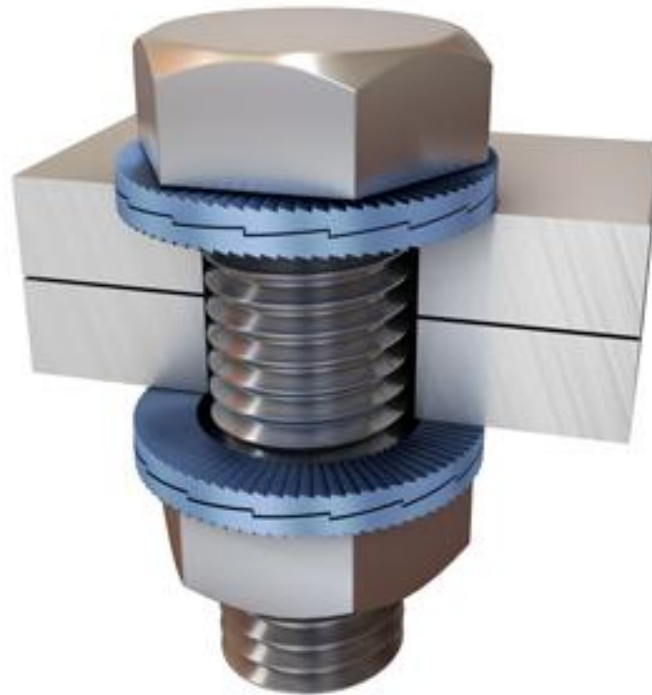


Reliable Securing Presentation
Prepared by; -
Richard Waddington
Nord-lock Bolt Securing Systems
October 2012

Please enable sound
and press enter to start the
presentation

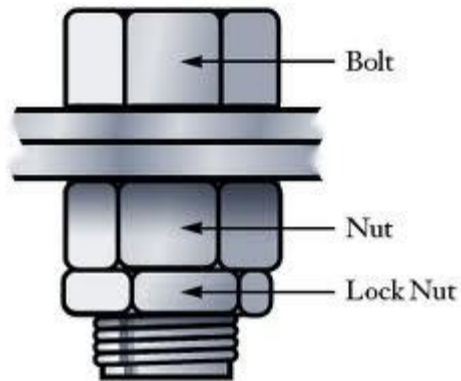
The Security of Bolted Joints



- **To take a fresh look at bolted joints**
- **Loose nuts & bolts, a few examples**
- **Gain a better understanding of why nuts and bolts come loose**
- **Offer a solution to the problem of nuts and bolts coming loose**

- **All of the dropped object examples used in this presentation are in the public domain.**
- **Thank you to all those who have provided information included in this presentation.**

The Issue.....Loose Nuts & Bolts?



- **The traditional, old fashioned methods of securing nuts and bolts against loosening are not always reliable.**
- **Past experience proves this, and testing in the lab confirms it.**
- **Loose nuts and bolts are a major factor in the cost of maintenance, breakdowns, lost production and accidents.**

Problem.....what problem?



Dropped Fast Line Guide Roller



Safety Alert

From the International Association of Drilling Contractors

ALERT 07 – 22

DROPPED OBJECT: FAST LINE GUIDE ROLLER

WHAT HAPPENED:

The day crew was tripping in DP to 11,000 ft. The trip was stopped to visually inspect the fast line stabilizer guide which had been repaired the previous day. They observed it for 4 stands and found it to be OK. Later during the trip a loud noise was heard above the crew. The trip was stopped and crewmen searched for cause of the noise. It was discovered that the bottom outside roller of the line guide, weighing 8.5 lbs, had fallen from the stabilizer assembly onto the roof. It bounced to an unmanned deck and into a cargo basket. Both sides of the roller had visible wear. One side of the bolt thread was worn down and half of the other bolt was worn down due to roller movement after the lock nut had backed off. There were no injuries.

WHAT CAUSED IT:

The locknut on the bottom outside roller had backed out allowing the roller to fall out. The stabilizer assembly had recently been rebuilt. Investigation revealed that some of the lock nuts had been loosened and re-tightened. All six rollers are seldom changed out at the same time, but it is necessary to loosen all lock nuts in order to re-install the assembly on the fast line. When a locknut is loosened and re-tightened, its break-out torque is reduced (and continues to be reduced further each time the nut is loosened and re-tightened.) To prevent this reduction in breakout torque, the lock nut must be replaced with a new one from the manufacturer and the old one discarded.



Fast Line Stabilizer Guide
with 6 rollers.

Lock nuts to be torqued only
once. Replace lock nuts if
broken out.

CORRECTIVE ACTIONS: To address this incident, this company gave rig personnel the following instructions:

Since the fast line stabilizer guide assembly is overhead and undergoes continuous rigorous vibration, it has high dropped-object potential. Therefore, it is mandatory that each lock nut be used only once.

When removing the stabilizer guide for service or to change one or more rollers:

1. All self-locking nuts on all rollers are to be replaced. Do not re-tighten a lock nut once it has been loosened. Discard all used lock nuts.
2. Do not torque up the nuts fully until the stabilizer assembly guide is squared on the fast line.
3. Ensure the assembly is inspected regularly (as well as subjected to Preventive Maintenance protocols).
4. Have a JSA for rebuilding, servicing or replacing one or more rollers in which the above points are specified.

The Corrective Actions stated in this alert are one company's attempts to address the incident, and do not necessarily reflect the position of IADC or the IADC HSE Committee.

