Rules for Classification and Construction

II  Materials and Welding

2  Non-metallic Materials

3  Guidelines for Elastomeric Adhesives and Adhesive Joints
The following Rules come into force on 1st November, 2002.

"General Terms and Conditions" of the respective latest edition will be applicable
(see Rules for Classification and Construction, I – Ship Technology, Part 0 – Classification and Surveys).

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Section 1

Requirements for the Adhesives and Adhesive Joints

B. General

1. Parts and components of metal, plastic and other materials may be bonded using elastomeric adhesives. The requirements concerning fire protection shall always be clarified for each individual case.

2. Elastomeric adhesive joints within the sense of this Guideline are adhesive joints which, in the tensile lap shear test, can endure a shear angle of more than 100% statically for a brief period at room temperature. Therefore an elastomeric adhesive is used which possesses elastomeric properties in the cured state.

3. Elastomeric adhesives do not offer any permanent protection against corrosion.

4. The adhesives and the surface treatment of the bonding surfaces may not adversely affect the material properties of the parts to be joined, i.e. the function of the parts after joining and the bonded joint itself shall not be impaired.

5. Depending upon the application, the adhesives shall exhibit a high durability, e.g. resistance against moisture (including seawater), acids, alkalis, fuel, oil, grease and UV radiation.

6. It must be possible to use the adhesives permanently within the temperature range from –20 °C to +60 °C.

7. For the elastic bonding of structural components and components which are integrated into the structure, only adhesives approved by Germanischer Lloyd (GL) shall be used.

8. The field of application of this Guideline is limited to the bonding of structural components and load-bearing components which are integrated into the structure, as well as components of relevance to ship safety. Depending on the area of application, an adhesive approval according to class A or class B will be required. For better understanding, the areas of application for class A and B are given below by way of example:

Class A:
Bonded joints under increased mechanical stressing (high strength with medium compliance):

– panes of insulating glass, single-pane safety glass or laminated safety glass
– rails for fastening seats
– door frames

Class B:
Bonded joints under medium mechanical stressing (high compliance with medium strength):

– transparent plastic sheets (single panes with dimensions under 0,5 m × 0,5 m)
– wind-break walls

The subdivision into class A or B shall be made in consultation with GL.

For bonded joints which are subjected to such high dynamic stresses that these form the decisive parameter for the bond, material tests in excess of the approval tests shall be performed (Section 2).

C. Approval of the Adhesives

1. The manufacturer of the adhesive, or the authorized representative, shall apply to Germanischer Lloyd for approval. Here it should be stated whether the application is for approval according to class A or class B.

2. Approval is granted if the adhesive meets the requirements prescribed in Section 2. Evidence that the requirements have been met shall be provided by means of a test certificate issued by an accredited testing laboratory.

3. Tests acknowledged by other classification societies can also be approved after consultation, provided that such tests comply with the requirements of this Guideline.
D. Requirements for the Adhesive-Processing Shops and the Personnel

1. General

1.1 All production facilities, storerooms and the operational equipment shall fulfil the requirements of the responsible safety authorities and employer’s liability insurance associations. The manufacturer shall bear the sole responsibility for compliance with these requirements.

2. Storage

2.1 Adhesives shall be stored in accordance with the manufacturer’s specifications. The temperature of the storerooms shall be recorded continuously by means of thermographs.

2.2 Storage shall be arranged in such a way that the identification of the materials, their storage conditions and the maximum period of storage (expiry date) as prescribed by the manufacturer are clearly visible. Adhesives whose duration of storage has exceeded the expiry date shall be removed immediately from the stores.

3. Production facilities

3.1 Production facilities shall be arranged so that the requirements for the processing and curing of the adhesive systems with regard to environment, cleanliness and industrial hygiene can be fulfilled.

3.2 Ventilation facilities shall be arranged in such a manner that fumes of solvents (e.g. of primers) are removed properly and targeted away, and also that no inadmissible workplace concentrations (MAC values) occur.

