

# CLASS PROGRAMME

## Type approval

DNVGL-CP-0183

Edition December 2015

# Flexible hoses - Non-metallic materials



## FOREWORD

DNV GL class programmes contain procedural and technical requirements including acceptance criteria for obtaining and retaining certificates for objects and organisations related to classification.

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## CHANGES – CURRENT

This is a new document.

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## SECTION 1 GENERAL

### 1 Introduction

#### 1.1 Objective

The objective of this class programme (CP) is to describe the type approval (TA) scheme for flexible non-metallic hoses with permanently fitted couplings and rubber compensators.

For a description of the Society's type approval scheme in general and further information on general conditions and procedures for obtaining the Society's TA certificate, see class programme DNVGL CP 0338 *Type approval scheme*.

The procedures and requirements described in this CP are applicable for obtaining the Society's TA certificate based on requirements in:

- *DNV GL rules for classification of ships* [RU SHIP Pt.4 Ch.6 Sec.1\[3.2\]](#), [RU SHIP Pt.4 Ch.6 Sec.6\[5.1.2\]](#), [RU SHIP Pt.4 Ch.6 Sec.9\[4\]](#).
- DNV GL offshore standard DNVGL OS D101 as governed by applicable rules for offshore units.

#### 1.2 Scope

This CP gives a description of the procedures and requirements related to documentation, design and type testing applicable for TA of flexible non-metallic hoses with permanently fitted couplings and rubber compensators.

This CP does not set the design requirements for flexible hoses. TA is based on compliance with design requirements given in the rules and/or other regulations and standards.

#### 1.3 Application

*DNV GL rules for classification of ships*, [RU SHIP Pt.4 Ch.6 Sec.6\[5.1.2\]](#), [RU SHIP Pt.4 Ch.6 Sec.9\[4\]](#) requires that flexible non-metallic hoses with permanently fitted couplings and rubber compensators are type approved by the Society, and TA in accordance with this CP is thus mandatory for equipment to be installed on vessels classed with the Society.

A TA certificate in accordance with this CP will confirm compliance with the requirements in the Society's rules as specified in [\[1.1\]](#). The TA certificate will not confirm compliance with requirements in other parts of the rules. In case additional requirements in other parts of the rules shall be covered by the TA certificate, this shall be specified in the application for TA and will be stated in the TA certificate.

## 1.4 Definitions

**Table 1 Definitions**

<i>hose assembly</i>	final product, complete and ready for service" i.e. a flexible non-metallic hose with end fittings attached usually built up with hose reinforcement consisting of steel wire braids or spiral braids, or braid(s) of synthetic fibre. It is hereinafter called the "hose assembly".
<i>hose assembly manufacturer</i>	<ul style="list-style-type: none"> <li>– hose manufacturers who fit their own couplings to their own hoses.</li> <li>– hose manufacturers who fit standard couplings manufactured by others to their own hoses.</li> <li>– coupling manufacturers who fit their own couplings to standard hoses manufactured by others.</li> <li>– hose assembling companies who fit purchased couplings to purchased hoses.</li> </ul>

## 2 Documentation

For TA of flexible non-metallic hoses with permanently fitted couplings and rubber compensators the following documentation shall be submitted:

- type approval application form
- hose design details: description of design and cross sectional drawings, or manufacturer's catalogue of all the hose types with reference to a recognised national/international standard. Reference to the manufacturer's standard for the hose and couplings, if relevant
- end couplings drawings: typical cross sectional drawings of all coupling categories, or manufacturers' catalogue covering the couplings used, with reference to a recognised national/international standard, if relevant
- specification of the material used in the hoses (inner tube, reinforcement and hose cover) and in the coupling (ferrule and insert). Reference to national/international material standards shall be given
- documentation of type testing as required by this document
- mounting procedure of the couplings to the hoses
- maximum working pressure of all types and sizes
- temperature range to be applied
- media to be carried by the hose assemblies (with reference to applicable hose standard or relevant type testing). For oxygen hoses the cleaning process is to be submitted
- special operational limitations
- marking of the hose assembly.

## SECTION 2 TECHNICAL REQUIREMENTS

### 1 Introduction

The quality and strength of the hose and the connection between the hose and the coupling shall be qualified by prototype testing in connection with the type approval. Standard connections (bends, flanges, threaded connections, etc.) at the outer ends of the end connections are not evaluated in connection with the prototype tests.

