



**BUREAU
VERITAS**

Anchor Windlass

June 2020

**Rule Note
NR 626 DT R03 E**



GENERAL CONDITIONS

1. INDEPENDENCE OF THE SOCIETY AND APPLICABLE TERMS

- 1.1 The Society shall remain at all times an independent contractor and neither the Society nor any of its officers, employees, servants, agents or subcontractors shall be or act as an employee, servant or agent of any other party hereto in the performance of the Services.
- 1.2 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.
- 1.3 The Society acts as a services provider. This cannot be construed as an obligation bearing on the Society to obtain a result or as a warranty. The Society is not and may not be considered as an underwriter, broker in Unit's sale or chartering, expert in Unit's valuation, consulting engineer, controller, naval architect, designer, manufacturer, shipbuilder, repair or conversion yard, charterer or shipowner; none of them above listed being relieved of any of their expressed or implied obligations as a result of the interventions of the Society.
- 1.4 The Society only is qualified to apply and interpret its Rules.
- 1.5 The Client acknowledges the latest versions of the Conditions and of the applicable Rules applying to the Services' performance.
- 1.6 Unless an express written agreement is made between the Parties on the applicable Rules, the applicable Rules shall be the Rules applicable at the time of entering into the relevant contract for the performance of the Services.
- 1.7 The Services' performance is solely based on the Conditions. No other terms shall apply whether express or implied.

2. DEFINITIONS

- 2.1 "Certificate(s)" means classification or statutory certificates, attestations and reports following the Society's intervention.
- 2.2 "Certification" means the activity of certification in application of national and international regulations or standards, in particular by delegation from different governments that can result in the issuance of a Certificate.
- 2.3 "Classification" means the classification of a Unit that can result or not in the issuance of a classification Certificate with reference to the Rules. Classification is an appraisal given by the Society to the Client, at a certain date, following surveys by its surveyors on the level of compliance of the Unit to the Society's Rules or to the documents of reference for the Services provided. They 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.
- 2.4 "Client" means the Party and/or its representative requesting the Services.
- 2.5 "Conditions" means the terms and conditions set out in the present document.
- 2.6 "Industry Practice" means international maritime and/or offshore industry practices.
- 2.7 "Intellectual Property" means all patents, rights to inventions, utility models, copyright and related rights, trade marks, logos, service marks, trade dress, business and domain names, rights in trade dress or get-up, rights in goodwill or to sue for passing off, unfair competition rights, rights in designs, rights in computer software, database rights, topography rights, moral rights, rights in confidential information (including know-how and trade secrets), methods and protocols for Services, and any other intellectual property rights, in each case whether capable of registration, registered or unregistered and including all applications for and renewals, reversions or extensions of such rights, and all similar or equivalent rights or forms of protection in any part of the world.
- 2.8 "Parties" means the Society and Client together.
- 2.9 "Party" means the Society or the Client.
- 2.10 "Register" means the public electronic register of ships updated regularly by the Society.
- 2.11 "Rules" means the Society's classification rules and other documents. The Society's Rules take into account at the date of their preparation the state of currently available and proven technical minimum requirements but are 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.
- 2.12 "Services" means the services set out in clauses 2.2 and 2.3 but also other services related to Classification and Certification such as, but not limited to: ship and company safety management certification, ship and port security certification, maritime labour certification, training activities, all activities and duties incidental thereto such as documentation on any supporting means, software, instrumentation, measurements, tests and trials on board. The Services are carried out by the Society according to the applicable referential and to the Bureau Veritas' Code of Ethics. The Society shall perform the Services according to the applicable national and international standards and Industry Practice and always on the assumption that the Client is aware of such standards and Industry Practice.
- 2.13 "Society" means the classification society "Bureau Veritas Marine & Offshore SAS", a company organized and existing under the laws of France, registered in Nanterre under number 821 131 844, or any other legal entity of Bureau Veritas Group as may be specified in the relevant contract, and whose main activities are Classification and Certification of ships or offshore units.
- 2.14 "Unit" means any ship or vessel or offshore unit or structure of any type or part of it or system 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.

3. SCOPE AND PERFORMANCE

- 3.1 Subject to the Services requested and always by reference to the Rules, the Society shall:
 - review the construction arrangements of the Unit as shown on the documents provided by the Client;
 - conduct the Unit surveys at the place of the Unit construction;
 - class the Unit and enter the Unit's class in the Society's Register;
 - survey the Unit periodically in service to note whether the requirements for the maintenance of class are met.The Client shall inform the Society without delay of any circumstances which may cause any changes on the conducted surveys or Services.
- 3.2 The Society will not:
 - declare the acceptance or commissioning of a Unit, nor its construction in conformity with its design, such activities remaining under the exclusive responsibility of the Unit's owner or builder;
 - engage in any work relating to the design, construction, production or repair checks, neither in the operation of the Unit or the Unit's trade, neither in any advisory services, and cannot be held liable on those accounts.

4. RESERVATION CLAUSE

- 4.1 The Client shall always: (i) maintain the Unit in good condition after surveys; (ii) present the Unit for surveys; and (iii) inform the Society in due time of any circumstances that may affect the given appraisal of the Unit or cause to modify the scope of the Services.
- 4.2 Certificates are only valid if issued by the Society.
- 4.3 The Society has entire control over the Certificates issued and may at any time withdraw a Certificate at its entire discretion including, but not limited to, in the following situations: where the Client fails to comply in due time with instructions of the Society or where the Client fails to pay in accordance with clause 6.2 hereunder.
- 4.4 The Society may at times and at its sole discretion give an opinion on a design or any technical element that would 'in principle' be acceptable to the Society. This opinion shall not presume on the final issuance of any Certificate or on its content in the event of the actual issuance of a Certificate. This opinion shall only be an appraisal made by the Society which shall not be held liable for it.

5. ACCESS AND SAFETY

- 5.1 The Client shall give to the Society all access and information necessary for the efficient performance of the requested Services. The Client shall be 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. Any information, drawing, etc. required for the performance of the Services must be made available in due time.
- 5.2 The Client shall notify the Society of any relevant safety issue and shall take all necessary safety-related measures to ensure a safe work environment for the Society or any of its officers, employees, servants, agents or subcontractors and shall comply with all applicable safety regulations.