3.3 The workplace shall be illuminated adequately and suitably, but precautionary measures shall be taken to ensure that the curing process is not impaired through either sunlight or lighting equipment.

4. Personnel

4.1 The pre-treatment of the joining surfaces and the bonding of structural components shall only be performed by persons with adequate skills and professional knowledge. This professional knowledge shall be documented by means of certificates from the corresponding training courses. A training course which is regarded as adequate is e.g. the "European adhesive bonder" of the German Welding Society (DVS). Other courses can be recognised, following consultation with GL.

E. Execution of the Bonding

1. General

1.1 The required characteristics of bonded joints for load-bearing parts shall be verified, using a procedure test to be agreed upon for each individual case. The scope of the required tests shall be determined in consultation with GL. An example for a procedure test is given in Annex B.

1.2 For the processing of the adhesives, the instructions of the adhesives manufacturer as well as the requirements of the responsible safety authorities and employer’s liability insurance associations shall be observed in addition to this Guideline. In cases of conflict in requirements, GL should be consulted.

1.3 During the bonding process, the processing time of the adhesives as specified by the manufacturer shall not be exceeded. If such a time is not specified, qualification tests shall be carried out to determine the permissible pot-life (in the case of thermosetting resin adhesives) or the skin-forming times (in the case of single-component systems) for the relevant environment and batch quantities. On the basis of these values, the processing times shall then be determined by agreement with GL.

1.4 Appliances for joining the components shall be constructed so that the admissible deformations of the components, as specified by the adhesive manufacturer and the designer, are not exceeded during the curing process.

1.5 Fibre-reinforced plastics, thermosetting resins and painted components shall only be bonded when fully cured.

1.6 For the elastic bonding of plastics with each other or with other materials, low-solvent adhesives shall be used.

2. Structural design

2.1 A design suitable for bonding shall be used which, as far as possible, avoids peeling moments and forces and for which, under long-term static loading, no creep occurs that could impair the function of the bonded joint.

2.2 If low stresses is required, in the parts in case of the deformation of the parts to be joined the bonding layer shall be thick. The stresses for large deformations shall be kept low through thick bonding layers. Whether thicknesses of less than 3 mm are admissible shall be clarified in each individual case with GL. To ensure that the bonding layer is of uniform thickness, flexible spacers (if possible with the same Shore A hardness as the fully cured adhesive) shall be provided.
2.3 The application limits for the adhesive shall be observed with regard to its resistance to certain temperatures and media, as specified by the manufacturer.

2.4 If necessary, suitable measures shall be taken to protect the edges of the bond against the direct effects of aggressive media (e.g. hydraulic oil), moisture and UV radiation.

2.5 The design shall provide for proper accessibility of the bonding layer for an inspection and for possible repair work.

3. Surface pre-treatment

3.1 The surface pre-treatment shall be arranged so that a surface with defined and reproducible properties is obtained.

3.2 A surface treatment procedure shall be applied, that is suitably effective for the adhesive system and for the parts to be bonded. Furthermore, steps shall be taken to ensure that the properties of the surface do not deteriorate before the bonding process is started.

3.3 If there are coatings on the surface of the materials to be bonded which impair adhesion (e.g. skin-forming agents in UP resins), these layers shall be removed by adopting suitable procedures.

3.4 If bonded joints are used in an environment with corrosive media, the parts to be joined and the joining surfaces shall be treated with a corrosion protection system. The compatibility of the corrosion protection with the adhesive system shall be verified within the procedure test.

3.5 In many cases, an increase in the interfacial strength can be achieved through the application of specially matched primers. For each individual object, the use of primers shall be coordinated with the adhesive supplier.

3.6 If primers or degreasing agents are used, due attention shall be paid to ensuring adequate compatibility with the part to be bonded. The manufacturer’s specifications for the evaporation time shall be observed.

3.7 The suitability of the surface treatment for the chosen adhesive shall be verified by means of a suitable test using the original substrate materials. An example for the assessment of the surface treatment is the peeling test following climatic conditioning.

