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D-02 WINDLASSES

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Foreword:

This Guide is a part of CCS Rules, which contains technical requirements, inspection and testing criteria related to classification and statutory survey of marine products.

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WINDLASSES

1 Application

1.1 This Chapter applies to windlasses of sea-going ships that are driven electrically or hydraulically or by steam or external forces.

1.2 The “windlass” referred to in this Chapter is to be understood as “windlass and anchor capstan”, where appropriate.

1.3 Windlasses combined with mooring winches are to be referred to Chapter 3 Winches of this PART in addition to this Chapter.

2 Normative references

2.1 The approval and inspection in this Chapter are to be based on the following documents:
(1) CCS Rules for Classification of Sea-going Steel Ships,
(2) CCS Rules for Materials and Welding,
(3) ISO 4568-2006 Shipbuilding – Sea-going vessels – Windlasses and anchor capstans.

3 Definitions

3.1 The definitions given in ISO 3828, ISO 4568 and CCS Rules for Classification of Sea-going Steel Ships are applicable to this Chapter.

3.2 For the purpose of this Chapter:
(1) Chain jumping is a phenomenon in weighing and casting the anchor by a windlass, i.e. one or more links of the chain cable jump(s) in the casting direction due to the chains being not properly engaged with the cable lifter. Chain jumping will have a large impact on the windlass.
(2) Chain blocking is a phenomenon in weighing the anchor by a windlass, i.e. the chain cable can not be normally disengaged from the cable lifter in the direction to the chain locker due to the cables being not properly engaged with the cable lifter. Chain blocking will have an impact on the hawse pipe and chain separator.

4 Plans and documents

4.1 The following plans and documents are to be submitted for approval:
(1) Main performance specifications;
(2) General assembly;
(3) Drawings of main parts (main shaft, transmission gearing, cable lifter, clutch, brake, frame and seating);
(4) Drawing of welded structure;
(5) Schematic diagrams of main systems (hydraulic system, electrically controlled system) and

safety alarm devices;
(6) Calculations;
(7) List of physical and chemical properties of main parts;
(8) test programme(If applicable)

4.2 The following plans and documents are to be submitted for information:
(1) Main acceptance criteria;
(2) Product instructions.

(3) Main technical documents(If applicable)

(4) Product nameplate

5 Materials and components

5.1 Materials and components are to comply with relevant requirements of CCS Rules
5.2 The following purchased parts of windlasses are to have the manufacturer's certificates:
(2) Gearboxes;
(6) Safety valves and solenoid valves.

5.3 The materials of the following purchased parts, if any, are to have CCS product certificates:
(1) Main shafts;
(2) Cable lifters.

6 Design and technical requirements

6.1 The technical requirements for windlasses are given in Table 6.1.

Table 6.1

No.	Items	Technical requirements	Basis of inspection	Remarks
1	Inclination angle of the ship	Heel ±15°, roll ±22.5° Trim ±5°, pitch ±7.5°	1.2.1.1 of PART THREE of CCS Rules for Classification of Sea-going Steel Ships	
2	Ambient temperature	-25℃ ~ 45℃	1.2.1.2 of PART THREE of CCS Rules for Classification of Sea-going Steel Ships	
3	Materials	Pressure components are to be made of steel, no brittle material is allowed	13.2.4 of PART THREE of CCS Rules for Classification of Sea-going Steel Ships	
		Materials containing asbestos are prohibited for brake band	SOLAS Reg. II-1/3-5	
4	Driving type	Driven by an independent prime mover, the normal work of the hydraulic windlass is not to be affected by other equipment connecting with its pipeline	13.2.5.1 of PART THREE of CCS Rules for Classification of Sea-going Steel Ships	
		For ships with single anchor weight not exceeding 250 kg, hand-operated windlass may be provided	13.2.5.1 of PART THREE of CCS Rules for Classification of Sea-going Steel Ships	
5	Working load	Class A1 stud link chains: 37.5 d^2 (N) Class A2 stud link chains: 42.5 d^2 (N) Class A3 stud link chains: 47.5 d^2(N)	13.2.5.2 of PART THREE of CCS Rules for Classification of Sea-going Steel Ships	Anchor casting depth (D) is to be less than 82.5m

