Certification of container securing devices
FOREWORD

DNV GL standards contain requirements, principles and acceptance criteria for objects, personnel, organisations and/or operations.

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This is a new document.
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Changes – historic
SECTION 1 GENERAL

1.1 Objective
This standard intends to guide through the certification process for container securing devices.

1.2 Application
The requirements in this document are supplementary to those given in RU SHIP Pt.5 Ch.2 Sec.8. They apply to container support fittings and container securing equipment. Additionally, they apply to fixed securing points and Society's certified portable securing devices used for lashing of vehicles, in accordance with the requirement given in the rules RU SHIP Pt.5 Ch.3 Sec.1 [5.1].

1.3 Scope
This document describes the procedures and requirements for obtaining product certificates for securing devices.
The following topics are covered:
— materials and welding
— type approval
— prototype testing
— production testing
— marking.

1.4 Definitions
For definitions not defined in this document, see RU SHIP Pt.5 Ch.2 Sec.1 [1.5].

Table 1-1 Definitions

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>lashing</td>
<td>a system for securing of containers using non-rigid devices such as lashing rods and turnbuckles, or a securing device used in a lashing system, e.g. a lashing rod</td>
</tr>
<tr>
<td>safe working load, SWL</td>
<td>the allowable load capacity for a device used to secure cargo to a ship</td>
</tr>
<tr>
<td>minimum breaking load, BL</td>
<td>the tested minimum breaking load of a container securing device</td>
</tr>
<tr>
<td>safety factor, S</td>
<td>= BL / SWL</td>
</tr>
<tr>
<td>usage factor, ( \eta )</td>
<td>= SWL / BL i.e. the inverse of safety factor</td>
</tr>
<tr>
<td>proof load, PL</td>
<td>the test load during testing of container securing devices</td>
</tr>
<tr>
<td>prototype</td>
<td>an equipment item considered to be representative for the production and the product to be approved, used for prototype testing. The prototype may either be manufactured specially for type testing or selected at random from a production series. If manufactured specially, it is assumed that the tools and the production process are comparable to those used for subsequent production.</td>
</tr>
</tbody>
</table>
1.5 Documentation

Documentation shall be submitted as per Table 1-2 and, if relevant, per Table 1-3.

**Table 1-2 Documentation requirements**

<table>
<thead>
<tr>
<th>Object</th>
<th>Documentation type</th>
<th>Additional description</th>
<th>Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>Securing device</td>
<td>C030 – Detail drawing</td>
<td>Including SWL, BL and PL</td>
<td>AP</td>
</tr>
<tr>
<td></td>
<td>M010 – Material specification, metals</td>
<td></td>
<td>AP</td>
</tr>
<tr>
<td></td>
<td>Z130 – Report from test at manufacturer</td>
<td>Prototype test report endorsed by a Society's surveyor, including:</td>
<td>FI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>— description of test arrangement</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>— applied loads</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>— results</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>— SWL, BL and PL.</td>
<td></td>
</tr>
</tbody>
</table>

**Table 1-3 Additional documentation requirements for fully automatic locks**

<table>
<thead>
<tr>
<th>Object</th>
<th>Documentation type</th>
<th>Additional description</th>
<th>Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully automatic locks</td>
<td>Z130 – Report from test at test laboratory agreed by the Society</td>
<td>Operational test report issued by the manufacturer and endorsed by the Society, including:</td>
<td>FI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>— description of test arrangement</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>— applied loads</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>— results</td>
<td></td>
</tr>
</tbody>
</table>

For general requirements to documentation, see RU SHIP Pt.1 Ch.3 Sec.2.
For a full definition of documentation types, see RU SHIP Pt.1 Ch.3 Sec.3.
SECTION 2 CERTIFICATION

2.1 General
According to the rules RU SHIP Pt.5 Ch.2 Sec.8 [2.2], all container securing devices, shall be delivered with product certificates. Product certificates are in general issued based on material certification, design approval, prototype testing and production testing. Design approval may be either type approval or case-by-case approval upon special agreement, i.e. an approval which is only valid for a single delivery. The various approval and test schemes are described in detail in the following sections.

2.2 Certification procedure
The flowchart in Figure 2-1 gives an overview of the procedure for obtaining a product certificate, with references to relevant sections.

![Flowchart over the product certification procedure](image)
SECTION 3 MATERIALS AND WELDING

3.1 General
Container support fittings shall be delivered with Society's material certificates. Container securing equipment shall be delivered with works material certificates from the manufacturer, e.g. an acceptance test certificate 3.1 as to EN 10204.

