Classification of Offshore Handling Systems

August 2014

Rule Note
NR 595 DT R01 E

Marine & Offshore Division
92571 Neuilly sur Seine Cedex – France
Tel: + 33 (0)1 55 24 70 00 – Fax: + 33 (0)1 55 24 70 25
Marine website: http://www.veristar.com
Email: veristarinfo@bureauveritas.com

BUREAU VERITAS

MARINE & OFFSHORE DIVISION

GENERAL CONDITIONS

ARTICLE 1

1.1. - BUREAU VERITAS is a Society the purpose of whose Marine & Offshore Division (the "Society") is the classification (" Classification ") of any ship or vessel or offshore unit or structure of any type or part of it or system therein collectively hereinafter referred to as a "Unit" whether linked to shore, river bed or sea bed or not, whether operated or located at sea or in inland waters or partly on land, including submarines, hovercrafts, drilling rigs, offshore installations of any type and of any purpose, their related and ancillary equipment, subsea or not, such as well head and pipelines, mooring legs and mooring points or otherwise as decided by the Society.

The Society:

- "prepares and publishes Rules for classification, Guidance Notes and other documents (" Rules ");
- "issues Certificates, Attestations and Reports following its interventions (" Certificates ");
- "publishes Registers.

1.2. - The Society also participates in the application of National and International Regulations or Standards, in particular by delegation from different Governments. Those activities are hereafter collectively referred to as " Certification ".

1.3. - The Society can also provide services related to Classification and Certification such as ship and company safety management certification; ship and port security certification, training activities; all activities and duties incidental thereto such as documentation on any supporting means, software, instrumentation, measurements, tests and trials on board.

1.4. - The interventions mentioned in 1.1., 1.2. and 1.3. are referred to as " Services ". The party and/or its representative requesting the services is hereinafter referred to as the " Client ". **The Services are prepared and carried out on the assumption that the Clients are aware of the International Maritime and/or Offshore Industry (the "Industry") practices.**

1.5. - The Society is neither and may not be considered as an Underwriter, Broker in ship's sale or chartering, Expert in Unit's valuation, Consulting Engineer, Controller, Naval Architect, Manufacturer, Shipbuilder, Repair yard, Charterer or Shipowner who are not relieved of any of their expressed or implied obligations by the interventions of the Society.

ARTICLE 2

2.1. - Classification is the appraisement given by the Society for its Client, at a certain date, following surveys by its Surveyors along the lines specified in Articles 3 and 4 hereafter on the level of compliance of a Unit to its Rules or part of them. This appraisement is represented by a class entered on the Certificates and periodically transcribed in the Society's Register.

2.2. - Certification is carried out by the Society along the same lines as set out in Articles 3 and 4 hereafter and with reference to the applicable National and International Regulations or Standards.

2.3. - **It is incumbent upon the Client to maintain the condition of the Unit after surveys, to present the Unit for surveys and to inform the Society without delay of circumstances which may affect the given appraisement or cause to modify its scope.**

2.4. - The Client is to give to the Society all access and information necessary for the safe and efficient performance of the requested Services. The Client is the sole responsible for the conditions of presentation of the Unit for tests, trials and surveys and the conditions under which tests and trials are carried out.

ARTICLE 3

3.1. - **The Rules, procedures and instructions of the Society take into account at the date of their preparation the state of currently available and proven technical knowledge of the Industry. They are a collection of minimum requirements but not a standard or a code of construction neither a guide for maintenance, a safety handbook or a guide of professional practices, all of which are assumed to be known in detail and carefully followed at all times by the Client.**

Committees consisting of personalities from the Industry contribute to the development of those documents.

3.2. - **The Society only is qualified to apply its Rules and to interpret them. Any reference to them has no effect unless it involves the Society's intervention.**

3.3. - The Services of the Society are carried out by professional Surveyors according to the applicable Rules and to the Code of Ethics of the Society. Surveyors have authority to decide locally on matters related to classification and certification of the Units, unless the Rules provide otherwise.

3.4. - **The operations of the Society in providing its Services are exclusively conducted by way of random inspections and do not in any circumstances involve monitoring or exhaustive verification.**

ARTICLE 4

4.1. - The Society, acting by reference to its Rules:

- "reviews the construction arrangements of the Units as shown on the documents presented by the Client;
- "conducts surveys at the place of their construction;
- "classes Units and enters their class in its Register;
- "surveys periodically the Units in service to note that the requirements for the maintenance of class are met.

The Client is to inform the Society without delay of circumstances which may cause the date or the extent of the surveys to be changed.

ARTICLE 5

5.1. - **The Society acts as a provider of services. This cannot be construed as an obligation bearing on the Society to obtain a result or as a warranty.**

5.2. - **The certificates issued by the Society pursuant to 5.1. here above are a statement on the level of compliance of the Unit to its Rules or to the documents of reference for the Services provided for.**

In particular, the Society does not engage in any work relating to the design, building, production or repair checks, neither in the operation of the Units or in their trade, neither in any advisory services, and cannot be held liable on those accounts. Its certificates cannot be construed as an implied or express warranty of safety, fitness for the purpose, seaworthiness of the Unit or of its value for sale, insurance or chartering.

5.3. - **The Society does not declare the acceptance or commissioning of a Unit, nor of its construction in conformity with its design, that being the exclusive responsibility of its owner or builder.**

5.4. - The Services of the Society cannot create any obligation bearing on the Society or constitute any warranty of proper operation, beyond any representation set forth in the Rules, of any Unit, equipment or machinery, computer software of any sort or other comparable concepts that has been subject to any survey by the Society.

ARTICLE 6

6.1. - The Society accepts no responsibility for the use of information related to its Services which was not provided for the purpose by the Society or with its assistance.

6.2. - **If the Services of the Society or their omission cause to the Client a damage which is proved to be the direct and reasonably foreseeable consequence of an error or omission of the Society, its liability towards the Client is limited to ten times the amount of fee paid for the Service having caused the damage, provided however that this limit shall be subject to a minimum of eight thousand (8,000) Euro, and to a maximum which is the greater of eight hundred thousand (800,000) Euro and one and a half times the above mentioned fee. These limits apply regardless of fault including breach of contract, breach of warranty, tort, strict liability, breach of statute, etc.**

The Society bears no liability for indirect or consequential loss whether arising naturally or not as a consequence of the Services or their omission such as loss of revenue, loss of profit, loss of production, loss relative to other contracts and indemnities for termination of other agreements.

6.3. - All claims are to be presented to the Society in writing within three months of the date when the Services were supplied or (if later) the date when the events which are relied on of were first known to the Client, and any claim which is not so presented shall be deemed waived and absolutely barred. Time is to be interrupted thereafter with the same periodicity.

ARTICLE 7

7.1. - Requests for Services are to be in writing.

7.2. - **Either the Client or the Society can terminate as of right the requested Services after giving the other party thirty days' written notice, for convenience, and without prejudice to the provisions in Article 8 hereunder.**

7.3. - The class granted to the concerned Units and the previously issued certificates remain valid until the date of effect of the notice issued according to 7.2. here above subject to compliance with 2.3. here above and Article 8 hereunder.

