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TYPE APPROVAL OF FIBRES AND YARNS

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RULE NOTE

BUREAU VERITAS

BUREAU VERITAS
RULES, RULE NOTES AND GUIDANCE NOTES

NR658 DT R01 December 2024 takes precedence over previous revision.

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These rules are provided within the scope of the Bureau Veritas Marine & Offshore General Conditions, enclosed at the end of Part A of NR467, Rules for the Classification of Steel Ships. The latest version of these General Conditions is available on the Bureau Veritas Marine & Offshore website.

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NR658

TYPE APPROVAL OF FIBRES AND YARNS

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Section 1 General

1 Scope

1.1 Application

1.1.1 This Rule Note defines the procedures and technical requirements for the type approval of fibres and yarns that are intended for the manufacturing of the load bearing part (core) of fibre ropes for the following marine applications (see [2.3]):

- ship (harbour) mooring lines, tow lines, or other marine applications
- jetty mooring lines (mooring lines for permanent installations), referred to as JM in this Rule Note
- single point mooring (SPM) hawsers, referred to as SH in this Rule Note
- deepwater anchoring lines for the stationkeeping of offshore platforms, or other specific offshore applications, referred to as SK in this Rule Note.

1.1.2 Unless otherwise specified, the requirements given in this Rule Note apply to all applications.

1.1.3 For SK and JM, the certification of fibres is to be generally performed as a part of activities for the classification of an offshore unit, for the assignment of the class notation POSA (or POSA JETTY) covering the stationkeeping system of that unit (see NR493).

For SH, the certification of fibres is performed as requested in NR216, Ch 10, [6].

Besides, the certification of fibres can be performed when requested by the manufacturer.

1.2 Type approval

1.2.1 The type approval of fibres and yarns used in the load bearing part of a fibre rope is to be performed at the request of the fibre manufacturer and is to follow the certification scheme for H_{BV} products (see NR320, Sec 1, [4.2]). This certification process will result in the issuance of a type approval certificate of the product.

Note 1: For fabricated or re-processed fibres or yarns (see Sec 2, [1.5]), the type approval is to be performed at the request of the rope manufacturer. In this case, the type approval of the base fibre is also required (only for SK other than Marine Renewable Energies (MRE) floating units).

Note 2: Type approval is not required for fibres or yarns used in the manufacturing of non-load-bearing part of a fibre rope (rope cover). However, such fibres / yarns are to have documented properties in accordance with the general requirements of the present Rule Note for “Other marine applications” (see Sec 2).

1.2.2 The evaluation of fibres and yarns is performed according to the requirements of the present Rule Note, complemented by:

- the procedures laid down in OCIMF - 2000 (see [2.4.3])
- the requirements of NR432, Sec 3, where applicable.

2 Definitions and reference documents

2.1 General

2.1.1 In addition to the definitions listed in [2.2] and [2.3], further relevant definitions can be found in OCIMF - 2000 (see [2.4.3]) and ISO 1968.

2.2 Fibres

2.2.1 Fibre

In the present Rule Note, the term “fibre” is used to designate a multi-filament fibre, resulting from extrusion and subsequent treatments of a synthetic material (natural and mineral fibres are excluded).

2.2.2 Yarn

A yarn is a bundle of fibres that are assembled together, generally by twisting, over a long continuous length.

2.2.3 Marine grade fibre

A marine grade fibre is a fibre that is provided with a marine finish or coating to improve the yarn-on-yarn abrasion performance of the fibre (see Sec 2, [1.3.3]).

2.3 Applications

2.3.1 Single point mooring (SPM) hawser (SH)

In the present Rule Note, SPM hawser means a fibre rope assembly used for the single point mooring of tankers to a buoy, a terminal or an offshore unit for temporary loading / offloading operations (or another similar application), and complying with the requirements of OCIMF - 2000 (see [2.4.3]).

2.3.2 Stationkeeping line (SK)

In the present Rule Note, stationkeeping line means the fibre rope sections which are parts of the stationkeeping system of offshore units or for other specific offshore applications (e.g. tethers), and complying with the requirements of NR432.

