DNV

CLASS PROGRAMME

Type approval

DNV-CP-0293 Edition May 2021

Abrasion resistant coatings

DNV AS

FOREWORD

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

Any comments may be sent by e-mail to *rules@dnv.com*

CHANGES – CURRENT

This document supersedes the July 2018 edition of DNVGL-CP-0293.
The numbering and/or title of items containing changes is highlighted in red.

Changes May 2021

Topic	*Reference*	*Description*
Rebranding to DNV	All	This document has been revised due to the rebranding of DNV GL to DNV. The following have been updated: the company name, material and certificate designations, and references to other documents in the DNV portfolio. Some of the documents referred to may not yet have been rebranded. If so, please see the relevant DNV GL document.

Editorial corrections

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

CONTENTS

SECTION 1 GENERAL

1 Introduction

1.1 Objective

The objective of this class programme is to describe the type approval (TA) scheme for abrasion resistant coatings.

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 the Society's document DNV-CP-0338 *Type approval scheme.*

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

— DNV-RU-SHIP Pt.6 Ch.6 Sec.3
— DNV-RU-SHIP Pt.6 Ch.6 Sec.7

Note:

This CP is not applicable for EU marine equipment directive (MED) certificates. Visit www.dnv.com for information on MED certification

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1.2 Scope

This CP gives a description of the procedures and requirements related to documentation, design and type testing applicable for TA of abrasion resistant coatings

This CP does not set the design requirements to the abrasion resistant coatings. TA is based on compliance with design requirements given in the Society's rules and/or other regulations and standards. The CP describes the applicable design requirements and how to document compliance with the requirements in order to obtain a TA certificate for the equipment. This includes, where relevant, technical requirements for how the type tests shall be performed.

This CP includes requirements for:

— abrasion resistant coatings on vessels intended for navigation in ice-infested waters and on other vessels where abrasion resistance and strength of coating is of importance due to e.g. frequent mechanical cleaning
— coatings for use in dielectric shields and similar applications.

The Society's type approval certificate will cover one grade of the actual product with the possibility to include variants.

For abrasion resistant coatings this means:

— Grades: one base resin. Full coating system, including one or more coats (as per system definition). Each type of reinforcement (fibres, flakes, particles) will be considered as grade.
— Variants: colour variants, thinned variants and similar. All variants shall fulfil the requirements to the same grade.

The Society’s type approval certificate is normally limited to one manufacturer at one production site, however, other arrangements may be agreed upon with the Society.

Type tests as specified in Sec.2 [4] shall be carried out and verified in one of the following ways:

— at a DNV laboratory
— at an accredited and recognized testing laboratory or a laboratory accepted by the Society

— at the manufacturer's premises in the presence of a surveyor.

1.3 Application

DNV rules does not require that abrasion resistant coatings are DNV type approved, and TA in accordance with this CP is thus voluntary.

A TA certificate in accordance with this CP will confirm compliance with the requirements in the DNV rules and standards 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.

2 References

Standards and documents referred to in this document:

- ISO 2812-2, Paints and varnishes -- Determination of resistance to liquids -- Part 2: Water immersion method
- ISO 4624, Paints and varnishes -- Pull-off test for adhesion
- ISO 6272-2, Paints and varnishes -- Rapid-deformation (impact resistance) tests -- Part 2: Falling-weight test, small-area indenter
- ISO 7784-2, Paints and varnishes -- Determination of resistance to abrasion -- Part 2: Method with abrasive rubber wheels and rotating test specimen
- ISO 8501-1, Preparation of steel substrates before application of paints and related products -- Visual assessment of surface cleanliness -- Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings
- ISO 12944-6, Paints and varnishes -- Corrosion protection of steel structures by protective paint systems -- Part 6: Laboratory performance test methods
- ISO 12944-9, Paint and varnishes -- Corrosion protection of steel structures by protective paint systems -- Part 9: Protective paint systems and laboratory performance test methods for offshore and related structures (replaces ISO 20340)
- ISO 15711, Paints and varnishes -- Determination of resistance to cathodic disbonding of coatings exposed to sea water
- ISO/IEC 17025, General requirements for the competence of testing and calibration laboratories
- ISO 20340, Paints and varnishes -- Performance requirements for protective paint systems for offshore and related structures (from 2018 replaced by ISO 12944-9)
- ASTM D4060, Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
- ASTM D4145, Standard Test Method for Coating Flexibility of Prepainted Sheet
- ASTM D4541, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
- NACE TM0104-2004, Offshore Platform Ballast Water Tank Coating System Evaluation
- Guidelines for the application of the Finnish-Swedish Ice Class Rules (2011)- TRAFI/21816/03.04.01.01/2011, can be downloaded here: http://www.sjofartsverket.se/pages/40584/Guidelines%20-%2020%20December%202011%20-%20Final.pdf.

