installations.
- (3) The following plans and documents for dynamic positioning systems in cases where such a system is installed on the ship.
 - (a) ~~The~~ Operating manuals specified in 18.1, Part P.
 - (b) ~~The~~ Plans specified in 12.2.2-1(2)(d).
- (4) For self-elevating ships, the following plans and documents~~s~~.
 - (a) Construction of all legs, leg connections to bottom mats or spud cans, leg tanks and leg jacking or other elevating systems.
 - (b) ~~Construction and control diagrams of jacking systems~~ The plans and documents specified in 11.7.3-1(1), Part O.

2 In the Classification Survey during Construction, the following plans and documents in addition to those plans and documents specified in relevant requirements in -1 above and **2.1.3** are to be submitted for reference.

- (1) For units with a dynamic positioning system, the plans and documents specified in **12.2.2-2(20)**.
- (2) For self-elevating ships, the following plans and documents~~s~~.
 - (a) Calculations substantiating the adequacy of the structure to transmit forces between legs and the hull through jacking or other elevating systems.
 - (b) Calculations of the ship’s ability to resist overturning.
 - (c) The plans and documents specified in 11.7.3-1(2), Part O.

((3) to (5) are omitted.)

3 (Omitted)

4 (Omitted)

Part O WORK-SHIPS

Chapter 11 WIND TURBINE INSTALLATION SHIPS

11.4 Hull Constructions

Paragraph 11.4.9 has been amended as follows.

11.4.9 ~~Deck Elevating Apparatus and Load Carrying Members~~ Structure of Jacking System Connections to Hulls

~~Load-carrying members of self-elevating ships~~ The structure of jacking system connections to hulls are to be in accordance with the ~~requirements in~~ following (1) and (2):

- (1) ~~Scantlings of load-carrying members which transmit loads from the legs to the hull such structures~~ are to have sufficient strength for the loads prescribed in 11.4.7 and Chapter 3, Part P and 11.4.7.
- (2) ~~Constructions of load-carrying members are to be so arranged that~~ Loads transmitted from the legs are to be properly diffused into the hull structures.

11.7 Machinery

Paragraph 11.7.2 has been amended as follows.

11.7.2 Tests

1 Before installation on board, equipment and components constituting ~~the~~ machinery installations are to be tested at the manufacturers in accordance with the relevant requirements in **Part D**.

2 Notwithstanding ~~the requirements in -1 above,~~ for machinery installations, (other than boilers, pressure vessels belonging to Group I or II and piping systems which contain inflammable or toxic liquids,) used solely for ~~the operations~~ which is the intended purpose of the ship, ~~the~~ tests may be as deemed appropriate by the Society.

3 ~~The~~ Systems or the equipment essential for the safety of the ship or for the propulsion of the ship (only applicable to the ships which have the main propulsion machinery) are, after installation on board, to be subjected to performance tests after installation on board.

4 Mechanical components used for load carrying components, torque transmitting components, components for fixation systems and hydraulic components of the jacking systems are to be subjected to the hardness tests and non-destructive tests specified in 5.5.1, Part D.

5 Rack and pinion jacking systems are to be tested in accordance with the following. However, in cases where systems are of equivalent design, the Society may allow such tests to be omitted in consideration of established service histories.

- (1) A load equivalent to 150 % of the maximum normal holding capacity rating of the unit is to be applied, and the climbing pinion is to make at least one complete revolution.
- (2) The unit is to be disassembled and it is to be confirmed that all pinions and gears are free from abnormal defects by non-destructive tests deemed appropriate by the Society.

Paragraph 11.7.3 has been amended as follows.

11.7.3 Jacking Systems*

1 The following plans and documents are to be submitted to the Society in addition to those specified in Chapter 15, Part B.