Continued Table 6.1

		Class A1 stud link chains: $37.5d^2 + (D - 82.5) \times 0.27\ d^2$ (N) Class A2 stud link chains: $42.5\ d^2 + (D - 82.5) \times 0.27\ d_2$ (N) Class A1 stud link chains: $47.5\ d^2 + (D - 82.5) \times 0.27\ d^2$ (N)	13.2.5.2 of PART THREE of CCS Rules for Classification of Sea-going Steel Ships	Anchor casting depth (D) is to be more than 82.5m
6	Overload pull	Not to be less than 1.5 times the working load	13.2.5.2 of PART THREE of CCS Rules for Classification of Sea-going Steel Ships	
7	Nominal speed	Not to be less than 9 m/min.	13.2.6.3 of PART THREE of CCS Rules for Classification of Sea-going Steel Ships	
8	Withstand load	45% of breaking load of chain cables	13.2.5.5 of PART THREE of CCS Rules for Classification of Sea-going Steel Ships	Fitted with stopper
		80% of breaking load of chain cables	13.2.5.5 of PART THREE of CCS Rules for Classification of Sea-going Steel Ships	Not fitted with stopper
9	Driving power	Windlasses are to be capable of working continuously for 30 min under working load.	13.2.5.2(1)of PART THREE of CCS Rules for Classification of Sea-going Steel Ships	
		Windlasses are to be capable of working at least for 2 min at reduced speed under overload pull	13.2.5.2(2)of PART THREE of CCS Rules for Classification of Sea-going Steel Ships	
		Power-operated windlasses are to be reversible	13.2.5.3 of PART THREE of CCS Rules for Classification of Sea-going Steel Ships	
10	Chain cables	Stud link chains of 3 strength grades	Section 2, Chapter 10, PART ONE of CCS Rules for Materials and Welding	
11	Cable lifters	The cable lifter is to have at least 5 snugs and must be able to disengage with the driving device	4.2.1 of ISO 4568	
12	Warping ends	The windlass may be designed with or without warping ends, which may be fitted on the intermediate shaft or on the cable lifter shaft. The profile of warping ends is to be in compliance with the relevant standard	4.3.1 of ISO 4568	
13	Clutches	Clutches are to be installed between cable lifter and driving shaft. Power-operated clutches are to be capable of being disengaged manually and to have efficient locking devices	13.2.5.4 of PART THREE of CCS Rules for Classification of Sea-going Steel Ships	
14	Control braking device	The brake is to be capable of holding a load on the chain cable of 1.5 times the working load of the windlass. Electromagnetic brakes are to have a hand release device	4.5.1 of ISO 4568 2.6.4.1 of PART FOUR of CCS Rules for Classification of Sea-going Steel Ships	Electric windlass
		The brake is to be capable of holding a load on the chain cable of at least 1.3 times the working load of the windlass	4.5.1 of ISO 4568	Driving types other than electric type
15	Brakes	Brakes are to be able to withstand a static pull of 45% of the breaking load of the cable or wire or a maximum static load of the cable. Parts bearing forces will not be permanently deformed and no slip will be found for the brakes	13.2.5.5 of PART THREE of CCS Rules for Classification of Sea-going Steel Ships	Fitted with stopper

Continued Table 6.1

		Brakes are to be able to withstand a static pull of 80% of the breaking load of the cable or wire. Parts bearing forces will not be permanently deformed and no slip will be found for the brakes	13.2.5.5 of PART THREE of CCS Rules for Classification of Sea-going Steel Ships	Not fitted with stopper
16	Stoppers	Windlasses are to be fitted with efficient stoppers which are subjected to loads equivalent to the proof test load of chain cables and of which the stress is not to be more than 90% of yield stress of the material used	13.2.5.6 of PART THREE of CCS Rules for Classification of Sea-going Steel Ships	
17	Operating device	The operating device which controls weighing and casting of the anchor is to be able to return to braking or stop position automatically	4.9 of ISO 4568	
18	Protection and prevention	Prime movers and transmission gears are to be provided with means for prevention of excessive moment and impact	13.2.5.7 of PART THREE of CCS Rules for Classification of Sea-going Steel Ships	
		Cable lifter and gearing are to be protected against excessive torque developed by the prime mover	4.7.2 of ISO 4568	
		The lowest protection level for electrical equipment on the exposed deck is IP56	4.10.1 of ISO 4568	
19	Hydraulic system	Relevant requirements in Section 7 of Chapter 2 and Section 7 of Chapter 4 in PART THREE of CCS Rules for Classification of Sea-going Steel Ships are to be complied with	13.2.5.8 of PART THREE of CCS Rules for Classification of Sea-going Steel Ships	
20	Securing of seating	Relevant requirements in Section 2, Chapter 3, PART TWO of CCS Rules for Classification of Sea-going Steel Ships are to be complied with	13.2.5.9 of PART THREE of CCS Rules for Classification of Sea-going Steel Ships	
21	Electrical control	Relevant requirements in Section 4 of Chapter 3 of PART FOUR of CCS Rules for Classification of Sea-going Steel Ships are to be complied with		