7.4. - The contract for classification and/or certification of a Unit cannot be transferred neither assigned.

ARTICLE 8

8.1. - The Services of the Society, whether completed or not, involve, for the part carried out, the payment of fee upon receipt of the invoice and the reimbursement of the expenses incurred.

8.2. - **Overdue amounts are increased as of right by interest in accordance with the applicable legislation.**

8.3. - **The class of a Unit may be suspended in the event of non-payment of fee after a first unfruitful notification to pay.**

ARTICLE 9

9.1. - The documents and data provided to or prepared by the Society for its Services, and the information available to the Society, are treated as confidential. However:

- "Clients have access to the data they have provided to the Society and, during the period of classification of the Unit for them, to the **classification file** consisting of survey reports and certificates which have been prepared at any time by the Society for the classification of the Unit ;
- "copy of the documents made available for the classification of the Unit and of available survey reports can be handed over to another Classification Society, where appropriate, in case of the Unit's transfer of class;
- "the data relative to the evolution of the Register, to the class suspension and to the survey status of the Units, as well as general technical information related to hull and equipment damages, may be passed on to IACS (International Association of Classification Societies) according to the association working rules;
- "the certificates, documents and information relative to the Units classed with the Society may be reviewed during certificating bodies audits and are disclosed upon order of the concerned governmental or inter-governmental authorities or of a Court having jurisdiction.

The documents and data are subject to a file management plan.

ARTICLE 10

10.1. - Any delay or shortcoming in the performance of its Services by the Society arising from an event not reasonably foreseeable by or beyond the control of the Society shall be deemed not to be a breach of contract.

ARTICLE 11

11.1. - In case of diverging opinions during surveys between the Client and the Society's surveyor, the Society may designate another of its surveyors at the request of the Client.

11.2. - Disagreements of a technical nature between the Client and the Society can be submitted by the Society to the advice of its Marine Advisory Committee.

ARTICLE 12

12.1. - Disputes over the Services carried out by delegation of Governments are assessed within the framework of the applicable agreements with the States, international Conventions and national rules.

12.2. - Disputes arising out of the payment of the Society's invoices by the Client are submitted to the Court of Nanterre, France, or to another Court as deemed fit by the Society.

12.3. - **Other disputes over the present General Conditions or over the Services of the Society are exclusively submitted to arbitration, by three arbitrators, in London according to the Arbitration Act 1996 or any statutory modification or re-enactment thereof. The contract between the Society and the Client shall be governed by English law.**

ARTICLE 13

13.1. - **These General Conditions constitute the sole contractual obligations binding together the Society and the Client, to the exclusion of all other representation, statements, terms, conditions whether express or implied. They may be varied in writing by mutual agreement. They are not varied by any purchase order or other document of the Client serving similar purpose.**

13.2. - The invalidity of one or more stipulations of the present General Conditions does not affect the validity of the remaining provisions.

13.3. - The definitions herein take precedence over any definitions serving the same purpose which may appear in other documents issued by the Society.

BV Mod. Ad. ME 545 L - 7 January 2013

RULE NOTE NR 595

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SECTION 1 GENERAL

1 General

1.1 Application

1.1.1 The present Note provides requirements for the classification of offshore handling systems and associated equipment for ships or offshore units intended to be granted with the additional class notation **OHS** defined in [1.2].

1.2 Class notation

1.2.1 The additional class notation **OHS** covers offshore handling systems such as winches, strand jacks, chain jacks, sheaves and their foundations used for lifting/pulling of a load. In particular, the following equipment are covered:

- equipment used for the installation and tensioning of mooring lines such as winches, chain jacks and sheaves
- tensioning winches and strand jack systems for riser pull-in.

Other handling equipment not listed above may be covered on a case by case basis.

1.2.2 As a rule, the following equipment are not covered by the notation **OHS**:

- offshore drilling equipment defined in NR570 Classification of Drilling Equipment
- lifting appliances covered by the additional notations **ALP**, **ALM** or **ALS** defined in NR526 Rules for the Certification of Lifting Appliances onboard Ships and Offshore Units
- mooring lines elements such as fairleads or chain stoppers covered by the notation **POSA** defined in NR493 Classification of Mooring Systems for Permanent Offshore Units
- windlass and other mooring equipment on mobile units
- self-elevating systems defined in NR445 Classification of Offshore Units.

Note 1: For the equipment listed above, the Society may refer to the technical requirements of the present Note.

1.2.3 For each project, the list of equipment intended to be covered by the notation **OHS** is to be specified by the party applying for classification, subject to the Society agreement.

1.2.4 As stated in the Offshore Rules, structural assessment of equipment foundations is mandatory for classification purpose, independently of the notation **OHS**.

1.3 Construction mark

1.3.1 In accordance with the provisions of Part A, chapter 1 of the Offshore Rules or the Ship Rules and considering the provisions of [1.3.2] to [1.3.4], the construction marks ✠, ✠, and • are associated with the class notation **OHS**.

1.3.2 The construction mark ✠ is assigned when the handling system is surveyed by the Society during its construction and the requirements below are fulfilled:

- approval of drawings and examination of documents required in [4]
- inspection at works of materials and equipment in accordance with NR526, Section 10
- survey of tests at works and after installation on-board in accordance with Sec 3
- certification of components in accordance with [2.2]

1.3.3 The construction mark ✠ is assigned when the handling system has been surveyed by an other IACS Society during construction and is admitted to class after construction, subject to the requirements below being fulfilled:

- examination of drawings and documents required in [4] (see Note 1)
- examination of materials inspection certificates, construction survey attestations and test certificates at works
- survey of the handling system (see Note 2).

Note 1: As a Rule, the documents are to be marked with the stamps of the organization by which they were approved upon construction.

Note 2: The extent of this survey depends on the existing conditions of certification, on the general maintenance conditions and on the age of the handling system. As a rule, general tests are not required if the existing certification for these tests (tests prior to first use and/or quinquenal renewal of tests) is valid.

1.3.4 The construction mark • is assigned to the handling system when the procedure for the assignment of classification is other than those detailed in [1.3.2] and [1.3.3], but however deemed acceptable and in compliance with the requirements below:

- approval of drawings and examination of documents required in [4] (see Note 1)
- examination of the certificates delivered after testing at works
- survey of the handling system (see Note 2).

Note 1:

- Upon agreement of the Society, the approval of the documents may not be required if proof is given that these documents have been previously approved by a recognized organization. In such a case, the hereabove mentioned drawings and documents are to be submitted for information.

- When some drawings and documents are not available, the Society is to appreciate whether it is possible to grant the requested class notation. Particular measurements or controls carried out on-board, and witnessed by a Surveyor of the Society, may be required.

Note 2: The extent of this survey depends on the existing conditions of certification, on the general maintenance conditions and on the age of the handling system. As a rule, general tests are not required if the existing certification for these tests (tests prior to first use and/or quinquenal renewal of tests) is valid. Checking of thicknesses of structural elements is to be carried out on the handling system the age of which is greater than, or equal to, 12 years.