6. PAYMENT OF INVOICES

- 6.1 The provision of the Services by the Society, whether complete or not, involve, for the part carried out, the payment of fees thirty (30) days upon issuance of the invoice.

6.2 Without prejudice to any other rights hereunder, in case of Client's payment default, the Society shall be entitled to charge, in addition to the amount not properly paid, interests equal to twelve (12) months LIBOR plus two (2) per cent as of due date calculated on the number of days such payment is delinquent. The Society shall also have the right to withhold Certificates and other documents and/or to suspend or revoke the validity of Certificates.

6.3 In case of dispute on the invoice amount, the undisputed portion of the invoice shall be paid and an explanation on the dispute shall accompany payment so that action can be taken to solve the dispute.

7. LIABILITY

- 7.1 The Society bears no liability for consequential loss. For the purpose of this clause consequential loss shall include, without limitation:
 - Indirect or consequential loss;
 - Any loss and/or deferral of production, loss of product, loss of use, loss of bargain, loss of revenue, loss of profit or anticipated profit, loss of business and business interruption, in each case whether direct or indirect.The Client shall defend, release, save, indemnify, defend and hold harmless the Society from the Client's own consequential loss regardless of cause.
- 7.2 Except in case of wilful misconduct of the Society, death or bodily injury caused by the Society's negligence and any other liability that could not be, by law, limited, the Society's maximum liability towards the Client is limited to one hundred and fifty per-cents (150%) of the price paid by the Client to the Society for the Services having caused the damage. This limit applies to any liability of whatsoever nature and howsoever arising, including fault by the Society, breach of contract, breach of warranty, tort, strict liability, breach of statute.
- 7.3 All claims shall be presented to the Society in writing within three (3) months of the completion of Services' performance or (if later) the date when the events which are relied on were first discovered by the Client. Any claim not so presented as defined above shall be deemed waived and absolutely time barred.

8. INDEMNITY CLAUSE

8.1 The Client shall defend, release, save, indemnify and hold harmless the Society from and against any and all claims, demands, lawsuits or actions for damages, including legal fees, for harm or loss to persons and/or property tangible, intangible or otherwise which may be brought against the Society, incidental to, arising out of or in connection with the performance of the Services (including for damages arising out of or in connection with opinions delivered according to clause 4.4 above) except for those claims caused solely and completely by the gross negligence of the Society, its officers, employees, servants, agents or subcontractors.

9. TERMINATION

- 9.1 The Parties shall have the right to terminate the Services (and the relevant contract) for convenience after giving the other Party thirty (30) days' written notice, and without prejudice to clause 6 above.
- 9.2 In such a case, the Classification granted to the concerned Unit and the previously issued Certificates shall remain valid until the date of effect of the termination notice issued, subject to compliance with clause 4.1 and 6 above.
- 9.3 In the event where, in the reasonable opinion of the Society, the Client is in breach, or is suspected to be in breach of clause 16 of the Conditions, the Society shall have the right to terminate the Services (and the relevant contracts associated) with immediate effect.

10. FORCE MAJEURE

- 10.1 Neither Party shall be responsible or liable for any failure to fulfil any term or provision of the Conditions if and to the extent that fulfilment has been delayed or temporarily prevented by a force majeure occurrence without the fault or negligence of the Party affected and which, by the exercise of reasonable diligence, the said Party is unable to provide against.
- 10.2 For the purpose of this clause, force majeure shall mean any circumstance not being within a Party's reasonable control including, but not limited to: acts of God, natural disasters, epidemics or pandemics, wars, terrorist attacks, riots, sabotages, impositions of sanctions, embargoes, nuclear, chemical or biological contaminations, laws or action taken by a government or public authority, quotas or prohibition, expropriations, destructions of the worksite, explosions, fires, accidents, any labour or trade disputes, strikes or lockouts.

11. CONFIDENTIALITY

- 11.1 The documents and data provided to or prepared by the Society in performing the Services, and the information made available to the Society, are treated as confidential except where the information:
 - is properly and lawfully in the possession of the Society;
 - is already in possession of the public or has entered the public domain, otherwise than through a breach of this obligation;
 - is acquired or received independently from a third party that has the right to disseminate such information;
 - is required to be disclosed under applicable law or by a governmental order, decree, regulation or rule or by a stock exchange authority (provided that the receiving Party shall make all reasonable efforts to give prompt written notice to the disclosing Party prior to such disclosure).
- 11.2 The Parties shall use the confidential information exclusively within the framework of their activity underlying these Conditions.
- 11.3 Confidential information shall only be provided to third parties with the prior written consent of the other Party. However, such prior consent shall not be required when the Society provides the confidential information to a subsidiary.
- 11.4 Without prejudice to sub-clause 11.1, the Society shall have the right to disclose the confidential information if required to do so under regulations of the International Association of Classifications Societies (IACS) or any statutory obligations.

12. INTELLECTUAL PROPERTY

- 12.1 Each Party exclusively owns all rights to its Intellectual Property created before or after the commencement date of the Conditions and whether or not associated with any contract between the Parties.
- 12.2 The Intellectual Property developed by the Society for the performance of the Services including, but not limited to drawings, calculations, and reports shall remain the exclusive property of the Society.

13. ASSIGNMENT

- 13.1 The contract resulting from these Conditions cannot be assigned or transferred by any means by a Party to any third party without the prior written consent of the other Party.
- 13.2 The Society shall however have the right to assign or transfer by any means the said contract to a subsidiary of the Bureau Veritas Group.

14. SEVERABILITY

- 14.1 Invalidity of one or more provisions does not affect the remaining provisions.
- 14.2 Definitions herein take precedence over other definitions which may appear in other documents issued by the Society.
- 14.3 In case of doubt as to the interpretation of the Conditions, the English text shall prevail.

15. GOVERNING LAW AND DISPUTE RESOLUTION

- 15.1 These Conditions shall be construed and governed by the laws of England and Wales.
- 15.2 The Parties shall make every effort to settle any dispute amicably and in good faith by way of negotiation within thirty (30) days from the date of receipt by either one of the Parties of a written notice of such a dispute.
- 15.3 Failing that, the dispute shall finally be settled under the Rules of Arbitration of the Maritime Arbitration Chamber of Paris ("CAMP"), which rules are deemed to be incorporated by reference into this clause. The number of arbitrators shall be three (3). The place of arbitration shall be Paris (France). The Parties agree to keep the arbitration proceedings confidential.

