Offshore fibre ropes
FOREWORD

DNV GL offshore standards contain technical requirements, principles and acceptance criteria related to classification of offshore units.

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CHANGES – CURRENT

This document supersedes DNVGL-OS-E303, July 2015.
Changes in this document are highlighted in red colour. However, if the changes involve a whole chapter, section or sub-section, normally only the title will be in red colour.

Main changes April 2016

• General
  — Explanation of the basic assurance principle concerning the balance between acceptance criteria for products and limits to operations has been added to Ch.1.
  — Restructured Ch.2 with the aim to arrange the requirements according to products.
  — Alignment with DNVGL-ST-E407 concerning role responsibilities, system integration and limits to operations. Alignment with DNVGL-RP-E305.
  — Alignment of definitions with DNVGL-ST-E407 and DNVGL-RP-E305. Definitions belonging to RP-E305 have been removed from this document.
  — Provisions have been added for documentation of in-line joints. Flexibility with respect to service provision to owner in the operations phase has been added.
  — Restructured Ch.3 to align with the restructured Ch.2.
  — For products that are not followed up in service under classification, certification of designated service has been added to state compliance with the limits to operations.
  — Interchanging of hardware and rope segments from different deliveries is facilitated by certifying fibre rope segments and termination hardware separately. Definitions have been amended accordingly and requirements to marking of products have been added.

• Ch.1 Sec.1
  — [1.1] Rewritten sub-section including new figure
  — [1.4.3] Updated clause with new items in listing
  — [3.2] Update (table 10) with new items and removing items as given in RP-E305

• Ch.2 Sec.1
  — New section

• Ch.2 Sec.2
  — New section for designated services including relevant content in former Ch.2 Sec.1

• Ch.2 Sec.3 to 6
  — New sections due to restructuring of Ch.2

• Ch.2 Sec.7
  — [2] Updated clause adding reference to manufacturing program and simplified table focusing on performance of delivered material
  — [3] Removed former table of testing and included new guidance note

• Ch.3 Sec.2
  — Restructured to align with updated structure of Ch.2
  — [2.2] Rewritten in line with new approach to interchanging hardware with segments
— [4.6.3] updated clause emphasizing that the testing specification is subject to approval
— [4.7] Updated clause with new list item
— [4.11.1] New clause clarifying applicability for offshore classification
— [4.11.3] New clause on how to handle cutting of ropes
— [6] New sub-section on certification of designated service

**Editorial corrections**

In addition to the above stated changes, editorial corrections may have been made.
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CHAPTER 1 INTRODUCTION

SECTION 1 GENERAL

1 About this standard

1.1 Introduction

1.1.1 General
The safety and reliability of operations depend on having equipment, devices and facilities that function as intended.
This standard provides the structure for assuring that offshore fibre ropes will perform as intended either alone or as part of a system, until discarded.

1.1.2 Assuring reliability for delivery (before use)
In order to function as intended then equipment, devices and facilities need to be
1) engineered properly, (build the right thing),
2) made properly, (build the thing right), and
3) commissioned properly, (put together right).
This standard stipulates how adequate acceptance criteria for delivery should be established in terms of 1, 2, and 3.

1.1.3 Assuring reliability in service (after delivery)
To continue to function as intended after delivery then equipment, devices and facilities need to be
a) applied correctly, (used for the right thing),
b) operated appropriately, (used in the right way), and
c) maintained adequately, (kept in the right condition).
This standard stipulates how adequate limits to operations should be established in terms of a, b, and c.
These six basic premisses for achieving defined performance (and reliability) are illustrated in Figure 1.
1.1.4 Validated requirements
The adequate set of acceptance criteria for delivery and limits to operations are called validated requirements.
The adequate limits to operations define the designated service.
The above principle forms the basis for this standard.

1.2 Objective
The objective of this standard is to ensure that the design and manufactured quality of offshore fibre ropes meet the requirements of the designated service, as basis for ensuring reliable offshore systems that use load-bearing lines made from synthetic fibre materials.

1.3 Scope
1.3.1 General
This standard is concerned with the production and furnishing of offshore fibre ropes for designated service and that the offshore fibre rope continues to be fit for the designated service whilst it is being used.

1.3.2 It provides requirements for documentation and a scheme for DNV GL certification of fibre ropes for designated offshore service.
1.3.3 This standard is intended to be used as reference for contracts between parties and it reflects the role responsibilities involved with deliveries and operations with offshore fibre ropes.

1.3.4 Materials
This standard covers offshore fibre ropes that are manufactured using aramid, polyester, HMPE, LCP, or polyamide (nylon) load-bearing yarn materials.
Other load-bearing yarn materials than those stated, including combinations, may be considered on a case-by-case basis. Appropriate technology qualification shall be performed in order to determine acceptance criteria and limits.

1.3.5 Rope construction
Information about types of offshore fibre ropes is provided in DNVGL-RP-E305.

Guidance note:
Offshore fibre ropes may be manufactured with a braided or helical arrangement of the strands (construction). The built-in twist of the strands depends on the production method. A bundle of many parallel, load-bearing elements with an external jacket may also be used. Those parallel elements may be braided or helical subropes, or large (assembled) yarns.

---end---of---guidance---note---

1.4 Application

1.4.1 General
This standard is applicable to fibre rope assemblies in designated offshore service with sufficient 3-T performance margins – and other margins – for the load-bearing yarns in the rope. The variation in loading shall be within the design range that has been demonstrated for the load-bearing yarn.

Guidance note:
The tests in the DNV Programme for Approval of Manufacturers 322 for manufacturers of load-bearing yarns are tailored at showing that tension variations within the design range do not affect the 3-T performance margins of the yarn.
The yarn testing for deliveries as required by this standard is aimed at validating and contributing to the data base on 3-T performance characteristics that have already been determined by previous delivery testing, and the initial testing according to the programme for approval of manufacturer.

---end---of---guidance---note---

1.4.2 Other reasons for managing the ranges of loading than 3-T endurance may exist and shall be accounted for in the dimensioning and in the operations.
This standard is applicable to offshore fibre ropes in the following applications with loading in tension:
— taut mooring of offshore units
— semi-taut and catenary moorings where only a portion contains fibre line
— tension leg platform (TLP) tendons
— towlines.

1.4.3 It is further applicable to the following applications with combined loading, i.e. with bending or twisting (or both) in addition to tension:
— offshore mooring systems where elements generate torque and twist
— deployment and recovery systems
— lifting slings
— lifting pendants.
Note:
For the TLP tendon application, due consideration shall be given to definition of the load cases, including that of around-axis rotation of the platform (yaw). The susceptibility of the tendon system to cutting by external objects shall be considered, and the redundancy of the design shall be described.

---end---of---note---

1.4.4 Offshore mooring applications
The provisions of DNVGL-OS-E301 are applicable under this standard.

1.4.5 Typical mooring applications are anchoring of long-term floating production systems and anchoring systems for mobile offshore units. This standard is applicable to synthetic fibre mooring lines for other offshore installations, such as wave-, wind-, or current energy plant.

1.4.6 Deployment and recovery applications
The provisions of DNVGL-ST-E407 are applicable under this standard for designated application in deployment and recovery systems.

1.5 Structure

Chapter 1 (this chapter) provides a general introduction with overview, definitions, general provisions and references relevant for Ch.2 and Ch.3.

Chapter 2 (Ch.2) provides the documentation requirements of this standard.

It is attempted to structure Ch.2 to reflect the function-orientated sequence of defining the right product for a designated application.

Requirements pertaining to the operations phase are thus presented prior to requirements pertaining to design and requirements to materials.

Chapter 3 (Ch.3) covers the following DNV GL certification processes:

— certification of products on behalf of the suppliers
— certification of designated service on behalf of the owner where products are not followed up in service under classification.

It is attempted to present the information pertaining to certification processes in chronological order.

1.5.1 The current, official issue of this standard and other DNV GL service documents are available at www.dnvgl.com.

Guidance note:
Readers are encouraged to provide their comments and input to rules@dnvgl.com as the document is being continually developed.

---end---of---guidance---note---

2 References

2.1 General
In case of conflict between requirements of this standard and a reference document, the requirements of this standard shall prevail.

The latest edition of the referenced document, including amendments, shall apply.

