
**Marine structures — Mobile offshore
units — Mooring positioning
windlasses and winches**

Structures maritimes — Unités mobiles au large — Treuils d'ancrage

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee 8, *Ships and marine technology*, Subcommittee 4, *Outfitting and deck machinery*.

This second edition cancels and replaces the first edition (ISO 9089:1985), which has been technically revised.

The main changes compared to the previous edition are as follows:

- Added no-load, nominal load, nominal speed, stalling/slipping load, anchor deployment (anchor dropping) speed limitation, anchor line length, speed and tension measurement, cable/wire rope stopper, ratchet mechanisms, etc. to the functional and operational requirements.
- Refined all sub-items in design and construction, and quantified the requirements of all indicators and formulae.
- Provided an overview of various tests, and specified test types, methods and requirements.
- Provided check items, sequence, qualification criteria for type inspection of mooring positioning windlass and winches.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Marine structures — Mobile offshore units — Mooring positioning windlasses and winches

1 Scope

This document specifies a classification, technical requirements and test methods, as well as designation, marking and documentation requirements for mooring positioning windlasses and winches of mobile offshore floating units, including drill-ships, semi-submersible drilling rigs, production platforms and offshore accommodation platforms.

It can be used as a reference for ship-shifting positioning winches of pipelaying, crane and pile-driving vessels.

This document is applicable to the design, manufacturing and acceptance testing of mooring positioning windlasses and winches.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1704, *Ships and marine technology — Stud-link anchor chains*

ISO 1968, *Fibre ropes and cordage — Vocabulary*

ISO 3108, *Steel wire ropes — Test method — Determination of measured breaking force*

ISO 3730, *Shipbuilding and marine structures — Mooring winches*

ISO 3828, *Shipbuilding and marine structures — Deck machinery — Vocabulary and symbols*

ISO 6336, *Calculation of load capacity of spur and helical gears*

ISO 6482, *Shipbuilding — Deck machinery — Warping end profiles*

ISO 7825:2017, *Shipbuilding — Deck machinery — General requirements*

ISO 9083, *Calculation of load capacity of spur and helical gears — Application to marine gears*

ISO 17893, *Steel wire ropes — Vocabulary, designation and classification*

ISO 18692, *Fibre ropes for offshore stationkeeping — Polyester*

IEC 60092, *Electrical installations in ships*

IEC 61892, *Mobile and fixed offshore units — Electrical installations*

API Spec 2F, *Specification for mooring chain*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3828 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1 mooring positioning windlass and winch

windlass and winch and associated electric control system used for mooring positioning of mobile offshore floating units, including windlass and winch bodies (chain wheels/drums, drives, braking systems, anchor deployment (anchor dropping) speed limiters, etc.), chain or wire rope stoppers, anchor line guides and electric control system

3.2 Right-hand (left hand) windlasses or winches

3.2.1 right-hand windlass or winch

windlass or winch where, in relation to an observer situated on the side of the prime mover, power supply or controller, the drive for the cable-lifter or drum is on the right of the cable-lifter or drum

Note 1 to entry: See [Figure 1](#).

3.2.2 left-hand windlass or winch

windlass or winch where, in relation to an observer situated on the side of the prime mover, power supply or controller, the drive for the cable-lifter or drum is on the left of the cable-lifter or drum

Note 1 to entry: See [Figure 2](#).

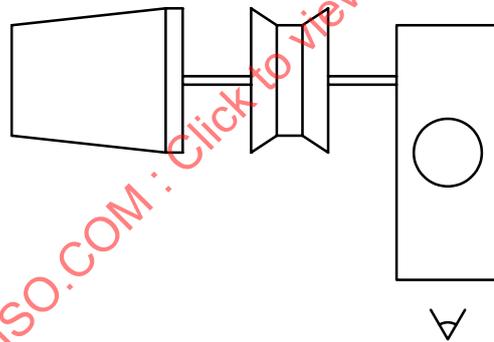


Figure 1 — Right-hand windlass or winch

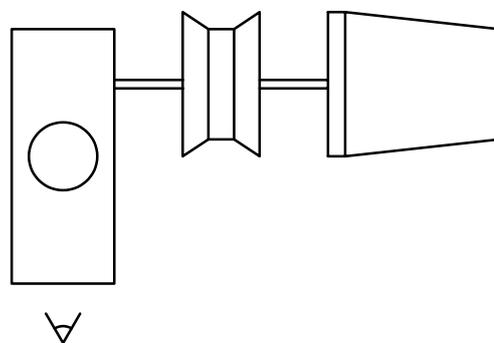


Figure 2 — Left-hand windlass or winch

3.3

nominal load

maximum chain or rope tension that the windlass or winch is able to maintain continuously when hauling at nominal speed, measured either at the cable-lifter exit, or at the rope exit of the first layer in the case of a drum

4 Classification of mooring positioning windlasses and winches

Mooring positioning windlasses and winches are divided into the following types according to functions and structural types.