3 Documentation

For TA of abrasion resistant coatings, the following documentation shall be submitted by the manufacturer at initial type approval and updated, at renewal. The documentation shall, to the extent possible, be submitted as electronic files. The manufacturer shall keep one (1) copy of type approval documentation in their own file. The documentation that forms the basis for the TA must be easily available for surveyors at the TA applicant’s premises. When documentation is submitted in paper format, normally two copies of the documentation shall be submitted to the Society. No documentation will be returned to the company applying for TA.

The documentation shall be in English, if not otherwise agreed (please number documentation according to below list to facilitate review):

1) type designation, i.e. product name (grade) with list of variants to be included in and stated on the type approval certificate.
2) name and address of manufacturer, to be listed on type approval certificate. Additionally, the following shall be specified, if applicable:
   - details for all relevant production places
   - manufacturer's name
   - mailing address
   - contact person
   - phone and fax number
   - e-mail and Web address (if applicable).
3) Basis for approval. A reference to applicable rules and standards, see [1.1], which the product shall comply with.
4) Product description (type of base resin, components, additives, reinforcements, etc.).
5) Field of application and special limitations of the product (curing procedure, application technique/ procedure, shelf life, compatibility/non-compatibility with other materials, etc.)
6) Product specification, including data sheets (TDS and MSDS) for all variants, including reinforcements used.[1]
7) Description of production processes, including standard operating procedures (SOP).
8) Description of quality assurance system or copy of ISO 9001 certificate.
9) Test results (from tests already carried out) with references to standards, methods, etc.
10) Information regarding marking of the product or packaging.[1]
11) Any relevant certificates with their issue number and/or date (e.g. *Quality management system certificate*).
12) List of test and measuring equipment, including calibration certificates.[2]
13) In-service experience, if available.
14) Witnessed type test results and initial assessment report by DNV local office shall be submitted when completed.

[1] To be verified by initial assessment prior issuance of type approval certificate
[2] To be verified by surveyor during type testing

SECTION 2 REQUIREMENTS

1 Design requirements

The abrasion resistant coatings shall comply with the relevant requirements in this class program.

The type approval comprises the coating in liquid condition and in the condition when applied in full compliance with the manufacturer's recommendations, Sec.1 [3] , item 4) to 6).

Quality control during surface preparation or application of the coating is, however, not included in the type approval.

The type approval certificate is invalid if the formulation of the coating is changed to a degree deemed significant by the Society.

2 Requirements to production and quality control arrangement

The manufacturer should have a quality system that meets ISO 9001 standards, or equivalent. If this quality standard is not fulfilled, the extent of testing and assessments will be specially considered.

The quality control arrangement shall be checked with respect to:

— control of incoming materials
— scope of quality control, i.e. proof that test methods, test quantity and test equipment complies to the applicable standard
— traceability and marking system
— production records
— storage condition and procedure.

3 Requirements to product

3.1 Reduction in corrosion allowance

The coating product, including any variants, shall be defined and documented as described in Sec.1 [3].

Guidance note:

With reference to DNV-RU-SHIP Pt.6 Ch.6 Sec.3, the corrosion allowance is normally to be taken as 2 mm. A reduction in corrosion allowance can be considered if a recognized abrasion resistant coating is applied to a vessel's external hull.

The reduced corrosion allowance is subject to adequate documentation submitted to the Society on a case-by-case basis. A DNV type approval certificate is considered as equivalent to case-by-case evaluation.

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4 Requirements to type tests

Type testing shall include a combination of laboratory testing and relevant field experience. The latter indicates that the coating shall have been exposed to ice conditions on a regularly basis. A log showing vessels' route and exposure to ice conditions to be provided.

Coatings that have shown good track records over long time may be evaluated for type approval without laboratory testing.

4.1 Service experience and laboratory testing

Approval of an abrasion resistant ice coating shall be based on both satisfactory and documented service experience and laboratory tests. The actual performance of an abrasion resistant ice coating cannot be accurately assessed in laboratory tests only, and relevant and documented service experience is particularly

important for assessing such products. Therefore, the coating manufacturer shall submit sufficient dry-docking reports in addition to laboratory test reports.

The laboratory tests should be carried out with a recognised coating system with long service history as a reference coating.

4.2 Surface preparation and coating application

The surface preparation and coating application are as important as selecting a correct coating and should strictly follow the manufacturer's surface preparation procedures. The coating thickness and number of coating layers shall be according to recommendations from the coating manufacturer.