2.2 Normative references
The documents listed in Table 1 through Table 5 include provisions, which through reference in the text constitute requirement of this standard. Other provisions may be taken as recommendations.
Table 1 DNVGL service specifications

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNVGL-SE-0056</td>
<td>Certification of rope based deployment and recovery systems for designated service</td>
</tr>
<tr>
<td>DNVGL-SE-0160</td>
<td>Technology qualification management and verification</td>
</tr>
</tbody>
</table>

Table 2 DNV GL standards

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNVGL-OS-B101</td>
<td>Metallic materials</td>
</tr>
<tr>
<td>DNVGL-OS-C401</td>
<td>Fabrication and testing of offshore structures</td>
</tr>
<tr>
<td>DNV-OS-C501</td>
<td>Composite Components</td>
</tr>
<tr>
<td>DNVGL-OS-E301</td>
<td>Position mooring</td>
</tr>
<tr>
<td>DNVGL-OS-E302</td>
<td>Offshore mooring chain</td>
</tr>
<tr>
<td>DNVGL-OS-E304</td>
<td>Offshore mooring steel wire ropes</td>
</tr>
<tr>
<td>DNVGL-ST-E407</td>
<td>Rope based deployment and recovery systems for designated service</td>
</tr>
</tbody>
</table>

Table 3 DNVGL and DNV recommended practices

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNV-RP-A203</td>
<td>Technology Qualification</td>
</tr>
<tr>
<td>DNVGL-RP-E304</td>
<td>Condition management of offshore fibre ropes</td>
</tr>
<tr>
<td>DNVGL-RP-E305</td>
<td>Design, testing and analysis of offshore fibre ropes</td>
</tr>
</tbody>
</table>

Table 4 DNV Programmes for Approval of Manufacturers

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>321</td>
<td>Manufacturers of Offshore Fibre Ropes</td>
</tr>
<tr>
<td>322</td>
<td>Manufacturers of Offshore Fibre Yarns</td>
</tr>
</tbody>
</table>

Table 5 Other reference

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN 10204</td>
<td>Metallic products – Types of inspection documents</td>
</tr>
</tbody>
</table>

2.3 Informative references

The documents listed in Table 6 through Table 8 might further be useful to readers of this standard.
Table 6 DNV GL rules for classification – Mobile units

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNVGL-RU-OU 0101</td>
<td>Offshore drilling and support units</td>
</tr>
<tr>
<td>DNVGL-RU-OU 0102</td>
<td>Floating production, storage and loading units</td>
</tr>
<tr>
<td>DNVGL-RU-OU 0103</td>
<td>Floating LNG/LPG production, storage and loading units</td>
</tr>
</tbody>
</table>

Table 7 DNV Offshore Standard

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNV-OS-H203</td>
<td>Transit and Positioning of Offshore Units</td>
</tr>
</tbody>
</table>

Table 8 Other references

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>API RP 21</td>
<td>In-service inspection of mooring hardware for floating structures</td>
</tr>
<tr>
<td>API RP 2SK</td>
<td>Design and analysis of station-keeping systems for floating structures</td>
</tr>
<tr>
<td>API RP 2SM</td>
<td>Design, Manufacture, Installation, and Maintenance of Synthetic Fiber Ropes for Offshore Mooring</td>
</tr>
<tr>
<td>ASTM D6611</td>
<td>Standard test method for wet and dry yarn-on-yarn abrasion resistance</td>
</tr>
<tr>
<td>CI 1500</td>
<td>Test methods for fibre rope</td>
</tr>
<tr>
<td>CI 1503</td>
<td>Test Method for Yarn-on-Yarn Abrasion</td>
</tr>
<tr>
<td>CI 2001-04</td>
<td>Fibre rope inspection and retirement criteria</td>
</tr>
<tr>
<td>EN 10204</td>
<td>Metallic materials – types of inspection documents</td>
</tr>
<tr>
<td>ISO 1968</td>
<td>Fibre ropes and cordage – vocabulary</td>
</tr>
<tr>
<td>ISO 3344</td>
<td>Reinforcement products – Determination of moisture content</td>
</tr>
<tr>
<td>ISO 18692</td>
<td>Fibre ropes for offshore station-keeping – polyester</td>
</tr>
<tr>
<td>OCIMF</td>
<td>Guidelines for purchasing and testing of SPM hawsers</td>
</tr>
</tbody>
</table>

3 Definitions

3.1 Verbal forms
The following verbal forms are used in this document.

Table 9 Verbal forms

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>shall</td>
<td>verbal form used to indicate requirements strictly to be followed in order to conform to the document</td>
</tr>
</tbody>
</table>
### 3.2 Terms

The terms that are applicable to this standard are provided below.

Terms and abbreviations that are provided in DNVGL-RP-E305 are also applicable under this standard.

**Table 10 Terms**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>should</td>
<td>verbal form used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required</td>
</tr>
<tr>
<td>may</td>
<td>verbal form used to indicate a course of action permissible within the limits of the document</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-T endurance</td>
<td>load-bearing capability of synthetic-yarn materials under tension and temperature over time As the criticality of each parameter ‘tension’, ‘temperature’ and ‘time’ depends on the other two critical parameters, all three may be seen as a single, three-dimensional, critical parameter called 3-T. See DNV-RP-A203 for definition and explanation of critical parameters.</td>
</tr>
<tr>
<td>3-T utilisation assessment</td>
<td>assessment of residual service life based on adequate data for 3-T endurance</td>
</tr>
<tr>
<td>adequate</td>
<td>assured with best endeavours to be relevant and complete for the case at hand (about a set of acceptance criteria for delivery and limits to operations)</td>
</tr>
<tr>
<td>aramid</td>
<td>para-aramid</td>
</tr>
<tr>
<td>acceptance criteria</td>
<td>set of requirements to the delivery so that the solution will have the qualified performance in designated service</td>
</tr>
<tr>
<td>characteristic strength</td>
<td>uniquely defined reference strength, often specified in terms of a defined fractile in the lower end of the distribution function for strength See DNVGL-OS-E301.</td>
</tr>
<tr>
<td>combined loading</td>
<td>tension with bending or twisting (or both)</td>
</tr>
<tr>
<td>condition management</td>
<td>programme for monitoring, inspection and maintenance during the service life in order to assure that the offshore fibre rope remains fit for designated service</td>
</tr>
<tr>
<td>programme</td>
<td></td>
</tr>
<tr>
<td>cyclic endurance</td>
<td>load-bearing capability under cyclic loading over time</td>
</tr>
<tr>
<td>critical parameter</td>
<td>parameter used to express quantitatively the difference between sufficient function and insufficient function</td>
</tr>
<tr>
<td>design range</td>
<td>difference between the highest occurring tension and the lowest occurring tension which will not impair the 3-T endurance</td>
</tr>
<tr>
<td>design verification report</td>
<td>report issued by the independent verifier after review and evaluation of the design documentation</td>
</tr>
<tr>
<td>DRS</td>
<td>deployment and recovery system See DNVGL-ST-E407.ian</td>
</tr>
<tr>
<td>DVR</td>
<td>design verification report</td>
</tr>
<tr>
<td>FEM</td>
<td>finite element modelling</td>
</tr>
<tr>
<td>feedstock</td>
<td>polymeric material used as basis for the production of filament yarns</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>fibre rope</td>
<td>flexible assembly of synthetic yarns which is able to carry useful tension the free length of rope (and sheathing as applicable), excluding terminations (splices and eyes) and termination hardware</td>
</tr>
<tr>
<td>fibre-rope segment</td>
<td>fibre rope with terminations, excluding termination hardware</td>
</tr>
<tr>
<td>filter</td>
<td>barrier towards ingress of foreign matter</td>
</tr>
</tbody>
</table>
| Guidance note               | advice which is not mandatory under this standard, but with which DNV GL, in light of general experience, advises compliance  
The reader may decide whether to apply the guidance note or not. Guidance notes might also contain statements provided for additional information. |
| HMPE                        | high-modulus polyethylene                                                                                                                |
| insert                      | short fibre-rope segment for retrieval as test material from a mooring line in service                                                   |
| ITP                         | inspection and test plan, which is a plan for the various steps in making the offshore fibre ropes, describing the involvement of QA department and surveyor |
| lifting line                | rope furnished for raising and lowering objects by winching                                                                               |
| lifting sling               | rope furnished for lifting from a bearing point                                                                                           |
| limits                      | set of restrictions to operations, that define the designated service so that the solution will have the qualified performance             |
| line                        | rope segment furnished for a designated purpose                                                                                           |
| long-term mooring           | anchoring of a unit at the same location for more than 5 years                                                                              |
| mobile mooring              | anchoring of a unit at the same location for less than 5 years                                                                           |
| NLLD                        | nominal load-bearing linear density                                                                                                       |
| nominal load-bearing linear density | linear density as stated by the yarn manufacturer for the total amount of load-bearing yarns in the fibre rope  
There is no rope testing required to determine nominal load-bearing linear density. |
| offshore fibre rope         | fibre rope furnished for designated offshore service                                                                                      |
| offshore fibre yarn         | yarns made from synthetic filaments for load-bearing service in offshore fibre ropes                                                       |
| pendant line                | fibre rope furnished to suspend an object independently from a bearing point                                                               |
| performance characteristics | properties that describe how the product performs in the designated application                                                           |
| performance description     | document that is issued by the manufacturer to describe how the offshore fibre rope performs in the application                             |
| qualification               | demonstration that a solution will have defined performance provided acceptance criteria and limits are met                                |
| sheathing                   | protective jacket and soil barrier (if present)                                                                                           |
| strand                      | principal component of the rope or subrope  
The strand is formed by an assembly of yarns which are grouped together. The strands form a rope by either a helical, braided, or parallel arrangement. |
<p>| stress rupture              | breakage of a synthetic fibre when its 3-T endurance is exhausted                                                                        |</p>
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>stretch</td>
<td>the change in rope length, $\Delta L$, as result of change in tension</td>
</tr>
<tr>
<td>subrope</td>
<td>rope that is part of a parallel bundle to form the load-bearing core in the full rope</td>
</tr>
<tr>
<td>system integrator</td>
<td>party that is responsible for integration of offshore fibre ropes into a larger system, such as a mooring system or deployment and recovery system</td>
</tr>
<tr>
<td>technology qualification</td>
<td>process of defining an adequate set of acceptance criteria for delivery and limits of designated service</td>
</tr>
<tr>
<td>tendon</td>
<td>tension member furnished to submerge a floating object by vertical tension and thereby also to keep it in position</td>
</tr>
<tr>
<td>tension vs. stretch performance</td>
<td>length and dynamic stiffness of the rope as function of loading sequence and time</td>
</tr>
<tr>
<td>termination hardware</td>
<td>component inserted in the rope eye to transfer the line loads from the fibre-rope segment to the connecting elements</td>
</tr>
<tr>
<td></td>
<td>Spool thimbles made from steel are most commonly used.</td>
</tr>
<tr>
<td>test material</td>
<td>load-bearing material retrieved from a line in service for assessment of rope condition</td>
</tr>
<tr>
<td>test unit</td>
<td>for manufacturing of steel termination hardware, a test unit is defined as items from the same heat of steel and same heat-treatment batch</td>
</tr>
<tr>
<td>tether</td>
<td>fibre rope furnished to keep an object in position</td>
</tr>
<tr>
<td>validated requirements</td>
<td>adequate set of acceptance criteria and limits</td>
</tr>
<tr>
<td>transport weight</td>
<td>weight of the fibre rope segment with a water content that is representative for outdoor conditions, after heavy rain and allowing excess water to drain off</td>
</tr>
<tr>
<td></td>
<td>The spliced eyes shall be self-draining, not to accumulate any water inside the PU coating, if present.</td>
</tr>
</tbody>
</table>
CHAPTER 2 REQUIREMENTS

SECTION 1 INTRODUCTION

1 General
This chapter describes the role responsibilities and the requirements to documentation and testing associated with the delivery of fibre ropes for designated offshore service.