3.2 Container support fittings

3.2.1
Container support fittings intended for welding into the hull structure shall be made of forged or cast carbon or carbon-manganese steels, or shall be cut from rolled materials of normal or high-strength hull structural steel.
The materials shall comply with relevant chapters and sections of RU SHIP Pt.2 and the additional requirements given in this subsection.

3.2.2
The carbon content of cast and forged steel shall not exceed 0.23%.

3.2.3
Specified minimum yield stress for castings and forgings shall not exceed 400 N/mm².

3.3 Container securing equipment

3.3.1
Container securing equipment shall be made of forged or cast steel or machined from rolled material. The materials shall comply with a recognised national or international standard and the additional requirements given in this subsection. Specifications deviating from the requirements given herein may be evaluated on the basis of documented experience or comprehensive test results.
Materials shall only be delivered from manufacturers approved by the Society.

3.3.2
Carbon and carbon-manganese steels shall be fully killed.

3.3.3
For items produced without any welding, the following applies:
— For carbon and carbon-manganese steels the C-content shall not exceed 0.40%.
— For alloy steels the C-content shall not exceed 0.45%.
— Ferritic nodular cast iron may be used only for fittings which are not subject to high dynamic loads, provided that the material satisfies grade VL NCI-2 requirements as given in RU SHIP Pt.2 Ch.2 Sec.9 [1] and RU SHIP Pt.2 Ch.2 Sec.9 [2].
In other respects the chemical composition shall comply with the recognised standard.
3.3.4
For welded items, the following applies:
— When welding is used in the production, the chemical composition shall be appropriate for the welding process, dimensions and heat treatment process in question.
— The carbon content of carbon and carbon-manganese steels manufactured with welding is in general not to exceed 0.23%.
— If the carbon content exceeds 0.23% preheating may be required, and normalising or stress relief heat treatment shall be carried out after welding; after heat treatment, the weld and heat-affected zone should be examined for cracks through suitable non-destructive testing.
— For thicknesses up to about 30 mm, when flash welded and heat treated according to [3.4] after welding, a carbon content of up to 0.35% for carbon and carbon-manganese steels and 0.40% for alloy steels may be accepted.
In other respects the chemical composition shall comply with the recognised standard.

3.3.5
Specified minimum yield stress for carbon and carbon-manganese steels shall not exceed 400 N/mm$^2$ when normalised, and 480 N/mm$^2$ when quenched and tempered. High-tensile alloy steels may be accepted upon special consideration of the material properties and the intended application.
In other respects the mechanical properties shall comply with the recognised standard.

3.4 Heat treatment
Castings and forgings of carbon and carbon-manganese steel shall be supplied in normalised or quenched and tempered condition. Rolled materials shall be supplied in the heat treatment condition prescribed in the recognised specification.
Alloy steels shall be quenched and tempered. Ferritic nodular cast iron shall be subjected to satisfactory heat treatment if not otherwise agreed.

3.5 Mechanical tests

3.5.1
Testing shall be carried out in accordance with relevant chapters of RU SHIP Pt.2 or with recognised standards, taking into consideration the additional requirements given in [3.5.2] to [3.5.4].

3.5.2
When a number of pieces are heat treated in the same furnace charge, a batch testing procedure may be adopted, using pieces from each batch for test purposes. One tensile test and one set of impact tests shall be made from each batch. The batch shall consist of pieces of about the same size and from the same cast, heat treated in the same furnace charge and with a total mass not exceeding 2 tonnes.

3.5.3
For chain cables produced in continuous lengths, one tensile test and one set of impact tests shall be taken from cable produced from the same steel cast unless the length is more than 1000 metres, in which case tests shall be taken from every 1000 metres or fraction thereof. The impact tests shall be taken clear of the weld. Test materials are obtained by supplying the cable with extra links.
### 3.5.4

Impact testing shall be carried out as Charpy V-notch tests according to the procedure given in RU SHIP Pt.2 Ch.1 Sec.3.

For container support fittings, testing shall be carried out at the temperature required for hull structural materials in the adjacent area or at 0°C, whichever is lower. The minimum absorbed energy shall meet the requirements given in the relevant chapter and section of RU SHIP Pt.2.