This material is presented for information purposes only. Managers & Supervisors should evaluate this information to determine if it can be applied to their own situations and practices.
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Issued July 2007



The locknut on the bottom outside roller had backed out, allowing the roller to fall

Dropped Derrick Light Fixture



Safety Alert

From the International Association of Drilling Contractors

ALERT 03 – 33

DROPPED OBJECT – DERRICK LIGHT FIXTURE

WHAT HAPPENED:

A 41-pound (18 kg) explosion proof 400-watt Mercury Vapor light fixture fell 20 feet (8 meters) from the derrick and landed on the rig floor in front of the Drawworks. The electrical cable pulled out of the light leaving the cable energized in the derrick. No injuries were associated with this incident.

WHAT CAUSED IT:

1. The bolts that connected the light fixture to the bracket, vibrated loose.
2. The light was a new type, and when the light was installed into the derrick a risk assessment was not done to identify the potential hazards. Because of this:
 - The safety cable was secured to the bracket, instead of the light fixture.
 - There is no means to secure the safety cable directly to the light fixture.
3. The loose bolts and the improper manner in which the safety cable was secured to the fixture were missed during the weekly derrick inspection.
4. During the weekly derrick inspection the inspector noted the safety cable was present, however a detailed inspection of the light and how the light was secured was not.

CORRECTIVE ACTIONS: To address this incident, this company issued the following directives and action items:

Directives

1. Risk assessments must be done when installing new equipment or same-type equipment in a new location to ensure all potential hazards are identified and safety measures are in place.
2. When performing the weekly derrick inspection the inspectors must carefully exam each item (lights, raceways, sheaves, secondary fall protection blocks, etc) and confirm that the item is properly secured to the bracket, and the bracket to the fixture, and that the safety cable is secured in a manner to prevent the fixture and bracket from falling.
3. Prior to the purchase of new items that are to be installed overhead it should be confirmed that the item is designed so a safety cable may properly be installed to the fixture.

Action items

1. Inspect all overhead equipment that has the potential to fall (lights, sirens, horns, etc) in the derrick, walkways, living quarters, etc., and ensure the safety cable is secured to the fixture and bracket. If the safety cable cannot be secured to the fixture, the equipment should be removed from service. Inspect all safety cables and ensure the cable is secured in a manner to prevent the dropped object from falling closer than 6-1/2 feet (1.95 meters) from the deck.
2. All overhead equipment must have "double nuts" if possible. If unable to "double nut" equipment due to design, than alternative means (jam nuts, lock washers, cotter pins, etc.) must be utilized to prevent nuts from vibrating loose.

Note: See IADC Alerts – 00 – 05, 00 – 18, 00 – 31, 02 – 04, 02 – 07, 02 – 35, 02 – 38, 03 – 06,

The Corrective Actions stated in this alert are one company's attempts to address the incident, and do not necessarily reflect the position of IADC or the IADC HSE Committee.

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Issued August 2003

WHAT HAPPENED:

An 18 kg explosion proof light fixture fell 20 feet to the rig floor.

The electrical cable pulled out of the light leaving the cable energised in the derrick.

WHAT CAUSED IT:

The bolts that connected the light fixture to the bracket, vibrated loose.

Dropped Manipulator Arm Hinge Pin



Underside of Manipulator Arm



Note the broken locking wire

V door Inspection

2 x runway beam
trolleys on each door



Trolley wheels are dislodged from runway beam.
Nuts and bolts are loose.

Further Inspection of V door



Wheel
Disconnected.

Nut missing.

Dropped CCTV Camera Shroud



VHIPO Dropped Object



3.5 kg derrick camera shroud
fell 5 ft to stabbing board.
Potential to fall 50 ft.