This standard organises the validated requirements as follows:
— limits of designated service, (operations phase)
— acceptance criteria for the furnished offshore fibre rope, (delivery phase)
— acceptance criteria for the individual parts, (delivery phase).

This organisation is used as basis for how a furnished fibre rope including termination hardware should be documented in order to justify that it will be reliable in its designated service.

Reference is further made to Ch.1 Sec.1 Figure 1.

The next two sections of this chapter contain provisions for the designated service and the finalised offshore fibre rope:
— Sec. 2: Designated service
— Sec. 3: Finalised offshore fibre rope

The further sections of this chapter contain provisions for the parts that make up the offshore fibre rope:
— Sec. 4: Load-bearing yarns
— Sec. 5: Fibre-rope segments
— Sec. 6: Termination hardware
SECTION 2 DESIGNATED SERVICE

1 Introduction
The designated service defines the limits to operations which shall keep the rope fit for purpose until it is discarded.
The limits to operations with offshore fibre ropes shall be specified in the designated service documents:
— designated application(s), (what the rope is used for)
— limitations to operation, (how people use the rope)
— requirements to condition management, (monitoring, maintenance and repair).

Guidance note:
DNVGL-RP-E304 discusses condition management. Failure modes that need to be managed by the provisions of the designated service documents are stated in DNVGL-RP-E305.

2 Role responsibilities

2.1 Owner-user information exchange

2.1.1 The owner of fibre rope assemblies shall provide to the user the adequate information to keep the rope within the limits of designated service.

2.1.2 The user shall provide to the owner the adequate information concerning performed operations and whether the limits have been complied with or not.

3 System integration for designated service

3.1 General

3.1.1 This sub-section provides requirements to documentation for system integration.
System integration is the process of making sure that fibre ropes perform reliably as part of a system in designated offshore service.
This entails assembly of a system with defined performance from individual components and establishing acceptance criteria (delivery phase) and limits (operations phase).

3.1.2 The recipient (system integrator or owner) and the supplier of fibre rope assemblies shall agree the defined performance. The supplier of the fibre ropes shall issue a rope performance description.
The performance agreement shall contain all information about required 3-T capacity, required design range, design temperature, line tensions in operation, required torque and twist characteristics, handling procedure, length of segments etc. that is needed for the rope manufacturer to propose and make the right rope for the designated application(s).

3.1.3 The designated application(s), the main principles for the requirements to operation and the main principles for the condition management programme should be submitted to the rope manufacturer as part of the enquiry.
Guidance note:
For long-term mooring systems and DRS systems, the system integrator is the role that is responsible for the performance of the integrated system including how the fibre ropes interact with the other elements of the system.
System integrator and rope manufacturer may well cooperate in establishing the condition management programme.

---end of guidance note---

3.1.4 In addition, the agreement for long-term moorings should as a minimum include the following:
— requirements to length of lines as-new and during the service life
— service requirements and operational boundaries for the finalised mooring system
— design life
— highest and lowest occurring sea-water temperature
— minimum bending diameter during transport and installation
— evaluation of sea-bed particles (e.g. sand and mud) experienced by the mooring line during installation.

3.1.5 If any of the components in the mooring leg are not torque neutral, then the torque / twist interaction shall be documented.
Analyses and/or test results shall be provided to demonstrate no adverse effects.

Guidance note:
The limits of designated service comprise installation sequence, pre-tension, loading scenario including the maximal occurring cyclic loading.
Mixing torque-generating steel-wire rope with torque neutral fibre rope is mainly a concern for the cyclic endurance of the steel-wire rope. As a general rule, mooring chain should not be subjected to excessive torque in operation. Swivels should be used with caution.

---end of guidance note---

3.1.6 In addition, the agreement for DRS rope shall as a minimum include the following:
— interfaces with the rope guide path and with the winching system including storage system
— rope design temperature at peak performance of DRS
— performance margin requirements with basis in critical parameters.

4 Designated application(s)

4.1 General
The designated application(s) shall be stated with associated limitations.
Depending on the designated application, there may be different performance characteristics that are of importance to the selection of load-bearing material, construction and sheathing for the rope.
Information on relevant failure modes (and methods of testing and analysis) is provided in DNVGL-RP-E305.
Reference is made to DNVGL-RP-E304 for information on condition management.

5 Operation

5.1 Handling and installation

5.1.1 The procedure for handling and installation shall contain the necessary instructions and limitations set to protect the integrity of the lines between manufacture and installed condition.

5.1.2 The procedure for handling and installation shall be adhered to.
5.1.3 Offshore fibre ropes should be protected from direct sunlight. If protective tarpaulin is applied to cover the rope on transportation reels then it should be of a light colour, and should be made in a canvas that also provides some protection against flame or fire.

5.2 Seabed contact
The lower parts of the fibre rope shall not be in contact with the sea bed during service, nor be handled or left in service in water with emulsified particles that may be transported into the load-bearing rope by the water that seeps in and out during changes in rope loading. Restrictions with respect to seabed contact shall be conspicuously stated in the procedure for handling and installation and in the condition management programme.

5.3 Offshore mooring systems

5.3.1 Mooring systems shall be operated with the required margins against failure, see DNVGL-OS-E301 for both mobile and long-term moorings.

5.3.2 The entire length of fibre rope mooring line shall be submerged at all times during service.

5.3.3 The load-bearing parts of the line shall be adequately protected from marine growth. Hard marine growth shall not be in contact with load-bearing yarns.

5.3.4 This standard is applicable to offshore mooring fibre ropes in a regular service scenario. The following applications are considered special service that requires technology qualification in order to define adequate acceptance criteria or limits, or both:
— seabed contact during the installation phase
— service with physical contacts to objects such as work wires
— service in shallow water where ample marine growth occurs
— service where part of the rope is above water.

5.3.5 In order to prohibit marine growth in mooring lines the sheathing shall be sufficiently dense to protect the rope interior from sunlight. It shall protect the load-bearing yarns against penetration of hard marine growth.

5.3.6 Fibre rope mooring lines should in general not be in contact with the seabed during installation or handling. Provided the protection against soil ingress has been duly qualified (with acceptance criteria and limits, ref. Ch.1 Sec.1 Figure 1), lines may be placed on the sea bed as part of the installation and handling procedure, pending retrieval and final hook up.

Guidance note:
The filter on an offshore mooring fibre rope is typically qualified as protection for unloaded rope which is not moving (limit). In case of pre installation of ropes to the sea bed, it should be substantiated that the ropes will not flutter on the sea bed as result of near-bottom current or other forces.

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5.3.7 Mooring lines intended for service with contact against external objects (such as work wires) shall be duly qualified for the designated service based on the principles of DNV-RP-A203 in order to determine acceptance criteria and limits.
5.4 Deployment and recovery systems
Reference is made to DNVGL-ST-E407.

6 Condition management

6.1 General

6.1.1 Due consideration shall be given to the operations phase during the design phase, and for the offshore fibre rope as part of a system.

Guidance note:
This is a general principle for any equipment, device or facility, and not limited to offshore fibre rope.

6.1.2 The condition of offshore fibre ropes shall be managed during service, in order to ensure sufficient margin towards relevant failure modes for the designated application(s). How this shall be done in practice shall be stated in the condition management programme.

6.2 Condition management programme

6.2.1 The condition management programme shall completely describe the methods and techniques for managing the condition of lines during service. Examinations and tests to be performed shall be described, together with a plan for retrieval of test material (as applicable) and evaluation criteria as appropriate.

6.2.2 Instructions for ROV checking of the termination areas of mooring lines shall include dimensional verification of the eyes and splices, their seating and alignment on the termination hardware and checks for potential chafing.

Guidance note:
Reference is made to applicable DNV GL rules for MOU with regard to mobile and long-term moorings, and to the recommended practices DNVGL-RP-E304 and DNVGL-RP-E305. Tension measurements provide vital input for assessment of 3-T utilisation as part of the condition management programme.

6.3 High tension

6.3.1 The 3-T endurance will be expended sooner under prolonged high tension or prolonged high temperature, or both.

6.3.2 If it is measured or suspected that a mooring line has been subjected to a tension level exceeding 70 % MBS then it should be re-qualified for service or discarded.