2 Society's involvement

2.1 Scope

2.1.1 The present Note covers the design, testing and in service survey of handling systems defined [1.2.1].

The NR526 Rules for the Certification of Lifting Appliances onboard Ships and Offshore Units are to be complied with regarding:

- electrical and hydraulic systems, NR526, Section 8
- control and safety systems, NR526, Section 9.

The Society may refer to the NR526 when deemed necessary.

2.2 Components

2.2.1 Rules reference

Rules reference for components of equipment covered by the additional class notation **OHS** are given in Tab 1. The requirements defined in these references are applicable in addition to the requirements of the present Note. In case of conflict between the rules in reference and the present Note, requirements of the present Note prevails.

2.2.2 Certification

Equipment components are to be certified based on the provisions of Tab 2.

Table 1 : Rules reference for components

Component	Reference
Load carrying member	NR526
Gear system	Offshore Rules, Part C
Wire and fiber rope	NR526
Hydraulic system	NR526 and Offshore Rules, Part C
Electric system	NR526 and Offshore Rules, Part C
Loose gear	NR526
Chain	NR216

Table 2 : Components certification

Component	Raw material certification	Product certification
1. Main load carrying structural elements: drum, flanges, supports or baseplate, shaft, etc.	C	C
2. Gear system	C	C
3. Ropes	-	C
4. Hydraulic system components	**(1)**	**(1)**
5. Hydraulic cylinders	C **(2)**	C
6. Electric system components	**(3)**	**(3)**
6. Loose gear and accessories	W	C **(4)**

(1) Survey to be done as per relevant requirements of Pt C, Ch 1, Sec 3 and Pt C, Ch 1, Sec 7 of the Offshore Rules.
(2) Cylinder shell and piston rod only.
(3) Survey to be done as per relevant requirements of Pt C, Ch 2 of the Offshore Rules.
(4) Individual load test.

2.2.3 Symbols

Symbols used in Tab 2 are consistent with the definitions of NR266 Survey of Materials and Equipment at Works for the Classification of Ships and Offshore Units. The following symbols are used for certification:

- "C" indicates that a product certificate of the Society is required with invitation of the Surveyor to attend the tests unless otherwise agreed, in addition to the manufacturer's document stating the results of the tests performed and/or compliance with the approved type as applicable.

Note 1: An alternative survey scheme (mode I) may be agreed by the Society with the manufacturer whereby the attendance of the Surveyor will not be required as indicated above. Accordingly, the product is covered by a Certificate for Alternative survey ("CA") delivered by the Society. The appropriate required documents and information are detailed in the procedures stated in the agreement for admission to the alternative survey scheme.

- "W" indicates that a manufacturer's certificate is required, stating the results of the tests performed and/or compliance with the approved type as applicable.

2.3 Cargo gear register

2.3.1 The equipment covered by the notation **OHS** are not listed and recorded in the Cargo Gear Register.

3 References

3.1 Definitions

3.1.1 Offshore Rules

When reference is made to Offshore Rules, the latest version of NR445 Rules for the Classification of Offshore Units is applicable.

3.1.2 Ship Rules

When reference is made to Ship Rules, the latest version of NR467 Rules for the Classification of Steel Ships is applicable.

3.1.3 NR526

When reference is made to NR526, the latest version of NR526 Rules for the Certification of Lifting Appliances onboard Ships and Offshore Units is applicable.

3.1.4 NR216

When reference is made to NR216, the latest version of NR216 Rules on Materials and Welding for the Classification of Marine Units is applicable.

3.1.5 Standardized equipment

Standardized equipment are equipment approved by the Society provided that the supplier proves that a prototype has been tested according to the present Note or has been submitted to tests considered equivalent by the Society.

3.2 List of recognized standards

3.2.1 The following standards are recognized for the purpose of the present Note:

- EN 14492 - Power driven winches and hoists
- EN 818-7 - Short link chain for lifting purpose
- ANSI/AISC 360-10 - American Institute of Steel Construction - Specification for Structural Steel Buildings
- API RP 2A - American Petroleum Institute - Recommended practice for planning, designing and constructing fixed offshore platforms.

4 Documents to be submitted

4.1 General

4.1.1 The documents listed below are to be submitted.

4.1.2 Relevant additional drawings and calculation notes may be requested by the Society in complement to the hereafter mentioned documents.

4.1.3 Technical specification

The characteristics of the handling system are to be submitted for information in the form of a detailed technical specification including in particular:

- the nominal pulling load or Safe Working Load in kN
- the brake capacity or holding force capacity in kN
- the force diagram in service conditions, when relevant
- the wire rope or fiber rope specification including end terminations details and Minimum Breaking Load in kN
- the chain specification with breaking strength and proof load
- the safety device specification, if any
- the list of all items of loose gears, marked in accordance with the relevant drawings and specifying the SWL and the test load of each item.

4.1.4 Drawings and documents

The following drawings and documents are to be submitted:

- general arrangement localizing the handling system and showing the working area and the different path of the rope
- general arrangement of the handling system showing clearly the reeving of the ropes and the number of parts of purchase tackles. All items of loose gears are to be marked and numbered on these drawings.
- construction drawings
- material specifications
- calculation notes as required per Sec 2, for information
- Power unit and driving system specifications and general drawings
- gearbox specification and general drawing, if any
- hydraulic and electric system specifications
- scantling drawings of the load carrying hydraulic cylinders.

4.2 Winch

4.2.1 The documents listed in [4.2] are to be submitted in addition to those listed in [4.1].

4.2.2 Technical specification

The characteristics of the winch are to be submitted for information in the form of a detailed technical specification including in particular:

- the rated line pull, in kN
- the reeled layer for which the rated line pull is specified
- the number of reeled layers
- the rated brake capacity (minimum and maximum), in kN
- the hoisting speed
- the stall load, in kN
- the safety device specification.

4.2.3 Drawings and documents

The following drawings and documents are to be submitted:

- general arrangement localizing the winch and showing the working area with deck sheaves, turndown sheaves and the different path of the wire rope
- gearbox specification and general drawing
- specification of the overload protection system or pulling capacity limiter, if any

4.3 Supporting structure of the handling system

4.3.1 The following documents are to be submitted:

- Drawings of the structural parts of the ship or offshore unit supporting the handling system and carrying the forces to the hull structure
- Drawings of the structural parts of the ship or offshore unit located in way of the fastening fittings
- Drawings of the foundations of the handling system.

SECTION 2 DESIGN REQUIREMENTS

1 General

1.1 Application

1.1.1 This Section addresses the basic principles and requirements for design and arrangements of handling systems of the following type:

- winch used for mooring lines installation
- winch used for riser tensioning
- sheaves
- chain jack
- strand jack.

Other types of equipment may be considered by the Society on a case-by-case basis.

1.2 Definitions

1.2.1 Nominal pulling load

The nominal pulling load of a handling system is defined as the maximum load which may be pulled by the system in a safe manner, in kN.

When the handling system is a lifting appliance, the nominal pulling load is equivalent to the Safe Working Load.

1.2.2 Safe Working Load (SWL)

The Safe Working Load (SWL) of a lifting appliance is defined as the maximum load which may be lifted by the appliance in a safe manner, in kN.