- Type A — positioning windlass (positioning windlass with mooring chains).
- Type B — positioning winch (positioning winch with steel wire ropes).
- Type C — friction positioning windlass and winch (positioning winches with friction drum).
- Type D — positioning windlass and winch of combined mooring chains and steel wire ropes (positioning windlass and winch capable of hauling in both mooring chains and steel wire ropes).
- Type E — hoisting positioning windlass driven by the cylinder.

5 Functional and operational requirements

5.1 General

Windlass and winches shall meet the general requirements for mooring winches in ISO 3730.

5.2 No-load

The windlass and winch operating under no-load at nominal speed shall be free from abnormal vibration or noise; the hydraulic system shall act flexibly and reliably without oil seepage or leakage.

5.3 Nominal load

The nominal load of the windlass and winch shall meet the following requirements.

- a) The nominal load of the windlass and winch is recommended to be not less than one third of the minimum breaking load of the chain or wire rope. The nominal load of the anchor gear connected by a combination of the chain and wire rope shall be not less than one third of the breaking load of either design anchor or rope, whichever is the lesser.
- b) The windlass and winch operating under nominal load shall be free from abnormal vibration or noise; the hydraulic system shall act flexibly and reliably without oil seepage or leakage; the cable-lifter shall engage the chains well without chain jumping.
- c) The windlass and winch shall stop immediately during the emergency stop.

5.4 Nominal speed

The nominal speed shall be agreed upon between the manufacturer and the purchaser. If windlasses and winches are required to be used for temporary mooring of windlass on sea trial, the nominal hoisting speed shall be not less than 9 m/min.

5.5 Stalling load

The windlass and winch shall be equipped with a torque limiter; the stalling load shall be not less than 40 % of the minimum breaking load of mooring chains or wire ropes, the windlass and winch

shall have the capacity of maintaining the stalling load before the braking system acts, without speed requirements. The cable-lifter or drum shall not slip under 40 % of the breaking load of the anchor line and shall slip under 45 % of the breaking load of the anchor line. For winches, the stalling load shall be designed to refer to the maximum allowable number of layers of ropes configured.

5.6 Static braking

Each cable-lifter (drum) shall be fitted with two separate static braking systems, the static brake load of each system shall be sufficient to withstand at least 0,5 times the breaking load of the anchor line. For the winch, the brake capacity shall be designed to refer to the maximum allowable number of layers of ropes configured.

For each braking system under a braking condition, there shall be no slip of cable-lifter or drum or permanent deformation of the cable-lifter/drum, shaft, braking system and foundation bracket.

The operation of the power operating system of the braking system shall not be affected by a failure of the primary power source. The emergency release system of the braking system shall be provided with an emergency power source.

Ratchet and pawl mechanisms are not considered as static brakes.

5.7 Automatic braking

5.7.1 The motor-driven windlass and winch shall be provided with an automatic braking system. For the hydraulic motor-driven windlass and winch, the setup of an automatic braking system shall be agreed upon between the manufacturer and the purchaser.

5.7.2 An automatic braking system shall meet the following requirements.

- a) The static braking force of the prime mover braking system shall be capable of holding the torque induced by the line pull force at 0,5 times the breaking load of the anchor line.
- b) The braking system shall be capable of automatic braking instantly when the control handle is in the stop position or when the power supply fails.
- c) Braking shall be reliable, without the cable-lifter or drum slip and without any permanent deformation of the cable-lifter/drum, shaft, braking system and foundation bracket. If the hydraulically-driven windlass and winch without automatic braking system achieves the function only with a balanced valve, the anchor line slippage shall be not more than 1 m/min under the load.

5.8 Emergency release

5.8.1 The windlass/winch shall be able to carry out an emergency release of the anchor line within 10s when the platform is under mooring conditions.

5.8.2 The operation of an emergency release shall meet the following requirements.

- a) It shall be possible to limit the speed of the released anchor line and to apply and release one of the brakes, at least once, during the emergency release.
- b) The emergency release operating device shall be installed next to the windlass and winch, or chain or wire rope stopper, as well as within the safety zone of the central console (if equipped with a central console). After the emergency release, the braking system shall be capable of restoring its normal functions instantly. At all control places, the operation of the same controller shall realize the emergency release. The winch prime mover shall not re-operate automatically after an emergency release. The control handles and buttons for emergency release shall be provided with protections to avoid misoperation.