6.2 The stress of windlass parts must be less than the elasticity limit of the material used and comply with the following 3 conditions:

(1) when the stress of transmission gear and other affected parts is calculated with the rated torque of the prime mover, the stress of the parts subject to forces is not to exceed 40% of the yield limit of the material;

(2) when the prime mover acts with maximum set torque, the stress of the affected parts is not to exceed 95% of the yield limit of the material;

(3) with the action of the withstand load, the stress of the affected parts is not to exceed 95% of the yield limit of the material.

6.3 The strength of brakes is to comply with the following requirements:

(1) For band type brakes, the pull of tight side and loose side of the brake band are to be calculated according to the following Euler formula:

$$T = t \cdot e^{\mu\alpha}$$

where: pull of tight side of the band: $T = P \times e^{\mu\alpha}/(e^{\mu\alpha} - 1)$

pull of loose side of the band: $t = P/(e^{\mu\alpha} - 1)$

circular brake force: $P = F_{supt}D_L/D$

where: F_{supt} – withstand load;

D_L – working diameter of cable lifter;

D – diameter of brake boss;

μ – friction coefficient of brake band;

α – brake band contact wrap angle;

e – base of natural logarithm.

(2) The maximum specific pressure of the brake band is to be calculated according to the pull of the tight side of the band, and the result is to be less than the permissible specific pressure of the material of the brake band.

(3) For other types of brakes, the strength is to be checked by recognized calculation methods.

(4) The stress of parts under force such as steel brake band, tight side pin shaft, tight side pull rod, loose side pin shaft and brake screw is to comply with the requirements of 2.6.2(3) of this Chapter.

2.6.4 The strength of bolts securing the seating is to comply with the following requirements:

(1) The forces acting on the bolts and thrust plates securing the windlass to the deck are to be calculated.

(2) The axial forces and combined shear forces of the bolt group (or bolts) are to be calculated according to the formula given in 3.2.5.5 and 3.2.5.6 of PART TWO of CCS Rules for Classification of Sea-going Steel Ships.

(3) The safety factor corresponding to bolt strength is not to be less than 2.0.

7 Type test

7.1 Selection of typical samples

The type test of the first set of the same Specifications is to be carried

7.2 The type test items are to include the following:

(1) no-load operation test of the whole set;

(2) working load test;

(3) control braking device test;

(4) overload pull test;

(5) load limiting device test, if applicable;

(6) operational test of brakes;

(7) brake withstand load test (may be dispensed with, see 2.7.3(7));

(8) hydraulic system test, if applicable;

(9) function test of other devices, if applicable;

(10) dismantling after test.

7.3 Methods and requirements for type test:

(1) No-load operation test of the whole set

① The windlass is to run without load for 30 min at a speed not less than the nominal speed, with 15 min for each rotating direction. After 30 min test, the windlass is to change the

speed as soon as possible, with 5 min for each speed and each rotating direction.

② Oil sealing and bearing temperature rise are to be examined during the test, with all moving parts running normally without abnormal noise.

(2) Working load test

① Chain cable is to be installed at the wrap angle for actual installation on board, the cable lifter clutch is to be turned on and the cable lifter brake loosened.

② The working load is to be raised and lowered continuously at the nominal speed for 30 min, and an emergency stop is to be tested to check the reliability of emergency stop.

③ During the test, nominal speed and electric motor current (or pressure of the hydraulic system) are to be measured and engagement of chain cable with cable lifter, oil sealing and bearing temperature rise are to be examined. All moving parts are to run normally without abnormal noise, chain jumping and chain blocking.

(3) Control braking device test

① The electrical windlass is to raise a load 1.5 times the working load to a height more than 2 m at low speed of the electric motor and then with the power supply being cut off, the control braking device is to brake the motor immediately without slip of the load.