1.2.3 Rated line Pull (RP)

The Rated line Pull (RP) of a winch is the maximum rope tension, in kN, that the winch can haul at the relevant layer, in normal service condition, when the drum rotates at its maximum service speed.

The Rated line Pull is defined for a specific reeled layer which is to be specified by the party applying for classification. The reeled layer may be the first layer (in contact with the drum) or the outer layer.

Note 1: Generally, riser tensioning systems and mooring lines installation winches have a RP specified at the outer layer.

1.2.4 Static brake

The static brake (or parking brake) of a winch is defined as the braking system which applies in static mode automatically when the motorization is stopped.

1.2.5 Minimum brake capacity

The minimum brake capacity of a winch is defined as the minimum rated holding force of the static brake system at the reeled layer for which the RP is specified.

1.2.6 Maximum brake capacity

The maximum brake capacity of a winch is defined as the maximum holding force of the static brake system at the reeled layer for which the RP is specified before that the brake slips or is released.

1.2.7 Minimum Breaking Load (MBL)

The Minimum Breaking Load of chain, wire ropes and fibre ropes are provided by the manufacturer in accordance with NR216.

1.2.8 Stall load

The stall load of a handling system is defined as the load at which the prime mover of a power-operated system stalls or the power to the prime mover is automatically released.

The stall load is the maximum pulling load that the handling system may provide.

1.2.9 Pulling capacity limiter

A pulling capacity limiter is a device that prevents the hoist from handling loads in excess of its rated or allowed overload capacity.

1.3 Marking

1.3.1 Winch

An information plate is to be fitted on the winch, as specified in the relevant standard used for the winch detailed design.

The Rated Line Pull and the reeled layer associated are to be marked on the information plate.

Note 1: Example: RP 2500 kN at outer layer.

1.3.2 Jack

An information plate is to be fitted on the jack, as specified in the relevant standard used for the jack detailed design.

The Safe Working Load is to be marked on the information plate.

2 Constructional arrangements

2.1 Materials and welding

2.1.1 General

The handling systems, their foundations and local reinforcements on the hull of the offshore unit are considered as offshore areas according to the Offshore Rules. Therefore material selection is to be in accordance with Pt B, Ch 3, Sec 2 of the Offshore Rules and construction and welding are to be in accordance with NR426 Construction Survey of Steel Structures of Offshore Units and Installations.

2.1.2 Structural category

The load bearing structures of the handling systems and foundations are to be considered at least as first category elements according to the Offshore Rules, Pt B, Ch 3.

2.1.3 Design temperature and steel grade selection

The design temperature to be considered for steel grade selection is to be as per Part B, Ch 3, Sec 2 of the Offshore Rules.

2.2 Bolting

2.2.1 Bolting used for load carrying connections are to comply with NR526, Section 2, [1.7].

3 Structural assessment

3.1 Allowable stress

3.1.1 General

The equipment and their foundations are to comply with allowable stress criteria defined in Offshore Rules, Pt B, Ch 3, Sec 3, [5] and transcribed below.

3.1.2 Criteria

The equivalent stress σ_c is not to exceed the allowable stress σ_a, for the loading condition considered, according to the following formula:

$\sigma_c \leq \sigma_a$

where:

σ_a : Allowable stress, given by:

$\sigma_a = 1,1\ \alpha\ R_f$

R_f : Material reference stress defined in Offshore Rules, Pt B, Ch 3, Sec 3, [5]

σ_c : Equivalent stress defined in Offshore Rules, Pt B, Ch 3, Sec 3, [5]

α : Basic allowable stress factor defined in [3.1.3].

3.1.3 Basic allowable stress factor

The basic allowable stress factor α is to be taken as follows:

a) In general:
- for load case 1 ("static"): $\alpha = 0,6$
- for load case 2 ("design"): $\alpha = 0,8$
- for load case 3 ("accidental"): $\alpha = 1,0$

with the load cases 1, 2 and 3 as defined in Offshore Rules, Pt B, Ch 2, Sec 3

b) For specific calculations:
- for load case 4 ("testing"): $\alpha = 0,9$

with the load case 4 as defined in Offshore Rules, Pt B, Ch 2, Sec 3.

3.1.4 Very fine mesh criteria

Where the stresses are obtained through a very fine mesh Finite Element Model, the above criteria may be replaced by the criteria defined in Offshore Rules, Pt B, Ch 3, Sec 3, [5.4.3].

3.2 Buckling

3.2.1 The equipment and their foundations are to comply with buckling check defined in Offshore Rules, Pt B, Ch 3, Sec 3, [6].

3.3 Fatigue

3.3.1 If deemed necessary, the equipment and their foundations are to comply with fatigue check defined in Offshore Rules, Pt B, Ch 3, Sec 3 [7].

3.3.2 In this case, the justification of the long term distribution of fluctuating stress is to be provided.

4 Winches and windlasses

4.1 Application

4.1.1 Applicable requirements for winches and windlasses are given in NR526. In particular NR526, Section 7 is to be applied to the design of winches, except when notified otherwise in the present Note.

4.2 Detailed design

4.2.1 The equipment detailed design is to be in accordance with recognized standards. The list of technical standards used is to be submitted by the party applying for classification.

The following calculation notes are to be submitted for information:

- drum yielding and buckling strength analysis
- shaft and other structural elements yielding strength analysis
- bearings capacity assessment
- gearing system and other load transmission components capacity assessment
- frame yielding and buckling strength analysis
- assessment of bolted connection to foundation with regards to bending moment and shear
- other components along the way of the load bearing path.

4.3 General requirements

4.3.1 Rated line Pull

The Rated line Pull with the relevant layer associated is specified by the party applying for classification, as defined in [1.2.3].

When the RP is specified at the outer layer, a pulling capacity limiter is to be fitted as described in [4.3.8].

4.3.2 Winch ropes

The Minimum Breaking Load of the winch rope is to be not less than η x RP, where η is a safety factor given in Tab 1.

Winch ropes intended to mooring lines or risers installations are to comply with [4.3.3].

Winch wire rope is to be adequately protected against corrosion.

Table 1 : Rope safety factor

Item	Safety factor η
steel wire rope	3
fibre rope	4,5
Note 1: Lower values of safety factors may be accepted by the Society when duly justified. **Note 2:** For mooring line installation, safety factors are defined in [4.3.3].	

4.3.3 Chains intended for mooring lines and risers installation

Chains intended for mooring lines and risers installation are to have a minimum breaking load of not less than μ x RP, where μ is a safety factor given in Tab 2, and providing that the requirements below are fulfilled:

a) The installation system is normally seldom used.

b) A detailed analysis of the pull-in loads is performed and submitted to the Society for review. This analysis is to take into account the following:

- the maximum floating unit excursion during mooring line installation
- the maximum floating unit motion during mooring line installation
- the maximum pull-in speed of the pull-in system at the considered loads
- an evaluation of the dynamic amplification loads.

c) The pull-in system is equipped with an overload control system

d) The proof load of the chain is not to be less than the minimum static brake capacity of the windlass or, in case of hydraulic system, to the load corresponding to the maximum pressure in hydraulic circuit before the Pressure Safety Valve (PSV) relief, which ever is the greatest.