6.4 Test material

6.4.1 Test material required to perform condition assessment may be taken when the line is not in service.

Guidance note:
Test material may be taken by cutting off a short length and re-terminating the rope segment.
6.4.2 For long-term moorings test material in the form of inserts can be retrieved and examined/tested if this is according to the provisions of the condition management programme.

6.5 Repair

6.5.1 The repaired rope shall be qualified for designated service, whereby an adequate set of acceptance criteria and limits are developed.

6.5.2 Any repair should only be performed by qualified personnel using qualified methods and materials.

6.5.3 The integrity of protective sheathing shall be reinstated.

Guidance note:
Information concerning fibre-rope damage assessment and repair can be found in DNVGL-RP-E304, API RP 2I, ISO 18692 and CI 2001-04.
Suppliers and service providers who are approved by DNV GL are listed at https://approvalfinder.dnvgl.com/.

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SECTION 3 FINALISED OFFSHORE FIBRE ROPES

1 General

1.1 Introduction
This section contains provisions for finalised offshore fibre rope with respect to application as part of a larger system.

1.2 Marking
The marking on the fibre rope segments and associated termination hardware shall be adequate to ensure that correct combinations of rope and hardware are being used.

Note:
Designated application and discard criteria shall be stated on label and certificate for lifting slings.

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2 Role responsibility

2.1 Documentation requirements
The supplier of offshore fibre rope shall provide agreed documentation to recipient in order that the fibre rope assembly perform required functions reliably as part of a larger system.
The documentation requirements for offshore fibre ropes are provided below for the following:
— Finalised offshore fibre rope (this section)
— Load-bearing yarns (Sec.4)
— Fibre rope segment (Sec.5)
  — Fibre rope without terminations
  — Terminations on fibre rope
— Termination hardware (Sec.6).

3 Performance characteristics

3.1 Performance description of rope with terminations and hardware
The behaviour of the fully furnished offshore fibre rope in the designated offshore service shall be described in the rope performance description.
This document shall be used for the integration of the offshore fibre rope into the system it shall be part of, in order that the behaviour of the integrated system can be defined within designated service.

Guidance note:
Test data that pertain to quality assurance and which are not relevant for system integration should not be included in the rope performance description. Recommendations can be found in DNVGL-RP-E305.

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The rope performance description shall include statement of performance with respect to corrosion of termination hardware over the design life.
3.2 Endurance of finalised offshore fibre rope

3.2.1 The endurance of the furnished offshore fibre rope shall be documented in terms of:
— 3-T endurance for continuous loading of fibre rope segment, considering temperature
— 3-T endurance in cyclic loading (design range) of fibre rope segment, considering temperature
— cyclic loading endurance of fibre rope segment
— cyclic loading endurance of termination hardware.

3.2.2 The cyclic loading endurance shall be demonstrated by testing, with subsequent examinations and tests.
Reduced-scale cyclic endurance testing shall be rigorously justified using technology qualification principles, ref. DNV-RP-A203.
The effects of interaction in the rope eye shall be covered, even if subropes in a mooring line are not scaled.

Guidance note:
On certain conditions a larger line can cover the cyclic-endurance test requirement of a smaller line. It is recommended to perform testing on a sample that covers more than just one delivery of the same yarn material, coating and type of rope and splices.
The requirement to cyclic endurance testing of fibre rope assemblies does not apply to mobile moorings.

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3.3 Torque and twist characteristics

3.3.1 The torque and twist characteristics are defined as the resulting torque and/or twist that the fibre rope assembly exerts when loaded.
The torque and twist characteristics shall be stated in the performance description and demonstrated by testing.

3.3.2 For designated application(s) together with torque-neutral components only, the torque and twist behaviour of inherently torque neutral ropes are not required to be characterised by testing.

3.4 Breaking strength

3.4.1 The characteristic strength ($S_c$) of the line shall be determined by testing. In the rope performance description, the characteristic strength shall be stated in kN and in N/tex relating to the nominal load-bearing linear density.

3.4.2 Break testing is important in order to demonstrate that the process for terminating the ropes is repeatable and reliable, and to verify the performance of the termination hardware and the termination-to-hardware integration.

3.4.3 The characteristic strength shall be adequate for short-term 3-T endurance, i.e. for adequate margin against rapid over-loading.

Guidance note:
Break tests serve as coarse verification of the strength of the fibre rope when tested under given conditions using test samples of limited length. The lowest result should meet or exceed the required MBS.
The breaking strength that is obtained in testing is a result of the tension-time-temperature (3-T) endurance; hence it will vary depending on the rate of loading in the final parts of the test, and the temperature of the load-bearing yarns.
The use of minimum break strength (MBS) as the governing performance characteristic for the rope is discouraged. The short-term and long-term 3-T endurance and the tension vs. stretch performance are more important than MBS. Under this standard, the minimum breaking strength is used as a casual reference for the rope.

If the lowest result fails to meet a specified value for MBS, it should be observed that increasing the nominal load-bearing linear density may have adverse effects such as increased fatigue exposure of steel components and a less compliant rope. Rope bulkiness is usually no advantage, and in a DRS system the tendency to generate heat will increase.

If the lowest result is significantly lower than the other results, leading to suspicion that something was wrong with the sample, then it may be disregarded provided the manufacturer produces a technical report with detailed analysis and explanation of the cause of the low result, and demonstrates the measures to be implemented to prevent the same error to occur during production of the delivery.

Sound judgement is encouraged.

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SECTION 4 LOAD-BEARING YARNS

1 Requirements

1.1 Role responsibility
The supplier of load-bearing yarns shall ensure that the delivery meets the acceptance criteria (performance requirements) agreed with recipient.

1.2 Documentation requirements

1.2.1 The manufacturer of the load-bearing yarn shall provide documentation to recipient (rope manufacturer) of characteristic design data as needed for dimensioning of products, and as stated in this standard for testing of deliveries.

1.2.2 The load-bearing linear density of yarns shall be stated in dtex. The weight of coating shall not be included in load-bearing linear density.

1.3 Performance characteristics

1.3.1 The load-bearing fibre yarns shall be fit for the designated service. The 3-T performance characteristics (time-to-failure and design range) of the yarn shall be sufficient for the designated service of the offshore fibre rope.

1.3.2 The load-bearing yarns shall be able to sustain loading within the entire design range, with sufficient performance margin to failure, as well as sufficient abrasion resistance and adequate tension vs. stretch behaviour for the application.

1.3.3 The load-bearing yarns shall be functional for the application with appropriate coating (such as marine finish for offshore mooring lines). Due consideration shall be given to the balance between low friction and locking of the splices.

1.3.4 The following performance characteristics shall be provided for the load-bearing yarn:
— characteristic 3-T (Tension-Time-Temperature) performance data
— design range
— tension vs. stretch characteristics.

Low-tension durability shall be considered as appropriate for aramid yarns and as otherwise applicable. The resistance to yarn-on-yarn abrasion shall be considered as relevant.

1.3.5 The amount of 3-T performance data shall be adequate for the engineering dimensioning of the actual case using characteristic values.
The recipient of the load-bearing yarns (the rope manufacturer) shall agree with the supplier (the yarn manufacturer) the conditions for which this information will be needed. This will largely depend on the type of rope and designated service.
SECTION 5 FIBRE ROPE SEGMENTS

1 General

1.1 Introduction
This section covers provisions for fibre rope segments, i.e. the long length of rope including terminations.

1.2 Role responsibility
The supplier of fibre rope segments shall ensure that the delivery meets the acceptance criteria (performance requirements) agreed with recipient (system integrator or owner).

2 Documentation requirements

2.1 General

2.1.1 The fibre rope segments shall be documented as part of the performance description for fibre rope assemblies.

The documentation from the supplier of offshore fibre ropes (the rope manufacturer) shall as a minimum contain:

— design description
— performance description
— testing specification
— procedure for handling and installation
— description of material for the fibre rope sheathing, consisting of filter and jacket
— description of load-bearing yarns
— documentation of the materials for spliced-eye protection
— documentation of the termination hardware
— limits of the designated service.

2.1.2 The design description shall include; type of fibre rope construction, type of termination, nominal load-bearing linear density, detailed design drawings, and weight of the line in sea water, performance characteristics, and tension vs. stretch characteristics.

2.1.3 The rope manufacturer shall issue a performance description, which details the performance characteristics of the offshore fibre rope.

The rope performance description shall include detailed information about how the line performs in the application, such as tension vs. stretch and torque responses, and changes in load sharing when it is twisted and bent.

**Guidance note:**
Recommendations are provided in DNVGL-RP-E305.

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2.1.4 The testing specification shall be specific to the tests that shall be performed.
It shall describe all activities and tasks, even if these are entirely based on or taken from existing standards. The testing specification shall not contain any references, i.e. all information needed to perform testing shall be stated in the testing specification.
Guidance note:
The testing specification is part of the documentation for design verification according to Ch.3 of this standard. The test machine operator should be allowed to devote time and attention to performing tests that are unambiguously described. It should not be put upon the test machine operator to interpret standards on behalf of the system integrator. Nor is that in the role of the independent verifier at commencement of testing.

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3 Performance characteristics

3.1 Tension-time-temperature (3-T) endurance
The ‘3-T’ performance characteristics shall be documented with basis in tests. Tension - time design curves shall be provided for the relevant temperatures.