3.8 Various surface pre-treatments for metals and plastics are listed in the VDI (Association of German Engineers) guidelines 2229 and 3821.

4. Processing

4.1 The adhesives intended for processing and the parts to be joined shall be brought into the production shops in good time to ensure proper acclimatization to the processing temperature ($\Delta T \leq 2 ^\circ$C).

4.2 During bonding, a room temperature between 10°C and 30°C and a maximum relative humidity of 70% shall be maintained. During the curing process, only the temperature limits need be observed. If these environmental conditions cannot be provided, the processing conditions shall be coordinated with the adhesive manufacturer and GL.

4.3 When using primer systems, the venting evaporation time specified by the manufacturer shall be observed. Similarly, between a mechanical pre-treatment of aluminium and the application of adhesive or primer, a delay of 20 to 120 mins. (depending on the alloy type) shall be observed.

4.4 If possible, the adhesive should be applied to the joining surfaces immediately after the surface pretreatment has been concluded.

4.5 The adhesive shall be applied uniformly and free of voids onto the parts to be joined. Care shall be taken to ensure good wetting of the joining surfaces.

5. Curing

5.1 The required curing time depends upon the environmental conditions (temperature/humidity, and the ratio of surface area to volume of the adhesive joint, or diffusion path for single-component adhesives). With increasing length of the diffusion path, the curing speed is reduced progressively. The manufacturer’s documentation shall be consulted for reference values.

5.2 For the curing of single-component systems, measures shall be taken to ensure a relative humidity of at least 30%, since these adhesives require water to cure properly. If this cannot be ensured, the adhesive shall be wetted after a skin has formed, e.g. by creating a fine mist of water at regular intervals in the vicinity of the adhesive bond using a spray bottle.

5.3 Bonded parts shall be loaded by their own weight or additional loads only after the adhesive has undergone sufficient curing.
F. Manufacturing Surveillance at the Applier

1. General

1.1 For the bonding of components, manufacturing surveillance consists of the quality control of the materials used in bonding, the monitoring of the bonding procedure and the inspection of the quality of the finished components.

1.2 In the case of manufacturing surveillance, a distinction is made between internal and third-party (external) surveillance. In the sense of this Guideline, third-party surveillance means periodic and random checks by GL of the internal surveillance as well as of the component quality.

1.3 Within the scope of manufacturing surveillance, GL reserves the right to carry out inspections in the production facilities without giving prior notice. The manufacturer shall grant the inspectors access to all areas used for production, storage and testing, and shall present all documentation concerning records and tests carried out.

1.4 For production facilities with a certified quality management system according to EN ISO 9000, the scope of third-party surveillance can be reduced.

2. Incoming inspection

2.1 As part of the incoming inspection, a check shall be made to ascertain whether the delivered adhesive bears a valid approval by GL.

2.2 The goods shall be stored in accordance with the requirements of the manufacturer.

3. Production surveillance

3.1 Details of the working sequences needed for the execution of the adhesive joint shall be described in a work instruction which accompanies each stage of production and is signed by the respective person in charge. Compliance with the required work sequences shall be documented at each stage of production (Annex B).

3.2 Production surveillance of the bonding of the components shall be carried out constantly by the internal quality department. The scope shall be stipulated in an inspection and test plan, and signed by the persons in charge.

3.3 The materials used in the production shall be documented. Parameters relevant for the quality (e.g. temperature and humidity) shall also be recorded in the production documentation.

3.4 A deferred sample shall be taken from each batch of two-component thermosetting adhesive that is mixed, and this shall be labelled, cured and stored for at least 2 years. If many small batches are removed from one packing unit on a single day, it is permissible to use a dosing report from the second batch and to dispense with the deferred samples. The deferred samples shall be subjected to random testing of their degree of curing, and the results shall be documented. The deferred samples and the dosing report are intended for finding errors in mixing and for detecting inadequacies in the curing cycle.

