CLASS PROGRAMME

Type approval

DNVGL-CP-0085 Edition December 2015

Sandwich adhesives - 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 sandwich adhesives.

The general requirements for obtaining DNV GL type approval certificate is given in class programme DNVGL CP 0338 Type approval scheme.

The procedures and requirements described in this CP are applicable for obtaining TA certificate based on requirements given in the Society's rules and standards, e.g. :
— DNV GL rules for classification of ships RU SHIP Pt.2 Ch.3
— DNVGL ST 0189 Lifeboats and rescue boats
— DNVGL ST 0342 Craft.

Guidance note:
This class programme is not applicable for obtaining EU Marine Equipment Directive (MED) certificates. Visit www.dnvgl.com for information on MED certification.

1.2 Scope

This CP gives a description of the procedures and requirements related to documentation, design and type testing applicable for TA of sandwich adhesives.

This CP does not set the design requirements for sandwich adhesives. TA is based on compliance with design requirements given in the Society's rules and standards. The CP describes 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.

The type approval of sandwich adhesives are separated into two different quality grades:

**Grade 1**: required quality of sandwich adhesives for hull constructions.

**Grade 2**: required quality of sandwich adhesives for less critical applications.

A type approval certificate issued by the Society will be valid for one quality grade of the actual product with the possibility to include variants.

For sandwich adhesives this means:
— *quality grade*: one base resin/chemical composition
— *variants*: different additives and fillers, and different densities.

All variants shall fulfil the requirements for the same quality grade.

A type approval certificate issued by the Society is normally limited to one manufacturer at one production site, however, other arrangements may be agreed with the Society.

Type tests shall be carried out and verified in one of the following ways:
— at a DNV GL 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.

The type test results shall be submitted to the Society in form of a test report according to ISO 17025 and the additional requirements for the relevant test standard for evaluation.
1.3 Application

*DNV GL rules for classification of ships RU SHIP Pt.2 Ch.3* requires that sandwich adhesives are type approved in accordance with this CP 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 given in the rules as specified in [1.1]. The TA certificate will not confirm compliance with requirements given in other parts of the rules. In case additional requirements given 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 referred to in this document:

— ISO 9001:2008, *Quality management systems - Requirements*
— ISO 1675; *Plastics – Liquid resins – Determination of density by the pyknometer method*
— ASTM D1084; *Standard Test Methods for Viscosity of Adhesives*
— ISO 3521; *Plastics – Unsaturated polyester and epoxy resins – Determination of overall volume shrinkage*
— ASTM C297/C297M; *Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions*
— ISO 527-1; *Plastics – Determination of tensile properties – Part 1: General principles*
— ISO 527-4; *Plastics – Determination of tensile properties – Part 4: Test conditions for isotropic and orthotropic fibre-reinforced plastic composites*
— ISO 1922; *Rigid cellular plastics – Determination of shear strength*
— DIN 50905-4; *Corrosion of metals; corrosion testing; corrosion testing in liquids under laboratory conditions without mechanical stress*
— ASTM D1141; *Standard Practice for the Preparation of Substitute Ocean Water.*

3 Documentation

For TA of sandwich adhesives 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 shall 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 the English language, 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 the manufacturer, to be listed on type approval certificate. The following shall be specified:
   — 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, ref. [1.1], which the product shall comply with
4) product description (type of base resin, fillers etc.)
5) field of application and special limitations of the product (application procedure and required surface treatment prior to lamination, compatibility/non-compatibility with other materials, etc.)
6) product specification, including data sheets (TDS and MSDS) for all variants
7) description of production processes, including standard operating procedures (SOP)\textsuperscript{1}
8) description of quality assurance system or copy of ISO 9001 certificate
9) quality Plan for material intended to be installed on board ships \textsuperscript{1}
10) test results (from tests already carried out) with references to standards, methods etc.
11) information regarding marking of the product or packaging \textsuperscript{1}
12) any relevant certificates with their issue number and/or date (e.g. quality management system certificate)
13) overview of test and measuring equipment, including calibration certificates\textsuperscript{2}
14) in-service experience, if available
15) witnessed type test results and initial assessment report by the Society local office shall be submitted when completed
16) list of test and measuring equipment including calibration certificate.

\textsuperscript{1} will verified by initial assessment prior to issuance of type approval certificate
\textsuperscript{2} will be verified by surveyor during type testing
SECTION 2 GENERAL REQUIREMENTS

1 Design requirements

The sandwich adhesive shall comply with the relevant requirements of the rules and standards given in Sec.1 [1.1].

2 Requirements for 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 type testing and assessments will be specially considered.

The quality control arrangement in production will particularly 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 EN or ISO
— traceability and marking system
— production records
— storage condition and procedure.

The extent of the manufacturer's quality control during production shall as a minimum be according to Table 1.