16. PROFESSIONAL ETHICS

- 16.1 Each Party shall conduct all activities in compliance with all laws, statutes, rules, economic and trade sanctions (including but not limited to UN sanctions and EU sanctions) and regulations applicable to such Party including but not limited to: child labour, forced labour, collective bargaining, discrimination, abuse, working hours and minimum wages, anti-bribery, anti-corruption, copyright and trademark protection, personal data protection (<https://personaldataprotection.bureauveritas.com/privacypolicy>).
- Each of the Parties warrants that neither it, nor its affiliates, has made or will make, with respect to the matters provided for hereunder, any offer, payment, gift or authorization of the payment of any money directly or indirectly, to or for the use or benefit of any official or employee of the government, political party, official, or candidate.
- 16.2 In addition, the Client shall act consistently with the Bureau Veritas' Code of Ethics. <https://group.bureauveritas.com/group/corporate-social-responsibility>



**BUREAU
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RULE NOTE NR 626

NR 626 **Anchor Windlass**

SECTION 1 ANCHOR WINDLASS

Section 1 Anchor Windlass

1	General	3
1.1	Application	
1.2	Definitions	
1.3	Main particulars	
1.4	Case of smaller ships	
2	Performances and strength	3
2.1	General	
2.2	Continuous duty pull	
2.3	Temporary overload	
2.4	Hoisting speed	
2.5	Brake capacity (Holding Load) HL	
2.6	Prime mover system brake	
2.7	Chain stoppers	
2.8	Strength	
3	Materials and welding	4
3.1	General	
3.2	Cable lifters	
4	Powering systems	5
4.1	Hydraulic systems	
4.2	Electrical systems	
5	Operational safety	5
5.1	Protection of mechanical components	
5.2	Couplings	
6	Attachment to deck	5
6.1	Deck reinforcement under windlass chain stopper	
6.2	Additional requirements for windlasses located on fore deck	
7	Approval procedure	7
7.1	Plans and particulars to be submitted for review	
7.2	Workshop inspection and testing	
7.3	On-board working test of windlass	
7.4	Type approval	
7.5	Marking	
8	Alternative method to brake capacity test at workshop	8
8.1	General	
8.2	Minimum torque calculation	
8.3	Achieved torque	
8.4	Strength assessment	

SECTION 1

ANCHOR WINDLASS

Symbols

- R_{eH} : Minimum specified yield stress of the steel considered, in N/mm²
- R'_{lim} : Minimum yield stress of the aluminium alloy considered, in N/mm², to be taken equal to the minimum value, in welded condition, between $R'_{p0,2}$ (proof stress) and $0,7 R'_m$ (tensile strength), where $R'_{p0,2}$ and R'_m are defined in NR561 Hull in Aluminium Alloys, Design Principles, Construction and Survey.

1 General

1.1 Application

1.1.1 The anchor windlasses of ships covered by NR467 and NR600 are to comply with the requirements of the present Note.

Note 1: NR467 Rules for the Classification of Steel Ships,

NR600 Hull Structure and Arrangement for the Classification of Cargo Ships less than 65 m and Non Cargo Ships less than 90 m.

1.1.2 In addition, the design, construction and testing of windlasses are to comply with a recognized standard or code of practice.

The following recognized standards are given as examples:

- SNAME T & R Bulletin 3-15: 2018 - Guide to the Design and Testing of Anchor Windlasses for Merchant Ships
- ISO 7825: 2017 - Deck machinery general requirements
- ISO 4568: 2006 - Shipbuilding - Sea-going vessels - Windlasses and anchor capstans
- JIS F6714: 1995 - Windlasses

Standards not listed above may be considered by the Society on a case-by-case basis.

To be considered acceptable, the standard or code of practice is to specify criteria for stresses, performance and testing.

1.2 Definitions

1.2.1 Windlass

A windlass is a winch designed to wind or unwind chains of ships anchors.

1.2.2 Cable lifter

A cable lifter is a special socketed wheel fitted on the windlass, designed to receive and drive the anchor chain. It should have at least five snugs and be declutchable from the drive.

1.3 Main particulars

1.3.1 The windlass is to be power driven and suitable for the size of chain cable and the mass of the anchors.

1.3.2 The windlass is to be fitted in a suitable position in order to ensure an easy lead of the chain cables to and through the hawse pipes.

1.3.3 For each chain cable, a chain stopper is normally fitted, arranged between windlass and hawse pipe.

1.4 Case of smaller ships

1.4.1 In mechanically propelled ships of less than 200 t gross tonnage, a hand-operated windlass or one of the cargo winches may be accepted, provided the requirements relative to the brake capacity and strength (see [2.5] and [2.8]) are satisfied, and that the hoisting power and speed are demonstrated to be sufficient and suitable for the mass of the associated chain and anchor.

2 Performances and strength

2.1 General

2.1.1 The windlass is to achieve the following minimum performances in order to efficiently and safely conduct its main functions.

2.2 Continuous duty pull

2.2.1 The windlass prime mover is to be able to exert for at least 30 minutes a continuous duty pull, Z_{cont} , in kN, corresponding to the grade and diameter, d , in mm, of the chain cables as follows:

- for anchorage depth D , in m, not greater than 82,5m, Z_{cont} is to be taken equal to Z_{cont1} , as given in Tab 1
- for anchorage depth D , in m, greater than 82,5m, Z_{cont} is to be taken equal to:

$$Z_{cont} = Z_{cont1} + (D - 82,5) 2,7 \cdot 10^{-4} d^2$$

Note 1: The value of Z_{cont} is based on the hoisting of one anchor at a time, with the effects of buoyancy and hawse pipe efficiency (taken equal to 70%) accounted for.

Table 1 : Continuous duty pull

Grade of chain	Z_{cont1}
Q1	0,0375 d^2
Q2	0,0425 d^2
Q3	0,0475 d^2

2.3 Temporary overload

2.3.1 The windlass prime mover is to be able to provide the necessary temporary overload for breaking out the anchor. This temporary overload or "short term pull" is to be at least 1,5 times the continuous duty pull Z_{cont} applied for at least 2 minutes.