5.8.3 If the platform is fitted with a riser disconnecting system, when the riser is still connected to the platform, the anchor line shall not be released; the protection is provided to prevent misoperation resulting in an emergency release, but after the safety protection is removed manually, the riser at a connected state may still achieve the function of emergency release.

5.8.4 Electrical equipment for emergency release mechanism, if located in the hazardous zone, shall be certified safe type. The cooling water system where required shall be provided to effectively prevent any sparks due to emergency release of the anchor line. The system shall be kept pressurized and arranged for auto starting of the pump to ensure immediate availability of cooling water supply.

5.9 Anchor deployment (anchor dropping) speed limitation

Each windlass and winch shall be equipped with a set of anchor deployment (anchor dropping) dynamic brakes and have the sufficient capacity of anchor deployment (anchor dropping) speed limitation, to control the dynamic load due to anchor deployment, continuously pay out anchor lines, and result in no damage or overheat during anchor deployment (anchor dropping). The speed of the anchor deployment should not exceed 2,5 m/s.

5.10 Anchor line length, speed and tension measurement

5.10.1 The windlass and winch shall be equipped with means to measure the length and speed of each anchor line.

5.10.2 The windlass and winch shall be fitted with two sets of tension measuring devices which have been subjected to calibration. The minimum measurement accuracy of the anchor line tension measuring device shall not exceed 5 % of the entire range. Unless otherwise specified, the range of the tension measuring device shall satisfy 10 %-70 % of the breaking load of the anchor line.

5.11 Chain or wire rope stoppers

The windlass and winch may be fitted with chain or wire rope stoppers, as necessary.

- a) The chain or wire rope stopper shall be capable of withstanding the static load equal to the breaking load of the chain or wire rope.
- b) After the operation of an emergency release, the chain or wire rope stopper shall be capable of emergency release.
- c) The chain or wire rope stopper shall stop the anchor line at all times without chain or wire rope slip, and without any permanent deformation of the chain or wire rope stoppers and brackets.

5.12 Ratchet mechanisms

The cable-lifter or drum may be fitted with a ratchet mechanism, as necessary, which shall meet the following requirements.

- a) The ratchet mechanism is used for the maintenance of windlasses and winches, and for the prevention of the cable-lifter or drum rotation.
- b) The strength of the engaged ratchet shall be not less than the stalling load of the windlass and winch.

5.13 Operating system

The operating system shall meet the following requirements.

- a) The local and central consoles shall be reliably controlled, and one of them shall be visible; the local console shall be fitted with communication equipment.

- b) The direction of motion of the operating device shall be such that the anchor is hoisted by a clockwise movement at a hand-wheel or alternatively by a movement of a hand-lever towards the operator, and vice-versa. The operating hand-lever shall return to the stop position automatically after it is released. The direction of motion of the operating system shall be permanently marked.
- c) The action of brakes, clutches and chain or wire rope stoppers shall be correct, flexible and reliable, and these elements shall be provided with corrosion-resistant indicating plates with operation instructions.
- d) The console shall be fitted with instruments indicating the tension, length and speed of the mooring chains or wire ropes; the tension, length and speed indications of the anchor lines shall be correct.
- e) The recovery speed shall be capable of adjusting to the minimum steady speed so as to adjust the tension or to stow the anchor.
- f) The central console shall be fitted for a centralized monitor or control, and the automatic tension recorder of the anchor lines shall also be fitted, as necessary.
- g) The windlass and winch shall be fitted with audible and visual alarm devices, such as operation warning, overload, overspeed and anchor line terminals; for hydraulic drives, alarms for low oil level, high oil temperature and filter clogging shall be provided.

6 Design and construction

6.1 General

Windlass and winches shall meet the general requirements for deck equipment in ISO 7825.

6.2 Mooring anchor lines

- a) Mooring chains shall comply with ISO 1704 or API Spec 2F-1997, or meet the specifications of mooring chains used for oil drilling barges manufactured according to the user's special requirements.
- b) Wire ropes shall meet the following requirements:
 - in terms of support capacity, applicable safety factors shall be selected for different use cases in accordance with ISO 3108 and ISO 17893 or requirements of the user;
 - steel wire ropes are woven from high strength steel wire and rope core; match loading capacity and life of steel wire rope core with different use cases;
 - where high torsion moment induced by steel wire rope tension may cause torsion, untwisted steel wire rope of equal torque and opposite direction to the rope should be used;
 - the surface of steel wires shall be treated to be anti-corrosive via galvanization or other protective methods.
- c) Nylon and fibre ropes shall meet the requirements of ISO 1968 and ISO 18692, and are applicable to windlasses and winches for permanently moored production platform.