Table 2 : Safety factor for chains intended for mooring lines and risers installation

Item	Safety factor μ
Chain	1.7

4.3.4 Rope attachment to the drum

The rope attachment to the winch drum shall be provided by means of a weak link or equivalent.

4.3.5 Static brake

Self-powered winches and windlasses which can be operated under load are to be provided with an efficient static brake with a minimum holding capacity at least equal to the one shown on Tab 3.

For winches the minimum brake capacity is to be effective on the reel layer at which the RP is defined.

Table 3 : Minimum static brake capacity

RP of winch, in kN	Minimum holding capacity
RP < 200	1,5 RP
200 ≤ RP ≤ 500	1,2 RP + 60 kN
RP > 500	1,32 RP

4.3.6 Gear system design

The gear system is to satisfy the requirements of Pt C, Ch 1, Sec 6 of the Offshore Rules.

For gear system operating at low speed, the following design verifications are to be provided:

- tooth root bending stress
- tooth contact stress.

The allowable contact stress may be specially considered by the Society.

4.3.7 Gear system material

Gear system material specifications are to be provided by the manufacturer according to the provisions of the NR216.

4.3.8 Pulling capacity limiter

When the RP is specified at the outer layer of a winch, a pulling capacity limiter is to be fitted. The setting of the limiter is to be such as to allow the overload tests defined in Sec 3 but without exceeding the overload test values, with a tolerance of ± 0,5% RP.

The limiter is to be of indirect acting type, i.e. switching off the energy supply of the pulling drive when the overload value is reached. For this purpose, the capacity limiter system is to include a pulling load monitoring sensor or equivalent.

4.4 Structural analysis

4.4.1 Loading conditions

The loading conditions to be considered for the calculation of both equipment and foundations are defined in Tab 4.

4.4.2 Design pulling loads

The design pulling loads are to be applied at the most unfavorable positions on the drum for the design of equipment and foundations. In particular, the applications of the design pulling loads on first and outer layers at each end of the drum are to be investigated.

In addition, possible dissymmetry of reactions between drive side and free side is to be taken into account, and combined with the rope location to maximize the reaction loads on each assessed element (shaft, bearing, frame and foundations).

4.4.3 Allowable stress

Allowable stress is given in [3.1].

Table 4 : Loading conditions

Loading conditions	Load cases	Design pulling loads	Environmental loads **(1)**
Transit - equipment stowed	Design	None	Extreme situation
Normal operation - static **(2)**	Static	Rated line Pull	None
Normal operation - dynamic **(2)**	Design	Rated line Pull including dynamic effects due to environmental loads	Extreme situation
Extreme condition	Design	Minimum brake capacity	Extreme situation
Accidental condition **(3)**	Accidental	Maximum brake capacity	Accidental situation

(1) Applicable to the design of the equipment foundation and as defined in applicable rules for the situation specified. Dynamic loads for equipment design are normally included in the design pulling load.

(2) When the Rated line Pull includes the dynamic effects due to environmental loads, normal operation - dynamic is to be considered. In this case, the Society may require a relevant analysis to be submitted.

(3) Applicable for design allowing maximum brake capacity exceeding 125% of the minimum brake capacity.

5 Sheaves

5.1 Application

5.1.1 Applicable requirements for sheaves are given in NR526. In particular NR526, Section 5 is to be used for the design except when notified otherwise in the present Note.

5.2 Detailed design

5.2.1 The equipment detailed design is to be in accordance with recognized standards. The list of technical standards used is to be submitted by the party applying for classification.

In particular, the following calculation notes are to be submitted for information:

- shaft yielding strength analysis
- bearings capacity assessment
- frame yielding and buckling strength analysis
- assessment of bolted connection to foundation with regards to bending moment and shear.

5.3 Structural analysis

5.3.1 Loading conditions

The loading conditions to apply for the structural assessment of sheaves and their foundations are similar to the loading conditions defined for the driving equipment.

5.3.2 Design pulling loads

The design pulling loads to apply on the sheave are to be similar to the design pulling loads defined for the driving equipment.

In general, the resulting design pulling load is to be taken equal to twice the design rope tension (assuming 180° warping angle).

When restrictions with respect to rope arrangement is given by the designer (turn-down sheave for instance), the resulting design load may be reduced accordingly.

Note 1: If the sheave is specified by the party applying for classification with an SWL greater than the RP of the winch, special considerations will be given by the Society.

5.3.3 Allowable stress

Allowable stress is given in [3.1].

6 Chain jacks and strand jacks

6.1 Application

6.1.1 Applicable requirements for hydraulic cylinders are given in NR526. In particular NR526, Section 8 is to be applied to the design of hydraulic systems, except when notified otherwise in the present Note.

6.2 Detailed design

6.2.1 The equipment detailed design is to be in accordance with recognized standards. The list of technical standards used is to be submitted by the party applying for classification.

Relevant calculation notes are to be submitted to the Society for information.

6.3 General requirements

6.3.1 Hydraulic systems

Hydraulic installations are to be in accordance with Offshore Rules, Pt C, Ch 1.

6.3.2 Strand cable

The safety coefficient for strand cables is to be taken equal at least to 3.

6.4 Structural analysis

6.4.1 Loading conditions

The loading conditions to be considered for the calculation of both equipment and foundations are defined in Tab 5.

6.4.2 Design pulling load

The design pulling load is to be applied in accordance with:

- chain direction for chain jack
- strand cable direction for strand jack.

6.4.3 Allowable stress

Allowable stress is given in [3.1].

Table 5 : Loading conditions

Loading conditions	Load cases	Design pulling loads	Environmental loads **(1)**
Transit - equipment stowed	Design	None	Extreme situation
Normal operation - static **(2)**	Static	Nominal pulling load	None
Normal operation - dynamic **(2)**	Design	Nominal pulling load including dynamic effects due to environmental loads	Extreme situation
Extreme condition	Design	Load corresponding to the max pressure in hydraulic circuit before Pressure Safety Valve (PSV) relief	Extreme situation

(1) Applicable to the design of the equipment foundation and as defined in applicable rules for the situation specified. Dynamic loads for equipment design are normally included in the design pulling load.

(2) When the nominal pulling load includes the dynamic effects due to environmental loads, normal operation - dynamic is to be considered. In this case, the Society may require a relevant analysis to be submitted.

7 Lattice type structure

7.1 Application

7.1.1 Applicable requirements for lattice type structure which are part of the handling system are given in Offshore Rules Pt B, Ch 3, Sec 3.

7.2 Detailed design

7.2.1 Strength of lattice type structures is to be assessed using codes or standards recognised by the Society, such as American Institute of Steel Construction's Specification for Structural Steel Buildings (AISC) or API RP 2A

7.2.2 The list of technical standards used is to be submitted by the party applying for classification.

7.2.3 The following calculation notes are to be submitted for information:

- yielding and buckling strength analysis
- assessment of bolted connection to foundation with regards to bending moment and shear.

7.3 Structural analysis

7.3.1 Loading conditions

The loading conditions to apply for the structural assessment of lattice structures are the loading conditions applicable to the foundation of the driving equipment, as defined in [4] to [6].