Roller fell from arch to drillfloor

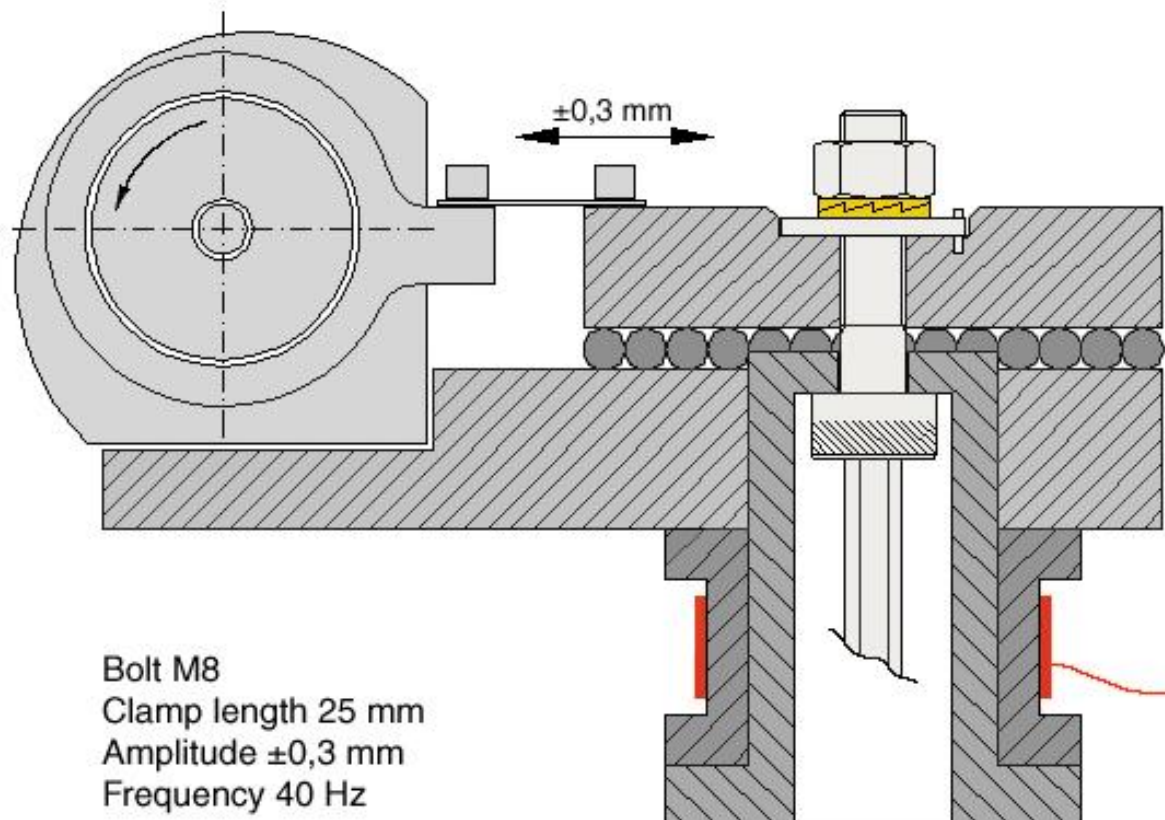


Weight of dropped roller
4.5kg, Height 24m

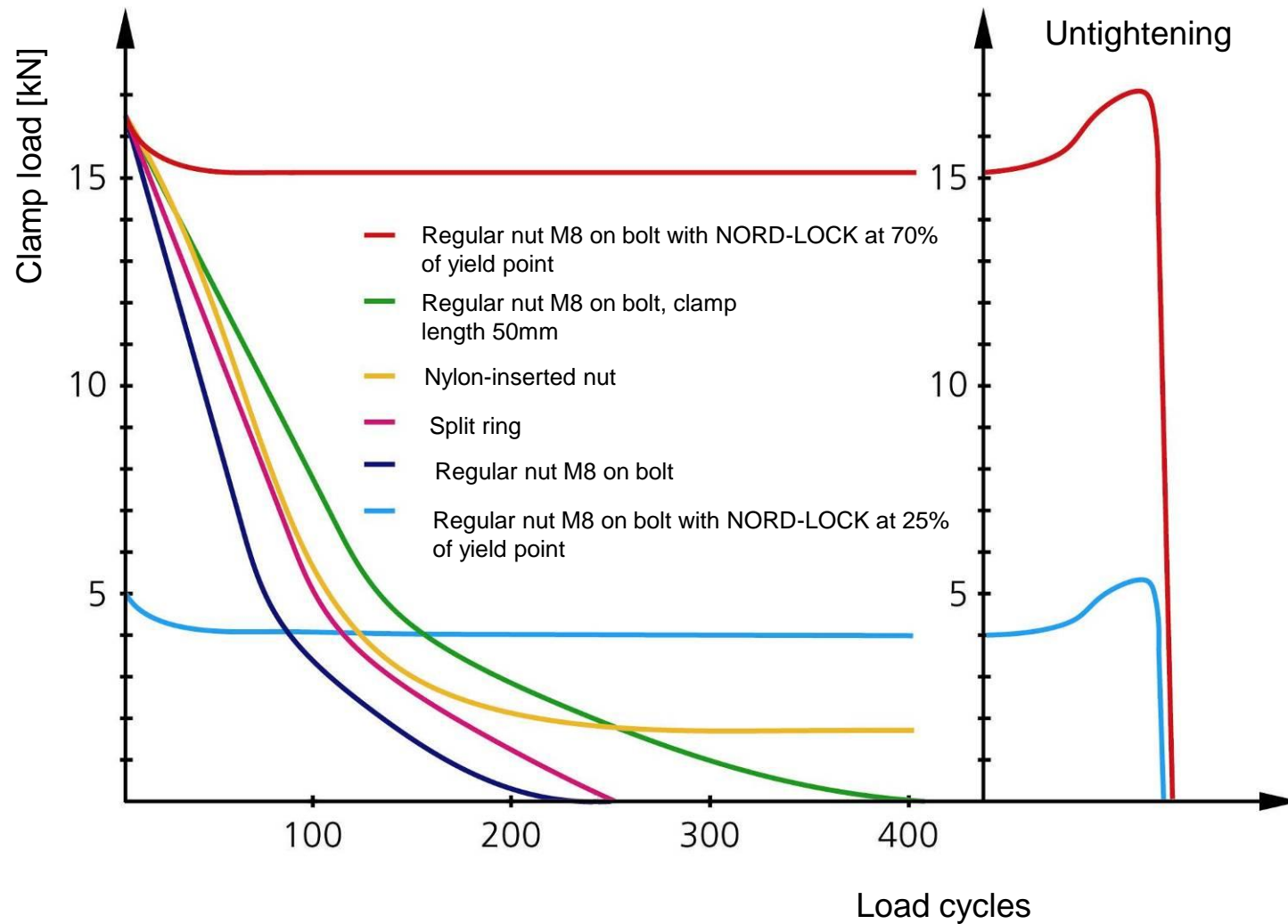
NORD-LOCK®
Bolt securing systems

**Testing exposes the limitations of
traditional bolt securing methods**

Junker vibration test (DIN 65151)



Junker Test Graphs



The Solution?



