DNV·GL

Certificate No:
TAD00000DS

TYPE APPROVAL CERTIFICATE

This is to certify:

That the Miscellaneous

with type designation(s)
Nord-Lock Locking Washers

Issued to
Nord-Lock AB
MALMÖ, Sweden

is found to comply with
DNV Standard for Certification No. 2.22 "Lifting Appliances"
DNVGL-OS-E101 – Drilling plant, Edition July 2015
DNV-OS-E201 "Oil and Gas Processing Systems" October 2010
DNV-OS-C101 "Design of Offshore Steel Structures, General (LRFD Method)" April 2011
DNV Rules for Classification of Ships Part 4 Chapter 4 "Rotating Machinery,Power Transmission"

Application :

Preloaded bolted assemblies subjected to dynamic, fatigue, impact and vibration induced loading

This Certificate is valid until **2021-06-26**.

Issued at **Høvik** on **2016-06-27**

for **DNV GL**

DNV GL local station: **Oslo Mooring, Diving & Offshore Equipment**

Approval Engineer: **Chenyu Sun**

Inger-Helene Hals
Head of Section

This Certificate is subject to terms and conditions overleaf. Any significant change in design or construction may render this Certificate invalid.
The validity date relates to the Type Approval Certificate and not to the approval of equipment/systems installed.

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Product description

NORD-LOCK washers are designed to prevent or minimize dynamic-, vibration- and impact-induced loosening of fasteners.
Each NORD-LOCK locking washer consists of a pair of washers that have inclined cams on the internal mating faces and radial tooth on the washer external bearing faces. The washers' incline cam angle is greater than the lead angle of the fastener thread (i.e. the rise of the cams is greater than the pitch of the thread).
When the fastener is tightened, the tooth on the external surfaces of NORD-LOCK washers grip and penetrate in the mating surfaces of the bolt head, nut and joint material, and lock the washers in place. If the nut tries to turn loose, the mating cams have to climb upon each other; the pair of washers tends to expand and results in an increase tension in the fastener. This prevents further rotation of the nut and, hence, loosening of the fastener.
Two NORD-LOCK washers are normally glued together with cam face on cam face and supplied pre-assembled. A pair of pre-assembled NORD-LOCK washers is hereafter referred to simply as NORD-LOCK washer.
NORD-LOCK washers can be classified as free running, preload dependent locking devices. Bolted connections fitted with NORD-LOCK washers do not require use of any additional appliances such as a lock wire, cotter pins, welding, jam nuts, adhesives, etc. to mechanically or chemically lock the nut and bolt together. Neither do they require application of any offset or distorted threads, slotted nuts, nor use of any non-metallic inserts to prevent self loosening of fasteners.

Application/Limitation

Bolting Sizes and Threads

This Type Approval Certificate covers regular and enlarged type of NORD-LOCK locking washers intended for use assembled with the following fastener sizes:

- M8 up to M42 coarse pitch metric thread fasteners according to ISO 898-1, and
- $^5/_{16}$" up to $1^1/_2$" UNC thread fasteners according to ANSI B1.1 1960.

NORD-LOCK washers are designed for right-hand threaded fasteners as standard. Washers for left-hand threaded fasteners may be available upon request.

Bolting Material Grades

NORD-LOCK washers are manufactured of alloy steel and stainless steel, and designed to be assembled respectively with:

- alloy steel fasteners Property Class 8.8, 10.9 and 12.9 according to ISO 898-1, and
- stainless steel fasteners Grade A4-80 according to AISI 316 or equivalent.

Maximum Hardness of Mating Surfaces

The hardness of the mating surfaces of bolt head, nut and joint material shall be lower than that of the NORD-LOCK washers used in the bolt assembly, i.e.:

- < 465 HV 1 for alloy steels fasteners, and
- < 520 HV 0.05 for stainless steels fasteners
- < 600 HV 0.05 for fasteners fitted with 254 SMO Nord-Lock washers

Minimum Bolt Preload

To function satisfactory, NORD-LOCK washers require that a certain minimum magnitude of bolt preload be maintained in the fastener during the intended service life of the bolted joint. The following minimum values of residual bolt preload are recommended:

- 0.30 f_y A_S for fasteners Property Class 8.8
- 0.40 f_y A_S for fasteners Property Class 10.9
- 0.50 f_y A_S for fasteners Property Class 12.9
- 0.30 f_y A_S for stainless steel fasteners Grade A4-80.

where:

f_y is the nominal ultimate strength of the fastener
A_S is the fastener stress area

Design Temperatures

The design service temperature ranges from -20° C up to 180° C for the alloy steel washers and from –160° C up to 500°C for stainless steel washers.

Regulations

This Type Approval is valid only if use of the product is in compliance with Regulations, DNV GL Rules and Standards, and manufacturer's Specification and Instruction for assembling and tightening applicable for the intended service.