2.4 Hoisting speed

2.4.1 The mean speed of the chain cable during hoisting of the anchor and cable is to be at least 0,15 m/s. For testing purposes, the speed is to be measured over two shots of chain cable and initially with at least three shots of chain (82,5 m in length) and the anchor submerged and hanging free.

2.5 Brake capacity (Holding Load) HL

2.5.1 A windlass brake is to be provided with sufficient capacity (holding load HL) to stop the anchor and the chain cable when paying out, and during all other stages of mooring maneuvers.

2.5.2 The capacity of the windlass brake HL, in kN, is to be sufficient to withstand the loads as defined in NR467, Pt B, Ch 9, Sec 4, [2.5] or NR600, Ch 5, Sec 4, [4.1.2], as applicable.

2.5.3 Alternatively, at the request of the interested parties, if duly justified, other values of windlass brake capacity may be accepted by the Society on a case by case basis. HL is to be therefore verified by test and/or calculations at the satisfaction of the Society and this acceptance is to be formally documented on an annex to the Classification certificate.

2.5.4 HL is to be assessed, among other performances to be reached, either during workshop/facilities tests or by calculations.

2.6 Prime mover system brake

2.6.1 The prime mover system of the windlass is to be capable of withstanding, without slipping, a static load exerted on the cable-lifter equal to 1,3 times the continuous duty pull Z_{cont} when the control drive system is in the neutral position (off), and/or when the power supply has been cut-off. Thus, electric windlasses are to be provided with an automatic brake control system.

2.7 Chain stoppers

2.7.1 Where a chain stopper is fitted, it is to be able to withstand a pull of 80% of the breaking load of the chain, without any permanent deformation of the stressed parts.

2.7.2 A chain stopper designed to a recognized national or international standard may be accepted provided its service experience is considered satisfactory by the Society.

2.8 Strength

2.8.1 In general, the stress level in each load-bearing part of a windlass under continuous duty pull (see [2.2]) is not to exceed 40% of R_{eH} or R'_{lim} .

2.8.2 The stress level in each load-bearing part of a windlass loaded at brake capacity (see [2.5]) is not to exceed R_{eH} or R'_{lim} (no permanent deformation allowed).

2.8.3 The design of the drive train, including prime mover, reduction gears, bearings, clutches, shafts, cable lifter, keyways, bolting and other stress raisers is to consider the dynamic effects of sudden stopping and starting of the prime mover or chain cable so as to limit inertial load.

3 Materials and welding

3.1 General

3.1.1 The characteristics of the materials to be used in the construction of windlass, the general requirements relevant to fabrication by welding and the qualification of welding procedures are to comply with the applicable requirements of NR216 Materials and Welding.

3.1.2 Windlass and chain stoppers may be cast components or fabricated from plate materials. The material in cast components shall be cast steel or nodular cast iron with elongation at break not less than 18%. Plate material in welded parts shall be of grade as given in Tab 2.

Table 2 : Steel grades for plates

Plate thickness t, in mm	Normal strength structural steel	High strength structural steel
t < 20	A	AH
20 < t < 25	B	AH
25 < t < 40	D	DH
40 < t < 150	E	EH

Note 1: For plates above 40mm joined with fillet / partial penetration welds, grade D will normally be accepted.

3.2 Cable lifters

3.2.1 Cable lifter shafts and cable lifters with couplings shall be made from materials as stated in Tab 3.

Table 3 : Cable lifters

	Chain cable diameter < 46mm	Chain cable diameter > 46mm
Cable lifters and couplings	Nodular cast iron or special iron	Cast steel
Cable lifter shaft	Forged or rolled steel, cast steel	

4 Powering systems

4.1 Hydraulic systems

4.1.1 Hydraulic systems, when employed for driving windlasses, are to comply with the provisions of NR467, Pt C, Ch 1, Sec 10, [14].

4.2 Electrical systems

4.2.1 Electrical systems, when employed for driving windlasses, are to comply with the provisions of NR467, Pt C, Ch 2, Sec 4.

4.2.2 Rotating machines of 100 kW and over are to be type approved or case-by-case approved and surveyed by the Society during testing and, if appropriate, during manufacturing. Tested machines are to be individually certified by the Society.

4.2.3 Where gears are fitted, they are to comply with the provisions of NR467, Pt C, Ch 1, Sec 6, and those rated 100 kW and over are to be certified.

5 Operational safety

5.1 Protection of mechanical components

5.1.1 To protect mechanical parts including component housings, a suitable protection system is to be fitted to limit the speed and torque at the prime mover. Consideration is to be given to a means to contain debris consequent to a severe damage of the prime mover due to over-speed in the event of uncontrolled rendering of the cable, particularly when an axial piston type hydraulic motor forms the prime mover.

5.2 Couplings

5.2.1 Windlasses are to be fitted with couplings which are capable of disengaging between the cable lifter and the drive shaft. Hydraulically or electrically operated couplings are to be capable of being disengaged manually.

6 Attachment to deck

6.1 Deck reinforcement under windlass chain stopper

6.1.1 Local reinforcement of deck structure is to be provided in way of windlass and chain stopper, and designed in accordance with:

a) Windlass

Brake capacity as defined in [2.5], associated to:

- for steel and aluminium structure: a permissible stress equal R_{eH} or R'_{lim}
- for composites materials structure: safety coefficient as defined in NR600, Ch 5, Sec 4, [4.1.4].

b) Chain stopper

Design load as defined in [2.7], associated to:

- for steel and aluminium structure: a permissible stress equal to R_{eH} or R'_{lim}
- for composites materials structure: safety coefficient as defined in NR600, Ch 5, Sec 4, [4.1.4].

6.1.2 As far as practicable, deck reinforcements are to be in line with the windlass frame, for proper load transmission.

6.2 Additional requirements for windlasses located on fore deck

6.2.1 General

Additional requirements provided under this sub-article apply only to windlasses located within the forward quarter length of the ship.

These requirements apply to all ship types of sea going service of length 80 m or more, where the height of the exposed deck in way of the item is less than 0,1 L or 22 m above the summer load waterline, whichever is the lesser.

Where mooring winches are integral with the anchor windlass, they are to be considered as part of the windlass.