It Has To Be Safe & Secure



Quick & Easy To Use

NORD-LOCK®
Bolt securing systems



Versatile & Adaptable

NORD-LOCK®
Bolt securing systems



Re-useable



Using Standard Tools

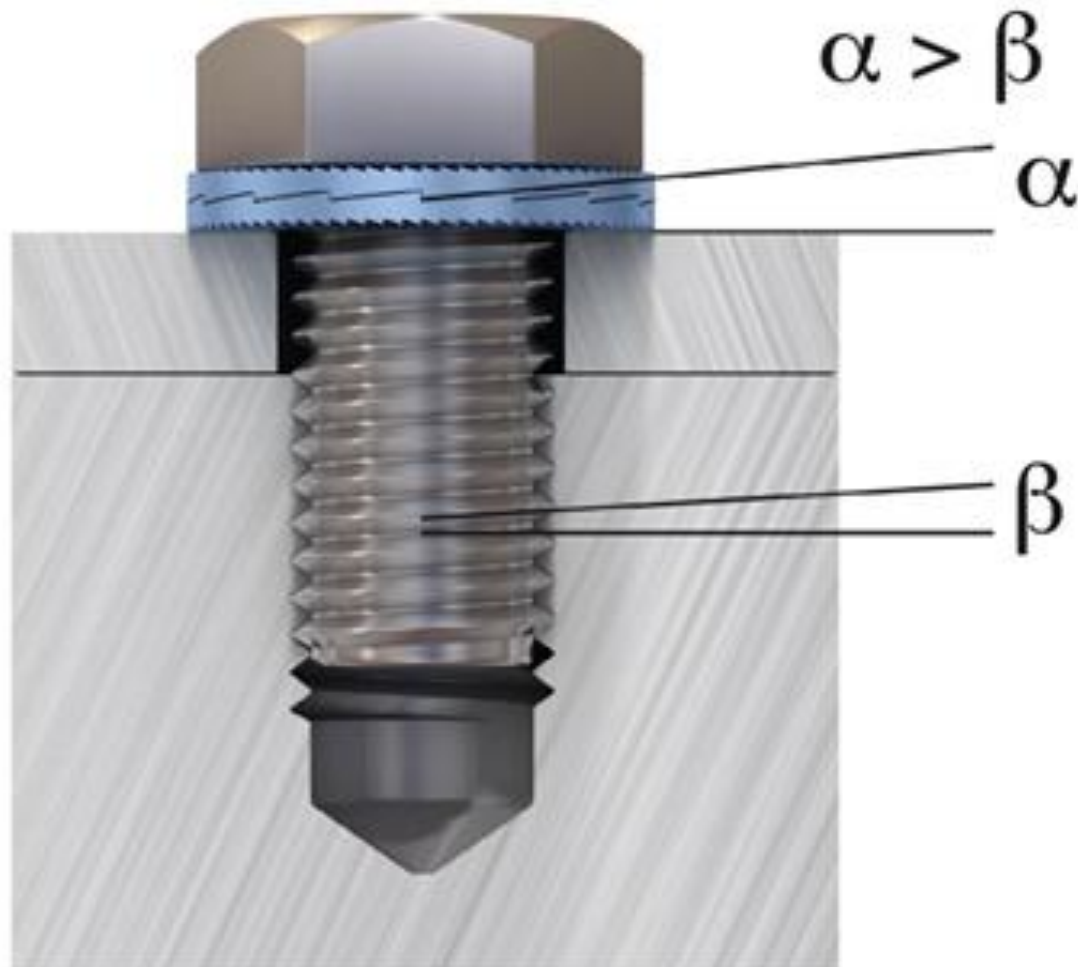


The Answer.....

NORD-LOCK®
Bolt securing systems



Use Geometry To Lock The Joint



Independantly Tested



DNV

DET NORSKE VERITAS TYPE APPROVAL CERTIFICATE

CERTIFICATE NO. D-3029
This Certificate consists of 5 pages

This is to certify that the
Miscellaneous
with type designation(s)
Nord-Lock Locking Washers

Manufactured by
Nord-Lock AB
Mattmar, Sweden

is found to comply with
DNV's "Rules for certification of lifting appliances", September 1994
DNV's Offshore Standard DNV-OS-C101 "Design of Offshore Steel Structures",
October 2000
DNV's Offshore Standard DNV-OS-E101 "Drilling Plant", October 2006
DNV's Offshore Standard DNV-OS-E201 "Hydrocarbon Production Plant", October 2000
DNV's "Rules for certification of Ships", Part 4, Chapter 4 "Rotating Machinery, Power
Transmission", January 2007

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

Place and date
Høvik, 2007-12-05
for DET NORSKE VERITAS AS

[Signature]
Astri Haukerud Gaarde
Head of Section



Local Office
DNV Trondheim

This Certificate is valid until
2011-12-31

[Signature]
Andrzej Serebicki
Surveyor

Notice: 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.



Certificate Number: 11-LD745334-PDA

Confirmation of Product Type Approval 10/OCT/2011

Please refer to the "Service Restrictions" shown below to determine if Unit Certification is required for this product.

This is to certify that, pursuant to the Rules of the American Bureau of Shipping (ABS), the manufacturer of the below listed product held a valid Manufacturing Assessment (MA) with expiration date of 05/SEP/2018. The continued validity of the Manufacturing Assessment is dependent on completion of satisfactory audits as required by the ABS Rules.

And, a Product Design Assessment (PDA) valid until 16/MAY/2016 subject to continued compliance with the Rules or standards used in the evaluation of the product.

The above entitle the product to be called Product Type Approved.

The Product Design Assessment is valid for products intended for use on ABS classed vessels, MODUs or facilities which are in existence or under contract for construction on the date of the ABS Rules used to evaluate the Product.

ABS makes no representations regarding Type Approval of the Product for use on vessels, MODUs or facilities built after the date of the ABS Rules used for this evaluation.

Due to wide variety of specifications used in the products ABS has evaluated for Type Approval, it is part of our contract that, whether the standard is an ABS Rule or a non-ABS Rule, the Client has full responsibility for continued compliance with the standard.

