

BOLTED

**CORUS STEEL**

**SAVING
A FORTUNE
WITH NORD-LOCK**

**4 NORD-LOCK
SECURITY
SOLUTIONS**

SANDVIK

**SECURING
MINING
EQUIPMENT**

ARCHETYPE JOINT

**PUTTING
JOINTS
TO THE TEST**

**COATINGS
FOR ALL OCCASIONS**

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INFORMATION IN YOUR LANGUAGE

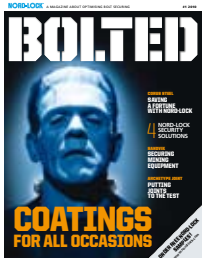
The Nord-Lock website provides information in fifteen languages, the material includes product and assembly information as well as torque guidelines. Our global team of sales engineers offer live product demonstrations and technical support on site.

We help optimize your bolted joints in order to minimize overall cost and maximize safety.



NORD-LOCK[®]
Bolt securing system

www.nord-lock.com
MADE IN SWEDEN



Bolted magazine is published by Nord-Lock, and strives to increase knowledge about bolt assemblies. Nord-Lock offers a unique bolt securing system for demanding applications. The system makes bolted joints self-locking and does not rely on friction. Nord-Lock withstands vibration and dynamic loads. For more information on Nord-Lock, visit www.nord-lock.com

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Big wheels keep on turning

IT'S BEEN GREAT receiving feedback on the first issue of Bolted, which we published in September. One of the comments I received from a marketing colleague at another technical company was: "Great magazine – but how will you continue to fill it after a few issues?" Well, this is only our second issue but I believe that we're just getting started! A typical first contact with Nord-Lock is often something along the lines of: "So you work with nuts and bolts?" Well, there's much more to it than that!

The world of bolt securing is a complex and interesting one, and there is an infinite variety of joint connections. Then there is the whole technical support side of our operations, plus the innovative new products we have under development, all of which promise to make for interesting reading.

ONE OF THESE EXCITING new areas for us is wheel nuts, and a new Nord-Lock product to be launched later this year has the potential to save lives out on the roads. Wheel nut loss is a more common problem than most people realise, with dozens of deaths each year in Europe alone as a result. We report on the problem, our solution, and the benefits it brings, on page 17.

In this issue we get under the skin of bolt coatings. There is more to coatings than meets the eye

and choosing the right one is not always straightforward. Our cover story features interviews with leading experts in the field and explores the latest developments within this important area.

WE ALSO GO UNDERGROUND in the far north of Sweden to report on one of our first customers and their experiences with bolt securing. Sandvik has been relying on Nord-Lock since the 1980s and its engineers explain what a difference a couple of small washers can make in terms of safety and money in the high-vibration and high-torque shaft-boring environment.

We want this magazine to serve as a forum for issues around the design of bolted joints and we welcome ideas for topics to look into in greater depth. Please feel free to send me any suggestions. In the meantime we will continue to make Bolted your essential guide to the world of nuts and bolts. □

CARIN ESBERG
MARKETING MANAGER



CONTENTS

08 All about coatings

The coating is a fastener's skin. But what types of coatings are there and what are their purposes? Bolted will provide you with a quick guide.

12 How Corus saved a fortune

Engineers at the Corus steelworks improved their maintenance regime with the simple expedient of switching to the Nord-Lock Bolt Securing System.

04 SECURED BY NORD-LOCK

07 THE EXPERTS

15 Testing joint safety

"Development testing can disprove many of the common misconceptions surrounding joint failure," says Dave Archer, President of Archetype Joint.

16 Underground operations

Sandvik Mining and Construction was having problems with the bolts clamping the cutting tools to the reaming head. Nord-Lock provided the solution.

17 BOLTING NEWS

18 QUALITY STEP BY STEP

CORRECTION In the last issue of Bolted, a photo byline was omitted by mistake. The image of a bridge member on page 11 was courtesy of www.boltscience.com. Bolted apologizes for any inconvenience.

SAIL OF THE CENTURY

CUSTOMER: ROYAL HUISMAN	VESSEL: SY METEOR	TYPE: SCHOONER RIGGED SAILING YACHT	LENGTH: 51.59 M	DISPLACEMENT: 298.3 TONS	HULL SPEED: 14.6 KNOTS
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A ROYAL HUISMAN YACHT is not so much an ocean-going vessel as a floating work of art. The Dutch family-owned company, founded in 1884, creates some of the world's most prestigious yachts which, despite their elegance and beauty, can handle the worst the seven seas have to offer.

Royal Huisman's demands on quality and attention to detail extend

throughout the 30–90 meters (98–295 ft) long vessels, from the sumptuous interiors to the very latest navigation technologies. When the shipyard was looking for a bolt-securing solution that could handle the dynamic loads unleashed by the harsh marine environment, it turned to Nord-Lock.

The team at Vollenhove, in the heart of Holland's maritime industry,

uses Nord-Lock washers at key points throughout the structure: on the reel winches; for attaching spreaders to masts; for attaching bow and stern thrusters; for mounting the steering pedestal and the transom door.

Each yacht is custom built and meticulously crafted for a discerning clientele who demand perfection – and get it. □

SHIP-SHAPE

They say that worse things happen at sea. By using Nord-Lock, Royal Huisman ensures that they don't. Four pairs of Nord-Lock washers are fitted for attaching each spreader to the mast.



PHOTO: ROYAL HUISMAN



WASHER THICK
 Each 109E has about 2,500 pairs of Nord-Lock washers ranging in size from M5 to M30.