3.2 Tension vs. stretch performance
The tension vs. stretch performance of the fibre rope segment shall be sufficiently described for calculating the behaviour of the integrated system. Thus, the testing shall be specified according to the measurement results that are needed in the adequate system analyses. The testing shall reflect the actual application of the system, including accommodation of lifetime extremes.

Guidance note:
The system integration for tension vs. stretch may be based on the testing requirements of generic loading scenarios, such as those given by ISO 18692 or API RP 2SM for offshore moorings, provided the results yielded are acceptable to perform the required analyses of rope tension vs. stretch behaviour in the system.

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3.3 Resistance to soil ingress of mooring lines

3.3.1 The resistance to soil ingress shall be stated in the rope performance description and validated by testing. Acceptance criteria and limits shall be defined using technology qualification principles based on DNV-RP-A203.

3.3.2 For lines subject to tension prior to sea-bed contact, the soil-ingress resistance test shall be performed on a specimen that has been stretched at a similar or higher tension level.

3.3.3 The resistance of the termination areas shall be documented in the rope performance description. Documentation should be provided in the rope design description, the manufacturing description and the test results from stretching of fibre-rope segments, if performed.

Guidance note:
The soil test samples may be taken from the free length, whilst the resistance of the termination areas can be covered by documentation that it is ‘equal to or better’ than the free length. ‘Equal to or better’ usually entails that the filter is continuous throughout the termination areas, and that no localised cracks may form if the rope is stretched prior to seabed exposure.

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3.4 Hysteresis heating
It shall be demonstrated that the maximum temperature inside the offshore fibre rope due to hysteresis heating and other heating contributions does not exceed the design temperature.
Guidance note:
In submersed service for offshore mooring any hysteresis heating is normally not expected, yet the requirement to free-flooding should be observed for all parts of the rope including terminations. Other heat sources than hysteresis heating may be internal and external friction; and high ambient temperature may impede heat dissipation.

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3.5 Sheathing

3.5.1 The sheathing, if applicable for the type of offshore fibre rope, consists of the following:
— the rope jacket
— the filter, if applicable
— the protection of spliced eyes.

3.5.2 An external sheathing is required for parallel-subrope, parallel-strand and for parallel-yarn ropes in order to hold the load-bearing bundle of elements together.

3.5.3 The sheathing may further be equipped with a soil filter to protect against particle ingress, or have added cut protection. The sheathing shall be free-flooded and self-draining, including in the termination areas. The permeability of the sheathing with respect to water and solids shall be stated in the rope performance description.

3.5.4 The description of the sheathing shall as a minimum include the following information:
— manufacturer and manufacturing plant
— designation
— sheathing weight/thickness
— permeability to water
— permeability to sunlight
— UV resistance
— seawater hydrolysis resistance
— resistance to chemicals.

The effect on the sheathing of UV light, of intensity corresponding to that experienced during transport, storage and operation, and after a time corresponding to the design life, shall be stated in the fibre-rope description.

3.6 Weight

3.6.1 The weight of the fibre rope in sea water shall be documented by calculation and stated in kg/m, together with the submersed weight of the terminations and termination hardware.

3.6.2 The transport weight of each fibre-rope segment and the termination hardware shall be stated.
4 Fibre rope without terminations

4.1 Marking
Offshore fibre ropes shall have a conspicuous length-ways marker in order that any undue twist can be observed. As an alternative, at least two strands (in the braided jacket or load-bearing rope as applicable) one left hand, and one right hand may be made from durable, water-resistant, coloured yarns.

4.2 Role responsibility
The supplier of fibre rope shall ensure that the delivery meet the acceptance criteria as agreed with recipient.

4.3 Load-bearing yarns
The supplier of fibre rope (rope manufacturer) should describe the following for the load-bearing yarn:
— manufacturer and manufacturing plant
— yarn designation
— nominal and actual range of linear density
— 3-T characteristic design data
— 3-T design range
— tension vs. stretch performance
— yarn breaking strength
— wet yarn-on-yarn abrasive performance
— marine finish designation
— seawater hydrolysis resistance.

The 3-T design range stated in the load-bearing yarn product certificate shall be verified to be adequate for the designated service of the system which the rope is part of.

4.4 Construction

4.4.1 The designated application(s) of the fibre rope with the modes of loading and the designated service shall govern the choice of rope construction – how it is made.

Guidance note:
Load-bearing cores of either parallel subropes or parallel (assembled) yarns rely on a jacket to hold the bundle together.
A rope that tolerates working under deflection may not need an external jacket, and it is the braided or helical arrangement of the strands in that single rope that accommodates deflection under tension without elements burrowing between other elements.
Reference is made to DNVGL-RP-E305 for additional information.

4.4.2 The nominal load-bearing linear density of ropes shall be stated in ktex or Mtex.
The nominal load-bearing linear density of strands and subropes shall be stated in ktex.
The weight of coating shall not be included in load-bearing linear density.

4.5 In-line joining

4.5.1 The integrity of in-line joints shall be demonstrated. In-line joints may be performed on yarn level, strand level or on sub-rope level.
Technology qualification principles as described in DNV-RP-A203 shall be employed to determine acceptance criteria and limits. In-line joints shall withstand operational loading without separating.
For joints that are adequately staggered in constructions where friction is active between elements the performance of the joints does not need to meet that of un-joined element provided the resulting performance of the finished product is adequate for designated service.

Guidance note:
Reference is made to requirements to splice integrity stated in this standard and to DNVGL-RP-E305 for additional information.

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4.6 Subropes
When subropes are assembled in a parallel arrangement the balance between them shall be ensured in order that the finalised rope will have the designated performance.

5 Terminations on the fibre rope

5.1 Types of termination

5.1.1 Fibre ropes shall normally be terminated with spliced eyes to make up the fibre-rope segment. Offshore fibre ropes may also be terminated with sockets provided the technology is qualified. For other types of fibre-rope terminations than the spliced eye, technology qualification shall be performed in order to substantiate that the termination is reliable in designated service. Reference is made to DNV-RP-A203 for principles pertaining to technology qualification with respect to critical parameters.

5.1.2 The spliced eyes shall be fitted on thimbles or other suitable termination elements. Termination hardware acts as the interface between the rope eye and the pin of the connecting element. Figure 1 illustrates a typical termination with termination hardware for a parallel-subrope rope. The actual design of the termination and termination hardware is part of the design of the furnished offshore fibre rope as determined by the supplier (rope manufacturer).

![Figure 1 Fibre rope segment furnished with spool thimble](image)

5.2 Marking
Each fibre rope segment shall be marked at each end with:

--- product designation as stated on the certificate
--- unique identifier traceable to the product certificate
--- identification of termination, e.g. A-side or B-side.
5.3 Role responsibility
The provider of fibre rope terminations shall ensure that the terminations meet the adequate acceptance criteria (performance requirements) established by the rope manufacturer.

5.4 Documentation requirements
The fibre rope terminations shall be documented as part of the performance description for fibre rope assemblies.

5.5 Splice integrity
The splice design shall be self-locking. The number of cycles to lock the splices shall be stated in the rope performance description and verified by testing.

Guidance note:
The splice is self-locking when the tension vs. pin-pin displacement curve has a clearly asymptotic behaviour towards a specific rope length at peak tension. Recommendations for testing are provided in DNVGL-RP-E305.

5.6 Protection cloth for spliced eyes
For spliced-eye terminations, protective cloth will normally be required between the eye and the termination hardware that fits through the eye. Such cloth should provide low friction and high wear resistance.
If a thin cover of elastomeric material is used to protect against chafing, then it shall be elastic such that the rope is not constrained from stretching or bending.
If a thick cover of elastomeric material is used to encapsulate the eye, it shall be applied over a tape or cloth that covers the eye and prevents direct adherence to and penetration onto the load-bearing rope.
Free-flooding of the eye shall be ensured.

Guidance note:
If a fibre rope segment is intended to be opened for later inspection, such as a service insert or test specimen, then the segment should be equipped with sufficient cloth beneath the PU coating such that the splice area can be opened as a loose carcass.

5.7 Sheathing

5.7.1 The splices and eyes shall have the same or better resistance to soil ingress as the fibre rope.

5.7.2 If the rope is equipped with a filter then this filter shall be continuous throughout the termination area.

5.8 Drainage and free flow
The fibre-rope segment shall be free flooded, including in the eye regions.
The spliced eyes shall be self-draining, not to accumulate any water inside the PU coating, if present.
SECTION 6 TERMINATION HARDWARE

1 General

1.1 Introduction

1.1.1 Termination hardware is the element which connects directly to the fibre rope segment and transfers the line loads. The termination hardware is part of the furnished fibre rope for designated offshore service, called the fibre rope assembly.

1.1.2 The spool thimble is the most commonly used termination hardware for spliced eyes. If the rope segment is connected directly to a shackle or an H-link, then that element is considered termination hardware.

1.2 Marking

Each item of termination hardware shall be marked with:

— product designation as stated on the certificate
— unique identifier traceable to the product certificate.

1.3 Role responsibility

1.3.1 The supplier of fibre rope termination hardware shall ensure that the delivery meets the acceptance criteria established by the responsible rope manufacturer.

1.3.2 It is the responsibility of the supplier of fibre rope segments to define the critical sections of the termination hardware, and to specify adequate materials’ testing requirements.

1.4 Documentation requirements

The manufacturer of the termination hardware shall submit documentation to the recipient of the termination hardware on material, processing, mechanical properties, dimensions, fabrication and tolerances of the finalised products.