Hose assemblies shall not be used where fixed piping is possible/required.

The cover on hoses for gaseous applications shall be pinpricked.

### 2 Material requirements

The material in flexible non-metallic hoses shall be suitable for the operational conditions and the medium carried. Carbon steel used in couplings shall be normalised when the minimum design temperature is  $-10^{\circ}\text{C}$  or below. This normalisation shall be performed after welding if the couplings are welded.

### 3 Type test requirements

Prior to any type testing hoses or hose assemblies shall be visually inspected.

#### 3.1 Type testing of non-metallic hose assemblies for ordinary machinery systems

The number of test specimens and sizes shall be selected according to the relevant test standard with the exception of burst testing where the selection is defined in [2.1.2] (c). Where standard does not define the selection for testing, a minimum three test specimens of different sizes (the smallest, the middle and the largest nominal diameter) shall be tested for each type and pressure class.

All test reports shall be signed by the QA manager for the manufacturer with the exception of burst test which shall be witnessed by a surveyor and fire test which shall be performed by an accredited laboratory or witnessed by a surveyor.

##### 3.1.1 The following tests shall be performed on the hose and documented:

- a) dimensional check test according to EN ISO 4671
  - i) to be performed on all hoses
- b) change in length according to EN ISO 1402
  - i) to be performed on all hoses
- c) cold flexibility: according to EN ISO 10619-2
  - i) to be performed on hoses with design temperature below  $0^{\circ}\text{C}$
- d) resistance against liquids according to ISO 1817
  - i) to be performed on hoses exposed to e.g. oil, water dissolutions, sea water, etc.
- e) cover adhesion test according EN ISO 8033
  - i) to be performed on all hoses
- f) ozone resistance according to EN ISO 7326
  - i) to be performed on hoses with outer cover of rubber material
- g) vacuum test according to EN ISO 7233

- i) to be performed on hoses subject to pressure below atmospheric.



### 3.1.2 The following tests shall be performed on the hose assembly and documented:

The fire test, the impulse test and the burst test shall be performed on hoses with the same type of couplings fitted that shall be included in the type approval certificate.

- a) fire resistance test according to EN ISO 15540 and EN ISO 15541
  - i) to be performed on hose assemblies intended for installation in piping systems for flammable media and seawater systems.
  - ii) to be performed by an accredited laboratory or to be witnessed by a surveyor.
- b) impulse test according to EN ISO 6803 or EN ISO 6802, if applicable
  - i) to be performed on hose assemblies intended for installation in systems where pressure impulses occur.
- c) burst pressure test according to EN ISO 1402
  - i) all hose assemblies shall pass a burst test.
  - ii) when hose assemblies of the same design are manufactured in a number of sizes, one size tested will qualify for the next upper and the next lower size.
  - iii) three identical samples of each test size shall be selected for testing.
  - iv) if one of the hose assemblies fails to meet the requirements, two additional hose assemblies of the same size as the one that failed shall be tested. If one of these hose assemblies fail to meet the requirements, all the untested, remaining sizes shall be burst tested.
  - v) the test shall be witnessed by a surveyor who also shall sign and stamp the test reports.

### 3.1.3 For special application further tests may be prescribed.

The test procedures as given in recognized standards such as SAE J517, EN 853, EN 854, EN 855, EN 856 and EN 857 may be accepted.

Usually there are a lot of different coupling configurations (straight, bend, etc. in different shapes), and if their design is comparable, straight couplings may be used for testing purposes. The outermost end of the coupling performing the connection to the fixed piping will not be specified in the type approval certificate.

In special cases a test plan shall be agreed with the Society.

Type testing of non-metallic hose assemblies for drilling equipment shall be performed according to the DNV GL offshore standard DNVGL OS E101 *Drilling Plant*.

## 3.2 Prototype testing of non-metallic hose assemblies for diving systems (umbilical)

To be performed according to the Society's offshore standard DNVGL OS E402 *Offshore Standard for Diving Systems*.

## 3.3 Type testing of hose assemblies for cargo handling

Burst tests shall be witnessed by a surveyor who also shall sign and stamp the test reports. Other type test reports may be signed by the QA manager of the manufacturer.