② The hydraulic windlass is to raise a load 1.3 times the working load to a height more than 2 m and then with the control handle of the hydraulic motor being moved to the intermediate position, the control braking device is to brake the hydraulic motor with slip of the load not exceeding 1 m/min.

(4) Overload pull test

① The windlass is to work for 2 min continuously with 1.5 times the working load at reduced speed.

② During the test, electric motor current (or pressure of the hydraulic system) is to be measured and engagement of chain cable with cable lifter, oil sealing condition and bearing temperature rise are to be examined. All moving parts are to run normally without abnormal noise, chain jumping and chain blocking.

(5) Load limiting device test

① The load limiting device of electrical windlasses is to be tested for effectiveness.

② The design load of the load limiting device is to be 1.6 times the working load. The load limiting device is not to act with 100% the design load but with 120% of the design load.

(6) Operational test of brakes

① A load 1.5 times the working load is to be applied on the chain cable, the brake operated tightly and the cable lifter clutch disengaged.

② There is to be no slip of the load and no permanent deformation of parts under force.

(7) Brake withstand load test

① If the design of brakes is mature and complies with the design calculation and strength requirements of 2.6.3 of this Chapter, the test may be dispensed with. For novel designs, however, the test is to be carried out.

② The brake is to be operated tightly and disengaged from the cable lifter clutch, and a withstand load is to be applied appropriately on the chain cable for 2 min.

③ There is to be no slip of the load and no permanent deformation of parts under force.

(8) Hydraulic system test

① Pressure test, tightness test, performance test of safety valves (relief valves) and test of

protective functions are to be carried out for pipelines of the hydraulic system of hydraulic windlasses.

② Pressure test is to be carried out for pipelines of the hydraulic system to 1.5 times the design pressure (but not exceeding design pressure plus 7 MPa) before assembly.

③ Tightness test is to be carried out for the hydraulic system to 1.25 times the design pressure (but not exceeding design pressure plus 7 MPa) after assembly.

(9) Function test of other devices

① The operation of any remote control or other special devices of the windlass, if fitted, is to be examined.

(10) Dismantling after test

① The contact of gear pair (or worm gear pair), main shaft and its bearings, open gear pair, brake band and its brake boss is to be examined for abnormal abrasion and obvious damage.

② The quality of oil of the gear box is to be examined and the cleanness is to comply with the requirements of related standards.

8 Unit/batch inspection

8.1 Inspection items

(1) The inspection of windlasses is to include examination of documents, inspections and function tests during manufacturing process.

(2) Inspections during manufacturing process are mainly to include material tests, non-destructive tests of main parts (if required), examination of quality of manufacturing and assembly of parts.

(3) Main castings and forgings such as main shafts and cable lifters, if purchased from manufacturers without CCS approval, are to be subject to tests of their mechanical properties.

(4) Windlasses are to be categorized for their structural types, specifications and grades. The type test of the first set is to be carried out according to 2.7 of this Chapter. The test of subsequent products is to be carried out according to test items for unit/batch inspection after approval.

8.2 The records or reports submitted by the manufacturer are at least to include the following:

(1) Quality certificates and/or reports of reexamination of physical and chemical properties of materials of main parts processed at the manufacturer.

(2) Qualification certificates and related certificates of main purchased parts.

(3) Inspection, measurement and test means of the manufacturer, together with a list of test and inspection equipment used and copies of valid calibration certificates.

(4) Test report of the manufacturer, covering product or sample type, specification, serial number, test location and date, test environment, test items, test data, problems revealed in the test and examination and description of how the problems are handled, and test conclusions.

8.3 The test items for unit/batch inspection after approval:

(1) no-load operation test of the whole set;

(2) working load test;

(3) control braking device test;

(4) overload pull test;

(5) load limiting device test, if applicable;

(6) operational test of brakes;
(7) hydraulic system test, if applicable;
(8) function test of other devices, if applicable.

8.4 Where the design of a windlass is changed after type test, with chain cables having the same (or lower) specification and grade and construction being the same as the original type or main components being kept, related test items may be reduced in CCS inspection.

8.5 If the manufacturer does not have adequate test facilities for a large windlass with working load of 300 kN or over, no-load test may be carried out and other test items are to be carried out on board.

8.6 If the test with an associated hydraulic pump station has not been carried out by the manufacturer for hydraulic windlasses, a flow conversion description for the pump station is to be provided to demonstrate that the actual speed of the windlass complies with the relevant requirements.