For container securing equipment, the average absorbed energy of three test specimens shall be as given in Table 3-1. One individual value may be below the specified value; however, it must not be less than 70% of that value. For rolled and forged materials, test specimens may be taken in the longitudinal direction. In castings the direction of the test specimens is optional.

**Table 3-1 Required impact energy for container securing equipment**

<table>
<thead>
<tr>
<th>Product</th>
<th>Impact energy [J]</th>
<th>Test temperature [°C]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Above weather deck</td>
</tr>
<tr>
<td>Rolled products</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$s_r \leq 270^{1)}$</td>
<td>27</td>
<td>-20</td>
</tr>
<tr>
<td>$s_r \geq 355^{1)}$</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>Forged steel</td>
<td>27</td>
<td>0</td>
</tr>
<tr>
<td>Cast steel</td>
<td>27</td>
<td>or</td>
</tr>
<tr>
<td>Ferritic nodular cast iron</td>
<td>12</td>
<td>design operating</td>
</tr>
<tr>
<td></td>
<td></td>
<td>temperature$^{2)}$, whichever is lower</td>
</tr>
</tbody>
</table>

1) For intermediate values the required impact energy shall be obtained through linear interpolation.
2) For tests performed at temperatures below -20°C, the required impact energy may be specially considered.
SECTION 4 TYPE APPROVAL

4.1 General
Type approval is based on plan approval and prototype testing, and will be issued in accordance with the general requirements outlined in RU SHIP Pt.1 Ch.1 Sec.4 and class programme DNVGL CP 0338. Type approval certificates are issued to manufacturers of components. Such certificates are based on a review of the design, i.e. plan approval, and are issued for products that have been manufactured and prototype tested, and is only valid for the one manufacturing plant. Certificates are valid for 5 years and will be listed on the internet site Approval Finder https://approvalfinder.dnvgl.com/.

4.2 Plan approval

4.2.1
For each equipment item, plans shall be submitted as required by Table 1-2 and, if relevant, Table 1-3.

4.2.2
Approval will be based on an evaluation of the strength of each securing device, as described in the following subsections. However, factors related to safe use will also be considered:

— Securing devices that function as mechanisms must have safe and reliable operation throughout their operational lifespan.
— The risk of incorrect application of securing devices should be minimised through design, marking or labelling and user instructions.
— For devices that may have small margins against malfunction or failure, a more detailed analysis of safety will be considered; such smaller margins may for instance be related to:
  — wear or corrosion
  — small contact areas for load transfer
  — difficult or impossible verification that the device is properly attached and locked after application
  — enhanced need for maintenance.

For securing devices based on novel design solutions, or where the Society has special concern linked to the conditions described above, the design approval may be given for a limited time. The Society reserves the right to re-evaluate the design and, if necessary, withdraw type approvals. This will normally not have any consequences for devices that are already certified and delivered to the user. Product certificates will not be withdrawn unless a securing device is shown not to be safe and reliable in use.

4.2.3
Securing devices may be subject to tension, compression or shear forces, or combinations thereof. The forces may be static or dynamic. However, during prototype testing the test specimens will normally be subject to one type of static force at a time.

During operation, securing devices are normally subjected to cyclic loads. This shall be taken into account in the design and choice of materials, so that the possibility of fatigue failure is minimised.

For some devices subject to compression loads, e.g. tension/pressure elements and long bridge stackers, buckling strength may have to be considered.

In general the SWL, in securing devices is not to exceed the safety factor S as given in [4.3.2].

The SWL in container securing devices is typically 50% of the BL.
In Table 4-1, SWL are shown as typical values for selected types of the container securing devices. For container securing calculation purposes, SWL values as given in the product certificates of actual devices shall be used as allowable limits.