For laboratory testing of abrasion resistant coatings for vessels intended for navigation in ice-infested waters, the methods listed in Table 1 shall be followed. The methods described in the table are based on the requirements listed in the *Guidelines for the application of the Finnish-Swedish Ice Class Rules* (2011) with stricter acceptance criteria for the abrasion resistance.

Table 1 Laboratory Tests

Test description	*Standard reference*	*Conditions*	*Acceptance criteria*	*Sample dimensions*
Cyclic ageing resistance	ISO 12944-9	As per ISO 12944-9	ISO 12944-9	75x150x5 mm
Water immersion test	ISO 2812-2	5% NaCl, 3000 h (according to IM2), 2 mm horizontal scribe, 40 ± 1 °C	ISO 12944-9	75x150x5 mm
Determination of resistance to cathodic disbondment	ISO 15711 (Method A)[1)]	-1050 ± 5 mV	ISO 12944-9	75x150x5 mm
Determination of abrasion resistance	ASTM D4060	1000 cycles, CS-17 wheel	Weight loss < 80 mg/1000 cycles	100x100x1 mm (8 mm hole in center)
Determination of impact resistance in falling-weight testing	ISO 6272	Passed impact resistance energy ≥ 4 J on 5 mm thick steel panel. Tested at room temperature and minimum operating temperature (or -30°C if not specified)	Result of testing will be listed in certificate	75x150x5 mm
Ice friction coefficient	Aker Arctic test procedure Manufacturer's proposal[2)3)]	Manufacturer's proposal[1)]	Result of testing (friction coefficients with different ice qualities) will be listed in certificate	Manufacturer's proposal[2)]
Fixed radii mandrel bend test (flexure strain of coating system)	NACE TM0104	Tested at room temperature and minimum operating temperature (or -30°C if not specified)	Results of testing (flexure strain calculated according TM0104 to be listed in certificate)	25x250x3 mm

Test description	*Standard reference*	*Conditions*	*Acceptance criteria*	*Sample dimensions*
Notes: [1] Method B mentioned in ISO 15711 may be used on request. [2] To be agreed with the Society in each separate case. [3] The "Aker Arctic test procedure" is a recognized procedure to which tests are often requested by ship owners.				

Additional tests or other test programmes may be evaluated case-by-case. In case special tests are carried out to demonstrate the coating's properties these will be listed in the certificate for guidance to the end-users.

4.3 How to evaluate new products

For new coating products, for which no previous field experience exists, laboratory test results shall be compared with those from a product already recognised and type approved by the Society.

Trial areas for new products

When a type approval certificate is granted for a new product that has no field experience it will be a condition that the Society shall be invited for one or more surveys related to (i) test fields applied to vessels or (ii) fully coated vessels after a period in relevant operation of minimum 2.5 years. The travel routes of the vessel and time in ice condition shall be provided.

Location of trial areas

The preferred location of trial areas are in the areas where the vessel experiences most severe ice contact, assumingly in the bow area (just above waterline is most prone to damage) and in the first half of vessel's length.

Size of the trial areas

The trial areas should be large enough to cover an area (i) well below the waterline and (ii) above the waterline (in line with the recommendations from the coating manufacturer and the owners of the vessels).

Witnessing of the application

If the coating manufacturer will make own report with photos before, during and after preparation/ application, this will normally be sufficient.

Guidance note:

It is recommended that in case there is a surveyor from the Society present at the yard. then the coating manufacturer or vessel Owner may ask the surveyor to attend and make a separate survey report. DNV may also be requested by the coating manufacturer to make a detailed report.

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Inspection of trials areas after a certain period

A surveyor from the Society should be invited to inspect the trial areas after some years operating in ice conditions to verify the coating condition. Trial areas shall be inspected after minimum 2.5 years in operation, with main-time operating in ice.

Quality of the ice in which the vessel must operate

No specific quality is specified, however, it is important to collect sufficient information on times operated in ice condition, and where.

5 Requirements to marking of product

The package shall be marked. The marking shall at least include the following information:

— manufacturer's name or trade mark
— production plant/place of manufacture

— type designation/product name
— production date/batch no
— storage instruction/shelf life (if relevant).

The marking shall be carried out in such a way that it is visible, legible and indelible. The marking of product shall enable traceability to the DNV type approval certificate.

CHANGES – HISTORIC

July 2018 edition

This is a new document.

About DNV

DNV is the independent expert in risk management and assurance, operating in more than 100 countries. Through its broad experience and deep expertise DNV advances safety and sustainable performance, sets industry benchmarks, and inspires and invents solutions.

Whether assessing a new ship design, optimizing the performance of a wind farm, analyzing sensor data from a gas pipeline or certifying a food company's supply chain, DNV enables its customers and their stakeholders to make critical decisions with confidence.

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