6.3 Cable-lifters

- a) The cable-lifter shall have at least 5 teeth, the slot width and tooth form shall be designed so that the connecting link can be passed through.
- b) The cable-lifter shall be capable of being disconnected from the drive.
- c) The cable-lifter shall be equipped with a belt brake wheel at its end. The braking surface may be smooth or treated to prevent rust.

6.4 Drums

- a) The drum diameter shall be not less than 16 times the diameter of the rope.
- b) The number of layers of rope reeled on the drum shall generally be not more than 7 layers. If it is more than 7 layers, the drum strength and stability shall be rechecked before submission to the relevant administrative authorities or classification societies for approval.
- c) The drum shall be capable of being disconnected from the drive.
- d) In case of release of wire ropes, the remaining reeling turns of the drum shall be not less than 3 turns. The strength of the wire rope fastened on the drum shall be about 0,25 times the breaking load of the wire rope.
- e) The drum shall be equipped with a belt brake wheel at its end. The braking surface may be smooth or treated to prevent rust.
- f) The drum strength shall be calculated when the maximum load is applied to the most unfavorable position of the drum.
- g) The drum flange height shall be determined in accordance with the following requirements.
 - For a winch with a rope guide, the drum shall be designed in such a way that when all the rope is reeled on the drum, the wire rope above the outermost layer does not project the flange height.
 - For a winch without a rope guide, it is recommended that the drum be provided with grooves. When all the rope is reeled on the drum, the flange shall project at least 1,5 times the rope diameter above the outermost layer. During design, layers of rope shall be superimposed directly upon each other without a half rope diameter offset between adjacent layers, the deflection angle of the rope shall be not more than 4° to avoid the superposition of ropes.

6.5 Friction winch drums

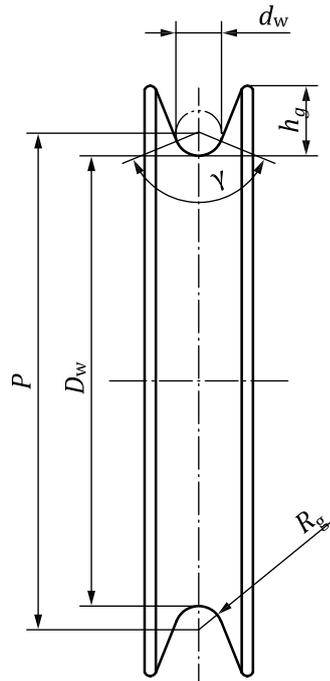
- a) The bottom diameter of the main drum groove and the diameter of the rope-storage drum shall be not less than 16 times the diameter of the wire rope.
- b) When all the rope is reeled on the rope-storage drum, the wire rope above the outermost layer shall not project the flange height.

6.6 Warping ends

The windlass and winch may be fitted with or without warping ends. If the windlass and winch are fitted with warping ends, their profile shall be in accordance with ISO 6482.

6.7 Anchor line guides

- a) Jockey sprocket
 - The jockey sprocket with teeth shall have at least 5 teeth; since the increase in tooth will reduce the stress and wear, the use of 7 or 9 teeth is recommended.
 - Guide sheaves of mooring chains without teeth shall be specially designed in each case.
- b) Guide sheave
 - Guide sheaves for wire rope shall have a minimum diameter of 16 times the wire rope diameter.
 - Grooves of guide sheaves shall comply with requirements of [Figure 3](#).



$$120^\circ \leq \gamma \leq 150^\circ$$

$$1,35 d_w \leq h_g \leq 1,75 d_w$$

$$R_g = 0,525 d_w$$

Figure 3 — Guide sheave groove

- c) The design wrap angle of the guide sheaves shall be $20^\circ \sim 90^\circ$, and the corner shall be $\pm 90^\circ$.
- d) The structural strength of the guide shall meet the requirements of the breaking load of the anchor line.
- e) The friction of the guide bearing shall be calculated.

6.8 Gears

The gear of the windlass and winch shall meet the following requirements.

- a) For involute cylindrical gears, the design and calculation of lifetime shall meet the requirements in ISO 6336 and ISO 9083.
- b) The gear life cycle shall be designed as at least 2 400 h (the service life of the platform is 20 years, travelling 5 times each year and working 24 h each time).
- c) The 2 400-hour life is distributed as follows:
 - 480 h for the maximum working load (40 % of the breaking load of the anchor line, with the stalling load of the windlass and winch considered);
 - 1 920 h for 70 % of the maximum working load (28 % of the breaking load of the anchor line).
- d) The safety factor of the gear is shown in [Table 1](#).