The strength of deck framing and hull structure supporting the windlass and its securing bolt loads as defined in [5.2.2] is to be checked according to relevant criteria in NR467, Ch 7, Sec 1 or NR467, Ch 7, Sec 2 or NR467, Ch 7, Sec 3, as applicable.

6.2.2 Loading

The following pressures and associated areas are to be applied (see Fig 1):

- 200 kN/m² normal to the shaft axis and away from the forward perpendicular, over the projected area in this direction
- 150 kN/m² parallel to the shaft axis and acting both inboard and outboard separately, over the multiple of f times the projected area in this direction, where:

$$f = 1 + B / H, \text{ without being greater than } 2,5$$

B : Width of windlass measured parallel to the shaft axis

H : Overall height of windlass.

Forces in the bolts, chocks and stoppers securing the windlass to the deck are to be calculated. The windlass is supported by N bolt groups, each containing one or more bolts, see Fig 2.

The axial force R_i in bolt group (or bolt) i, positive in tension, may be calculated from:

$$R_{xi} = (P_x h x_i A_i) / I_x$$

$$R_{yi} = (P_y h y_i A_i) / I_y$$

$$R_i = R_{xi} + R_{yi} - R_{si}$$

where:

A_i : Cross sectional area of all bolts in group i, in cm²

h : Shaft height above the windlass mounting, in cm

I_x : $\sum A_i x_i^2$ for N bolt groups

I_y : $\sum A_i y_i^2$ for N bolt groups

- P_x : Force, in kN, acting normal to the shaft axis
- P_y : Force, in kN, acting parallel to the shaft axis, either inboard or outboard whichever gives the greater force in bolt group i
- R_{si} : Static reaction at bolt group i, due to weight of windlass
- x_i, y_i : x and y coordinates of bolt group i from the centroid of all N bolt groups, positive in the direction opposite to that of the applied force, in cm.

Shear forces F_{xi} , F_{yi} applied to the bolt group i, and the resultant combined force F_i may be calculated from:

$$F_{xi} = (P_x - \alpha g M) / N$$

$$F_{yi} = (P_y - \alpha g M) / N$$

$$F_i = (F_{xi}^2 + F_{yi}^2)^{0.5}$$

Where:

- α : Coefficient of friction, taken equal to 0,5
- g : Gravity acceleration, taken equal to 9,81 m/s²

M : Mass of windlass, in tonnes

N : Number of bolt groups.

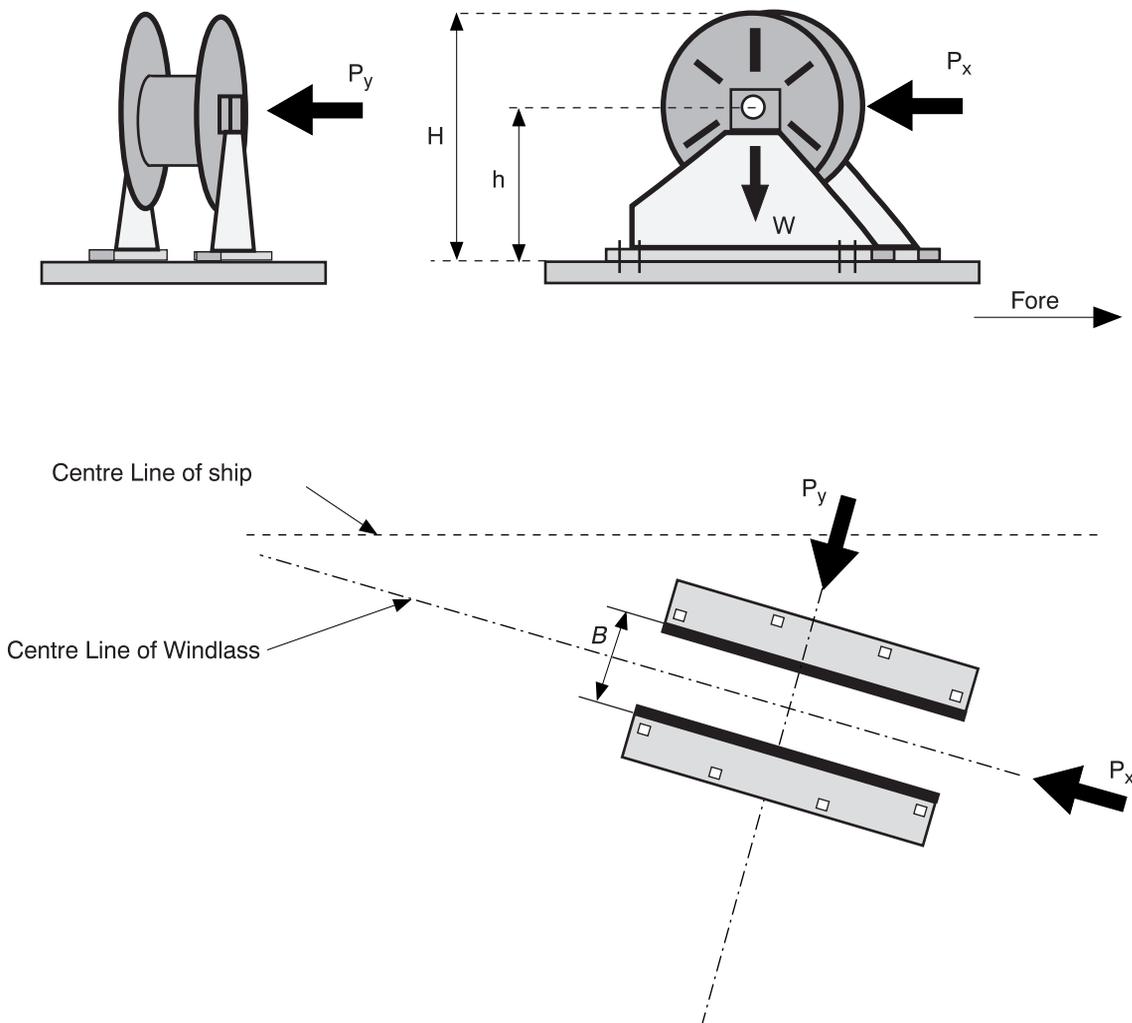
The design of the supporting structure are to take also into account the axial tensile and compressive forces R_{xir} , R_{yir} , R_{ir} and lateral forces F_{xir} , F_{yir} , F_{ir} calculated for bolt groups according to formulae above.