### 3.3.1 LNG/LPG hose assemblies

The hose assemblies shall be in compliance with the Society's rules for liquefied gas carriers [RU SHIP Pt.5 Ch.7](#). In addition they shall be tested according to the IMO IGC code.

### 3.3.2 Hose assemblies for chemicals

The hose assemblies shall be in compliance with the Society's rules for chemical carriers [RU SHIP Pt.5 Ch.6](#). In addition they shall be tested according to the IMO IBC code.

### 3.3.3 Hose assemblies for bulk and bunker hoses

In addition to the tests described in [2.1.1] and [2.1.2] (or any equivalent standard) the following tests shall be performed:

- a) electrical resistance and conductivity test according to EN ISO 8031.
- b) abrasion resistance test according to ISO 4649.
- c) end load test

an end load test shall be performed on hose design for axial load

test load =  $1.5 \times (\text{external axial load} + \text{weight of hose} + \text{content of hose})$ .

rated test load = (test load)/1.5

## 3.4 Hose assemblies for CO<sub>2</sub>

The following type approval procedure is applicable for the type approval of CO<sub>2</sub> hose assemblies made of synthetic rubber. For other hose materials e.g. thermoplastic, special test requirements shall be defined.

CO<sub>2</sub> hose assemblies shall be designed for a working pressure of at least 100 bar. In addition, the hose cover shall be pinpricked.

In addition to the tests described in [2.1.1] and [2.1.2] the following tests shall be performed:

### 3.4.1 Burst pressure

Burst pressure (as described in [2.1.2] c) shall be done at minimum design temperature.

### 3.4.2 Pin prick procedure

By adequate pin pricking it shall be ensured that gas escaping from the internal layer may escape through the external layer without creating bubbles or further deficiencies. The procedure shall ensure, that the needles of the pricking device do not damage the internal layer that means the prick procedure shall be made in controlled manner. For release of the prick procedure to be used the outer layer of the test specimens including the spare parts shall be perforated.

After pin pricking of the hose assembly a visual inspection and pressure test shall be performed according to hose standard. No leakage is allowed. In case of a leakage is detected caused by a damaged internal layer the pin pricking tool shall be adjusted and documented accordingly.

After the test, no leakage is allowed. If one of the hose assemblies fails to meet the requirements, two additional hose assemblies of the same size as the one that failed shall be tested. If one of these hose assemblies fails to meet the requirements, subsequently an adequate modification of the prick procedure shall be done.

### 3.4.3 Endurance test with liquid carbon dioxide

The test serves to prove that the hoses are not impaired concerning tightness and form stability by CO<sub>2</sub>.

The test specimens shall be connected to one or more CO<sub>2</sub> cylinders, which are arranged standing with a total volume of at least 45 kg in U-form with the minimum permissible bending radius. For at least 24 hours they shall be exposed to liquid carbon dioxide with room temperature. After expiration of the test period the content of the cylinders shall be emptied via the test specimens within 30 minutes into the open.

Immediately after endurance test, cold flexibility test (according to [2.1.1] c) shall be done.

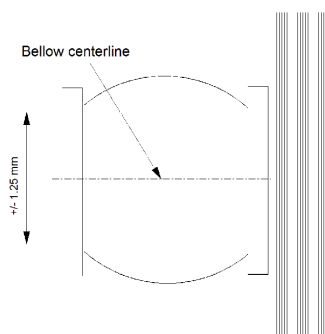
The proof of suitability for CO<sub>2</sub> application is deemed to have passed if the test specimens show no cracks, swellings, bubbles and further deficiencies. Afterwards a pressure test with 2 times the maximum allowable working pressure shall be performed. No leakage is allowed.

## 3.5 Type testing of rubber compensators

### 3.5.1 The following tests shall be performed on rubber compensators and documented :

Except for the fire resistance test and the burst test, the test reports shall be signed at least by the QA Manager of the manufacturer.

