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Fibre ropes for offshore stationkeeping — Aramid

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National foreword

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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).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 38, *Textiles*.

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Fibre ropes for offshore stationkeeping — Aramid

1 Scope

This Technical Specification specifies the main characteristics and test methods of new aramid fibre ropes used for offshore stationkeeping.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 139, *Textiles — Standard atmospheres for conditioning and testing*

ISO 1968, *Fibre ropes and cordage — Vocabulary*

ISO 2060, *Textiles — Yarn from packages — Determination of linear density (mass per unit length) by the skein method*

ISO 7500-1, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tension/compression testing machines – Verification and calibration of the force-measuring system*

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

ASTM D1907, *Test Method for Linear Density of Yarn (Yarn Number) by the Skein Method*

ASTM D1776, *Practice for Conditioning and Testing Textiles*

ASTM D6611, *Standard Test Method for wet and dry Yarn-on-Yarn Abrasion resistance*

ASTM D7269, *Test Methods for Tensile Testing of Aramid Yarns*

CI 1503, *Test method for yarn-on-yarn abrasion*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1968, ISO 18692, and the following apply.

3.1
aramid
long-chain synthetic polyamide in which at least 85% of the amide linkages are attached directly to two aromatic rings

[SOURCE: ISO 1968, 3.3.1, modified]

3.2
axial compression fatigue
failure mode for fibre rope such as *aramid* (3.1) under low tension or compression

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4 Materials

4.1 Rope core material

The aramid fibre used in the core of the rope shall have an average tenacity of not less than 1,8 N/tex and in accordance with Annex A. Qualification and testing requirements are given in Annex A.

4.2 Rope cover material

Where polyester yarn is used in the protective cover, its minimum tenacity shall be 0,73 N/tex.

4.3 Other materials

Other materials employed in rope assembly shall be identified in the rope design/manufacturing specification.

For each material, the following shall be specified, as applicable:

a) base material;

b) size (linear density, mass per unit area, ...);

c) relevant mechanical properties (tenacity, stiffness, ...).

5 Requirements — Rope properties

5.1 Minimum breaking strength

The minimum breaking strength (MBS) of the rope (spliced) when tested according to Annex B shall conform to Table 1.

Table 1 — Minimum breaking strength (MBS)

Reference number[a]	Minimum breaking strength kN
80	2 500
90	3 100
100	3 900
106	4 400
112	5 000
118	5 600
125	6 300
132	7 000
140	7 800
150	8 700
160	10 000
170	11 200
180	12 500

[a] The reference number corresponds to the approximate outer diameter of the rope, in millimetres (mm). Actual diameters may vary for a given reference number.

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Table 1 *(continued)*

Reference number[a]	Minimum breaking strength kN
190	14 000
200	15 500
212	17 500
224	19 500

[a] The reference number corresponds to the approximate outer diameter of the rope, in millimetres (mm). Actual diameters may vary for a given reference number.

5.2 Minimum core tenacity

The minimum tenacity of the aramid rope core shall be 0,90 N/tex measured according to Annex B. All samples tested shall comply with the minimum value specified herein.

5.3 Axial compression fatigue properties

The rope shall have demonstrated 95 % retention of MBS following the axial compression fatigue test method in Annex C.

5.4 Particle ingress protection

If specified, the rope shall be constructed with a protection of the core against the ingress of particles having a size greater than 20 µm (microns) or as agreed between involved parties. Testing of the protection shall be performed in accordance with Annex B.

5.5 Cyclic loading performance

The rope shall have demonstrated performance under cycling loading following the requirements of 7.1.7 and B.5.

6 Requirements — Rope layout and construction

6.1 General

The typical section of a rope shall comprise a rope core providing intended strength and stiffness and a cover.

6.2 Type of construction

The rope shall be of one of the following types of construction:

— torque-neutral construction (type TF);

— torque-matched construction (type TM).

The type of rope shall be specified by the purchaser.

NOTE Torque-neutral ropes are intended for use in mooring systems together with chain or torque-neutral spiral strand wire ropes. Torque-matched ropes are intended for use in mooring systems together with six-strand wire ropes or other non torque-neutral wire ropes. Typical constructions are illustrated in Figure F.3 and Figure F.4.

6.3 Rope core

6.3.1 The total number of yarns in the rope shall be at least the number specified in the rope design specification.

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6.3.2 Splices are not allowed in the rope core nor in sub-ropes except for those at the end terminations.