6.2.3 Strength requirements

Tensile axial stresses in the individual bolts in each bolt group i are to be calculated. The horizontal forces F_{xi} and F_{yi} are normally to be reacted by shear chocks. Where "fitted" bolts are designed to support these shear forces in one or both directions, the von Mises equivalent stresses in the individual bolts are to be calculated, and compared to the stress under proof load. Where pour-able resins are incorporated in the holding down arrangements, due account is to be taken in the calculations.

The safety factor against bolt proof strength is to be not less than 2,0.

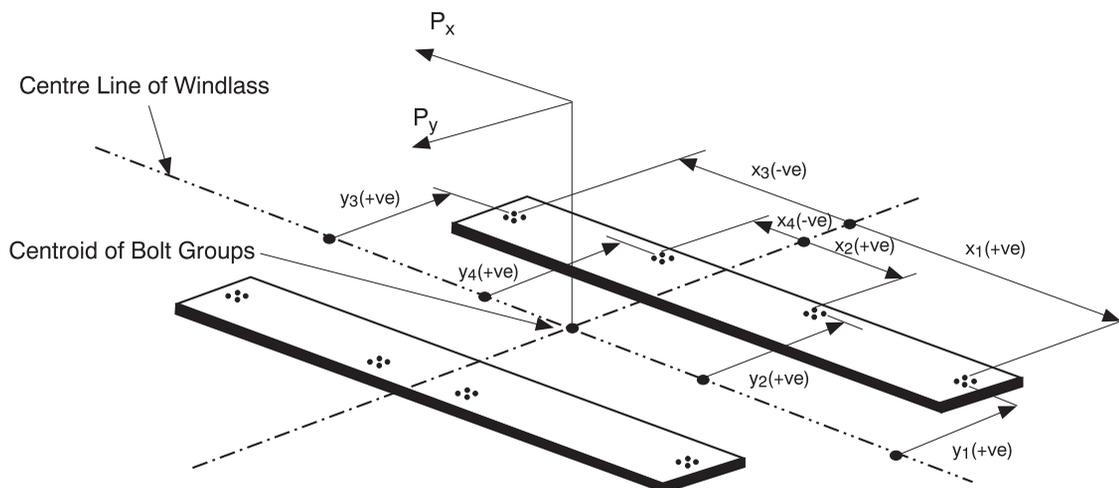
Figure 1 : Direction of forces and weight



Note that P_y is to be examined from both inboard and outboard directions separately - see [6.2.2].

The sign convention for y_i is reversed when P_y is from the opposite direction as shown.

Figure 2 : Sign convention



Coordinates x_i and y_i are shown as either positive (+ve) or negative (-ve).

7 Approval procedure

7.1 Plans and particulars to be submitted for review

7.1.1 The following plans showing the design specifications, the standard of compliance, engineering analyses and details of construction, as applicable, are to be submitted to the Society for evaluation:

- Windlass technical specifications; anchor and chain cable particulars (diameter and steel grade); main performances; design anchorage depth; standard of compliance
- Windlass arrangement plan showing all of the components of the anchoring/mooring system such as the prime mover, shafting, cable lifter, anchors and chain cables; mooring winches, wires and fairleads, if they form part of the windlass machinery; brakes; controls; etc
- Dimensions, materials, welding details, as applicable, of all torque-transmitting components (shafts, gears, clutches, couplings, coupling bolts, etc.) and all load bearing components (shaft bearings, cable lifter, sheaves, drums, bed-frames, etc.) of the winch, where applicable, including brakes, chain stopper (if fitted) and foundations
- Hydraulic piping system diagram along with system design pressure, safety valves arrangement and setting, material specifications for pipes and equipment, typical pipe joints, technical data and details of hydraulic motors, as applicable
- Electric one line diagram along with cable specification and size; motor controller; protective device rating or setting; as applicable
- Control, monitoring and instrumentation arrangements
- Engineering analyses for torque-transmitting and load-bearing components demonstrating their compliance with

recognized standards or codes of practice. Analyses for gears are to be in accordance with a recognized standard

- Windlass foundation structure, including under deck supporting structures, and holding down arrangements
- Plans and data for windlass electric motors including associated gears rated 100 kW (135 hp) and over
- Calculations demonstrating that the windlass prime mover is capable of attaining the hoisting speed, the required continuous duty pull, and the overload capacity are to be submitted if the workshop load test is not carried out according to [6.2.5]
- Operation and maintenance procedures for the anchor windlass are to be incorporated in the vessel operations manual.

7.2 Workshop inspection and testing

7.2.1 General

Windlasses are to be inspected during fabrication at the manufacturers' facilities by a Surveyor for compliance with the approved plans.

7.2.2 Material

Material certificates of the main structural parts, including main shaft and brake are to be available.

7.2.3 Prime mover

Each prime mover is to be tested at the shop to verify its ability to meet the power, speed and braking capacity, as required in [2.2], [2.3], [2.4] and [2.6].

For electric motors of more than 50 kW, Type Approval documents must be available.

For hydraulic windlass, the hydraulic system is to be tested at 1,5 times the maximum working pressure. In addition to the hydraulic motor, the hydraulic pump is also to be tested at the shop. During the testing, the input/output torque, speed, delivery pressures and flow rates of the pump and the hydraulic motor are to be measured, as appropriate.

7.2.4 No-load test

The windlass is to be run without load at nominal speed in each direction for a total of 30 minutes. If the windlass is provided with a gear change, additional run in each direction for 5 minutes at each gear change is required.

7.2.5 Load test

The windlass is to be tested to verify that the continuous duty pull, temporary overload and hoisting speed as specified in [2.2], [2.3] and [2.4] can be attained.

Where the manufacturer's shop does not have adequate facilities to perform these tests, the following procedure is to be followed:

- The windlass manufacturer is to submit calculations to the Society for review in order to demonstrate the windlass performances and strength. For the purpose of these calculations the stresses in each torque-transmitting component are not to exceed 40% of R_{eH} or R'_{lim} of the material under duty pull loading condition (see [2.2]), or 60% of R_{eH} or R'_{lim} of the material under temporary overload condition (see [2.3])
- The load tests, including the adjustment of the overload protection, are to be carried out on board ship.