3.5 Parallel to the bonding process, reference samples shall be produced on which the peeling tests are to be performed. The reference samples shall be identical to the parts to be bonded with regard to base material, surface structure, adhesive, and pre-treatment of the bonding surfaces. The reference samples serve to check the compliance with the required surface structure and the pre-treatment quality, as defined by qualification tests. The number of reference samples shall be agreed with GL for each individual case. Through the use of reference samples, the scope of the structural tests can be reduced.

3.6 The documentation accompanying each stage of production shall be archived for at least 10 years.

4. Testing

4.1 During and at the end of the bonding process, the parts to be joined, the joining surfaces and the adhesive shall be subjected to a visual inspection. Here special attention shall be paid to good wetting of the joining surfaces with the adhesive, and also to voids, discoloration, stress cracking, damage or similar defects.

4.2 The quality of the bond shall be determined with non-destructive testing methods, if possible. Ultrasonic testing can be used to determine the presence of adhesive, the thickness of the bonding layer, large voids, and any gap between adhesive and joining surface. By knocking (tapping) on the bonded joint, experienced inspectors can find defects in certain cases. Further testing methods include radiographic inspection and sound emission analysis. However, with non-destructive testing methods it is not possible to detect variations in the adhesion between the adhesive and the joining part.

4.3 In the case of series production, random tests of completed component bonds shall be performed in coordination with GL.
Section 2

Approval of Elastomeric Adhesives

A. Requirements

1. General

1.1 The manufacturer of the adhesive, or an authorized representative, shall apply to Germanischer Lloyd for approval of an elastomeric adhesive. The following shall be appended to the application:

- product description
- safety data sheet
- storage and processing instructions
- copy of the test certificate issued by an accredited test laboratory.
- evidence of a quality management system according to DIN EN ISO 9000, if such a system exists.
- written confirmation of the manufacturer stating that the sample adhesive is identical to the adhesive for which the approval is being sought, and that this Guideline was observed during the manufacture of the sample.

1.2 The minimum properties required by GL for the tests shall be attained by all samples.

1.3 If the test results of individual samples are unsatisfactory, the following conditions shall be observed (for a basic quantity of 6 tests):

- If one or two samples exhibit inadequate test results, the tests shall be repeated with double the number of samples.
- If three or more samples exhibit inadequate test results, the test can be repeated on newly manufactured samples, provided that GL agrees to renewed testing.
- Even if only one sample exhibits inadequate results during the repeat tests, approval will not be granted.

1.4 If the material conforms to the requirements of this Guideline, an adhesive approval according to class A or B will be granted. This will be limited to a period of five years, whereby extensions of validity are possible.

1.5 Modifications or other changes in the material shall be reported to GL without delay. A decision on the continued validity of the material approval will then be taken in each individual case.

1.6 By means of suitable quality assurance measures, the manufacturer shall ensure that the properties specified under item 2 and the minimum properties required under item 3 are observed. If this cannot be guaranteed, then GL reserves the right to suspend or retract the approval.

1.7 During the validity period of adhesive approvals, GL reserves the right to request or perform checks on the material properties. If inadequate results are obtained in comparison to the values submitted, the material approval will lose its validity.

2. Requirements

2.1 General

2.1.1 For an adhesive approval, the basic prerequisites listed under item 1 shall apply.

2.1.2 A general description of the adhesive shall be given. The fundamental properties of the cured adhesive shall be verified by the test certificate of an accredited test laboratory.

2.1.3 The tests shall be performed according to the standards listed below. In exceptional cases, equivalent standards of other countries can also be applied.

2.1.4 Upon request by the applicant, further tests (e.g. fatigue tests) can be included in the approval. These tests will then be listed separately on the certificate.
2.2 Description

2.2.1 A description which permits an unambiguous identification of the adhesive is required:
- type of adhesive
- manufacturer
- trade name
- storage conditions
- processing and curing guidelines
- volume shrinkage during curing

2.3 Properties of the adhesive

2.3.1 The following shall be stated for the ready-to-use condition:
- density, e.g. DIN EN ISO 1675
- pot-life for two-component products (100 g mixture in a beaker) at 10 °C and 30 % relative humidity (RH) and also at 30 °C and 70 % RH.
- skin-forming time at 10 °C and 30 % RH and also at 30 °C and 70 % RH.