Table 1 Manufacturer's quality control for sandwich adhesives

<table>
<thead>
<tr>
<th>Property</th>
<th>Test standard 1)</th>
<th>Acceptance Criteria</th>
<th>Minimum level of verification</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>ISO 1675</td>
<td>msv ±10%</td>
<td>Results documented in production log</td>
<td>Each batch</td>
</tr>
<tr>
<td>Viscosity</td>
<td>ASTM D1084 Method B (for free-flowing adhesives)</td>
<td>msv ±20%</td>
<td>Results documented in production log</td>
<td>Each batch</td>
</tr>
</tbody>
</table>

1) other standards may be agreed upon with the Society prior to testing

3 Description of type testing

The extent of type testing covers both the liquid adhesive properties and the cured adhesive properties in [4]. These tests shall ensure that the product properties are as stated by the manufacturer.

Type testing results from all variants shall be submitted to the Society for evaluation, including a summary of the type tests results in the enclosed table, App.A. If there are several similar variants a less extensive test programme can be agreed upon with the Society.

Other standardised test methods than those given for the respective materials may be used upon agreement. Liquid properties of adhesive will be checked according to product specification at the Society’s assessments.
### 3.1 Definitions

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>mean</td>
<td>arithmetic mean of type test results</td>
</tr>
<tr>
<td>sdev</td>
<td>standard deviation of type test results</td>
</tr>
<tr>
<td>m-2sdev</td>
<td>mean - 2 x sdev of type test results</td>
</tr>
<tr>
<td>msv</td>
<td>manufacturer’s specified value</td>
</tr>
<tr>
<td>msmv</td>
<td>manufacturer’s specified minimum value</td>
</tr>
<tr>
<td>num</td>
<td>number of parallels</td>
</tr>
<tr>
<td>initial</td>
<td>initial assessment</td>
</tr>
<tr>
<td>retention</td>
<td>periodical assessment, carried out after two (2) years</td>
</tr>
<tr>
<td>renewal</td>
<td>periodical assessment, carried out after five (5) years</td>
</tr>
</tbody>
</table>

### 4 Requirements for material

#### 4.1 General

The sandwich adhesive shall have stable long-term properties. Continuous chemical processes, diffusion, etc. shall not affect the physical properties of the adhesive or the core laminate interface. If considered necessary, documentation of long-term properties may be required.

On delivery the material shall normally be such that no further surface treatment is required to obtain proper bonding to the surfaces. If surface treatment is required, this shall be stated in the application for type approval, and it will be stated on the type approval certificate.

The sandwich adhesives shall normally be compatible with laminating resins based on polyester, vinyl ester and epoxy and core materials such as PVC, SAN and balsa. Limited compatibility may be accepted upon special considerations. Limitations will be specified in the type approval certificate.

The following properties will be printed in the type approval certificate:
- flatwise tensile strength at 23°C and at heat resistance temperature
- tensile strength at −10°C, 0°C, 23°C and at heat resistance temperature
- fracture elongation at −10°C, 0°C, 23°C and at heat resistance temperature
- shear strength, 23°C
- water resistance.

If one or more of the requirements given in this sub-section are not met, the Society may consider if the material is fit to be type approved with a statement regarding the deviation from the requirements to be printed in the type approval certificate.

#### 4.2 Preparation of test samples

Curing conditions shall be according to the manufacturer’s specifications, preferably at temperatures obtainable in the production facility/yard. Detailed description of surface treatment and application procedure is required.

For testing of shear strength and flatwise tensile strength, the test samples shall be made of two pieces of high density core material (preferably PVC foam) with the sandwich adhesive located in the mid-plane.
parallel to the steel supports. The adhesive shall be > 1 mm thick. And the core material used shall be specified.

4.3 Heat resistance temperature

Heat resistance temperature is defined as the temperature at which flatwise tensile strength has decreased to 80% of the room temperature strength.

The heat resistance temperature shall be specified by the manufacturer, and shall be greater than +45ºC.

The heat resistance temperature shall be confirmed by testing according to flatwise tensile testing at the specified temperature, where the flatwise tensile strength shall be > 80% of the results obtained at room temperature.