Documentation of the termination hardware shall include drawings specifying material, geometry, location of critical section from where mechanical test pieces will be taken, method of manufacture. A structural-strength calculation report should be submitted if applicable.

Requirements to testing are stated in Sec.7.

1.5 Performance requirements

Termination hardware is required to fit and support the eye and the profile of the termination hardware shall be described.

1.6 Materials and fabrication

Termination hardware should be made of steel and may be cast, forged, machined or welded from plates/tubes.

The preparation of test pieces and the procedures used for mechanical testing shall comply with the relevant requirements of DNVGL-OS-B101.

The test values shall satisfy the requirements of the agreed material.
1.7 Castings and forgings

1.7.1 The materials shall satisfy a Charpy V-notch impact toughness of 50 J at -20°C.

1.7.2 The mechanical tests shall be taken from sacrificial items from the actual delivery. One sacrificial item shall be taken per test unit. For each test unit, 1-off tensile tests and 3-off Charpy V-notch tests shall be performed to document the engineering properties of the product. The test pieces for mechanical testing shall be taken at 1/3 thickness from the surface at the critical section. If an alternative test program is applied then this shall be rigorously justified.

1.7.3 All items shall be 100% visually inspected and be free from burrs, rough edges, cracks, dents, cuts, and other injurious imperfections. Particular attention shall be paid to rope interface. All surfaces that are in contact with the rope eye shall be magnetic-particle tested (MT) or Liquid Penetrant Tested (DPI) in accordance with a recognised standard.

1.8 Manufacturing from rolled plate

1.8.1 The material in plates (and tubes) shall comply with the requirements to mechanical properties of grades NV D as given in DNVGL-OS-B101.

1.8.2 Fabrication and non-destructive testing shall be in accordance with DNVGL-OS-C401. Welds shall be considered as special category.

1.9 Other termination elements
Shackles and H-links shall comply with DNVGL-OS-E302. Sockets shall comply with DNVGL-OS-E304. The material in custom-made termination elements shall comply with DNVGL-OS-E302 or DNVGL-OS-C401, as appropriate.

1.10 Other materials than steel
Termination hardware made from other materials than steel (including synthetic materials) shall be duly qualified in accordance with the principles of DNV-RP-A203 whereby acceptance criteria and limits shall be developed. The strength, ductility and toughness of the termination hardware material shall be such that it can withstand the actual break loading of the offshore fibre rope at the lowest design temperature.
SECTION 7 TESTING OF DELIVERIES

1 Introduction

This section covers the testing of deliveries in connection with delivery of fibre ropes fully furnished for designated offshore service.

All methods of testing shall be described in the testing specification which is part of the documentation that shall be provided by the supplier(s) of fibre rope assemblies.

Recommendations for methods and extent of testing are provided in DNVGL-RP-E305.

It shall be rigorously justified that the proposed testing is sufficient for documenting the delivery.

2 Testing of load-bearing yarn

The key performance characteristics of delivered yarns shall be documented.

In order that test results obtained are reproducible and give reliable information about the material, the sampling shall be true and representative. The sampling procedure should be designed to take account of the known sources of variability such as the variation between spindles, the variation along the length of the bobbin, etc. sampling may be based on ASTM D2258.

The recommended test methods are provided in Table 1.

The yarn manufacturer shall keep records of all testing.

Applicable quality control tests are stated in DNV Programme for Approval of Manufacturer 322.

Table 1 Yarn tests for documentation of delivered materials

<table>
<thead>
<tr>
<th>Test</th>
<th>Reference 1)</th>
<th>Acceptance criteria</th>
<th>Minimum level of verification</th>
<th>Frequency of testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-T endurance</td>
<td>DNVGL-RP-E305</td>
<td>Characteristic value, agreed with recipient</td>
<td>Agreed with recipient</td>
<td>Agreed with recipient</td>
</tr>
<tr>
<td>Tension vs. stretch</td>
<td>DNVGL-RP-E305</td>
<td>Characteristic value, agreed with recipient</td>
<td>Agreed with recipient</td>
<td>Agreed with recipient</td>
</tr>
<tr>
<td>Linear density</td>
<td>ASTM D885M</td>
<td>Manufacturer’s specified value</td>
<td>Results documented in production log</td>
<td>Each day</td>
</tr>
<tr>
<td>Coating</td>
<td>Specified by the manufacturer</td>
<td>Manufacturer’s specified value</td>
<td>Results documented in production log</td>
<td>Each day</td>
</tr>
</tbody>
</table>

1) Or other appropriate reference

3 Testing of rope segments

3.1 Testing of deliveries

3.1.1 Tested samples shall be representative of the delivery.

Guidance note:

Recommendations for rope test methods and extent of testing may be found in DNVGL-RP-E305

---end---of---guidance---note---
3.1.2 It is the rope manufacturer’s responsibility to take sufficient number of rope samples in order to complete the necessary tests to document the fibre-rope properties. This includes necessary spare length if other testing should be required later.

The same set of termination hardware may be used for all tests that require specimens of the full fibre rope assembly to be tested.

3.2 Rope test methods

3.2.1 All tests shall be described in the testing specification, which is part of the documentation from the supplier of fibre rope assemblies.

3.2.2 The tension levels, sequences of loading and other information derived from the system analysis as needed to define the performance testing shall be agreed between the manufacturer and the recipient and stated in the testing specification. Due to the dependence of rope length on actual loading, the testing specification should reflect the actual loading scenario as closely as possible.

3.2.3 Test specimens shall in general be soaked by complete immersion in fresh water prior to testing. However some tests may require dry specimens as explained in DNVGL-RP-E305.

In case of polyamide load-bearing yarn, soaking time and handling should be in accordance with OCIMF requirements.

**Guidance note:**

In addition to the recommendations that are provided in DNVGL-RP-E305, recommendations concerning test methods can be found in API RP 2SM and ISO18692, and in other standards, recommended practices, or guidelines and company specifications.

Since a mobile mooring system is normally used in different locations and service scenarios, with ample possibilities for line-length adjustment, it may be sufficient to perform tension vs. stretch testing based on API RP 2SM or ISO 18692.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

3.3 Offshore mooring systems

3.3.1 The following properties should be established by testing for mobile moorings:

— 3-T endurance
— 3-T design range
— splice integrity
— tension vs. stretch behaviour
— breaking strength
— torque and twist (not for torque-neutral ropes, unless other components are non-torque neutral)
— soil ingress resistance.

In addition, the following properties should be established by testing for long-term moorings:

— cyclic endurance
— 3-T endurance at end of cyclic design life.

Fibre ropes for long-term offshore moorings shall be tested based on the requirements derived from appropriate system analysis. The testing specification shall reflect the actual loading scenario for the mooring system.

If samples of the actual line are break tested without termination hardware from the actual delivery, then the interface to the fibre-rope eye shall be identical to that of the termination hardware.

The testing should be performed identically on each specimen such that variability can be assessed. For helical subrope constructions, both S and Z shall be tested.
3.4 Testing of temperature due to hysteresis heating in mooring lines
If deemed necessary, the maximum temperature shall be measured during cyclic endurance testing. The measuring method shall ensure that it is the internal temperature of the fibre at critical location, and not that of the surrounding air or water, which is measured.

Guidance note:
If, during the cyclic endurance test of a fibre rope, the measured temperature is considered to be higher than can be expected under actual load conditions, e.g. due to application of a broader than actual load range, then the loading regime should be modified during the temperature measurements to avoid over conservatism.

---end---of---guide---note---

3.5 Deployment and recovery systems
The requirements to testing of fibre ropes for deployment and recovery systems shall be established on a case-by-case basis in order to suit the assurance argument. The requirements to testing of fibre ropes shall thus be system specific and are set by the integrated system requirements. Reference is made to DNVGL-ST-E407. The definition of rope tests (test design) will depend on the qualification strategy for the system.

3.6 Other application areas
The methods and extent of testing need to be determined on a case-by-case basis using technology qualification principles to determine the adequate set of acceptance criteria and limits.

4 Testing of termination hardware

4.1 Testing as part of fibre rope assembly
4.1.1 One set of the actual termination hardware shall be tested as part of specimens of the actual line during break testing and cyclic endurance testing.

Guidance note:
The same set of hardware may be used for both break testing and endurance testing. Hence, a minimum of two thimbles will be needed with pinholes adapted to fit the test machine. The test thimbles should be made as part of the actual delivery.

---end---of---guide---note---

4.1.2 If termination hardware produced as part of the supply is not available at the time of break testing, then the strength of the termination hardware may be demonstrated through non-linear FEM analysis. It is the responsibility of the rope manufacturer to define the distribution of loading on the termination hardware.
Flange bending shall be included in the load case.
The cyclic endurance testing shall be performed using termination hardware from the actual delivery. FEM analysis is only applicable to the strength of the thimbles.

Guidance note:
Recommendations for test methods for termination hardware may be found in DNVGL-RP-E305.

---end---of---guide---note---

4.2 Materials testing of termination hardware
Requirements to materials testing and non-destructive examination for delivery are given in Sec.6 Termination hardware of this standard.
CHAPTER 3 CLASSIFICATION AND CERTIFICATION

SECTION 1 CLASSIFICATION

1 General

As well as representing DNV GL’s recommendations on sound engineering practice for general use by the offshore industry, the offshore standards also provide the technical basis for DNV GL classification, certification and verification services.

A complete description of principles, procedures, applicable class notations and technical basis for offshore classification is given by the DNV GL rules for classification of offshore units, see Table 1.