2.3.2 For the curing process, the following shall be given:
- curing distance at 10 °C / 30 % RH and 30 °C / 70 % RH after 24 hours, and also after 3, 7 and 28 days, for single-component systems.
- Tensile stress at yield according to DIN 53504, measured after 24 hours, and 2, 4 and 7 days, for two-component systems. For one series, storage shall take place at 10 °C and for the other at 30 °C. Testing climate: 23 °C / 50 % RH
- volume shrinkage, e.g. according to DIN 52451

2.3.3 For the cured state, the following properties shall be stated:

2.3.3.1 The following shall be specified for the adhesive (by the manufacturer):
- shore A hardness according to DIN 53505
- qualitative assessment of the resistance to certain media, e.g. against
  - seawater
  - UV radiation
  - fuel
  - mineral oil
  - hydraulic fluid
  - grease
  - acid and alkaline solutions

2.3.3.2 For the adhesive, the following properties shall be verified by means of a certificate issued by an accredited testing body:
- modulus of torsional shear according to DIN EN ISO 6721-2B (min. temperature range - 30 °C to + 80 °C)
- tensile stress at yield and fracture strain according to DIN 53504 at - 20 °C, plus 60 °C and standard climate (23 °C and 50 % RH)
- tear propagation resistance according to DIN 53515 for the standard climate

2.3.3.3 The following shall be determined at bonded joints with an adhesive layer thickness of 3 mm for the standard climate (in deviation from DIN EN 1465, test samples with a test-sample thickness of at least 10 mm shall be used, with an overlap length of 20 mm and a testing speed of 5 mm/min):
- tensile lap-shear test according to DIN EN 1465

  Furthermore, a long-duration tensile lap-shear test (based on DIN EN 1465) shall be performed to determine the strain in creep. Here the samples shall be loaded with an average tensile lap-shear stress of 0,25 MPa (class A) in a standard climate and with 0,15 MPa (class A) at 60 °C for at least three months. These measurements can be performed in the manufacturer’s own laboratory, if the deformations occurring during the tensile lap-shear tests at 0,25 MPa (class A) and 0,15 MPa (class A) were specified by the accredited testing body and if these correspond to the manufacturer’s own measurements. In the case of adhesives for which an approval according to class B is sought, the manufacturer shall specify minimum properties for 23 °C and 60 °C, and verify them within the long-duration tensile lap shear test.

  As part of a relaxation test (based on DIN EN 1465), the samples shall be stored for 90 days with a constant elongation of 30 % (class B at RT) with conditioning according to DIN 50017-KFW. Temperature-related changes in elongation are permissible. In the case of adhesives for which approval according to class A is sought, a minimum property shall be specified by the manufacturer and verified within the relaxation test.

3. Minimum properties

3.1 For an adhesive approval, the following minimum properties acc. Table 2.1 shall be attained:
Table 2.1 Minimum properties to be achieved

<table>
<thead>
<tr>
<th>Property</th>
<th>Standard</th>
<th>Class A</th>
<th>Class B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shore A</td>
<td>DIN 53505</td>
<td>≥ 45</td>
<td>≥ 30</td>
</tr>
<tr>
<td>Facture strain at − 20 °C</td>
<td>DIN 53504</td>
<td>≥ 50 %</td>
<td>≥ 100 %</td>
</tr>
<tr>
<td>Tensile stress at yield for + 60 °C</td>
<td>DIN 53504</td>
<td>≥ 1,5 MPa</td>
<td>≥ 0,6 MPa</td>
</tr>
<tr>
<td>Tear propagation resistance</td>
<td>DIN 53515</td>
<td>≥ 4 N/mm</td>
<td>≥ 4 N/mm</td>
</tr>
<tr>
<td>Tensile lap-shear strength</td>
<td>DIN EN 1465</td>
<td>≥ 2 MPa</td>
<td>≥ 0,7 MPa</td>
</tr>
<tr>
<td>Values for the long-term tensile lap-shear test at 23 °C / 50 % rel. humidity at 60 °C</td>
<td>Based on DIN EN 1465</td>
<td>0,25 MPa 1</td>
<td>Specified by manufacturer</td>
</tr>
<tr>
<td>Relaxation test after 90-day conditioning</td>
<td>Based on DIN EN 1465 and DIN 50017</td>
<td>0,15 MPa 1</td>
<td>Specified by manufacturer</td>
</tr>
</tbody>
</table>