2.3.3 Jetty mooring line (JM)

In the present Rule Note, jetty mooring line means the fibre rope sections which are parts of the permanent jetty mooring of a unit.

2.3.4 Other marine application

For fibre ropes used for general marine services, other than those specified in [2.3.1] to [2.3.3], reference is made to NR216.

2.4 Reference documents

2.4.1 Bureau Veritas documents

The following Rules are referred to as in this Rule Note:

- NR216- Rules for materials and welding for the classification of marine units
- NR320 - Certification scheme of materials and equipment for the classification of marine units
- NR432 - Fibre ropes for offshore services
- NR493 - Classification of mooring systems for permanent offshore units.

2.4.2 ISO documents

When they are referred to as in this Rule Note, the following version of ISO standards is to be considered:

- ISO 1968:2004 - Fibre ropes and cordage - Vocabulary
- ISO 9554:2019 - Fibre ropes - General specifications
- ISO 2307:2019 - Fibre ropes - Determination of certain physical and mechanical properties
- ISO 18692-1:2018 - Fibre ropes for offshore stationkeeping - Part 1: General specification
- ISO 18692-2:2019 - Fibre ropes for offshore stationkeeping - Part 2: Polyester
- ISO 18692-3:2020 - Fibre ropes for offshore stationkeeping - Part 3: High Modulus Polyethylene (HMPE)
- ISO18692-4:2023 - Fibre ropes for offshore stationkeeping - Polyarylate
- ISO18692-5:2024 Fibre ropes for offshore stationkeeping - Aramid.

2.4.3 Other guidelines

When they are referred to as in this Rule Note, the following version of guidelines is to be considered:

- CI 1503-09: Test method for yarn-on-yarn abrasion
- CI 2009N-13: Performance requirements for marine grade nylon yarn for fibre rope
- CI 2009P-12: Performance requirements for marine grade polyester yarn for fibre rope
- OCIMF 2000 Guidelines for the purchasing and testing of single point mooring hawsers, Witherby & Co., Ltd., London.

Section 2 Design and Manufacturing Documents

1 Documents to be submitted

1.1 General

1.1.1 Design and manufacturing documents are to be provided by the manufacturer for review, covering:

- general documentation on manufacturer and on the product(s) intended for approval, including at least the following:
  - name and site address of the manufacturer, location of workshops
  - organization and quality (organizational chart, total staff, ISO9001 certification if any...)
  - manufacturing facilities (flow-chart of manufacturing process, equipment and capacities...)
  - catalogues of product(s)
- technical documentation (see [1.2] and [1.3]) including:
  - material specification
  - general material properties
  - physical and mechanical properties
  - marine finish efficiency, as applicable, for SH and SK
  - marine finish persistence, as applicable, for SK
  - other specific fibre properties, as applicable, for SK and JM
  - in-rope properties specific to intended application, as available and as applicable, for SK and JM
- quality plan and proposed forms for quality control
- routine (production) test programme
- routine test report
- format of certificate.

1.2 Fibre specification

1.2.1 The fibre specification is to define:

- producer of fibre
- fibre designation and material
- size and construction data
- fibre physical and mechanical properties
- designation and content of marine finish or other lubricant/coating/additive for SH, SK or JM.

A detailed check list of relevant data for the applications described in Sec 1, [2.3] is given in Tab 1.

1.3 Technical documentation and type testing

1.3.1 General material properties

The general properties of material are to be provided. Where applicable, reference may be made to table A1 in ISO 9554. The material safety data sheet is to be provided for information.

1.3.2 Physical and mechanical properties

The detailed specification of fibre physical and mechanical properties is to include tolerances on specified characteristics.

Mechanical properties are generally determined on fibre in dry condition. When relevant for considered material (such as polyamide), properties in both dry and wet conditions are to be specified.

These properties are to be documented by samples of production tests results or specific tests at time of fibre qualification, as applicable.

Linear density and breaking strength of the fibre are to be tested in accordance with recognized standards. Alternatively, and subject to agreement, reference to a test methodology established by the fibre manufacturer may be considered.

The average yarn breaking strength and elongation is to be determined and recorded.