Strands shall be uninterrupted over the length of the rope with no splice or strand interchange.

NOTE Yarns may be joined if necessary.

6.4 Protective cover

6.4.1 A protective cover shall be provided around the rope core to protect the rope core from mechanical damages during handling and in service.

The protection shall be water-permeable.

6.4.2 A polyester braided protective cover shall have a minimum thickness, *t*, with

— t = 7,0 mm, for a reference number RN above 100, and

— t = 0,07 × RN, but not less than 4 mm, for a reference number RN less than 100.

Strand interchanges, i.e. the overlapping continuation of an interrupted strand with another identical strand following the same path, are permitted if they are properly staggered.

6.4.3 If an alternative protective cover is used, it shall demonstrate a level of protection equal to that of a polyester braided cover.

6.4.4 A braided cover shall include coloured strands forming a pattern so that rope twist during installation or in service can be identified. There shall be a minimum of one “S” coloured strand and one “Z” coloured strand to form a cross on the rope.

An alternative protective cover shall be fitted with an axial stripe of contrasting colour or other means to identify rope twist during installation or in service.

6.5 Terminations

The terminations shall be made of an eye splice plus abrasion protection materials.

NOTE There can be other terminations provided that they do not jeopardize the rope performance.

The dimensions and arrangement of the eye shall match the diameter and groove shape of the thimble (or other interface piece) to be used for end connections and shall be the same as for the rope prototype testing.

In the splice area, the integrity and the continuity of rope cover and particle-ingress protection, if fitted, shall be preserved or restored.

The eye and the splice area shall be further covered by an abrasion protection coating such as polyurethane. Each termination shall be made according to the manufacturing practice as described in the termination specification.

6.6 Length of rope

The bedded-in lengths of the rope sections shall be calculated in accordance with 7.2.2 under 20 % of MBS unless otherwise agreed on the purchase order or contract.

The calculated length of supplied rope shall be within ±1 % of the specified length.

For each supplied rope, the actual length at the reeling tension or during manufacture shall be reported as an indicative value.

Adequate extra length shall be manufactured in order to prepare the samples for testing which are considered to be part of the delivery.

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7 Rope testing

7.1 Type testing

7.1.1 General

Prototype tests shall demonstrate that ropes certified by the manufacturer as complying with the requirements laid down in this Technical Specification possess the properties specified in this Technical Specification. The purpose of these tests is to verify the design, material, and method of manufacture of each size of finished rope including protective cover and terminations.

All ropes to be prototype tested shall comply with all the other requirements laid down in this Technical Specification. The tests specified below shall be carried out on a prototype rope for each size of rope, unless otherwise noted in this Clause.

Any change in the design, material, method of manufacture, including protective cover and terminations which may lead to a modification of the properties as defined in Clause 5, shall require that the prototype tests specified in this Technical Specification be carried out on the modified rope.

7.1.2 Sampling

The number of rope samples to be tested is given in Table 2.

Table 2 — Number of samples for testing

Test	Number of samples
Breaking strength, core tenacity, and stiffness	3
Axial compression fatigue	1[a]
Torque properties	1[b]
Linear density	1
Cyclic loading endurance	1[c]

[a] See 7.1.4.
[b] See 7.1.5.
[c] See 7.1.7.

7.1.3 Breaking strength, core tenacity and stiffness tests

7.1.3.1 Three samples shall be tested according to the procedure specified in Annex B and each shall be capable of meeting the requirements of 5.1 (minimum breaking strength) and of 5.2 (minimum core tenacity).

7.1.3.2 The rope core tenacity and stiffness at the end of bedding-in shall be calculated according to the methods defined in Annex B.

7.1.3.3 Measurement of the stiffness at other load levels shall be performed within the same tests.

These measurements are, however, not required when results are available for another qualified rope of the same design, material and method of manufacture with a reference number of not less than 90, and when the stiffness at end of bedding-in does not differ by more than 10 %.

NOTE 1 These measurements are performed for design purposes only. There are no acceptance criteria on these parameters.

NOTE 2 These measurements can also be performed on a separate rope sample (see Annex B).

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7.1.4 Axial compression fatigue properties test

One sample shall be tested for axial compression fatigue properties.