1 No failure may take place within the long-duration shear tension tests. The strain-in-creep values that are determined shall be specified versus the time.
Annex A

Applicable Standards and Guidelines

A. Applicable Standards and Guidelines for Section 1

Table A.1 Applicable Standards and Guidelines for Section 1

<table>
<thead>
<tr>
<th>Standard</th>
<th>Part</th>
<th>Title</th>
<th>Date of issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIN EN</td>
<td>10204</td>
<td>Metallic products - Types of inspection documents</td>
<td>08.95</td>
</tr>
<tr>
<td>VDI</td>
<td>2229</td>
<td>Metal bonded joints - Instructions for design and production</td>
<td>06.79</td>
</tr>
<tr>
<td>VDI</td>
<td>3821</td>
<td>Adhesive bonding of plastics</td>
<td>09.78</td>
</tr>
</tbody>
</table>

B. Applicable Standards and Guidelines for Section 2

Table A.2 Applicable Standards and Guidelines for Section 2

<table>
<thead>
<tr>
<th>Standard</th>
<th>Part</th>
<th>Title</th>
<th>Date of issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIN EN</td>
<td>1465</td>
<td>Determination of tensile lap-shear strength of rigid-to-rigid bonded assemblies</td>
<td>01.95</td>
</tr>
<tr>
<td>DIN EN ISO</td>
<td>1675</td>
<td>Plastics; Liquid resins; Determination of density by the pyknometer method</td>
<td>02.98</td>
</tr>
<tr>
<td>DIN EN ISO</td>
<td>6721</td>
<td>2 Plastics; Liquid resins; Determination of density by the pyknometer method</td>
<td>12.96</td>
</tr>
<tr>
<td>DIN</td>
<td>50017</td>
<td>Climates and their technical application; condensed water containing climates</td>
<td>10.82</td>
</tr>
<tr>
<td>DIN</td>
<td>52451</td>
<td>1 Prüfung von Dichtstoffen für das Bauwesen; Bestimmung der Volumenänderung; Pyknometer-Verfahren</td>
<td>05.91</td>
</tr>
<tr>
<td>DIN</td>
<td>53504</td>
<td>Testing of rubber; determination of tensile strength at break, tensile stress at yield, elongation at break and stress values in a tensile test</td>
<td>05.94</td>
</tr>
<tr>
<td>DIN</td>
<td>53505</td>
<td>Prüfung von Kautschuk, Elastomeren und Kunststoffen; Härteprüfung nach Shore A und Shore D</td>
<td>06.87</td>
</tr>
<tr>
<td>DIN</td>
<td>53515</td>
<td>Testing of rubber; tear test using the Graves angle test piece with incision</td>
<td>01.90</td>
</tr>
</tbody>
</table>
Annex B

Example for a Documentation Accompanying Each Stage of Production / Procedure Test

A. Documentation

1. Materials used

1.1 Joining part no. 1

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Material designation:</th>
<th>Batch No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface condition:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Joining part no. 2

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Material designation:</th>
<th>Batch No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface condition:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1.2 Cleaning agent

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Trade name:</th>
<th>Batch No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basis:</td>
<td>Expiry date:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1.3 Mechanical surface treatment agents

- Sanding: Sandpaper grade:
- Blasting: Grit-blasting agent:

1.4 Primer / Manufacturer

<table>
<thead>
<tr>
<th>Coupling agent / Trade name:</th>
<th>Batch No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activators</td>
<td>Basis:</td>
</tr>
</tbody>
</table>