- a) resistance against liquids according to ISO 1817
  - i) to be performed on compensators exposed to e.g. oil, water dissolutions, sea water, etc.
- b) ozone resistance according to EN ISO 7326
  - i) to be performed on compensators with outer cover of rubber material
- c) fire resistance test according to EN ISO 15540 and EN ISO 15541
  - i) to be performed on compensators intended for installation in piping systems for flammable media and seawater systems.
  - ii) to be performed by an accredited laboratory or to be witnessed by a surveyor.
- d) impulse test according to EN ISO 6803
  - i) to be performed on compensators intended for installation in systems where pressure impulses occur.
- e) burst pressure test according to EN ISO 1402
  - i) all compensators shall pass a burst test.
  - ii) when compensators of the same design are manufactured in a number of sizes, one size tested will qualify for the next upper and the next lower size.
  - iii) three identical samples of each test size shall be selected for testing.
  - iv) if one of the compensators fails to meet the requirements, two additional compensators of the same size as the one that failed shall be tested. If one of these compensators fail to meet the requirements, all the untested, remaining sizes shall be burst tested.
  - v) the test shall be witnessed by a surveyor who also shall sign and stamp the test reports.
- f) endurance test
  - the rubber compensator shall be installed in a rig where the following conditions apply:
  - the temperature shall be maintained at  $+75^{\circ}\text{C} \pm 5^{\circ}\text{C}$ .
  - one end of the compensator shall be rigidly fixed to the rig. The other end shall be fixed to a device producing circular vibration. The arrangement may be as shown in [Figure 1](#).



**Figure 1 Test assembly, endurance testing**

The flange bolts shall be tightened to the manufacturer's recommended torque.

The compensator shall be pressurised with test liquid to the design pressure. The vibration shall act along an angle of 90° to the centreline of the compensator. The vibration shall impart lateral movement to the compensator. The amplitude shall be  $\pm 1.25$  mm around the compensator's centreline with a frequency of 3000 cycles per minute for  $10^7$  cycles. No leakage or other defects are allowed at the end of the test.

Minimum three test specimens of different sizes shall be tested for each type and pressure class. The smallest, the middle and the largest nominal diameter shall be tested.

The fire test, the burst test and the endurance test shall be performed on compensators with the same type of connection fitted that shall be included in the type approval certificate.

## 4 Production testing

For hose assemblies and compensators to be delivered on vessels classed with the Society, a production test according to [RU SHIP Pt.4 Ch.6 Sec.9](#) is applicable.

In this case a copy of the pressure test report shall follow the hose assemblies and compensators..

## 5 Marking

Each hose and each coupling shall be permanently marked in a way that enables identification versus the type approval certificate. Additional marking may be performed at the manufacturer's option. Information on how the marking is applied on the products and the design of the marking shall be submitted together with the application for type approval.

## 6 Certification renewal

For general terms refer to the Society's document DNVGL CP [0338](#) *Type approval scheme*. In addition, a surveyor shall witness the following tests on every 3rd size:

- dimensional check test
- change in length test
- burst test
- production test.

## SECTION 3 CERTIFICATION OF HOSE ASSEMBLING COMPANIES

### 1 General

Hose assembling companies shall be certified by the Society.

If a hose assembling company is holder of a type approval certificate an additional assembling certification for the range of the hose assembly covered by the type approval certificate is not necessary.

A holder of assembling certificate shall keep a list of all their designated hose assemblers.

### 2 Application for certification

Application for the certification of manufacturers of hose assemblies shall be submitted to the Society.

To receive certification from the Society, the hose assembling company shall submit the following documents prior to the initial audit:

- certification of the QM system (e.g. ISO 9001), if available
- description of the manufacturing processes as well as of production and test facilities
- procedure specifications, work instructions/mounting procedures/crimp tables and testing instructions for the product's manufacture
- description of hose pressure test bench
- list of designated persons being responsible for the hose assembling, including qualification records.

### 3 Initial assessment

The Society will carry out an initial assessment covering the quality system, the production and testing processes as well as the training plan and training requirements for assemblers of the hose assembling company.

During the assessment tests (e.g. burst test) will be witnessed on a range of types and sizes.

### 4 Certification

#### 4.1

If the assessment is successful a certification will be granted which will refer to specific type approved hose assemblies.

#### 4.2

The certification remains valid for a period of 5 years. During this period the effectiveness of the quality system and the manufacturing processes shall be verified by a periodical assessment after two years.

#### 4.3

Application for a renewal of the certificate shall be made at least three months prior to expiry of the certification. The Society will carry out a renewal assessment to verify that the conditions for the certificate are not altered.

#### 4.4

The Society reserves the right to suspend the certification in case of deficiencies in the quality system or the processes which affect the required product quality.

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