**Table 4-1 Typical SWL values and test loads for container securing devices**

<table>
<thead>
<tr>
<th>Item</th>
<th>Type</th>
<th>Safe Working Load (SWL) [kN]</th>
<th>Proof Load (PL) [kN]</th>
<th>Min. Breaking Load (BL) [kN]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Lashing rod</td>
<td>245</td>
<td>307</td>
<td>490</td>
</tr>
<tr>
<td>1.2</td>
<td>Lashing chain</td>
<td>80</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>1.3</td>
<td>Lashing steel wire rope</td>
<td>200</td>
<td>250</td>
<td>450</td>
</tr>
<tr>
<td>2</td>
<td>Turnbuckle</td>
<td>245</td>
<td>307</td>
<td>490</td>
</tr>
<tr>
<td>3</td>
<td>Penguin hook</td>
<td>245</td>
<td>307</td>
<td>490</td>
</tr>
<tr>
<td>4</td>
<td>D-Ring</td>
<td>245</td>
<td>307</td>
<td>490</td>
</tr>
<tr>
<td>5</td>
<td>Lashing plate</td>
<td>245</td>
<td>307</td>
<td>490</td>
</tr>
<tr>
<td>Item</td>
<td>Type</td>
<td>Figure</td>
<td>Safe Working Load (SWL) [kN]</td>
<td>Proof Load (PL) [kN]</td>
</tr>
<tr>
<td>------</td>
<td>--------------------------------</td>
<td>--------</td>
<td>-----------------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>6</td>
<td>Twist lock (single)</td>
<td></td>
<td>210</td>
<td>263</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Flush ISO socket</td>
<td></td>
<td>250</td>
<td>313</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Pedestal ISO socket</td>
<td></td>
<td>250</td>
<td>313</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Dove tail socket with twist lock</td>
<td></td>
<td>210</td>
<td>263</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tension</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Shear</td>
<td></td>
</tr>
</tbody>
</table>
### Item | Type | Safe Working Load (SWL) [kN] | Proof Load (PL) [kN] | Min. Breaking Load (BL) [kN] | Figure
--- | --- | --- | --- | --- | ---
10 | Stacker (single) | 210 | 263 | 420 | ![Stacker Figure]
11 | Stacker (double) | 560 | 620 | 730 | ![Stacker Double Figure]
12 | Linkage plate | 150 | 188 | 300 | ![Linkage Plate Figure]
13 | TP Bridge fitting | 210 | 263 | 420 | ![Bridge Plate Figure]
14 | Buttress | Between tiers | 650 | 715 | 850 | ![Buttress Figure]
 | | Top tier | 250 | 275 | 325 | ![Buttress Top Tier Figure]
| General note: | Deck | SWL | 1.25 SWL | 2.0 SWL | 
| | Hold | SWL | 1.1 SWL | 1.33 SWL |

The BL is normally to be verified by prototype testing as described in [4.3].
For support fittings, the influence on the BL by the supporting hull structure is to be taken into account, e.g. location of stiffeners below flush sockets.

### 4.3 Prototype testing

Type approval certificates are issued after satisfactory prototype tests have been carried out. Support fittings may, upon special consideration, be exempt from prototype testing.

#### 4.3.1

Prototype testing of each item shall be performed on at least three samples. Test loads shall be applied in a test rig simulating the actual service conditions. All test samples shall withstand PL without any permanent deformation or significant damages and at least the BL. A test result report describing the test arrangement, supports, test angles, applied loads and results shall be issued.
4.3.2
Following safety factors $S_{BL}$ apply for securing devices and support fittings:

- Safety factor in general: $S_{BL} = 2.0$
- For lashing ropes: $S_{BL} = 2.25$
- For lashing chains: $S_{BL} = 2.50$

Typical values for SWL, PL and BL for most commonly used fittings as well as the test arrangement are shown in Table 4-1.

4.3.3
A prototype test may be required for an assembly consisting of several securing devices in order to verify the joint performance of the assembly.

4.3.4
For fully automatic locks, an operational test is required as described in [4.4]. For novel designs of fully automatic locks, the operational test procedure will be evaluated by the Society on a case-by-case basis.

4.3.5
For support fittings which are to be welded into the hull structure, the test condition shall simulate the welded, in-service condition. Furthermore, the parts of support fitting which are directly integrated to the hull structure shall have at least the same material grade and strength group of the hull structure where they are welded into.

4.3.6
All welding-in pockets of support fittings shall be checked for tightness and delivered with proof issued by the manufacturer. The Society reserves the right to be present at tightness test.

4.3.7
Prototype tests shall be repeated latest after 5 years to renew the type approval certificate.

4.4 Operational testing of fully automatic locks

4.4.1
For fully automatic locks (FAL) operational testing shall be carried out in addition to prototype testing as given in [4.3]. Type approval certificate are issued after satisfactory prototype tests and operational tests have been carried out.