Yarn tenacity is to be determined and is to be in accordance with the requirements of NR432, Sec 3, [1.3.1](for SK).

Samples of the load-elongation characteristic are also to be provided. Further documentation of the load-elongation properties of fibre, as available, may be provided for information (for SK and JM).

1.3.3 Marine grade fibre (for SH and SK)

a) Polyester and polyamide

- Efficiency (applicable to SH and SK): testing for qualification of the efficiency of coating is to be performed by yarn-on-yarn abrasion tests on wet yarn, following the method provided in CI 1503.

  Tests execution and results are to be in accordance with the performance requirements defined in:

  - for polyester:

    ISO 18692-1 and -2 (for SK)

    CI-2009P (for SH)

  - for polyamide:

    CI-2009N (for SK and SH)

  Criteria for yarn-on-yarn abrasion tests during fibre production are also to be specified.

- Persistence (applicable to SK): the persistence of the marine finish in a marine environment is to be demonstrated, e.g. by yarn-on-yarn abrasion tests after artificial ageing (see ISO 18692-2, Annex B), or another duly documented method.

b) Aramid and polyarylate

The persistence of fibre coating in marine environment is to be documented.

Note 1: For these fibres, the efficiency of coating can be documented following [1.3.5], but will have to be demonstrated by tests on ropes as per NR432 (yarn-on-yarn abrasion tests as defined in CI1503 are not adequate for this purpose).

1.3.4 Other fibre properties (for SK)

The following properties specific to fibre are to be documented or tested as relevant.

- Creep: For HMPE fibres where creep is a potential mode of failure at load levels in the range of those considered for service, documentation of creep properties, as a function of load and temperature, is to be provided in accordance with the requirements of ISO 18692-3, Annex A, as applicable.
- Hydrolysis: For aramid and polyarylate fibres that are sensitive to hydrolysis, fibre properties in this respect are to be tested in accordance with the requirements of ISO 18692-4 and -5.

1.3.5 In-rope properties (for SK and JM)

The following documentation of in-rope properties specific to fibre and/or intended application(s), should be provided, as available:

- endurance under cyclic tension-tension loading
- axial compression fatigue
- angled endurance (for JM)
- others as relevant.

Such documentation should be based on results of testing on small size ropes with a construction typical of ropes for the application, or full size ropes, whenever available. Any rope coating applied to samples tested is to be duly specified.

1.4 Certification of produced fibres (for SH, SK and JM)

1.4.1 Fibres are to be delivered with a work's certificate (such as type 3.1 as per EN10204:2004) including:

- product and batch identification
- results of routine tests: the mean value, the standard deviation (or range), and the number of tests are to be reported
- result of test of finish application (for SH and SK).

Note 1: When the product is for internal use, same information is to be given in a test report.

1.5 Fabricated yarns

1.5.1 The requirements given in this sub-article apply to yarns made of several fibres, of one or several material or size, assembled together, generally by twisting, with possibly the addition of a coating (to obtain a “marine grade” fibre) or other lubricant.

Note 1: Further mechanical or thermal treatment will be given special consideration.

1.5.2 Material specification

The material specification is to define:

- producer of yarn and designation
- material(s), with designation and producer of base fibres
- size and construction data
- fibre physical and mechanical properties
- designation and content of marine finish or other lubricant/coating/additive (for SH, SK and JM).

1.5.3 Technical documentation

Technical documentation is to include:

- general properties of material(s) (see [1.3.1])
- specifications of base fibres, with documentation of properties supported by:
  - data from base fibre type approval (for SK other than MRE - see Sec 1, [1.2])
  - test certificates issued by fibre producer(s) (see [1.4], as applicable) for other applications
- manufacturing procedures
- detailed specification and documentation of yarn physical and mechanical properties, as per [1.3.2] to [1.3.4].

1.5.4 Yarn certificate/test report

The certificate or test report for yarn is to be as per [1.4].