In this case, functional testing at the manufacturer's shop is to be performed under no-load conditions as per [7.2.4].

7.2.6 Brake capacity test

The holding Load of the brake is to be verified through testing, by applying for 2 min the required load, as defined in [2.5], on the cable-lifter.

During testing, the cable-lifter is to be disengaged from the prime mover system.

Upon testing, a visual inspection is to be carried out to check that there is no permanent deformation on the windlass structural and mechanical parts.

Where this test cannot be performed for practical reasons, the windlass manufacturer is to submit calculations to the Society for review. See details and guidance in [7].

7.3 On-board working test of windlass

7.3.1 General

The working test of the windlass is to be carried out on board in the presence of a Surveyor to demonstrate satisfactory operation.

Each unit is to be independently tested for braking, clutch functioning, lowering and hoisting of chain cable and anchor, proper riding of the chain over the chain lifter, proper transit of the chain through the hawse pipe and the chain pipe, and proper stowage of the chain and anchor.

It is to be confirmed that anchors properly seat in the stored position and that chain stoppers function as designed if fitted.

The test is to demonstrate that the windlass complies with the requirements of [2] and, in particular, that it works adequately and has sufficient power to weigh the bower anchor

at the required speed (excluding the housing of the anchor in the hawse pipe) when suspended to the maximum practicable length of chain cable.

The braking capacity is to be tested by intermittently paying out and holding the chain cable by means of the application of the brake. Where the available water depth is insufficient, the proposed test method will be specially considered.

Where a double windlass or two windlasses are fitted, the tests are to be performed on both sides.

7.4 Type approval

7.4.1 General

At the request of the manufacturers, windlass produced in series may be Type Approved.

To achieve type approval procedure, the first windlass unit is to be fully approved as per the present note requirements, including the load and brake tests. For each next unit, the following points will have to be checked by the Surveyor before certification can be granted individually:

- consistency with approved drawings (materials, design)
- no-load test at workshop
- working test on board.

7.5 Marking

7.5.1 Windlass shall be permanently marked with the following information:

- nominal size of the windlass (e.g. 100/3/45 is the size designation of a windlass for 100 mm diameter chain cable of grade 3, with a holding load of 45% of the breaking load of the chain cable)
- maximum anchorage depth, in metres.

8 Alternative method to brake capacity test at workshop

8.1 General

8.1.1 Where the brake capacity test is not possible or practical at the workshop, the manufacturer is to submit calculations to the Society for review, demonstrating that the windlass is capable of attaining the required performances listed in [2.5], including a strength assessment of every load bearing component.

8.2 Minimum torque calculation

8.2.1 The minimum braking torque t_{min} , in kN.m, to be achieved by the windlass brake in order to withstand the requested load HL defined in [2.5] can be expressed as follow in the case of ordinary drum brake design:

$$t_{min} = HL \cdot 0,5d_{cl}$$

where:

d_{cl} : Diameter of the cable-lifter, in m.

8.3 Achieved torque

8.3.1 General

The maximum torque achieved by the windlass brake, t_{actu} , in kN.m, is to be at least equal to t_{min} as defined in [8.2], so that:

$$t_{actu} \geq t_{min}$$

The achieved maximum torque may be calculated as follow:

$$t_{actu} = E \cdot 0,5 \cdot d_d$$

where:

- d_d : Brake drum diameter, in m
- E : Force tangential to the brake drum, in kN.

The calculation of E is proposed in [7.3.2] to [7.3.4] for the following typical drum brakes arrangements:

- fixed in one point (in point A on Fig 3)
- with two pivots (in points C and D on Fig 3)
- with one pivot (in point E on Fig 3)
- with a rod link (in point A on Fig 3).

For any other brake arrangement, the torque is to be calculated using an appropriate standard.

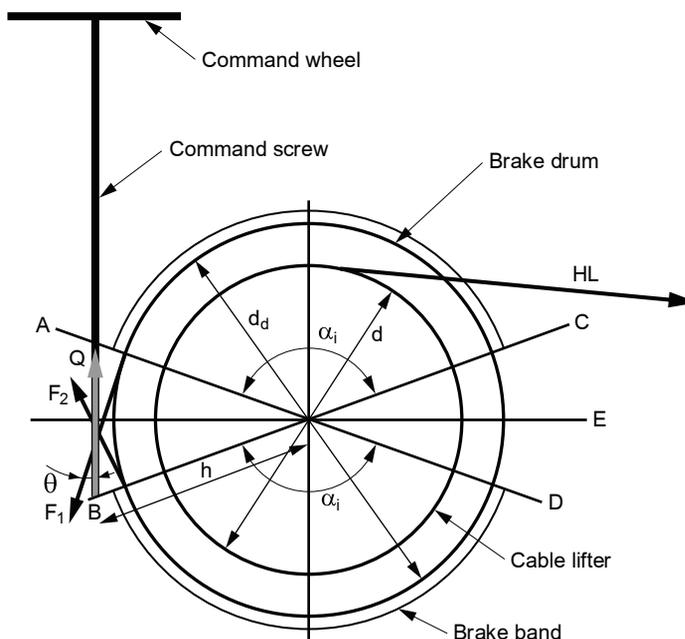
8.3.2 Calculations for brake arrangement with one fixed point

The loads in the various parts of the brake system may be calculated according to the formulae given in Tab 4.

Table 4 : brake system with one fixed point

Tangential force E, in kN	$E = F_1 - F_2$
Larger force F_1 , in kN (1)	$F_1 = F_2 \cdot e^{\alpha \rho}$
Smaller force F_2 , in kN (1)	$F_2 = \frac{Q \cdot \cos \theta \cdot h}{0,5 \cdot d_d}$
Force in the command screw Q, in kN (1)	$Q = \frac{2M_w \cdot (1 - \tan \beta \cdot f_s)}{d_s \cdot (\tan \beta + f_s)}$
Torque in the command wheel M_w , in kN.m	$M_w = F_c \cdot d_w$
(1) See Fig 3.	
Note 1: See Fig 3 for definition of θ , h and α	
β	: Angle, in degree, of the command screw thread
d_s	: Command screw mean diameter, in m, taken at the middle of the thread
d_w	: Command wheel diameter, in m
F_c	: Force applied on each side of the command wheel, in kN. In case of manual command, this force is to be taken not more than 0,1 kN
f_s	: Friction coefficient of the command screw, taken equal to 0,15 unless otherwise justified
ρ	: Friction coefficient between the brake band and the brake drum, taken equal to 0,25 unless otherwise justified by testing.