Table 1 DNV GL rules – Offshore units

<table>
<thead>
<tr>
<th>No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNVGL-RU-OU-0101</td>
<td>Offshore drilling and support units</td>
</tr>
<tr>
<td>DNVGL-RU-OU-0102</td>
<td>Floating production, storage and loading units</td>
</tr>
<tr>
<td>DNVGL-RU-OU-0103</td>
<td>Floating LNG/LPG production, storage and loading units</td>
</tr>
<tr>
<td>DNVGL-RU-OU-0104</td>
<td>Self elevating units</td>
</tr>
</tbody>
</table>
SECTION 2 CERTIFICATION

1 Introduction

Product certification is performed in order to state that adequate acceptance criteria have been complied with and that the products are thus considered to be suitable for designated service.

Where applicable, approval certification of manufacturers is a condition for product certification. Under this standard this is a requirement for:

— manufacturers of load-bearing yarns
— manufacturers of fibre rope segments
— manufacturers of termination hardware.

For products that are not followed up in service under the scope of classification, certification of designated service may be performed to affirm that the designated service of products is being complied with.

2 Product certification of fibre rope assemblies

2.1 General

This sub-section contains provisions for DNV GL certification of products for delivery according to this standard.

The certification of products for delivery is performed by DNV GL on behalf of the suppliers (manufacturers).

2.2 Product certificates for deliveries

2.2.1 The following parts of fibre rope assemblies shall be furnished with DNV GL product certificates:

— load-bearing yarns
— fibre rope segments
— termination hardware.

The designated service for which the product certification is valid shall be stated on the product certificate for fibre rope segments.

2.2.2 The load-bearing yarns for the fibre ropes shall be ordered with DNV GL certification at the manufacturer with reference to this standard.

Termination hardware shall be ordered with DNV GL certification at the manufacturer, with reference to this, or the appropriate other, DNV GL standard as detailed in Ch.2.

DNV GL certificates for fibre rope segments shall be issued with reference to this standard.

2.3 Approval of manufacturer

Load-bearing yarn, fibre rope segments and termination hardware shall be manufactured at works which have been approved by DNV GL.

Applicable DNV Programmes for Approval of Manufacturers are shown in DNVGL-RP-E305 App.B.

Guidance note:
Approved manufacturers are published on https://approvalfinder.dnvgl.com/.

The approval of yarn converters is covered by the approval of manufacturers for load-bearing yarns.
2.4 Design verification
Fabrication survey shall be based on attending tests and inspections, monitoring manufacturing, and review of records.
Follow-up and witness of the production shall be based on the manufacturing description and the inspection and test plan (ITP).
Fibre rope segments are subject to design verification prior to manufacturing.

2.5 Manufacturing survey
Fabrication survey shall be based on attending tests and inspections, monitoring manufacturing, and review of records.
Follow-up and witness of the production shall be based on the manufacturing description and the inspection and test plan (ITP).

2.6 Qualification for special service

2.6.1 For applications which are considered as special service the fibre rope assembly shall be duly qualified with acceptance criteria for delivery and limits to operations according to DNVGL-SE-0160, subject to approval by DNV GL.
Full qualification entails substantiating that all failure modes are managed by adherence to acceptance criteria and limits, as established with basis in critical parameters, ref. DNV-RP-A203.

2.6.2 For mooring lines, reference is made to Ch.2 Sec.2 [5.3.4] of this document for special service categories.

2.7 Deviations and waivers
If a supplier or recipient wishes to deviate from the requirements of this offshore standard, or any reference standard, then a substantiated request for waiver of test or deviation shall be submitted for approval by DNV GL.
Any such request should be included in the request for certification.
Any deviations, exceptions and modifications to referenced codes and standards shall be documented and agreed between recipient, supplier and DNV GL.

3 Product certification of yarns

3.1 General

3.1.1 Load-bearing yarns shall be certified by DNV GL for delivery. At least one product certificate for load-bearing yarn will be issued for each delivery of offshore fibre ropes.
Deliveries to different clients shall not be covered by the same certificate, even if the load-bearing yarns are from the same production. If, for example, the same production of load-bearing yarns is split between two clients, then two certificates will be issued for the load-bearing yarns.

3.1.2 Product certification of yarn consists of monitoring and witnessing of testing according to an inspection and test plan (ITP).
The extent of survey and testing should be according to the Approval of Manufacturer documentation.
The types of testing for production deliveries are given in Ch.2.
3.2 Certificate
The following particulars will be listed in the certificate:
— recipient’s name, order number
— manufacturers name
— description of products
— grade of yarn, delivery condition (coating etc.)
— identification marking
— test results.

3.3 Feedstock
Feedstock shall be delivered with the manufacturers own certificate or a works certificate.

3.4 Non-load-bearing components
Sheathing materials should be ordered with 2.2 certificates, as defined in EN 10204.
For jackets with increased cut resistance, materials shall be ordered with 3.2 certificates.

4 Product certification of fibre rope segments

4.1 General

4.1.1 This sub-section describes the product certification process for fibre rope segments.
It is attempted to give this chapter a chronological order such that the prerequisites for certain steps or
milestones may be readily determined. The requirements are found in Ch.2.

4.1.2 Fibre rope segments shall be certified by DNV GL.
The certification process consists of design verification and then survey according to ITP.
The scope of survey shall as a minimum include intervention points as listed in App.A.

4.2 Certificates
One DNV GL certificate will normally be issued for the entire delivery. For certain applications such as mobile
moorings it may be desirable to issue one certificate for each fibre rope segment.
The following particulars will be included on the certificate:
— manufacturers name and product name
— nominal load-bearing linear density
— reference to approval of manufacturer certificate of offshore fibre rope
— reference to approval of manufacturer certificate of offshore fibre yarns
— identification marking
— termination code
— reference to description of designated service
— conditions

4.3 Work process for product certification of fibre rope segments
The work process consists of the following main steps:
— request for certification
— pre-production meeting
— submittal of documentation for approval
— design verification
— production and survey
— issuance of certification documents.
This work process is described in the following.

4.4 Request for certification
The request for certification should be sent to DNV GL by e-mail. The following information should be included:
— manufacturer name, plant location and reference to manufacturer-approval certificate
— production and delivery schedules for fibre-rope segments and termination hardware
— testing facilities, location and foreseen testing schedule
— type of application
— scope of delivery
— any requests for deviations or test waivers, fully documented
— dimension, breaking strength of the line, including type of fibre and rope construction.
Additional information for long term mooring systems:
— in-service condition assessment scheme
— key results from analysis in order to decide the load levels to be used in the certification test program and determine the rope length in production.

4.5 Pre-production meeting

4.5.1 A pre-production meeting shall be held at the manufacturer’s premises prior to start of the certification process.
The meeting shall include representatives from the following organisations:
— manufacturer of the fibre ropes
— DNV GL surveyor from local survey station appointed to follow up production and testing
— representative from DNV GL’s responsible approval centre in case of special service requirements requiring additional qualification activities
— representative from testing facility if the tests are not carried out by the manufacturer or by DNV GL.

4.5.2 The presentation made by the manufacturer shall include:
— scope of work
— outline and description of the components to be produced
— content and requirements of purchase orders/specifications
— testing facilities
— any requests for deviations or test waivers
— any elements not directly covered by this standard
— manufacturer’s description/specification regarding production, terminations and testing.
The presentation made by DNV GL shall include:
— presentation of DNVGL-OS-E303 (this standard)
— outline and explanation of specific requirements regarding class and certification
— scope of design verification and survey to be carried out by DNV GL:
  — status of documentation submitted to DNV GL
  — status approval of rope manufacturer and sub suppliers
  — survey during fabrication of fibre-rope segments and termination hardware
— certification of the termination hardware (type of certificate it shall be ordered with, and requirements to materials and testing)
— witnessing during testing
— final documentation requirements:
  — content
  — issue and distribution
  — review of final documentation.

Minutes of meeting from the pre-production meeting should be issued by the QA responsible of the manufacturer and distributed to the involved parties.

4.6 Design verification

4.6.1 The design verification will be carried out based on the required documentation which shall be submitted by this stage in the work process.

Documentation requirements are found in Ch.2 of this standard.

The design verification shall confirm that the offshore fibre ropes are sufficiently documented.

4.6.2 The work consists of review of agreements, specifications, drawings, calculations and other data supplied for the system integration and the documentation from the supplier (manufacturer), documenting the capacity and serviceability of the actual line including the termination hardware.

4.6.3 The testing specification for all tests and reporting is subject to approval by DNV GL.

Subject to documentation and approval by DNV GL, fibre rope specimen(s) may be used for tension vs. stretch testing for mobile moorings, instead of subropes.

**Guidance note:**
This depends on the measurement accuracy which is required for system integration.

---end---of---guidance---note---

If cyclic endurance testing and subsequent examinations according to approved procedure of an equal-size or larger, but otherwise identical, rope has been carried out before, then the test may be waved — subject to a substantiated waiver request and approval by DNV GL.

**Guidance note:**
The same specimen can be used for measuring different properties.

In offshore mooring, the tension vs. stretch performance is paramount to the system design. Thus, design-specific specification should be made for each mooring system. However, universal test results for stiffness and tension vs. stretch may be accepted.

*Examples* on tension vs. stretch tests can be found in DNVGL-RP-E305, API RP 2SM, ISO 18692 or in CI 1500.

*Examples* of torque-measurement testing and soil-ingress resistance testing can be found in DNVGL-RP-E305 and in ISO 18692.