Table 1 : Check list of fibre data

Fibre data	Applications			
	SH	SK	JM	Other applications
GENERAL				
Producer of fibres	X	X	X	X
Fibre designation	X	X	X	X
Fibre material	X	X	X	X
Nominal size (linear density)	X	X	X	X
Marine finish designation	X	X	X	X
Finish content	X	X	X	X
Finish solubility in water	X	X	X	X
MATERIAL PROPERTIES				
Density	X	X	X	X
Moisture regain	X	X	X	X
Melting point	X	X	X	X
Shrinkage	X	X	X	X
Abrasion resistance	X	X	X	X
Creep resistance **(1)**	X	X	X	X
Sun resistance	X	X	X	X
Environmental resistance	X	X	X	X
Resistance to chemical exposure	X	X	X	X
PHYSICAL PROPERTIES				
Number of filaments	X	X	X	X
Linear density **(2)**	X	X	X	X
Coating content	X	X	X	X
MECHANICAL PROPERTIES				
Testing conditions (dry/wet, twist)	X	X	X	X
Dry break strength **(2)**	X	X	X	X
Dry elongation at break (EAB) **(2)**	X	X	X	X
Wet break strength **(1) (2)**	X	X	X	X
Wet elongation at break (EAB) **(1) (2)**	X	X	X	X
Elongation at a specified load level (EASL) **(2)** or Load at specified elongation (LASE) **(2)**	X			
Yarn on Yarn abrasion efficiency	X	X		
Yarn on Yarn abrasion persistence		X		
Other specific properties (see [1.3.4])		X	X	

(1) As applicable
(2) Including tolerances on specified characteristic
Note 1: See Sec 1 for the definitions of SH, SK, JM

Section 3 Type Approval

1 Surveys

1.1 General

1.1.1 As part of the procedure for the type approval of fibres and yarns, a general assessment of the factory including the laboratory for control and testing of the production is to be made for the recognition in accordance with BV Mode II scheme as per NR320. A recognition certificate is issued upon satisfactory completion of the procedure. This recognition is subject to intermediate assessment as agreed.

1.1.2 An audit of production quality system is to be performed in accordance with App 1, with spot inspections and assessment of the production sites, testing and quality control records, to cover the following:

- implementation of quality control procedures
- review of in-coming material work's certificate and traceability
- control of manufacturing parameters (base fibre)
- yarn manufacturing (fabricated yarns)
- testing (with spot witnessing)
- identification/marking of product.

An audit report is issued by the auditor.

2 Type approval certificate

2.1 General

2.1.1 The documentation prepared by the producer/manufacturer and the above audit reports are to be reviewed by the Society. Based on the above and the satisfactory completion of all activities, a type approval certificate, with a validity of 5 years (renewable), is delivered.

The type approval certificate will mention the intended usage(s) for which the fibre or yarn is type approved (see Sec 1, [2.3]) and the production sites which are covered.

Appendix 1 Scope of Work for Survey of Fibre Manufacturing Plant

1 General

1.1 Scope

1.1.1 For the type approval of a fibre, a visit of the fibre manufacturing plant is made, for the purpose of:

- assessing the works and testing laboratories (recognition for BV Mode II Survey as per NR320)
- performing spot inspection of fibre production process, quality control, and testing.

A report of inspection is issued by the surveyor.

The type approval certificate is delivered following the relevant procedures of the Society, after review of applicable documentation and after the survey of the manufacturing plant is performed in accordance with this Appendix.

1.2 Documentation

1.2.1 Following documentation is to be available to surveyor:

- documentation of ISO 9001 certification, if any
- fibre specification
- quality plan for the production of fibres.

1.3 Scope of survey

1.3.1 Production

The visit is to cover the following topics, with respect to the proper operation of manufacturing and quality control procedures for the fibre subject to the survey.

- Fibre production:
  - acceptance of in-coming material (granulates)
  - control of manufacturing parameters (from extrusion to winding)
  - acceptance/rejection criteria of production fibre
  - traceability of product until packaging
  - identification/marking of product.
- Marine finish / fibre coating or other lubricant/additive (where applicable):
  - identification of specification
  - control of preparation
  - control of application.
- Testing:
  - calibration of load testing machine(s)
  - reporting system.

1.3.2 Test spot-witnessing

- fibre breaking test
- yarn-on-yarn abrasion test (where applicable)
- other specific test (where applicable).

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