NORD-LOCK AB
Model Name(s): Nord-Lock Locking Washer

Presented to:
NORD-LOCK AB
HALABACKEN 180
MATTMAR
Sweden

Intended Service: Locking washer used to prevent or minimise the dynamic, vibration, shock or impact-induced loosening of threaded fasteners.

Description: Each locking washer consists of two pre-assembled washers with cams on the inner mating faces and radial teeth on the outer faces of the washers. The rise of the cams is greater than the pitch of the thread on the fastener.

Ratings: See attached Tables. NL3 to NL130 (material EN 1.7182 or equivalent). NL3ss to NL80ss (material EN 1.4404 or equivalent). NL3ss-254 to NL30ss-254 (material EN 1.4547 or equivalent). NL3ss-718 to NL42ss-718 (material EN 2.4807 or equivalent). NL3ss-278 to NL42ss-278 (material EN 2.4810 or equivalent). Steel washers metric grade 12.9 and imperial grade ASTM A547. Stainless steel washers metric grade A4-80 and imperial grade ASTM F593.

Service Restrictions: Unit Certification is not required for this product. If the manufacturer or purchaser request an ABS Certificate for compliance with a specification or standard, the specification or standard, including inspection standards and tolerances, must be clearly defined.

Comments: Steel washers up to NL36 are available with an enlarged outer diameter to suit flanged fasteners.

Notes / Documentation: DNV Technical Report Project No. 724 06 310 "Accelerated vibration test of Nord-Lock Locking Washers" dated 02 August 2008, ABS Report reference 1110-INT 09 February 2011.

Term of Validity: This Product Design Assessment (PDA) Certificate 11-LD745334-PDA, dated

DNV HISC Test Report

DET NORSKE VERITAS
Report for NORD-LOCK International AB
HISC testing of Washers

MANAGING RISK



HISC testing of Washers	DET NORSKE VERITAS AS P.O. Box 7400 5020 Bergen, Norway Tel: +47 55 94 36 00 Fax: +47 55 94 36 02 http://www.dnv.com Org. No: NO 945 748 931 MVA
For: NORD-LOCK International AB Box 336 401 25 Göteborg Sweden	
Account Ref.:	

Date of First Issue:	2011-11-21	Project No.:	EP023231
Report No.:	2011-5281	Organisation Unit:	Failure Investigation & Corrosion Management
Revision No.:	00	Subject Group:	Technology Qualification

Summary:

Det Norske Veritas (DNV), Section for Failure Investigation and Corrosion Management, has been requested by Nord-LOCK International AB to carry out testing with regard to hydrogen induced stress cracking (HISC) of custom made washers for locking of bolts.

Based on the results from the HISC testing presented in this report the following can be concluded:

- The integrity of the locking washer systems seem to be unaffected after 12 months of exposure in seawater with cathodic protection.
- No hydrogen induced stress cracking (HISC) has been observed on the locking washers after exposure.
- The exposure testing presented in this report indicates that, in spite of the surface hardening, the washer materials should be applicable for use subsea with CP.

Prepared by:	Name and Position Bjarre Lillebo Principal Engineer	Signature	
Verified by:	Name and Position Kristian Heen Senior Engineer	Signature	
Approved by:	Name and Position Marius Scott Head of Section	Signature	

<input checked="" type="checkbox"/>	No distribution without permission from the client or responsible organisational unit (however, free distribution for internal use within DNV after 3 years)	Indexing Terms	
<input type="checkbox"/>	No distribution without permission from the client or responsible organisational unit	Key Words	HISC
<input type="checkbox"/>	Strictly confidential	Service Area	
<input type="checkbox"/>	Unrestricted distribution	Market Segment	

Rev. No. / Date:	Reason for Issue:	Prepared by:	Verified by:	Accepted by:
© 2010 Det Norske Veritas AS Reference to part of this report which may lead to misinterpretation is not permissible.				

*“DNV approves NORD-LOCK for
preloaded bolted assemblies
subjected to dynamic, fatigue, impact
and vibration induced loading”*

With Full Traceability

LuCoil Steel
— ett företag i SSAB Tunnpått —

INSPECTION CERTIFICATE

Our order No. 001003
Your order No. 00045

No. 15852
Goods refer to certificate No. in correspondence regarding this document.

Inspection: SS-EN 10204-3 T.B

Quality: BO 02 GLÖDGAT KALL BAND

Item No. 1 Length mm 87,50 Thickness mm 2,00

Item No. Length mm Width mm Thickness mm

Item No. Length mm Width mm Thickness mm

Material: NORD-LOCK AB
MARCUS CLAESON
HALA BACKEN
830 02. MATTMAR

ANKOM

Certificates required: ANALYS, MEKANISKA VÄRDE

Chemical Composition %										Cat. No.	Cat. No.
x 100					x 1000						
C	Si	Mn	P	S	Cr	Ni	Al	Ti	Se		
23	29	116	16	6	190		44	40	30	224278	21-1591

Tensile properties		Elong.	Smoothness	Hardness	Others	Decarburization depth µm		Cat. No.	Cat. No.
R _m N/mm²	R _t N/mm²	A B %		HV		Ferrite min	Total max		
345	473	25				6		224278	21-1591

Inspector: *Pelle Forsvall* QA-DEP, Place: Luleå Date: 2006-09-07

Periodic/Petal address: LUCCOIL STEEL AB S-971 81 Luleå, Sweden 0920 - 920 00 0920 - 25 50 50

We hereby certify that the material has been made and tested in accordance with the above mentioned order.

Material Certificate

NORD-LOCK®

Production and test Document
Produktions och testdokument
Steel washer electro zinc plated
Stålbrickor elförzinkade

Dimension Control no.* 4984
NL 125p...