(1) Plans and documents for approval

(a) A description of the jacking system and plans for its arrangement

(b) Rack and pinion jacking systems

i) Detailed plans for rack and pinions (including details of tooth geometry in cases where it is not an involute gear)

ii) Plans for power transmitting components, shafts, bearings, couplings, casings and brakes

iii) Detailed plans for gear elements

iv) Diagrams for electric and hydraulic control systems

v) Detailed plans for hydraulic power packs

iv) Detailed plans for electric motors (including specifications and operating characteristics)

vii) Detailed plans for fixation systems (if provided)

viii) Prototype test procedures (if applicable)

(c) Ram and pin jacking systems

i) Detailed plans for hydraulic cylinders and control valves

ii) Details for pins and activating mechanisms

iii) Detailed plans and arrangements for pin holes

iv) Diagrams for electric and hydraulic control systems

v) Detailed plans for hydraulic power packs

vi) Detailed plans for electric motors (including specifications and operating characteristics)

vii) Detailed plans for casings and supporting structures of the system (including fixed and movable crossheads)

(d) Detailed plans for monitoring and alarm systems

(e) Material specifications for load carrying components (racks and jackcases for rack and pinion units, jacking pins and yokes for hydraulically actuated units, etc.), torque transmitting components (climbing pinions, gears, pinions, planet carriers, pins, shafts, torque supports, couplings, coupling bolts, torque flanges, brakes, etc.), fixation system components and hydraulic components (hydraulic cylinders, actuators, etc.) of (b) and (c) above

(f) Design calculations (including strength, fatigue, buckling, rigidity, critical speed (resonance) analysis) of (b) and (c) above

(2) Plans and documents for reference

(a) Documents for Failure Modes and Effects Analysis (FMEA)

(b) Details and procedures for non-destructive tests for components subject to direct load (including inspection locations, inspection types and acceptance criteria)

(c) Details for operating temperature and heating arrangements for low-temperature service

(d) Limits for alignment and misalignment between rack and pinions

~~12~~ The driving gears, mechanisms, strength and safety devices material of load carrying components and torque transmitting components, fixation system components and hydraulic components of jacking systems are to be those deemed appropriate by the Society suitable for the temperature conditions of the operating areas of intended use and are to comply with Part K.

~~23~~ A jacking systems (including fixation systems in cases where separately equipped as holding mechanisms) is are to be such as to maintain the safety of the ship in the event of the failure of any part of the system, control device or loss of the source of power for the driving gear. A suitable monitoring device is to be provided at a permanently attended control station to indicate such failure.

4 With respect to -3 above, Failure Modes and Effects Analysis (FMEA) is to be used to confirm

that the safety of the ship will not be compromised by the jacking system.

35 Where electrical motors, hydraulic or pneumatic systems are used as a source of power for a jacking system (including fixation systems in cases where separately equipped as holding mechanisms), two or more sets of sources of power are to be provided so as to be capable of operating the jacking system even when one of the sets fails. However, one set may be acceptable for ships designated for use in restricted areas (except for ships which have a large embarking capacity).

46 Elevating Jacking systems (including fixation systems in cases where separately equipped as holding mechanisms) are to be designed and constructed for the maximum lowering and lifting loads of a ship as specified in the ship's operating manual for at least the following loading conditions. In addition, friction loss from leg guiding and the effect of variation in location of the centre of gravity of the hull are to be included in the maximum lowering and lifting loads.

- (1) Normal lifting, lowering, holding of hull (static loading)
- (2) Pre-load lifting, lowering, holding of hull (static loading in cases where lifting and lowering as well as combined loading in cases where holding)
- (3) Normal lifting, lowering, holding of legs (static loading)
- (4) Severe storm holding under the elevated condition and the afloat condition (combined loading)

7 Allowable stresses of the mechanical components used in jacking systems (including fixation systems in cases where separately equipped as holding mechanisms) are to comply with the values specified in 7.2.2, Part P under all the loading conditions specified in -6 above. In addition, buckling strength and fatigue strength are to be in accordance with the requirements of 7.1.5 and 7.1.6, Part P respectively. In the case of gears, tooth surface contact and tooth root bending are to be in accordance with requirements specified otherwise by the Society.

58 Elevating Jacking systems (including fixation systems in cases where separately equipped as holding mechanisms) are to be able to withstand the forces imposed upon a ship from the maximum environmental criteria for the ship.

9 All lifting and lowering operations as well as applicable repeated loads are to be considered for fatigue strength. In the case of gears, the following safety factors are to be applied for cumulative fatigue in the fatigue design life.

Tooth surface contact: 1.0

Tooth root bending: 1.5

10 In cases where hydraulic cylinders are used as power sources for ram and pin jacking systems, the requirements of Chapter 10, Part D are to be applied mutatis mutandis. For piping attached to such cylinders, the requirements of Chapter 12 and Chapter 13, Part D are to be applied mutatis mutandis.