### Table 2 Requirements for sandwich adhesives

<table>
<thead>
<tr>
<th>Property</th>
<th>Test standard 1)</th>
<th>Number of specimen</th>
<th>Acceptance criteria</th>
<th>Minimum level of verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall volume shrinkage</td>
<td>ISO 3521 2)</td>
<td>min. 5</td>
<td>msmv</td>
<td>the Society's assessment</td>
</tr>
<tr>
<td>Flatwise tensile strength</td>
<td>ASTM C297, (specimen: 5 x 5 cm, speed: 1 mm/minute) 3)</td>
<td>min. 5</td>
<td>msmv min 1.0 (MPa) All values &gt; 80% of msmv at 23ºC</td>
<td>the Society's assessment</td>
</tr>
<tr>
<td></td>
<td>Conditioned to heat resistance temperature, then flatwise tensile testing according to ASTM C297</td>
<td>min. 5</td>
<td>min. 45ºC All values &gt; 80% of msmv at 23ºC</td>
<td>the Society's assessment</td>
</tr>
<tr>
<td></td>
<td>Tensile strength</td>
<td>min. 5</td>
<td>msmv (MPa)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fracture elongation</td>
<td>min. 5</td>
<td>msmv at 23ºC: min. 3.5% at –10ºC, 0ºC, 23ºC and at Heat resistance temperature</td>
<td>the Society's assessment</td>
</tr>
<tr>
<td></td>
<td>Shear strength</td>
<td>min. 5</td>
<td>msmv min 0.4 (MPa)</td>
<td>the Society's assessment</td>
</tr>
<tr>
<td></td>
<td>Water resistance</td>
<td>min. 5</td>
<td>minimum 80% retained tensile strength after immersion</td>
<td>the Society's assessment</td>
</tr>
</tbody>
</table>

Approval may be refused for materials considered having a too low fracture elongation.

1) other standards may be agreed upon with the Society prior to testing
2) curing shrinkage is relevant only for gap-filling adhesives
3) the test samples shall be made of two pieces of high density core material (preferably PVC foam) with the sandwich adhesive located in the mid-plane parallel to the steel supports. The adhesive shall be > 1 mm thick. (specimen: 5 x 5 cm, speed: 1 mm/minute)
5 Requirements for marking of product

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

— manufacturer’s name and address or trade mark
— production plant
— product name (grade).
— Storage instruction:
— production date/batch number
— quality guarantee period, if any.

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 type approval certificate.
# APPENDIX A FOR ENTRY OF TYPE TEST RESULTS

<table>
<thead>
<tr>
<th>Property</th>
<th>Test method</th>
<th>Requirement</th>
<th>Type test results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cured resin</td>
<td></td>
<td>Grade 1</td>
<td>Grade 2</td>
</tr>
<tr>
<td>Overall volume shrinkage</td>
<td>ISO 3521</td>
<td>msv</td>
<td>msv</td>
</tr>
<tr>
<td>— density liquid</td>
<td></td>
<td>msv</td>
<td>msv</td>
</tr>
<tr>
<td>— density cured</td>
<td></td>
<td>msv</td>
<td>msv</td>
</tr>
<tr>
<td>Flatwise tensile strength</td>
<td>ASTM C297, At 23°C</td>
<td>msv min 1.0 (MPa)</td>
<td>msv min 1.0 (MPa)</td>
</tr>
<tr>
<td>Heat resistance strength</td>
<td>ASTM C297, At Heat Resistance Temperature, °C</td>
<td>min. 45°C All values &gt; 80% of msv at 23°C</td>
<td>min. 45°C All values &gt; 80% of msv at 23°C</td>
</tr>
<tr>
<td>Tensile strength</td>
<td>ISO 527-1/4</td>
<td>msv (MPa)</td>
<td>msv (MPa)</td>
</tr>
<tr>
<td></td>
<td>At 0°C</td>
<td>msv</td>
<td>msv</td>
</tr>
<tr>
<td></td>
<td>At 23°C</td>
<td>msv</td>
<td>msv</td>
</tr>
<tr>
<td></td>
<td>At heat resistance Temperature, °C</td>
<td>msv</td>
<td>msv</td>
</tr>
<tr>
<td>Fracture elongation</td>
<td>ISO 527-1/4</td>
<td>msv at -10°C: min. 2.0%</td>
<td>msv at -10°C: min. 1.0%</td>
</tr>
<tr>
<td></td>
<td>At 0 °C</td>
<td>msv at 23°C: min. 3.5%</td>
<td>msv at 23°C: min. 2.0%</td>
</tr>
<tr>
<td></td>
<td>At 23°C</td>
<td>msv at 23°C: min. 3.5%</td>
<td>msv at 23°C: min. 2.0%</td>
</tr>
<tr>
<td></td>
<td>At heat resistance temperature, °C</td>
<td>msv</td>
<td>msv</td>
</tr>
<tr>
<td>Shear strength</td>
<td>ISO 1922 (23°C)</td>
<td>msv min. 0.4 (MPa)</td>
<td>msv min. 0.4 (MPa)</td>
</tr>
<tr>
<td>Water resistance</td>
<td>Tensile test ASTM C297 - after 4 weeks immersion in salt water (DIN 50905/ASTM D1141) at 40°C.</td>
<td>msv (MPa)</td>
<td>msv (MPa)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Manufacturer's specification, To be msv or msv</th>
<th>Mean</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Sandwich adhesives - Non-metallic materials
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