Press start Press complete

Control no. 050928
Control (Kontroll av): 050928

Number of pairs. 20000
Antal par. 20000
total amount. 20000 pair
totalt antal till B-serie. 20000 par

Coil no. 224278

Amount of cams and teeth approved according to document NL-spec.
Antal kammar och tänder enl. dokument nr. NL-spec. 25 date: 050928

1. Dimension control. Approved test by gauge according to instruction no 62.
Dimensionskontroll med tolk enl. dokument 62. ID 130...OD 254...T. 34... Sign: *P* date: 050928

2. Core hardness test approved according to instruction no 81.
Kärnhårhetsprov enl. instruktion nr. 81. HRA 170... Sign: *P* date: 050928

3. Heat treatment before plating according to instruction no 72.
Värmebehandling före ytbehandling enl. instruktion nr. 72. Sign: *P* date: 050928

4. Electro zinc plated approved test according to instruction no 91.
Elförzinkning, skickstjektest enl. instruktion nr. 91. Zink layer 12.6 µm Sign: *P* date: 050928

5. Heat treatment against hydrogen embrittlement according to instruction no 91.
Värmebehandling mot väte sprickor enl. instruktion nr. 91. Sign: *P* date: 050928

6. Hydrogen embrittlement test approved according to instruction no 101.
Vättest test utförd enl. instruktion nr. 101. Sign: *P* date: 051010

7. Waxing according to instruction no 91.
Vaxning enligt instruktion nr. 91. Sign: *P* date: 051010

8. Bending test approved according to instruction no 110.
Böckprov utförd enl. instruktion nr. 110. Sign: *P* date: 051011

9. Mechanical function approved according to instruction no 120.
Mekanisk funktionskontroll utförd enl. instruktion nr. 120. Sign: *P* date: 051011

10. Core hardness test approved according to instruction no 116.
Kärnhårhetsprov enl. instruktion nr. 116. HV1 170... Sign: *P* date: 051011

11. Gauge and measure control approved according to instruction no 115.
Tolk och mätkontroll enl. instruktion nr. 115. Sign: *P* date: 051011

* the control number have a prefix B.C.D etc. if there is different treated.
* kontrollnummer har B.C.D ändelse om serien är bruten.
Date: 990819 revised 040707 BP approved sign: *P*

1:\Delad\Word\ISO9000\NLPROD\MA\BLANKETT\Produktions och testdok\Stålbrickor elförz.doc