4.4.2
Operational test shall be performed on at least three test specimens. The test arrangement shall represent realistic stowage of ISO containers secured by FAL. The load scenario shall demonstrate that the FAL is capable of withstanding transverse racking forces in combination with lifting forces in accordance with following test arrangement and procedure. The test location and test jig shall be agreed by the Society.
### Table 4-2 Test procedure for fully automatic locks

<table>
<thead>
<tr>
<th>Type</th>
<th>Test arrangement and loading scenario</th>
<th>Test Load [kN]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully automatic locks</td>
<td>Test setup:&lt;br&gt;The distance between centre lines of the corner casting apertures on the test jig shall be 4 mm less than distance between centre lines of the corner casting apertures on the test platform.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Loading scenario:&lt;br&gt;First, the test jig shall be shifted in the direction of racking force as far as possible within the clearance of the locks. Subsequently, test forces shall be applied in the following sequence:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) Compressive forces 1 and 2&lt;br&gt;b) Racking force</td>
<td></td>
</tr>
</tbody>
</table>

[Diagram of test setup and loading scenario]
<table>
<thead>
<tr>
<th>Type</th>
<th>Test arrangement and loading scenario</th>
<th>Test Load [kN]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully automatic locks</td>
<td>Test setup:                                                                                                                                  The distance between center lines of the corner casting apertures on the test jig shall 5 mm less than distance between center lines of the corner casting apertures on the test platform.</td>
<td>Test Load</td>
</tr>
<tr>
<td></td>
<td>Loading scenario:                                                                                                                First, the test jig shall be shifted in the direction of racking force as far as possible within the clearance of the locks. Subsequently, test forces shall be applied in the following sequence:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) Compressive force                                                                                                           b) Racking force                                                                                           c) Lifting force</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Notes:                                                                                                                                   1) Two ISO top corner fittings in mint condition shall be fixed on the test platform. 2) A stiff test jig, linking two ISO bottom corner fittings in mint condition, shall be used. 3) The top and bottom apertures of all ISO corner fittings shall be exactly 65 mm wide.</td>
<td>Notes:</td>
</tr>
<tr>
<td></td>
<td>4) The orientation of the racking force shall be always opposite to the nose of the fully automatic lock. 5) During the sequential application of test forces, the previously applied forces shall be kept constant. 6) Devices for application of test forces shall not laterally jam the test jig. 7) Permanent deformations, incipient cracks, or failure of the lock as such will not be accepted. 8) At least three randomly selected fully automatic locks shall be tested.</td>
<td>Notes:</td>
</tr>
</tbody>
</table>
4.4.3

The operational test shall be witnessed by the Society. A test report shall be prepared and submitted by the manufacturer of the fully automatic lock.
SECTION 5 CASE-BY-CASE APPROVAL

5.1
As an alternative to type approval, the product certification may be based on case-by-case design approval in accordance with approval principles described in Sec.4.
SECTION 6 PRODUCTION TESTING

6.1 General

6.1.1
Production testing shall be carried out as follows:
At least 2% of all items shall be proof tested. For a delivery batch of less than 50 items at least one item from each lot (including prototypes) shall be tested.
The test load to be applied in proof tests is normally to be taken as 1.25 times the SWL for devices to be used on deck and 1.1 times SWL for devices intended for use in cargo holds. See Table 4-1. Upon completion of the proof test, each item shall be examined and confirmed to be free of permanent deformations and significant defects.

6.1.2
For support fittings which have to be welded-in for the purpose of testing, the scope of testing may be reduced to 0.5% of all items, provided that
— latest prototype test is not older than 12 months, and
— a valid type approval certificate is available for these support fittings.

6.1.3
The certification may, as an alternative to the production testing described in [6.1.1], be based on a scheme for non-destructive examination, if agreed by the Society. The details of such a scheme shall be agreed in a manufacturing survey arrangement.

6.1.4
Non-standardised securing equipment, such as wires and chains, will be specially considered.

6.1.5
Where a lashing assembly consists of several devices (e.g. turnbuckles, twistlocks) supplied by different manufacturers, testing shall be carried out upon the assembly.

6.1.6
Where found necessary, the Society’s surveyor may request tests carried out beyond the prescribed scope, e.g. additional material testing.
SECTION 7 MARKING

7.1
Each item shall be marked with suitable identification marking to allow traceability to the product certificate. The marking shall include the manufacturer’s/supplier’s name or mark, type designation and, if relevant, charge or heat number.
CHANGES – HISTORIC

There are currently no historical changes for this document.
Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil and gas, and energy industries. We also provide certification services to customers across a wide range of industries. Operating in more than 100 countries, our 16 000 professionals are dedicated to helping our customers make the world safer, smarter and greener.