611 Elevating Jacking systems are to be operable from central jacking control stations.

712 Jacking control stations are to be provided for the following safety devices.

- (1) Audible and visual alarms for jacking system overload and out-of-level. For rack and pinion jacking systems, visible and audible alarms for rack phase differential are to be provided in cases where required for design reasons.
- (2) Indicators for the following:
 - (a) The inclination of the ship on two horizontal perpendicular axes
 - (b) Power consumption or other indicators for the lifting or lowering of the legs, (as applicable)
 - (c) Brake release status

813 Communication systems are to be provided between the central jacking controls and locations at each leg.

Paragraph 11.7.4 has been amended as follows.

11.7.4 Bilge Piping

The bilge piping of self-elevating ships is to be in accordance with the requirements in following (1) to (3):

((1) and (2) are omitted.)

- (3) Notwithstanding 13.5.3-1, Part D, Bbranch bilge suction pipes from each compartment are to have an internal diameter obtained from the following formula or be standard pipes which have an internal diameter nearest to the calculated diameter. In cases where the internal diameter of such standard pipes is less than the calculated value by 5 mm or more, standard pipes of one grade higher diameter are to be used.

$$d' = 2.15\sqrt{A} + 25 \text{ (mm) minimum 50 (mm)}$$

where

d' : Internal diameter of branch bilge suction pipes (mm)

A : Wetted surface area of the compartment, (excluding stiffening members) when the compartment is half filled with water (m^2)

Part P MOBILE OFFSHORE DRILLING UNITS AND SPECIAL PURPOSE BARGES

Chapter 3 DESIGN LOADS

3.2 Design Loads

3.2.4 Current and Tidal Current Loads

Sub-paragraph -1 has been amended as follows.

1 ~~The e~~Current and tidal current loads are to be obtained ~~from the~~ as follows.

(1) Drag force

Drag force (F_D) per unit length along the member due to the current and the tidal current is to be obtained from following formula.

$$\del{F_D = 5.03DC_D U_C |U_C| (kN/m)}$$

$$F_D = 0.5\rho DC_D U_C \times |U_C| + 0.25\pi D^2 \rho C_M a_n (kN/m)$$

where

ρ : density of seawater 1.025 (t/m^3)

D : the projected width of the unit in the direction of the cross flow component of velocity.
(m)

C_D : drag coefficient in steady flow, (the value is to be deemed appropriate ~~to~~ by the Society)

U_C : current velocity (m/sec.)

C_M : inertia coefficient in steady flow (value is to be deemed appropriate by the Society)

a_n : acceleration (m/s^2)

(2) Lifting force

Lifting force (F_L) per unit length along the member due to the current and tidal current is to be obtained from following formula.

$$\del{F_L = 5.03DC_L U_C |U_C| (kN/m)}$$

$$F_L = 0.5\rho DC_L U_C \times |U_C| (kN/m)$$

where

C_L : lifting force coefficient in steady flow, (the value is to be deemed appropriate ~~to~~ by the Society)

ρ , D and U_C are specified in (1).

Chapter 11 MACHINERY INSTALLATIONS

11.1 General

Paragraph 11.1.3 has been amended as follows.

11.1.3 Tests

1 Before installation on board, equipment and components constituting the machinery installations are to be tested at the plants provided with installations and equipment necessary for the tests (hereinafter referred to as “manufacturers, etc.” in this Part) in accordance with ~~the~~ relevant requirements in **Part D**.

2 Notwithstanding ~~the requirements~~ in -1 above, for machinery installations, (other than boilers, pressure vessels belonging to Group I or II and piping systems which contain inflammable or toxic liquids,) used solely for ~~the operations~~ which ~~is~~ are the intended purpose of the unit, ~~the tests may be as~~ deemed appropriate by the Society.

3 Notwithstanding ~~the requirements in -1 and -2 above~~, for equipment manufactured by mass-production systems deemed appropriate by the Society, ~~the test procedures~~ suited to the production method may be accepted upon the request of the manufacturer.

4 ~~The~~ Systems or the equipment essential for the safety of the unit or for the propulsion of the unit (only applicable to the units which have the main propulsion machinery) are, after installed on board, to be subjected to performance tests after installation on board.

5 Remote control devices and automatic control devices attached to boilers are, ~~after installed on board,~~ to be subjected to performance tests after installation on board.

6 The safety devices required by this ~~Chapter~~ are, as a rule, ~~after installed on board,~~ to be subjected to performance tests after installation on board.