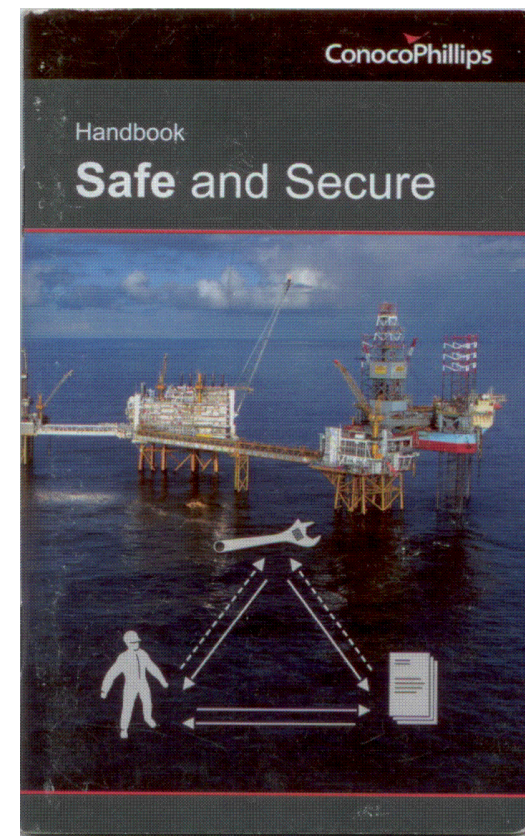
Traceability Document

Every Washer Laser Marked

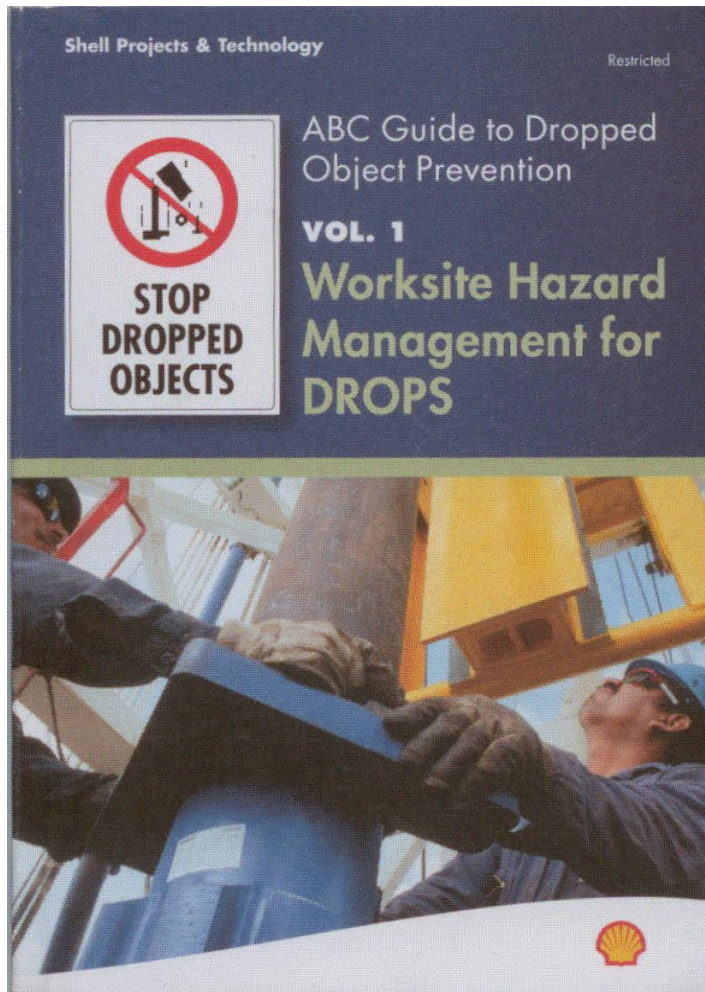
NORD-LOCK®
Bolt securing systems



Oil & Gas Company Safety Handbooks Recommending The Use Of Nord-Lock Washers



Shell Guide to Dropped Object Prevention



Bolted Connections

Dual nuts are forbidden for locking of bolted connections. The following methods are recommended for locking bolted connections.

Nord-Lock Bolt Securing System
www.nordlock.com

When correctly installed, the Nord-Lock Bolt securing system provides a guaranteed secure bolted connection. Locking is achieved by means of two washers that ensure the clamping force is maintained in the bolted connection. Nord-Lock has DnV (Det Norske Veritas) type approval.

Areas of use:
Particularly suitable for connections exposed to vibrations, e.g. grating, loudspeakers, cable trays, ladders, guide rails, etc. But it has an almost unlimited range of applications.

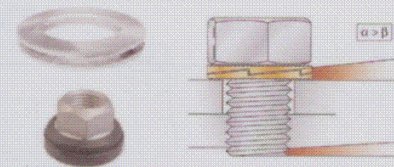


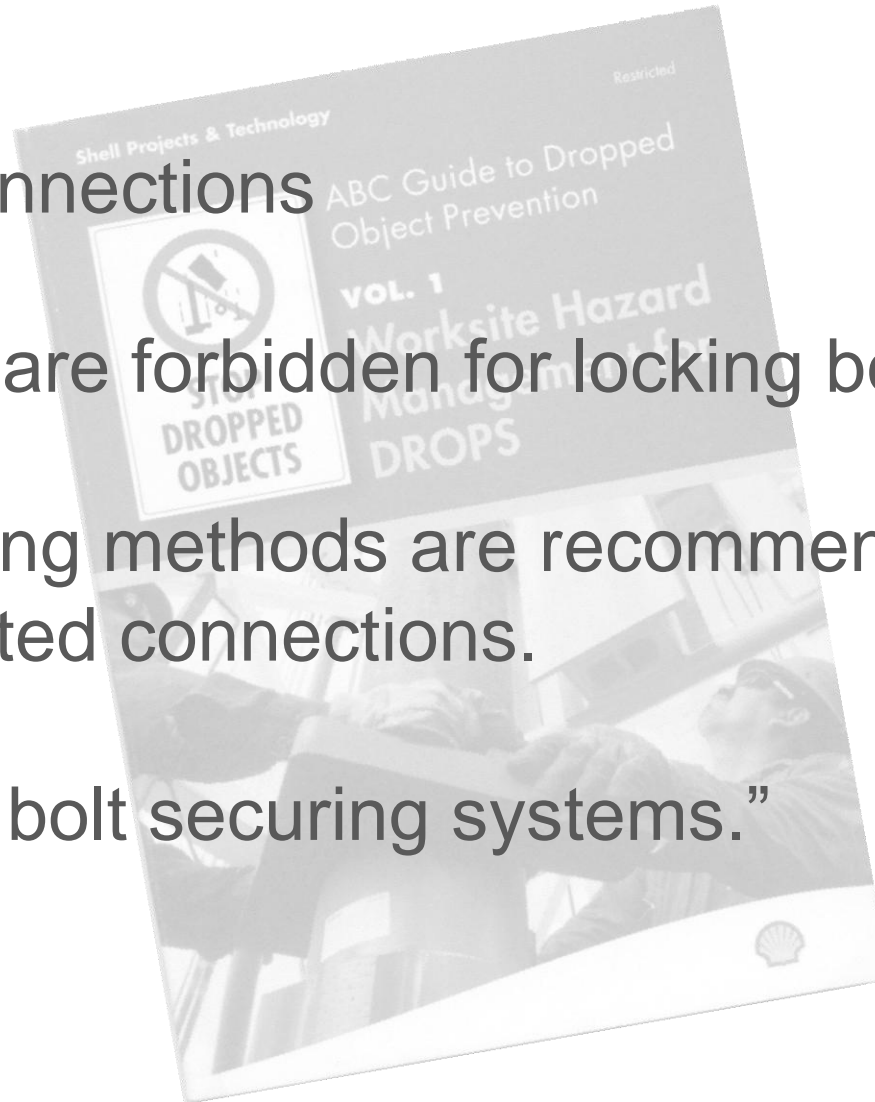
Figure 11: Nord-Lock bolt securing system

Bolted Connections

“Dual nuts are forbidden for locking bolted joints.

The following methods are recommended for locking bolted connections.

Nord-Lock bolt securing systems.”



- Delta Protekt coated steel washers from NL3-NL130
- Stainless steel 316L (EN 1.4404) NL3-NL80
- 254SMO (EN 1.4547) NL3-39
- Two special materials: Inconel 718, Hastelloy / Inconel C-276



Dörken's Delta Protekt® zinc flake coating, performed in-house by dip-spin
2 layers of base coat (KL100) and 1 layer of top coat (VH302GZ)



***After 1000 hours of
salt spray testing***

Standard or sp washers?



Standard



SP – enlarged outer diameter



sp washers



NORD-LOCK washers are designed to create impression marks without scoring the mating surface.



NORD-LOCK washers with standard outer diameter.