7.3.2 Design pulling loads

The design pulling loads to apply on the lattice structure are to be similar to the design pulling loads defined for the driving equipment.

7.3.3 Structural members connections

The design of the members connections is to comply with a recognised standard such as API RP 2A.

8 Other equipment

8.1 Detailed design

8.1.1 The detailed design of handling systems not covered by the previous Articles are to be in accordance with recognized standards. The list of technical standards used is to be submitted by the party applying for classification.

If deemed necessary, the Society may require the calculation note of the load bearing components for information.

SECTION 3 TESTING

1 Handling systems testing

1.1 Application

1.1.1 The handling systems covered by the present Note are to be tested at the manufacturer's workshop (FAT) and after installation on board the unit as per Tab 1 and procedures defined in this Section.

1.2 Testing procedure

1.2.1 Testing is to be performed as requested in [1.4] to [1.6]. Equivalent testing based on recognised standards may be accepted by the Society on a case-by-case basis.

1.2.2 Attendance of a Society's surveyor is required for each test unless otherwise agreed.

1.2.3 After completion of each test, a thorough visual examination of the equipment is to be performed and a test report including load record and inspection results is to be produced by the party applying for classification and submitted by the Society.

1.3 Standardized equipment

1.3.1 For standardized equipment defined in Sec 1, [3.1.5], only functional tests with no load are requested.

1.4 Winch system testing

1.4.1 Rope installation on the winch

The wire or fiber rope is to be installed on the winch drum in compliance with good workmanship.

It is strongly recommended that spooling of the rope on the winch drum is performed with a minimum tension as specified by the rope manufacturer.

Note 1: Generally, a constant tension of minimum 10% of the Rated line Pull is to be applied when reeling the rope.

For the proper forming of the wire rope on the drum, a complete reel-in and pay-out should be performed before testing.

1.4.2 Functional test with no load

The functional test with no load is carried out at maximum speed and in continuous operation for 5 minutes in each direction of rotation and for each gear change.

During testing, good operation of control device and oil tightness are checked.

1.4.3 Functional test under Rated Line Pull

The functional test under Rated Line Pull (RP) applied to the relevant layer is carried out at nominal speed for 30 minutes while hoisting and lowering a load corresponding to the RP.

As far as practicable, the test is to ensure a complete rotation of drum under load. The pause between two consecutive cycles should not exceed 20 seconds.

In case the length of wire rope used for testing differs from final wire rope, attention is to be paid to the test load applied in order to obtain the design value of torque on the winch.

Moreover, if the winch is fitted with fixed ratio change-speed gear, good operation of the winch are to be checked for 5 minutes for each speed ratio with the maximum working load corresponding to each ratio. Upon each speed change-over, automatic application of the brake are to be checked when the control lever is on the neutral position.

If the winch is fitted with a continuous speed variator, a test of speed variation is to be carried out over the whole range of the possible speeds.

After these tests, several dynamic tests of the operation of the brake (at least two when the winch is recovering and two when the winch is rendering) are to be carried out at the maximum service speed.

A cut off in the power supply to the motor and the control device is to be simulated and the coming into operation of the braking device is to be checked in both cases.

The emergency stop is to be tested when the test load is lowered at its maximum speed.

During testing, the following elements are checked or measured:

- satisfactory operation
- oil-tightness
- bearing temperature
- power input
- actual speeds for recovering and rendering
- efficient working of the braking device which must operate without sudden shocks.

Note 1: Testing with a non-gravitational load may be allowed subject to Society approval.

1.4.4 Dynamic overload test

The dynamic overload test is to be carried out during two hoisting/lowering cycles at least, without speed condition, with a load equal to the RP increased by the overload value defined in Tab 2. The static brake is to be applied with the load being stopped at least once during each lowering phase.

The pulling force is to be monitored using a calibrated load cell.

Note 1: Testing with a non-gravitational load may be allowed subject to Society approval.

Table 1 : Testing of equipment

Equipment	Tests to be carried at the manufacturer's workshop (FAT) **(1)**	Test to be carried out on-board
Winches	a) Functional test with no load as per [1.4.2] b) Functional test under RP as [1.4.3] c) Dynamic overload test as per [1.4.4] d) Static braking test as per [1.4.6] **(3)** e) Pulling capacity limiter test as per [1.4.7]	a) Functional test with no load b) Static overload test as per [1.4.5]
Chain jacks	a) Functional test with no load as per [1.5.1] b) Functional test under load as per [1.5.2] c) Overload test as per [1.5.3] d) Hydraulic test as per [1.5.4]	a) Functional test with no load b) Overload test, at least for one of each representative chain jack foundation design
Strand jacks	Tests are defined on case by case	Tests are defined on case by case
Deck and turndown sheaves	Overload test to be done for at least one of each representative deck sheaves and turndown sheaves. Test to be conducted as per [1.4.4]. **(2)**	a) Functional test with no load b) Overload test, at least for one of each representative deck sheaves and turndown sheave foundations design

(1) Refer to [1.3.1].

(2) When the sheave is designed for operation with both wire rope and chain, overload test is to be carried out with each representative loadings, using representative wire rope and chain.

(3) It is recommended to use a wire rope dedicated to testing with end termination identical to the definitive one.

Table 2 : Overload value

RP, in kN	Overload
RP < 200	25%
200 ≤ RP ≤ 500	50 kN
RP > 500	10%
Note 1: For jacks, RP is to be replaced by SWL.	

1.4.5 Static overload test

A static overload test may replace the dynamic test defined in [1.4.4] when conducted onboard the unit. For the purpose of this test, the winch is to pull on a proper anchor point fixed to the unit structure with a load equal to the RP increased by the overload value defined in Tab 2.

The pulling force is to be monitored using a calibrated load cell. The test is to be performed in several stages with increments of the load at each stage. At each intermediate stage the load is to be held for at least one minute. On the final stage, when overload value is reached, the load is to be held for at least 5 minutes with the motorization stopped in order to test the braking system.

1.4.6 Static braking test

For the statical test of the braking system, a force equal to the holding capacity as defined in Sec 2, [1.2.5] is to be applied for 5 minutes to the reeled layer at which the RP is specified. This test is achieved by inactivating the motorization and by pulling with an external actuator.

Drum does not rotate during testing.

1.4.7 Pulling capacity limiter test

When fitted, the pulling capacity limiter is to be tested by hoisting a load in excess of the overload value defined in Tab 2 and checking that the motorization is stopped and the brake applied. The pulling capacity limiter test may be combined with the overload test.

1.5 Chain jack system testing

1.5.1 Functional test with no load

The functional test with no load is carried out at maximum speed during 5 minutes in pay-out and pull-in directions.

During testing, good operation of control device and oil tightness are checked.

1.5.2 Functional test under load

The functional test under Safe Working Load is carried out at nominal speed for 30 minutes while hoisting and lowering a load corresponding to the SWL.

Emergency stop is to be checked during functional test under load.

After testing, a thorough inspection of the chain stopper device including measurements of the deformation is to be performed.