Figure 3 : Brake arrangement



- α : Total angle, in radian, of brake band coverage, taken as the sum of α_i
- h : Distance, in m, from the center of the brake drum to the command screw
- θ : Angle, in degree, between the command screw and the direction of F_1 force. May generally be taken equal to half the angle between points A and B.

8.3.3 Calculations for brake arrangement with one or two pivots

The loads in the various parts of the brake system may be calculated according to the formulae given in Tab 5.

8.3.4 Calculations for brake arrangement with a rod link

The loads in the various parts of the brake system may be calculated according to the formulae given in Tab 6.

8.4 Strength assessment

8.4.1 General

The maximum load in each part of the windlass is to be deduced from the maximum achieved torque t_{actur} in order to check that the stress is nowhere greater than the following admissible values:

$$\sigma_{all} = R_{eH}$$

$$\tau_{all} = \frac{R_{eH}}{\sqrt{3}}$$

A special attention is to be paid to pad eyes and pins and to the structures and frames they are welded to, to ensure proper structural continuity.

Table 5 : Brake system with one or two pivots

Tangential force E, in kN	$E = \frac{Q \cdot \cos\theta \cdot h}{0,5 \cdot d_d}$
Larger force F ₁ , in kN (1)	$F_1 = E \cdot \frac{e^{\alpha\rho}}{e^{\alpha\rho} - 1}$
Smaller force F ₂ , in kN (1)	$F_2 = F_1 \cdot E$
Force in the command screw Q, in kN (1)	$Q = \frac{2M_w \cdot (1 - \tan\beta \cdot f_s)}{d_s \cdot (\tan\beta + f_s)}$
Torque in the command wheel M _w , in kN.m	$M_w = F_c \cdot d_w$
(1) See Fig 3.	
Note 1: See Fig 3 for definition of θ , h and α See Tab 4 for definitions of ρ , β , f_s , d_s , d_w and F_c	

Table 6 : Brake system with a rod link

Tangential force E, in kN	$E = F_1 - F_2$
Larger force F ₁ , in kN (1)	$F_1 = F_2 \cdot e^{\alpha\rho}$
Smaller force F ₂ , in kN (1)	$F_2 = \frac{Q \cdot \cos\theta \cdot h}{0,5 \cdot d_d}$
Force in the command screw Q, in kN (1)	$Q = \frac{2M_w \cdot (1 - \tan\beta \cdot f_s)}{d_s \cdot (\tan\beta + f_s)} \cdot r$
Torque in the command wheel M _w , in kN.m	$M_w = F_c \cdot d_w$
(1) See Fig 3.	
Note 1: See Fig 3 for definition of θ , h and α See Tab 4 for definition of ρ , β , f_s , d_s , d_w and F_c See Fig 4 for definition of d_i , and d_e	
f_t	: Friction coefficient of the rod link toe, taken equal to 0,15 unless otherwise justified
r	: Ratio ℓ/L of the rod link, as shown on Fig 4.

8.4.2 Brake band pressure

In general, the pressure p_b , in kN/m², between the brake band and the brake drum is not to exceed the allowable pressure according to the band lining manufacturer's specification.

The value of p_b at maximum braking capacity is taken equal to:

$$p_b = \frac{E}{(\rho \cdot S_b)}$$

where:

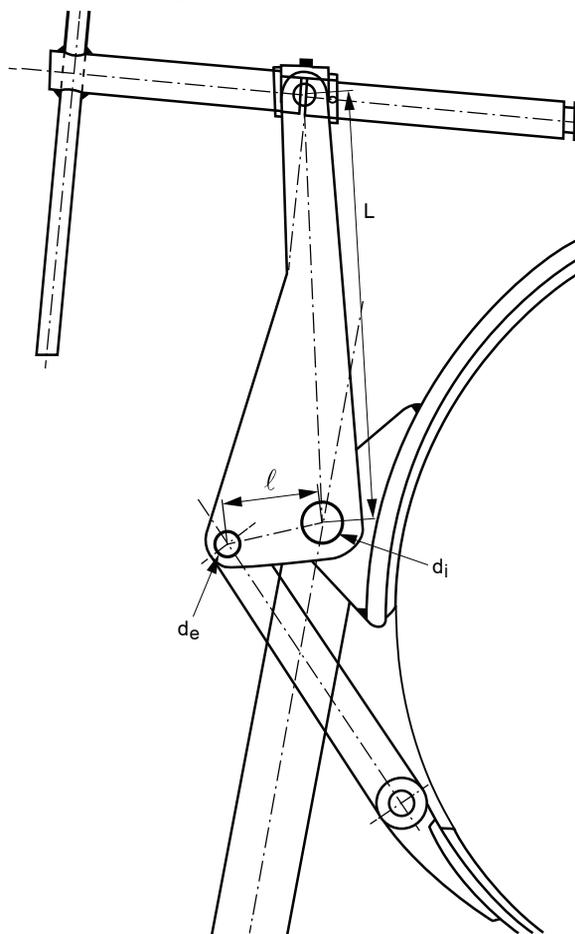
- E : Force tangential to the drum, as defined in [8.3.1]
- ρ : Friction coefficient between the brake band and the brake drum, as defined in Tab 4
- S_b : Contact surface, in m², between the brake band and the brake drum, taken equal to:

$$S_b = \frac{\alpha \cdot d_d \cdot b_b}{2}$$

where:

- α : Total angle of brake band coverage, as defined in Tab 4
- b_b : Band breadth, in m
- d_d : Brake drum diameter, in m.

Figure 4 : Rod dimensions



- d_e : Diameter, in m, of the rod link external pivot
- d_i : Diameter, in m, of the rod link internal pivot
- L, ℓ : Dimension, in m, of the rod link.



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Marine & Offshore
Le Triangle de l'Arche - 8 Cours du Triangle - CS 50101
92937 Paris La Defense Cedex - France
Tel: + 33 (0)1 55 24 70 00
<https://marine-offshore.bureauveritas.com/bv-rules>
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