7 The Society may require, ~~when deemed necessary,~~ other tests than those specified in **11.1.3** when deemed necessary.

8 Mechanical components used for load carrying components, torque transmitting components, components for fixation systems and hydraulic components of jacking systems are to be subjected to the hardness tests and non-destructive tests specified in 5.5.1, Part D.

9 Rack and pinion jacking systems are to be tested in accordance with the following. However, in cases where such systems are of equivalent design, the Society may allow such tests to be omitted in consideration of established service histories.

(1) A load equivalent to 150 % of the maximum normal holding capacity rating of the unit is to be applied, and the climbing pinion is to make at least one complete revolution.

(2) The unit is to be disassembled and it is to be confirmed that all pinions and gears are free from abnormal defects by non-destructive tests deemed appropriate by the Society.

Paragraph 11.1.14 has been amended as follows.

11.1.14 Jacking Systems*

1 The following plans and documents are to be submitted to the Society in addition to those specified in Chapter 15, Part B.

(1) Plans and documents for approval

(a) A description of the jacking system and plans for its arrangement

(b) Rack and pinion jacking systems

i) Detailed plans for rack and pinions (including details of tooth geometry in cases where it is not an involute gear)

ii) Plans for power transmitting components, shafts, bearings, couplings, casings and brakes

- iii) Detailed plans for gear elements
- iv) Diagrams for electric and hydraulic control systems
- v) Detailed plans for hydraulic power packs
- iv) Detailed plans for electric motors (including specifications and operating characteristics)
- vii) Detailed plans for fixation systems (if provided)
- viii) Prototype test procedures (if applicable)
- (c) Ram and pin jacking systems
 - i) Detailed plans for hydraulic cylinders and control valves
 - ii) Details for pins and activating mechanisms
 - iii) Detailed plans and arrangements for pin holes
 - iv) Diagrams for electric and hydraulic control systems
 - v) Detailed plans for hydraulic power packs
 - vi) Detailed plans for electric motors (including specifications and operating characteristics)
 - vii) Detailed plans for the casings and supporting structures of the system (including fixed and movable crossheads)
- (d) Detailed plans for monitoring and alarm systems
- (e) Material specifications for load carrying components (racks and jackcases for rack and pinion units, jacking pins and yokes for hydraulically actuated units, etc.), torque transmitting components (climbing pinions, gears, pinions, planet carriers, pins, shafts, torque supports, couplings, coupling bolts, torque flanges, brakes, etc.), fixation system components and hydraulic components (hydraulic cylinders and actuators, etc.) of (b) and (c) above
- (f) Design calculations (including strength, fatigue, buckling, rigidity, critical speed (resonance) analysis) of (b) and (c) above
- (2) Plans and documents for reference
 - (a) Documents for Failure Modes and Effects Analysis (FMEA)
 - (b) Details and procedures for non-destructive tests for components subject to direct loads (including inspection locations, inspection types, and acceptance criteria)
 - (c) Details for operating temperature and heating arrangements for low-temperature service
 - (d) Limits for alignment and misalignment between rack and pinions

~~12~~ The driving gear, mechanism, strength and safety device material of load carrying components and torque transmitting components, fixation system components and hydraulic components of the jacking systems are to be those deemed appropriate by the Society suitable for the temperature conditions of operating areas of intended use and are to comply with Part K.

~~23~~ The jacking systems (including fixation systems in cases where separately equipped as holding mechanisms) are to be such as to maintain the safety of the unit in the event of failure of part of the system or the control device or loss of source of power for driving gear. A suitable monitoring device is to be provided at a permanently attended control station to indicate such failure.

4 With respect to -3 above, Failure Modes and Effects Analysis (FMEA) is to be used to confirm that the safety of the unit will not be compromised by the jacking system.

~~35~~ Where electrical motors, hydraulic or pneumatic systems are used as a source of power for the jacking systems (including fixation systems in cases where separately equipped as holding mechanisms), two or more sets of sources of power are to be provided so as to be capable of operating the jacking system even when either one of the sets becomes out of action. However, one set may be acceptable for the units designated for use in restricted areas (except for units which have a large embarking capacity), one set may be acceptable.

