Guideline No.:A-02(202204)

A-02

FIBER ROPES

Issued date: April 24, 2022

Foreword:

China Classification Society (hereinafter referred to as CCS) Product Inspection and Testing Guideline (hereinafter referred to as this Guideline) contains the technical requirements, inspection and testing criteria related to classification and statutory survey of marine products to be applied for CCS approval/inspection.

This Guideline frees the users to adopt other test methods and requirements which are equivalent to or are stricter than this Guideline.

This Guideline is published and updated by CCS, and is released at http://www.ccs.org.cn. Your comments or suggestions are welcomed and may be sent to our email addressed mp@ccs.org.cn.

Historical versions and release date : A-02(201510)　October 20, 2015

A-02(201705)　May 9，2017

Main changes:

Adjust some terms and test methods to keep the content consistent with China Classification Society Rules for Materials and Welding.

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FIBER ROPES

1 Application

1.1 This Guideline applies to synthetic fiber ropes for ships engaged on international voyages and domestic voyages:

(1) Ship securing, towing and towed;

(2) Goods securing, hoisting and lashing.

2 Normative references

2.1 Chapters 7, Part Two of China Classification Society Rules for Materials and Welding.

2.2 ISO2307 Ropes — Determination of Certain Physical and Mechanical Properties.

2.3 ISO1346 Fibre Ropes-Polypropylene Split Film, Monofilament and Multifilament (PP2) and Polypropylene High-tenacity Multifilament (PP3)-3-,4-,8-and12-strand Ropes;

2.4 ISO1141 Fibre Ropes-polyester-3-,4-,8- and12-strand Ropes;

2.5 ISO1140 Fibre ropes-Polyamide-3-,4-,8- and 12-strand Ropes;

2.6 ISO10325 Fibre Ropes-High Modulus Polyethylene-8-strand Braided Ropes,12-strand Braided Ropes and Covered Ropes

2.7 National standard, ISO standard and other standards accepted by CCS.

If the standards renewed above, CCS accept the latest effective version.

3 Terms and definitions

3.1 Linear density means the mass per unit length of fiber rope under preload, in ktex.

3.2 Minimum breaking load means the nominal value which is to be reached or exceeded during breaking test, and also used to verify the nominal diameters of fiber ropes, in kN.

3.3 Actual breaking load means the actually measured value of fiber rope breaking load during breaking test, in kN.

3.4 Preload means load applied to determine nominal diameter and linear density of a fiber rope, to be obtained from the following formula: $F=n^2/8\times0.01$ *kN*

3.5 Nominal diameter means the nominal value of a given fibre rope diameter in recognized standards.

3.6 Measured diameter means the diameter measured under preload, in mm.

3.7 Lay length means the length of same stranded rope with n complete strands for stranded rope and length of same twisted rope with n complete twists for plaited rope, in mm.

4 Drawings and documents

4.1 The applicant is to submit the following documents to CCS for approval when applying for works approval to CCS:

(1) Technical requirements for acceptance or enterpriser's standard;

(2) Type test program.

4.2 The applicant is to submit the following documents to CCS for information when applying for works approval to CCS:

(1) The standard applicable to rope;

(2) Source of raw materials and technical requirements for acceptance;

(3) Quality management and control documents;

(4) Particulars of manufacturer, history and relevant description of rope manufacturing;

(5) A list of main equipment for rope producing and inspection (the factory testing equipment should match the production capacity[1]);

(6) Conditions of inspection personnel;

(7) Flow chart of manufacturing process and documents;

(8) Format of report for approval and delivery inspection test;

(9) Document of entering to the register of enterprise;

[1] The maximum tensile force of the manufacturer's tensile machine shall not be less than 90% of the maximum allowable broken load of fiber rope

(10) Specimen of product quality certificate.

5 Technical requirements

5.1Any lubricant in the natural fiber ropes is to be kept to a minimum, and any rot-proofing or water repellency treatment is not to be deleterious to the fiber.

5.2Fiber ropes may be of a three-strand, four-strand, six-strand, eight-strand, twelve-strand or double-braid construction appropriate to their respective materials and types, other construction forms will be specially considered.

6 Materials and components

6.1 Fiber ropes may be made of natural fibers (coir, hemp, manila or sisal) or may be composed of synthetic fibers (polyamide, polyester, polypropylene polyolefin, ultra-high molecular weight polythene or the mixture of above materials). If it is intended to use other materials, sufficient data are to be available to show compliance of their properties with service requirements. The material used for the manufacture of fiber ropes is to be of good and consistent quality and resistant to corrosion and aging.

6.2 The qualified supplier list of raw materials should be investigate by CCS, and the list includes raw materials' name, type/specification, control mode and supplier. The raw materials should be re-tested by the manufacturer incoming inspection.