---end---of---guidance---note---

4.6.4 Design verification is only valid for the product designation(s) covered.

The design verification is only valid for the designated application(s).

4.7 Design verification report

Following successful design verification a design verification report (DVR) may be issued for the delivery.

Approved design documentation and procedures will be listed in the Design Verification Report (DVR). The DVR will state:
— documents which have been reviewed
— complying standards
— assumptions
— acceptance criteria and limits
— conditions and limitations
— list of all documents from the customer (manufacturer) will be included together with reference correspondence; any comments which shall be taken into account.

4.8 Start-up of production
The production of the fibre-rope segments may commence when DNV GL’s responsible approval centre has issued the design verification report.
This will be notified in an e-mail to the manufacturer from the DNV GL surveyor.

4.9 Scope of survey of production
The scope of survey of production consists of:
— Check of product certificates for load-bearing yarns received.
— Check of product certificates for received yarns and fabrics to be applied in the sheathing process.
— Witness that the production is carried out in accordance with the manufacturing specification and associated QA plans regarding the production of subropes, fibre ropes, terminations and sheathing.
The scope of survey at the rope manufacturer can be found in App.A of this standard.

4.10 Scope of survey of testing

4.10.1 The testing shall be carried out according to the provisions set forth in the testing specification.
Prior to start of testing, the attending surveyor and the responsible test engineer should review the approved testing specification together.

4.10.2 Number of rope tests to be witnessed has to be decided by the attending DNV GL surveyor based on experience with the product and the testing laboratory.
For testing carried out by DNV GL, the survey may be performed by the responsible test engineer.

4.11 Re-certification of offshore fibre ropes

4.11.1 Re-certification is applicable to products which are not followed up in service under classification.
Existing fibre rope segments may be re-certified for continued or prolonged service according to the provisions of this standard.
Cases which may require re-certification can be:
— rope design life has expired and the service period shall be extended
— the system has seen excessive loads compared to the design premise
— the line has not been previously certified by DNV GL
— the rope has been damaged and needs repair.

4.11.2 The requirements for re-certification will be determined by DNV GL’s responsible approval centre on a case-by-case basis.
The repair work will be subject to DNV GL survey according to DNV GL approved ITP.

Guidance note:
If a rope is re-certified either in connection with repair or after expiry of previous certificate, an endorsement of the previous certificate will be issued. The endorsement will refer to the certificate number. The endorsement will be issued by the DNV GL
surveyor witnessing the repair. Depending on the extent of the repair, design verification will be required. The history of the rope will be stated to the extent possible.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

4.11.3 The certificate of a rope that is repaired by cutting off the shortest section and performing re-termination according to approved procedure for production may be endorsed without design verification of the repair. The certificate of a rope that is repaired according to an approved repair procedure that is part of the scope approval of manufacturer or service supplier by DNV GL may be endorsed without design verification of the repair. Fibre rope segments that are divided into two or more, shorter segments will be furnished with updated, individual certificates based on the original, single certificate.

5 Product certification of termination hardware

5.1 General
Thimbles shall be certified by DNV GL, based on the requirements of this standard. Other termination hardware elements shall be certified by DNV GL according to the appropriate certification scheme (standard).

5.2 Certificates
One DNV GL certificate will normally be issued for the entire delivery. For certain applications such as mobile moorings it may be desirable to issue one certificate per termination hardware element.

6 Certification of designated service

6.1 General

6.1.1 Certification of designated service is applicable to cases where products are not followed up in service under classification. Certification of designated service may warrant the use of non-classified products on classified units. For deployment and recovery systems the provisions of DNVGL-SE-0056 are applicable.

6.1.2 The following requirements will be applied in conjunction with DNV GL certification of designated service according to this standard. The designated service is expressed by the limits to operations as stated on product certificates for fibre rope segments. The certification of designated service is performed by DNV GL on behalf of the owner of the offshore fibre ropes.

6.1.3 For certification of designated service DNV GL will review the designated service documentation and how the provisions of the designated service documents are implemented in the organisation. Detailed requirements will be decided on a case-by-case basis. The objective of the certification of designated service is to affirm that DNV GL believes that the service context is managed and kept within the limits of designated service. The in-service verification of compliance with the limits of designated service shall confirm that the offshore fibre ropes can remain fit for designated purpose until discarded.
6.2 Renewal

The certificate of designated service will be subject to renewal after 5 years, subject to review of the documentation of the limits not being exceeded.
APPENDIX A SCOPE OF SURVEY AT ROPE MANUFACTURER

1 General
Surveyor shall have access to the manufacture at any time of production.
An inspection and test plan shall be issued by the manufacturer. The ITP shall be reviewed and approved by the surveyor prior to start of production.
The DNV GL intervention points should as a minimum include following:

Table 1 Survey scope

<table>
<thead>
<tr>
<th>Activity</th>
<th>DNV GL role</th>
<th>Description</th>
</tr>
</thead>
</table>
| Pre-production meeting | H           | Scope of delivery  
Schedule/ITP  
Rope manufacturer, AoM status  
Yarn type/manufacturer, AoM status  
Termination hardware, AoM status  
Testing facilities  
Design documentation status |
| Materials              | M/R         | Procurement of materials (yarns, filters, sheathing)  
Recipe of goods:  
Check certificates and traceability for load-bearing yarns  
Check certificates and traceability of termination hardware  
Certificates and traceability of non-load-bearing yarns, filters, etc. |
<p>| Manufacturing of subropes | H(W)/M     | Witness start of production then monitoring. Procedure compliance. Witness that the production is carried out in accordance with the manufacturing specification and associated QA plans regarding the production of subropes. Hold point on first subrope if next rope is manufactured with same setup. Witness point on remaining subropes. |
| Braiding of rope       | H(W)/M     | Witness start of production. Set up of register plates, set up of machines. Then monitoring. Procedure compliance. Witness that the production is carried out in accordance with the manufacturing specification and associated QA plans regarding the production of ropes. Hold point on first rope if next rope is manufactured with same setup. Witness point on remaining ropes. |
| Eye splicing/Coating   | H/W         | Hold point on first splice. For each step in the production process for the soft eye the DNV GL surveyor will witness compliance to manufacturing description and rope design description. For remaining terminations witnessing will be carried out. Procedure compliance. Including application of PU coating. |</p>
<table>
<thead>
<tr>
<th>Activity</th>
<th>DNV GL role</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Testing of rope</td>
<td>H</td>
<td>Survey of all tests on the subropes and the full ropes. Prior to start of testing, the attending DNV GL surveyor and the responsible test engineer should review the approved testing specification together. Visual inspection of the finished line with hardware fitted, marking, splices, how thimbles are sitting and ease of assembly. Testing shall be in accordance with approved testing specification.</td>
</tr>
<tr>
<td>Final inspection</td>
<td>H</td>
<td>Visual inspection of the finished fibre rope. Inspection on transportation/packing of the rope, shall be within specification for handling and installation. Marking and packing in accordance to approved procedure. Check identification marking of ropes, thimbles etc. Visual inspection of the rope, no cuts and abrasion, eyes thimbles, chafe protection.</td>
</tr>
<tr>
<td>Records (Data book)</td>
<td>R</td>
<td>Production and test reports</td>
</tr>
<tr>
<td>Issuance of certificate</td>
<td>H</td>
<td>Complete design documentation</td>
</tr>
</tbody>
</table>

**Definitions:**

*Hold point (H):* A point where DNV GL shall be present for survey. Advance notification to DNV GL shall be given in writing or any other agreed system of notification. Work shall not proceed beyond a hold point without DNV GL present or, in exceptional cases where presence is waved, without first obtaining a written authorisation from DNV GL.

*Witness point (W):* A point where DNV GL may be present for survey, at their discretion. Advance notification to DNV GL shall be given in writing or any other agreed system of notification. Work may proceed beyond a witness point with or without DNV GL present.

*Monitoring (M):* Intermittent survey of any stage of the work in progress including, but not limited to, checking compliance with procedures/instructions for manufacture, testing and inspection, observing workmanship, traceability, etc.

*Review (R):* Examination of records of activities performed or results achieved.
CHANGES - HISTORIC

July 2015 edition

Main changes July 2015

• General
The revision of this document is part of the DNV GL merger, updating the previous DNV standard into a DNV GL format including updated nomenclature and document reference numbering, e.g.:
— Main class identification **1A1** becomes **1A**
— DNV replaced by DNV GL
— DNV-RP-A201 to DNVGL-CG-0168. A complete listing with updated reference numbers can be found on DNV GL's homepage on internet

To complete your understanding, observe that the entire DNV GL update process will be implemented sequentially. Hence, for some of the references, still the legacy DNV documents apply and are explicitly indicated as such, e.g.: Rules for Ships has become DNV Rules for Ships.

There is no change in the technical or documentation requirements from DNV-OS-E303, February 2013.
The structure of this document has been converted to decimal numbering. Older references to this document may normally be interpreted by analogy to this example: Ch.2 Sec.3 D506 is now Ch.2 Sec.3 [4.5.6].

• Ch.1 Sec.1
In [4] Safe Service Assessment has been re-named to 3-T utilisation assessment.

• Ch.2 Sec.5
— Table 1: Reference to change-in-length has been updated as specified by the client.
— In [4.1.3] and [4.2.2] it is emphasised that the rope manufacturer is responsible for defining the load case.

• Ch.3 Sec.2
In [7] the description of certification requirements has been simplified.
— Previous Appendices B to E. Appendices showing examples of certificates have been removed.
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