Table 1 — Safety factor of windlass and winch gear

Stress type	Safety factor
Root bending stress	1,4
Tooth face contact stress	1,0
Tooth surface abrasion	1,0

6.9 Drive equipment

Electrical drives and control equipment shall conform to the requirements of IEC 60092 and IEC 61892.

6.10 Strength requirements

- a) The strength requirements of the windlass and winch shall conform to [Table 2](#).

Table 2 — Design load and strength requirements of windlass and winch

Item	Anchor line load	Maximum equivalent stress σ_e shall not exceed the following value
Chain or wire rope stopper	S_{mbs}	$0,9\sigma_f$ (chain or wire rope stopper)
Brake	$0,5 S_{mbs}$ for each set of brakes	$0,9\sigma_f$
The ring rope body of the windlass and winch	$0,4 S_{mbs}$	$0,6\sigma_f$
Guide	S_{mbs}	$0,9\sigma_f$ (guide)

$\sigma_e = \sqrt{\sigma_1^2 + \sigma_2^2 - \sigma_1 \cdot \sigma_2 + 3\tau^2}$, where σ_1 and σ_2 are two main stresses on the main plane vertical to each other, τ is the shear stress on the plane formed by σ_1 and σ_2 .

σ_f is the minimum upper yield strength stress of the material, σ_b is the minimum tensile strength of the material, S_{mbs} is the minimum breaking load of the anchor line.

- b) When an emergency release is effected, the stresses shall not result in permanent deformation in any part.
- c) Fatigue calculation shall be made for components of more than 10 000 load cycles; the calculated stresses shall not be greater than 0,4 times the upper yield strength (ReH) or the 0,2 % yield strength, non-proportional extension (Rp0,2); components shall be designed for at least 10 years life.
- d) Attention shall be given to the followings when the stresses are calculated:
- the stress concentration of keyways and other heavily stressed parts;
 - the dynamic effects due to sudden start and stop of the prime mover or mooring chain;
 - the calculation method used when the stresses are calculated;
 - the relevant regulations of the user.

7 Test methods

7.1 General

The windlass and winch shall pass the tests specified in [7.3](#) to [7.13](#)

7.2 Test conditions

- a) The windlass and winch shall be a complete unit during the prototype tests, including machinery, electrical and hydraulic equipment. The manufacturer's test equipment conforming to the test requirements may be used for electrical and hydraulic controls.
- b) Before the tests, the manufacturing and assembly quality of the windlass and winch shall pass the inspection; the reduction box shall be subjected to run-in, lubricating oil grade and level shall conform to requirements; each lubricating point shall be filled with lubricating oil; the hydraulic system shall be filled with hydraulic fluid complying with the requirements after flushing.
- c) Test stands and special technological equipment shall be fitted for factory tests. Test stands shall be such that the travel of mooring chains at the exit of cable-lifters or the travel of wire rope at the drum exit is more than 6 m.
- d) Test instruments and meters shall be qualified for measurement and within validity period.

7.3 No-load test

The windlass and winch shall run for 60 min continuously at nominal speed, 30 min in each direction, and run for 5 min in each direction at the minimum steady speed adjusted before or after operation.

7.4 Nominal load test

Tests shall be carried out continuously for 30 min as factory tests and sea trials, during which the emergency stop shall be operated at least once to be checked.

7.5 Nominal speed test

The windlass and winch shall continuously run under nominal load.

7.6 Stalling load

The cable-lifter or drum shall engage the clutch, the braking system of the windlass or winch shall be released, the automatic braking system shall be released and the torque value shall be adjusted, to apply 40 % of the breaking load of the anchor line and 45 % of the breaking load of the anchor line separately. The results shall meet the requirements of [5.5](#).

7.7 Static braking load

The cable-lifter or drum shall disengage from the clutch, to apply a set of braking systems once tightly with the static braking load for 2 min. The results shall meet the requirements of [5.6](#).

7.8 Automatic braking

The cable-lifter or drum shall engage the clutch, the braking system of the windlass and winch shall be released, to apply the automatic braking system tightly with 50 % of the breaking load for 2 min. The results shall meet the requirements of [5.7](#).

An emergency release shall be operated during sea trial, for which the cooling water system shall be opened in advance to operate the emergency release device. The results shall meet the requirements of [5.8](#).

7.9 Anchor deployment (anchor dropping) speed limitation

The anchor deployment speed shall be limited by dynamic braking. The results shall meet the requirements of [5.9](#).