7 Type test

7.1 Selection of typical samples

(1) Samples are to be taken from the fiber ropes with the same raw materials lot number, the same structure and sizes, and the same production procedure. Except as agreed otherwise, S samples are to be taken at random from the above mentioned fiber ropes for test. S is obtained by the following formula:

$$S = 0.4 \times \sqrt{N} \qquad \text{(Number)}$$

where: S — number of samples, in number;

N — the batch size, expressed as the number of continuous coils of 220m (less than 220m is regarded as one coil).

When N is counted, 220 meters can be accumulated as one reel when the length of each rope is less than 20 meters,(less than 220m is counted as 1 roll).

If the calculated *S* value is not an integer, it is to be rounded to the closest integer. When *S* is less than 1, one sample only is to be taken.

(2) In the type approval test, generally one maximum sized rope is to be taken, and samples must be taken from the complete rope rather than calculating by breaking strands.

(3) Raw materials subject to sampling test: selecting samples in principle that the ropes of same color and same grade are regarded as a batch, while threads and lines of different materials are sampled respectively. Take 5 packages from a batch in a raw material warehouse and select 2 reels (hanks) from each package as specimen.

7.2 Inspection items for raw materials: to carry out test in accordance with raw materials acceptance technical requirements provided by the manufacturer.

7.2.1 Visual inspection: for the same batch of products, their color differences are generally in consistency, surface are smooth, no scratch, and no undrawn yarn is allowed.

7.2.2 For physical property, the following items are to be tested:

(1) Test for fiber breaking elongation;

(2) Fiber breaking load;

(3) Fiber linear density.

7.3 Inspection items for ropes

7.3.1 Visual examination

(1) Visually inspect the strands evenness and smoothness, breaking strands, slack twists and to check if there is any wearing, scratch, cutting or other types of damage existing.

(2) Visually inspect any oil and color variance on rope surface.

7.3.2 Test methods and procedures for physical properties may be referred to in Chapter 2, Part Two of China Classification Society Rules for Materials and Welding.

7.3.3 Physical property test items

(1) Diameter measuring;

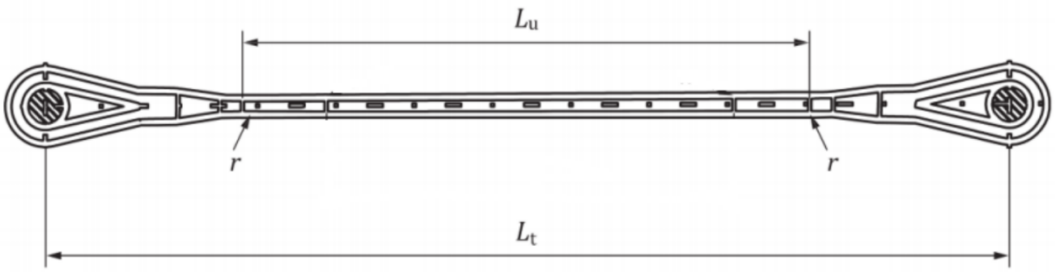
(2) Linear density calculation;

(3) Breaking test; (test is to adopt completed rope instead of calculating by breaking strands).