~~46~~ ~~The elevating~~ Jacking systems (including fixation systems in cases where separately equipped as holding mechanisms) ~~is~~are be designed and constructed for the maximum lowering and lifting loads of the unit as specified in the unit's operation manual ~~in accordance with 18.2.2-1(8)~~ for at least the following loading conditions. In addition, friction loss from leg guiding and the effect of variation in location of the centre of gravity of the hull are to be included in the maximum lowering and lifting loads.

- (1) Normal lifting, lowering, holding of hull (static loading)
- (2) Pre-load lifting, lowering, holding of hull (static loading in cases where lifting and lowering, and combined loading in cases where holding)
- (3) Normal lifting, lowering, holding of legs (static loading)
- (4) Severe storm holding under the elevated condition and the afloat condition (combined loading)

~~7~~ Allowable stresses of mechanical components used in jacking systems (including fixation systems in cases where separately equipped as holding mechanisms) are to comply with the values specified in 7.2.2 under all loading conditions specified in -6 above. In addition, buckling strength and fatigue strength are to be in accordance with the requirements of 7.1.5 and 7.1.6 respectively. In the case of gears, tooth surface contact and tooth root bending are to be in accordance with requirements specified otherwise by the Society.

~~58~~ ~~The elevating~~ Jacking systems (including fixation systems in cases where separately equipped as holding mechanisms) ~~is~~are to be able to withstand the forces imposed on the unit from the maximum environmental criteria for the unit.

~~9~~ All lifting and lowering operations as well as applicable repeated loads are to be considered for fatigue strength. In the case of gears, the following safety factors are to be applied for cumulative fatigue in the fatigue design life.

Tooth surface contact: 1.0

Tooth root bending: 1.5

~~10~~ In cases where hydraulic cylinders are used as power sources for ram and pin jacking systems, the requirements of **Chapter 10, Part D** are to be applied mutatis mutandis. For piping attached to such cylinders, the requirements of **Chapter 12 and Chapter 13, Part D** are to be applied mutatis mutandis.

~~611~~ ~~The elevating~~ Jacking systems ~~is~~are to be operable from a central jacking control stations.

~~712~~ ~~The j~~Jacking control stations ~~is~~are to be provided for the following safety devices.

- (1) Audible and visual alarms for jacking system overload and out-of-level. For rack and pinion jacking systems, visible and audible alarms for rack phase differential are to be provided in cases where required for design reasons.
- (2) Indicators for the following:
 - (a) The inclination of the unit on two horizontal perpendicular axes
 - (b) Power consumption or other indicators for lifting or lowering the legs, (as applicable)
 - (c) Brake release status

~~813~~ ~~A c~~ommunication systems ~~is~~are to be provided between ~~the~~ central jacking controls and a locations at each leg.

“Guidance for the survey and construction of steel ships” has been partly amended as follows:

Part O WORK-SHIPS

O11 WIND TURBINE INSTALLATION SHIPS

O11.7 Machinery

Paragraph O11.7.3 has been added as follows.

O11.7.3 Jacking Systems

1 In applying **11.7.3-2, Part O of the Rules**, materials are to meet the specified values for impact tests equivalent to or greater than those of steels used for hull construction in cases where materials are used for which there are no specified values for the impact tests in **Part K of the Rules**.

2 The wording “permanently attended control station” specified in **11.7.3-3, Part O of the Rules** means the locations where jacking systems are controlled. In cases where fixation systems are separately provided as holding mechanisms, the locations where such systems are controlled are also included.

3 The wording “requirements specified otherwise by the Society” specified in **11.7.3-7, Part O of the Rules** means the requirements specified in **Annex 5.3.5, Part D of the Rules**.

Part P MOBILE OFFSHORE DRILLING UNITS AND SPECIAL PURPOSE BARGES

P11 MACHINERY INSTALLATIONS

P11.1 General

Paragraph P11.1.14 has been added as follows.

P11.1.14 Jacking Systems

1 In applying 11.1.14-2, Part P of the Rules, materials are to meet the specified values for impact tests equivalent to or greater than those of steels used for hull construction in cases where materials are used for which there are no specified values for the impact tests in Part K of the Rules.

2 The wording “permanently attended control station” specified in 11.1.14-3, Part P of the Rules means the locations where jacking systems are controlled. In cases where fixation systems are separately provided as holding mechanisms, the locations where such systems are controlled are also included.

3 The wording “requirements specified otherwise by the Society” specified in 11.1.14-7, Part P of the Rules means the requirements specified in Annex 5.3.5, Part D of the Rules.