1.5 Adhesive / Manufacturer:

| Coupling agent / Trade name: | Batch No. |
| Activators | Basis: | Expiry date: |
2. **Bonding process**

2.1 Surface preparation

Person responsible: ___________________________ ___________________________ (Signature)

2.1.1 Cleaning of the surface

Date: ____________ Location: ____________ Time: ____________

2.1.2 Mechanical surface pre-treatment

- [ ] not performed (e.g., in case of an anodised surface)
- [ ] grit-blasting

Date: ____________ Location: ____________ Time: ____________

Contamination level of blasting medium:
- [ ] low
- [ ] as new
- [ ] new

- [ ] Sanding
  - [ ] by machine
  - [ ] by hand

Date: ____________ Location: ____________ Time: ____________

2.1.3 Cleaning or post-treatment of the surface

Date: ___________________________ Type: ___________________________

Location: ___________________________ Time: ___________________________

2.1.4 Application of primer

- [ ] not performed
- [ ] performed

Date: ____________ Location: ____________ Time: ____________
2.2 Joining of the parts

Person responsible: ____________________________ ___________________ (Signature)

2.2.1 Climatic conditions

Temperature of the joining parts: ___________ Temperature of the adhesive: ___________

Ambient temperature: _________________ Relative humidity: _________________

2.2.2 Time of bonding

Date: _______________ Location: _______________ Time: _______________

2.2.3 Dimensions of the adhesive gap

Target: ______________________________________

Smallest dimension is: ______________________________________

Largest dimension is: ______________________________________

2.3 Curing of the bonded joints

Required climate (temperature and relative humidity)

Recording device for temperature and relative humidity was available and switched on?

☐ yes

☐ no
B. Check of the Bonded Joints (in the Case of Documentation Accompanying each Stage of Production)

Person responsible: ________________________________  __________________________

1. Visual inspection

Conspicuous features: □ yes  □ No

If "yes", please describe the type of deviation(s) and what measures were taken.

2. Peeling test on reference sample with and without climatic conditioning

- Type of failure: comprising __________________________ % adhesion failure without conditioning
- Type of failure: comprising __________________________ % adhesion failure with conditioning

3. Remarks:

4. Check by adhesive bonding specialist

Person responsible: ________________________________  __________________________
C. Testing of the Bonded Joints (in the Case of a Procedure Test)

1. Peeling test with and without conditioning

Three round beads of adhesive, with a diameter of 10 mm and a length of approx. 200 mm, shall be applied to the surface to be bonded. After complete curing of the adhesive in a standard climate (23 °C and 50 % relative humidity), the first adhesion test shall be conducted. Then the specimens shall be stored for 7 days at 23 °C in distilled water and for 2 hours in a standard climate. After this conditioning, the second adhesion test shall be conducted. Following this, an object-specific climatic conditioning shall be performed. The following types of climatic conditioning are recommended:

- For bonding to glass panes:
  Cataplasma test (7 days conditioning at 70°C and 100% relative humidity plus 1 day at –30°C and 1 day at 23 °C and 50 % relative humidity), followed by an adhesion test.

- For interior bonding:
  ASTM D 1183 method B, followed by an adhesion test, repeated conditioning according to method B and again an adhesion test.

- For bonding outside or in the cargo area:
  ASTM D 1183 method D (depending on the ship's range of trade, the minimum testing temperature of –57°C can be increased after agreement with GL-HO), followed by an adhesion test, repeated conditioning according to method D and another adhesion test.

For the evaluation of the fracture, a statement on the relationship between adhesion failure and cohesion failure shall be made, and this shall be compared with results from test samples that have not been subjected to climatic conditioning.

If it is already known beforehand that the bonded joints will be exposed to special media (e.g. acids, alkalis or industrial cleaning agents), the specimens shall also be stored in these media and then subjected to an adhesion test.

2. Ageing of the test samples with subsequent tensile lap-shear test according to Section 2, A.2.3.3.3.