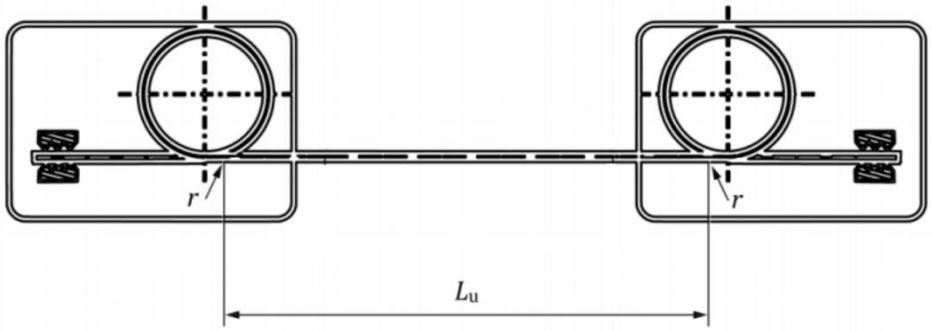
7.4 Test procedure

7.4.1 The measurement of breaking force

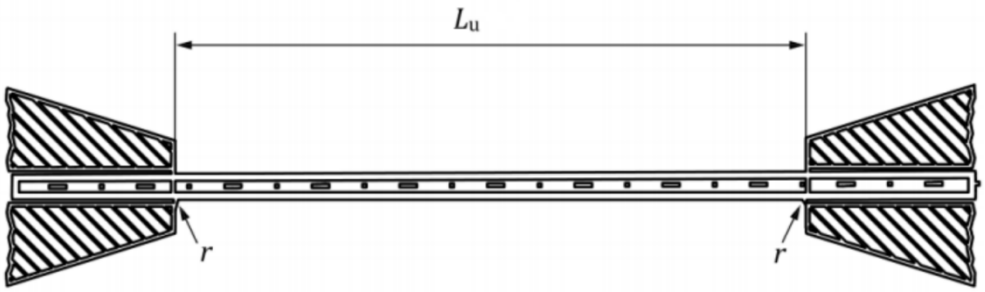
(1) The test piece of breaking test is be of adequate length to give a minimum free length, L_u, between terminations which is at least equal to 5 pitches or lays or 400 mm, whichever is greater. The distance from each mark "r" to the end of the splice (or to the tangent point in the case of a bollard) is to be a minimum of twice the diameter and a maximum of three times the diameter of the rope. See Figure 1.



(a) Diagram of a fiber rope with nominal diameter not less than 20mm tested using eye splices



(b) Diagram of a fiber rope with nominal diameter less than 20mm tested using bollard grips



(c) Diagram of a fiber rope with nominal diameter less than 20mm tested using wedge grips

Figure..1Diagram of a fiber rope mounted between grips

(2) Then continue to increase the tension, at the same speed, until the rope breaks. After application of preload, the diameter and even lay-up of the sample are to be checked. The sample is then subject to load at the test speed given in Table 1 from preload to 50% of the minimum breaking force for 3 or 10 consecutive cycles (the number of cycles are to be recorded in the test report), followed by load at the same speed until it breaks.

Table 1 Loading speed of breaking test

Type of grips	Test speed (mm/min)
Eye splices	（2%~12%）×Lt① (L_t is given in Figure 1(a))
Bollard grips,wedge grips	250±50

(3) The test results should meet the following requirements:

① During testing, if the sample is held by grips and the break occurs within the “r” marks and the breaking load is not less than the minimum breaking load specified in the recognized standard, the test may be accepted;

② If the break occurs outside the “r” marks at the gripped or twisted portion while the breaking load has attained to or is higher than 90% of the minimum breaking load, the test may be accepted. However, it should not be assumed that the true breaking load of the specimen would be represented by multiplying the result by 10/9;

③ If the test result failed, two more samples can be taken from the original rope for retest. Both samples pass the test and the results are accepted. If one of the samples is unqualified, the judgment result is unqualified.

7.4.2 Linear density calculation

The linear density is to be tested as follows: after adjusting the temperature and moisture of the sample according to recognized standards, apply preload (the error is to be controlled within ±5%) on the rope and maintain for 1 min. Place two marks on the rope 2 m apart, then remove the load and detach the sample from the parent length by cutting cleanly at the two marks. Weigh the mass of the sample and calculate linear density using the following formula:
Linear density may be obtained by formula (1):

$$\rho X = \frac{m_o}{L} \qquad (1)$$

where: ρ_X —linear density, in ktex;

m_o—is the mass, in grams, of the test piece;

L— is the measured length, 2m of the test piece under the reference tension.

7.4.3 Lay length

The lay, l_p, expressed in millimeters, is given be Equation:

$$l_p = \frac{l_n}{n}$$

where l_n is the length of n complete tums of the same strand or, in the case of plaited ropes, the length between n successive plait points,

8 Unit/batch inspection

8.1 Take specimen in accordance with paragraph 7.1.

8.2 Test items and procedures are to be performed in test and inspections according to 7.2 ~7.4 of this Guideline.

In principle, breakage calculation method is not accepted to replace whole rope test for breaking test in the unit/batch inspection. Fiber rope can not be broken, when the load reaches 105% of the minimum broken load (the cable minimum broken load is more than 5000KN) or 110% (the cable minimum broken load is less than 5000KN).

8.3 Test reports are to contain the following items:

Minimum breaking load	**kN**	**Rope materials**	
Structure of rope	Strand	Specifications	(mm×m)
Model of tension machine		Period of validity	
Ambient temperature	(℃)	Relative humidity	(%)
Test No.		Measured diameter	(mm)
Lay length	(mm)	Actual breaking load	kN
Stretching speed	(mm/min)	Breaking position	
Rated linear density	(ktex)	Linear density	ktex
Results		Test date	

9 Others

9.1 Each roll of finished fiber ropes subject to acceptance is to be obviously tied with a label indicating product name, serial number, materials, structure, specifications, manufacturer name and CCS mark.

9.2 The manufacturer is to provide the qualified fiber ropes with qualification certificate containing at least the following:

(1) Product names, models and serial numbers;

(2) Materials used for fabricating fiber ropes;

(3) Length of whole fiber rope roll and diameter of rope;

(4) Linear density of fiber ropes;

(5) Fabric of fiber ropes;

(6) Minimum breaking load of fiber ropes (indicate the actual breaking load where necessary).