This test need not be performed when data is available from the previous qualification test of another rope with the same design, material and method of manufacture of rope core, and a size not less than reference number 90.

7.1.5 Torque properties tests

Where applicable, torque properties tests shall be performed according to the procedure specified in ISO 18692. These tests are, however, not required when results are available for another qualified rope of the same design, material, method of manufacture, and termination with a reference number of not less than 90.

7.1.6 Linear density test

The linear density shall be calculated from the measured weight and elongation according to the method defined in Annex B.

7.1.7 Cyclic loading (endurance) test

7.1.7.1 One sample shall be tested for cyclic loading. However, cyclic loading (endurance) tests performed with one size of qualified rope having the same design, material, and method of manufacture including protective cover and terminations is enough to qualify all sizes with an MBS between 50 % and 200 % of the size tested. The test for cyclic loading (endurance) is not required if such data is available.

7.1.7.2 The cyclic loading (endurance) test shall be performed according to the procedure specified in B.5. A load range shall be selected by the manufacturer and the rope shall withstand, without breaking, at least the number of cycles for that load range as given in Figure B.2.

The residual strength of the rope shall be at least 80 % of its MBF.

7.1.8 Protective cover thickness

The thickness of the protective cover shall be verified.

The thickness of a braided cover shall be measured as twice the thickness of cover strands under the maximum braiding tension.

7.1.9 Particle ingress protection

See 5.4 and Annex B.

7.2 Testing of current production

7.2.1 Sampling and testing

When the ropes are already certified by the manufacturer as complying with the requirements laid down in this Technical Specification, the rope tests including breaking strength and core tenacity, as well as protective cover thickness verification, shall be performed on one sample taken from the manufacturing process for each type and size of rope.

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7.2.2 Length measurement

The bedded-in length of each supplied rope section (other than short sections) shall be calculated from the linear density, ρ_l, by Formula (1):

$$L = \frac{(m_T - m_S) \cdot 1000}{\rho_{l,20}} \tag{1}$$

where

L is the length of the rope in metres (m);

m_T is the mass of the total rope length in kilograms (kg);

m_S is the mass of the materials used to form the eyes and the splices in kilograms (kg);

$\rho_{l,20}$ is the linear density of the rope, in ktex, obtained from the prototype test in accordance with 7.1.6.

The length of short rope sections (i.e. sections of less than 20 m) shall be measured at a load of 2 % of MBS as the length between the centres of termination fittings (i.e. same as L_u on Figure B.1).

8 Report

8.1 Prototype rope

A complete and detailed report of the prototype rope manufacturing shall be supplied including the fibre manufacturer, the fibre type and finish, and all rope characteristics that can influence the mechanical properties like design, material specifications, and method of manufacture, including protective cover and terminations, with sketches or pictures.

A complete and detailed report of type tests with sketches or pictures of the test set-up shall also be provided.

8.2 Current production

The manufacturing report of supplied ropes shall be provided. A complete and detailed report of rope tests with sketches and pictures of the test set-up shall also be provided.

9 Certification

The certificate of approval and control issued by an RCS (recognized classification society) shall be presented together with the ropes in order to ensure that testing and fabrication are in accordance with the approved specifications.

The rope manufacturer shall issue or obtain a rope certificate including at least the following information:

a) reference number;

b) type of construction;

c) linear density;

d) MBS;

e) individual identification number;

f) length at a specified load;

g) length at the reeling handling tension.

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NOTE A suggestion for a certificate of conformity can be found in Annex E.

10 Marking, labelling, and packaging

10.1 Marking

A tape of at least 3 mm wide printed with a reference identifying the manufacturer shall be incorporated into the rope. The maximum distance between two consecutive markings shall be 0,5 m.

10.2 Labelling

An identification plaque or alternative means shall be installed close to the splice with the following information as a minimum:

a) purchase identification;

b) individual identification number;

c) reference to this Technical Specification;

d) type of construction (TF or TM) in accordance with 6.2;

e) rope MBS;

f) rope length at a specified load according to 7.2.2.

10.3 Packaging

If the assembly is packed on a spool or a reel, these shall be suitable for the applicable transportation means and of appropriate construction in terms of strength.

The packaging shall be marked with the manufacturer's trademark and with the lot identification number.

NOTE The ropes may be delivered in steel reels or in containers. Alternative packaging designs may be provided with the prior approval of the purchaser.

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