Note 1: Testing with a non-gravitational load may be allowed subject to Society approval.

1.5.3 Overload test

The overload test is to be carried out for two pull-in /pay-out cycles with a load equal to the SWL increased by the overload value in Tab 2.

During testing, good operation of control device, mechanism and structure are checked.

This overload test may be replaced by a static overload test subject to Society approval.

1.5.4 Hydraulic test

Hydraulic components are to be tested under hydrostatic pressure at least equal to 1,5 times the design pressure, as specified in NR526, Section 10. The testing pressure is to be applied during 30 minutes at least.

During testing, good operation of control device and oil tightness are checked.

1.6 Strand jack system testing

1.6.1 Strand jack system testing is to be defined on a case-by-case basis.

SECTION 4 IN-SERVICE SURVEY

1 General

1.1 Application

1.1.1 Requirements provided in the present Section for in-service surveys are applicable to handling systems for which the additional class notation **OHS** is granted.

1.1.2 In-service surveys are based on the provisions of Pt A, Ch 2 of Offshore Rules for offshore units and Part A, Ch 5 of Ship Rules for Ships, including the survey periodicity.

1.1.3 When the equipment is not used for a long period, the Owner may apply for a lay-up procedure as defined in [3].

1.1.4 Requirements of the present Note covers handling systems permanently and non-permanently onboard.

1.2 Non-permanent equipment

1.2.1 Non-permanent equipment means equipment not remaining onboard during the operation of the unit but installed periodically for the purpose of specific works related to mooring lines or risers.

1.2.2 The Owner is to inform the Society about any equipment or part of equipment which is returned onshore for storage, modifications, repair or maintenance.

1.2.3 As a rule, the equipment is to be tested onshore after modifications, repair or maintenance, in accordance with the workshop tests defined in Sec 3.

1.2.4 A release statement will be issued upon satisfactory completion of tests and visual examination, subject to satisfactory installation onboard the unit and examination during the forthcoming class survey. The release statement is to be maintained onboard the unit for verification during classification surveys.

1.3 Service record book

1.3.1 The Owner is to establish and maintain a service record book for each handling system covered by the notation **OHS**. The service record book is to contain all service and maintenance operations.

1.3.2 The service record book is to be available onboard and presented to the Society surveyor during periodic inspection.

2 Survey of handling systems

2.1 Annual survey

2.1.1 The annual survey consists as a minimum in the following:

- visual examination of the winches including: drums, end flanges, reduction gears and brakes
- visual examination of the sheaves
- visual examination of the chain jacks and strand jacks
- visual examination of the equipment foundations including related reinforcements of the structure
- general examination of the hydraulic and electric systems
- inspection of the wire ropes, as defined in [2.3]
- inspection of the installation chains, as defined in [4.1]
- functional test with no load of the winches in order to detect vibration, leaks, shocks or sticking points and to check emergency stop and alarms
- functional test with no load of the braking systems
- functional test with no load of the chain jacks and strand jacks
- functional test of the sheaves
- functional test of the turndown sheaves, as far as practicable.

2.1.2 The review of Owner's service record books is to be carried out. The purpose is to ensure that:

- periodical testing of the equipment has been carried out in accordance with relevant standards, when applicable
- eventual repair, maintenance or replacement of equipment or components are done in accordance with applicable standards.

2.1.3 When applicable, the review of release statements since the previous class survey is to be carried out. Concerned equipment is to be inspected at the satisfaction of the surveyor.

2.1.4 When the equipment is laid-up, the survey system defined in [3] is to be applied.

2.2 Class renewal survey

2.2.1 In addition to the items of annual survey, the class renewal survey consists as a minimum in the following:

- verification of the equipment condition with disassembly as deemed necessary
- Control of the safety devices with disassembly as deemed necessary
- examination of wire ropes as defined in [2.3]
- winch static overload test according to Sec 3.

3 Wire and fibre ropes

3.1 Rope inspection

3.1.1 Wire and fibre ropes are to be inspected to check or to detect:

- corrosions or chemical attacks
- wear condition, especially on curved portions
- broken wires or strands
- deformation or straining of wires and strands (wire extrusions, kinks, protusions of core, bends, flattened portions, etc.)
- local increase or decrease in rope diameter
- condition of rope terminations inclusive of winch end fastenings.

3.1.2 The end termination of rope is to be carefully examined to detect corrosion due to infiltration into the rope sockets.

3.1.3 After examination, the wire rope must be suitably cleaned and lubricated according to manufacturer specification.

3.1.4 If any defect as defined in [3.2] is detected on the wire rope during inspection, the wire rope is to be replaced.

3.2 Rope discard criteria

3.2.1 The wire ropes must be discarded and replaced in the following cases:

- when damages such as wire extrusions, kinks, core protusions, bends, flattened portions, increase or decrease in diameter, etc., are noticed
- when the sectional area of the outer wires is reduced by 40% due to wear or corrosion
- when internal corrosion is noticed
- when a strand is broken
- when the number of broken wires results in 5% reduction of the metal sectional area of the rope on a rope length equal to 10 times its diameter. For application of this criterium, wires highly corroded or deformed and those which have reached the wear limit of 40% mentioned above are to be considered as broken.

3.2.2 The above criteria are given for guidance. Reference can also be made to the standard ISO 4309-2004: "Wire rope for lifting appliances - Code of practice for examination and discard", which gives detailed particulars in this respect.

Each time deemed necessary, the Surveyor may require replacement of a wire rope before the discard criteria are entirely met.

4 Installation chains

4.1 Chain inspection

4.1.1 Chains are to be inspected to check or to detect:

- corrosion or chemical attack
- wear condition
- reduction in diameter
- missing stud for studlink chains.

4.1.2 If any defect as defined in [4.2] is detected on the chain during inspection, the chain or the defective part of the chain is to be replaced.

4.2 Chain discard criteria

4.2.1 As a rule, for studless or studlink chains, a link is to be considered as defective if one of the following criteria is not satisfied:

- the average of the two measured diameters (90 degrees apart) is to be more than 95% of the as-built diameter
- diameter in any direction is to be more than 90% of the as-built diameter.

4.2.2 In the case of chains design taking into account a corrosion margin, the following criteria should be fulfilled: the lowest measured diameter D_m should be higher than the as-built diameter D reduced by the total design corrosion margin C:

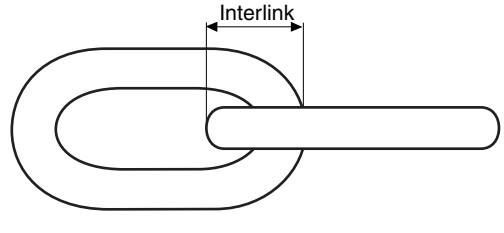
- $D_m > 95\% (D - C)$

4.2.3 At least one measurement at the interlink (See Fig 1) and one in an other location visually judged as the worst should be performed.

For criteria at interlink, consideration on fabrication tolerance should be given.

4.2.4 For studlink chain, if a stud is missing, the link is considered as defective.

Figure 1 : Interlink measurement



5 Lay-up and re-commissioning

5.1 General principles

5.1.1 When the equipment is not used for a long period, the Owner may apply for a lay-up procedure.

An equipment put out of commission may be subject to specific requirements for maintenance of class, as specified below, provided that the Owner notifies the Society of the fact.