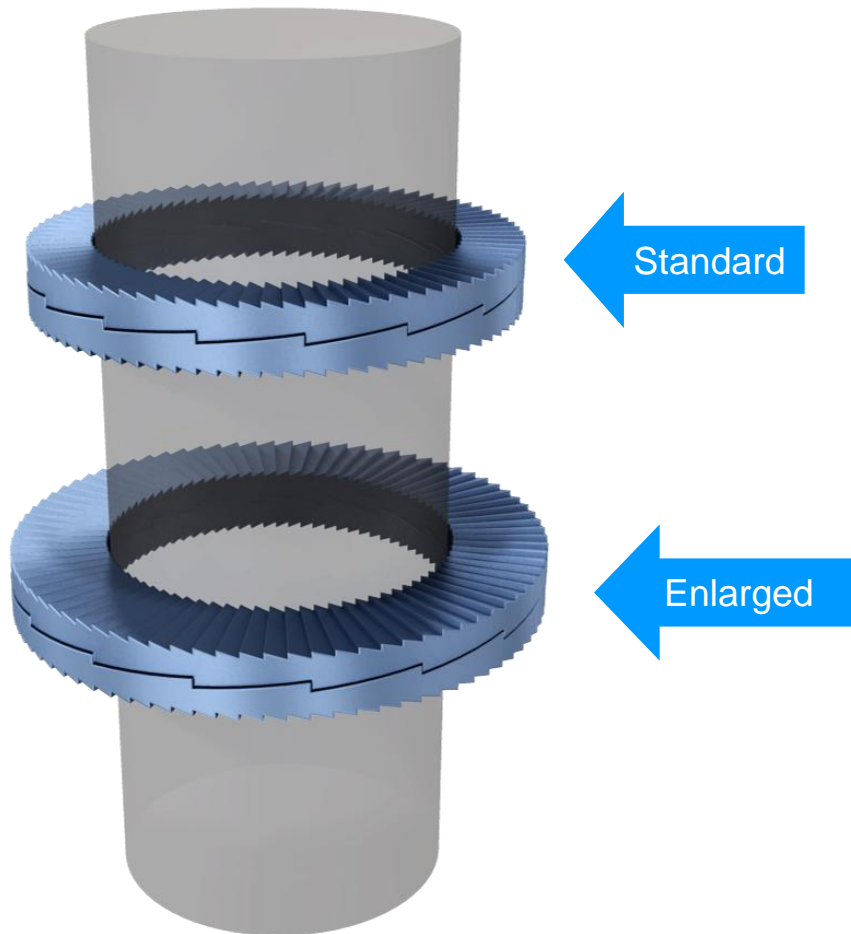
NORD-LOCK washers with increased outer diameter (sp).

Washers with enlarged outer diameter (sp)

Large / slotted holes

Soft underlying materials

Painted surfaces



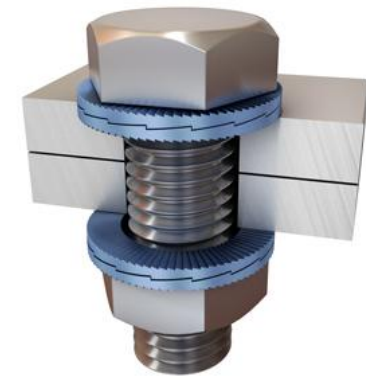
Assembly examples



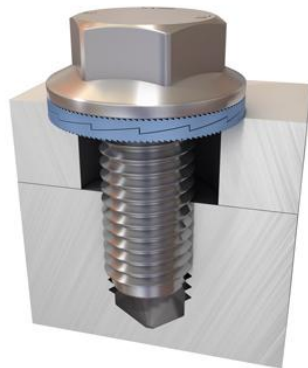
Studded assembly



Tapped hole



For through holes
use two washer pairs



Large holes, slots & soft
materials, use sp washers

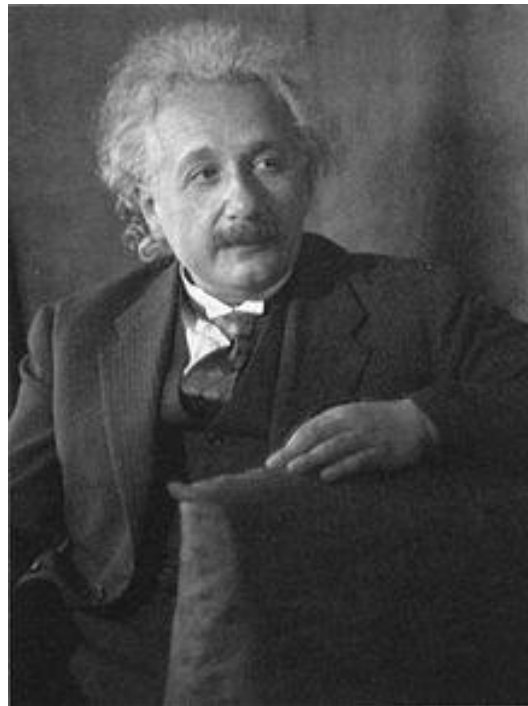


Counter bore hole



Do not use on washers that
are not locked in place

“We can't solve problems by using the same kind of thinking we used when we created them.”



Albert Einstein

Do we change,

**.....or do we carry on having the
same problems as before?**

- **Who is responsible for the security of bolted joints?**
- **The equipment design engineer?**
- **The equipment supplier?**
- **The rig manager?**
- **The maintenance engineer / fitter?**
- **The inspection company?**
- **The QHSE / DROPS manager?**

**For more information on Nord-Lock
bolt securing systems
please go to; -**

www.nord-lock.com