Other Applications

On request, NORD-LOCK AB may supply locking washers for threaded fasteners of other dimensions, thread types, materials and material property classes and/or coated with other corrosion protective systems than those specified in this Certificate. Also, locking washers designed for other service temperatures may be supplied on request. Those special products, however, are not covered by this Type Approval Certificate but may be evaluated and approved on case to case basis.

Type Approval documentation

Generic Drawings and Technical Data

The washers' type identification, basic dimensions and tolerances are given in the following NORD-LOCK generic drawings:

- Dwg. No.: 4-100-08 – Zinc flake coated Nord-Lock washers, Edition B, Sheet 1/1, dated 2006-01-17
- Dwg. No.: 4-100-07– Stainless steel A4 Nord-Lock washers, Edition H, Sheet 1/1, dated 2006-01-17
- 257 SMO washers are manufactured according to the same generic drawings as those applied for the stainless steel washers.

Further technical date and information are given in the manufacturer's product catalogue. Reference: www.nord-lock.com

Material Specification

Alloy steel NORD-LOCK washers are manufactured of Docol Bo 04 material (similar to EN 1.7182) and hardened to min 465 HV 1 according to EN 10083-3:2006.

Stainless steel NORD-LOCK washers are manufactured of SS 14 2348 material (equivalent to EN 1.4404) and surface hardened to 520 HV 0.05 by Kolsterising® – a proprietary surface treatment process for austenitic stainless steels by Bodycoate.

High alloy steel Nord-Lock washers are manufactured of 254 SMO ® material (equivalent to EN 1.4547) and surface hardened to 600 HV 0.05 by kolsterising ®

Corrosion Protection

Alloy steel NORD-LOCK washers are supplied protected with an inorganic zinc-flake-system consisting of DELTA-PROTEKT KL 100 basecoat and DELTA-PROTEKT VH 302 GZ topcoat by Dörken MKS-Systeme GmbH & Co., Germany. Reference: www.doerken-mks.de.

Stainless steel NORD-LOCK washers are surface treated with Kolsterising® process that offers enhanced corrosion resistance according to Bodycote. Reference: www.bodycote.com.

Assembly Instruction

Examples of correct and incorrect assembly of NORD-LOCK washers in bolted joints of different types are given in the manufacturer's product catalogue. Reference: www.nord-lock.com.

Guidance on selection of tightening torque is provided in the manufacturer's product catalogue. Reference: www.nord-lock.com. When in doubt, the required torque shall be determined by test at the job site using as-received bolts, nuts, NORD-LOCK washers and lubricant.

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Quality Control System

NORD-LOCK AB holds the following Quality Control Certificates:

- Quality Management System certified in accordance with the requirements of EN ISO 9001-2000. Certificate No.: 27072 issued by Intertek Certification AB of Sweden on 13 May 2012.
- Environmental Management System certified in accordance with the requirements of EN ISO 14 001 2004. Certificate No.: 1417752, issued by Intertek Certification AB of Sweden on 13 May 2012.
- DNV GL audit visit to Mattmar factory on 2012-02-23. Reference audit report: Project No.: 419 81 027

Tests carried out

- Vibration Tests of a range of NORD-LOCK washer sizes, materials and corrosion protection coatings were carried out in Junker test apparatus (according to DIN 65151) at NORD-LOCK AB premises in Malmö, Sweden in November 2005 and in October 2010. The tests were witnessed by DNV GL surveyor.
- Accelerated Vibration Test as per NASM 1312-7 of NORD-LOCK washer size M16 and of various materials and corrosion protection coatings was carried out in DNV GL Laboratory in Høvik, Norway in February, June 2006 and September 2010.

Vibration Tests are reported in two DNV GL Technical Reports: No. 2007-0997, "Accelerated Vibration Test of NORD-LOCK Locking Washers", Rev. 02, December 2007 and No. 12QT6G7-8 "Vibration testing of Nord-Lock locking washers", Rev. 01 , 2011-04-01.

Marking of product

Standard NORD-LOCK washers are supplied pre-assembled as a pair of washers glued together with cam face on cam face. The washers are delivered in boxes containing 25 to 200 pieces of pre-assembled pairs dependent of the washer size. For traceability to this Type Approval Certificate each box shall be marked as follows:

- Manufacturer's name and trademark
- Washer Identification No. as per Technical Data Sheet/Catalogue (washer/bolt size, material, washer type regular/enlarged, corrosion protection system applied)
- Number of glued washer pairs in the box
- Item Control No. and/or Lot No.
- Maximum allowable surface hardness of mating bolt, nut and joint material

Reference to this Type Approval Certificate: **VL TAD00000DS**

Certification Retention Survey

For retention of the Type Approval, DNV GL Surveyor shall perform a survey – every 2.5 year and before the expiry date of this certificate – to verify that the conditions for the type approval are complied with.

END OF CERTIFICATE