5.1.2 The lay-up maintenance program provides for a "laying- up survey" to be performed at the beginning of lay-up and subsequent "annual lay-up condition surveys" to be performed in lieu of the normal annual surveys which are no longer required to be carried out as long as the equipment remains laid-up. These surveys are to be carried out in the presence of a Society surveyor.

The other periodical surveys which become overdue during the lay-up period may be postponed until the re-commissioning of the equipment.

5.1.3 Where the equipment has an approved lay-up maintenance program and the period of class of the offshore unit expires, the equipment lay-up period is extended until it is re-commissioned.

5.1.4 The minimum content of the lay-up maintenance program as well as the scope of the decommissioning, annual lay-up condition and recommissioning surveys are to be submitted to the Society for approval.

The annual lay-up condition survey shall contain, through a lay-up log-book, the inspection items of the annual survey defined in [2.1] as deemed necessary.

The re-commissioning procedure shall contain, through a lay-up log-book, the inspection items of the Class renewal survey defined in [2.2], as deemed necessary.

5.1.5 During the lay-up period, the exposed part of the equipment are to be adequately protected and regularly inspected.

5.1.6 Lay-up and recommissioning operations are to be carried out in the presence of a Society surveyor.

When recommissioning of the equipment is carried out in emergency and the Society surveyor is not present, a report of the recommissioning inspection and tests is to be submitted to the Society.

APPENDIX 1 PADEYE DESIGN

Symbols

R_{eG} : Minimum specified yield stress, expressed, in MPa

P_L : Design load on padeye.

1 General

1.1 Application

1.1.1 This Appendix provides guidelines for the design of padeyes intented for lifting operations.

1.1.2 The prescriptive requirements provided in the present Appendix are for typical padeye design as shown on Fig 1. For padeye of an unusual type, the Society may require additional verifications.

1.2 Recognised standards

1.2.1 Standards and codes of practice recognised for padeye design are listed below:

- AISC 360-10, American Institute of Steel Construction
- EN 1993 - Eurocode 3 - Design of steel structure.

Other standards may be accepted by the Society on a case-by-case basis.

2 Padeye design

2.1 General

2.1.1 The slings shall be connected to the padeyes with shackles. Bow shackle with bolt is preferred. The padeye design is to allow sufficient space for sling end termination.

2.1.2 Typical lifting padeyes are to comply with the strength criteria specified in this Article. Padeyes with special design may need a local Finite Element Model to obtain the actual stresses.

2.1.3 Padeyes dimensions shown in Fig 1 are in mm.

2.1.4 As a rule, padeyes are to be slotted in the primary structure.

2.2 Geometry

2.2.1 In order to prevent lateral bending moments, padeyes should be aligned with the sling to the centre of lift, with a maximum manufacturing tolerance of ± 2,5°.

2.2.2 The diameter of holes in padeyes shall match the shackle used, clearance between shackle pin and padeye hole shall not exceed 6% of the nominal shackle pin diameter.

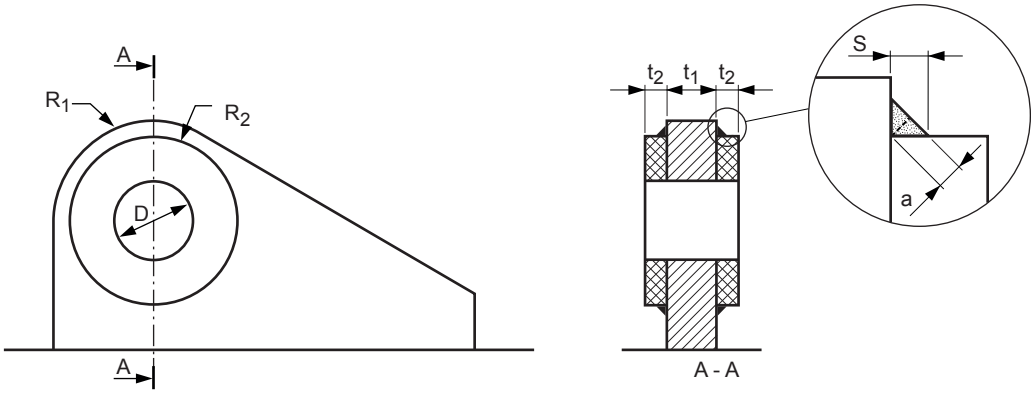
2.2.3 The tolerance between padeye thickness and inside width of shackle shall not exceed 25% of the inside width of the shackle.

2.2.4 Padeyes shall be so designed as to permit free movement of the shackle and sling termination without fouling the padeyes.

2.3 Welding

2.3.1 Welding of padeyes shall be made with 100% full penetration.

Figure 1 : Typical padeye



3 Design load

3.1 General

3.1.1 The design load on the padeye, P_L, is to consider the dynamic factors, uncertainties related to the cargo and consequence of member failure, as defined in the applied Rule or Standard.

In particular, the following may be considered:

- uncertainties about the cargo mass or centre of gravity location
- skew load due to uncertainties on the sling length or fabrication tolerances
- structural consequence factor, if any
- influence of cargo self-motions
- influence of external conditions
- Level of Non Destructive Testing applied on the padeye.

4 Structural assessment

4.1 General

4.1.1 Both the shear tear out, bearing pressure, Hertz contact stress and cheek plates welding criteria are to be satisfied.

4.2 Shear tear out

4.2.1 The shear tear out occurs in two directions.

The shear tear out stress is to comply with the below criterion:

$$\frac{P_L}{2\left[(R_1 \times t_1 + 2R_2 \times t_2) - \frac{D}{2}(t_1 + 2t_2)\right]} \leq 0.4R_{eG}$$

4.3 Diametrical bearing pressure

4.3.1 Diametrical bearing pressure is to comply with the below criterion:

$$\frac{P_L}{D_P \times (t_1 + 2t_2)} \leq 0.9R_{eG}$$

D_P : Pin diameter in mm.

4.4 Hertz contact stress

4.4.1 Hertz contact stress is to comply with the below criteria:

$$0.591\sqrt{\frac{P_L \times E \times (D - D_P)}{D \times D_P \times (t_1 + 2t_2)}} \leq 2.5R_{eG}$$

where:

E : Young's modulus (206 000 MPa for steel).

4.5 Cheek plates welding

4.5.1 When cheek plates are fitted on the padeye, the cheek welding stress is to comply with the below criterion:

$$\frac{P_L \times t_2}{a \times \pi R_2 \times (t_1 + 2t_2)} \leq 0.4R_{eG}$$

where:

a : weld throat in mm

4.6 Padeye foundations

4.6.1 Critical sections of the padeye are to be checked against combined stress. The Von Mises stress shall not exceed:

$\sigma_{VM} \leq 0{,}85\ R_{eG}$

4.7 Out of plane check

4.7.1 When the sling alignment requirements defined in [2.2.1] are not satisfied during lifting operations, out-of-plane loading conditions are to be checked using the above allowable stress.