PHOTO: ŠKODA TRANSPORTATION

ON TIME ON THE MAINLINE

CUSTOMER:
 ŠKODA TRANSPORTATION

MODEL: 109E/CD380 ELECTRIC LOCOMOTIVE	TOP SPEED: 200 KM/H
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WIDTH: 3.08 M	NOMINAL OUTPUT 6,400 kW	LENGTH OVER BUFFERS: 18 M
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SPEED, COMFORT AND LUXURY are all very well, but any stressed commuter can tell you that the most important attribute for a train is reliability. Škoda, the Czech industrial giant, has been building itself a reputation for getting passengers from A to B on time since its first electric locomotives hit the rails in 1927. To date, more than 5,500 have been delivered.

Škoda Transportation's latest state-of-the-art model is the 109E/CD380, designed and liveried by the Porsche Design studio and the first locomotive to meet stringent TSI safety standards. The locomotive is able to reach speeds of 200 km/h with a fully-loaded passenger train in tow, which means considerable dynamic loads and vibrations on key structures such as the bogies.

Škoda has turned its back on bolt securing solutions such as castle nuts and spring lock washers in favour of Nord-Lock washers. Each 109E has about 2,500 pairs of Nord-Lock washers ranging in size from M5 to M30 on bogies, bumper assemblies and mounting other equipment under the main frame of the locomotive. □



GREAT WHITE
IHC Engineering Business's Pipeline Plough 3 is built to withstand extreme forces, and does so with the assistance of more than 1,000 pairs of Nord-Lock washers.



YOU'RE GONNA DIG THIS

WEIGHT: 210 TONNES	CUSTOMER: IHC ENGINEERING BUSINESS	HEIGHT: 11.5 M (STOWED)	MODEL: PIPELINE PLOUGH 3 (PL3)	LENGTH: 22 M
		OPERATING SPEED: 500 M/HOUR		

A KILOMETRE BELOW the churning waves, IHC Engineering Business's massive pipeline plough gouges through the seabed with a tow force of up to 4,000 kN. It excavates a stable 2.5 m-deep trench, moving a staggering 60–65 m³ of soil a minute. Variations in the seabed and rock in the soil create vibrations and shock loads that the

plough must withstand as it works.

It is part of a complex and precisely choreographed process for protecting, stabilising and insulating oil and gas pipes under the sea; a 'rigid' concrete-clad pipe is laid directly onto the seabed by a pipelay vessel, to be then buried by the pipeline plough which digs the trench beneath

the pipe as it is pulled along the pipe route on the seabed. A backfill plough then scoops back the excavated soil to cover the pipe.

IHC Engineering Business, which is based in Northumberland in the UK, turned to Nord-Lock in 2008 after seeing a demonstration of the bolt securing system's performance compared with the more conventional methods it was using on its ploughs. Today more than a thousand pairs of Nord-Lock washers are used throughout the ploughs for applications where clamp load must be maintained in the bolted joints. □

PHOTO: IHC



TRACK AND FIELD

Chemical adhesives were no good for the tough off-road conditions faced by Soucy's products. But now dozens of pairs of Nord-Lock washers keep combine harvesters on the right track.

PHOTO: SOUCY

A GIANT THAT TRENDS SOFTLY

CUSTOMER: SOUCE INTERNATIONAL INC.	LENGTH: 3.3 M	HEIGHT: 1.7 M	WEIGHT: 5,000 KG
MODEL: SOUCE TRACK ST-1000	TOP SPEED: 25 KM/H	CARRYING CAPACITY: 27,500 KG	

IT IS THE BIGGEST AND HEAVIEST machine in the field – yet it compacts the soil less than a farmer's boots.

A combine harvester fitted with the Soucy Track system reduces the pressure per centimetre exerted on the ground by a factor of four compared with a vehicle with conventional tyres. At the same time, the tracks provide 330 percent more traction than conventional tyres.

Canada-based Soucy International also manufactures heavy-duty rubber tracks and accessories for all-terrain vehicles, industrial and military vehicles, and the rough terrain they encounter means heavy vibrations.

The chemical adhesives it used for bolt securing in the past often failed, so today Soucy chooses Nord-Lock washers. For its track kits Soucy uses Nord-Lock for bolt securing on all pivot points, on knuckle attachments and sprockets. Each combine kit is fitted with 62 pairs of washers. □



OLENA KALMYKOVA
APPLICATIONS
ENGINEER

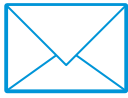


DAMIEN THOMAS
FIELD APPLICATIONS
ENGINEER



FRIDA CULLIN
MATERIAL
EXPERT

Email your questions about bolt securing to experts@nord-lock.com



ASK THE EXPERTS

Do you have a question about bolt securing? Put the Nord-Lock experts to the test.

Can I use other washers with Nord-Lock?

Q: Can I put another washer under a Nord-Lock washer?

A: It is recommendable to use Nord-Lock washers directly on the mating surface. An additional washer can only be used with Nord-Lock if the underlying washer is locked in place. Nord-Lock washers only lock and prevent rotation in the adjoining surfaces. If the underlying washer is not firmly locked in place, rotation may still occur (see Fig 3), resulting in considerable loss of clamp load. Insufficient clamp load, in turn, can lead to fatigue failures. Also note that extra washers mean more settlements, which results in increased loss of clamp load.

In applications where the mating surface is too hard for Nord-Lock washers to obtain the necessary impression marks, a softer underlying washer can be used to create these marks. However, it is crucial to make it impossible for the underlying washer to rotate. This can be achieved using a washer that is large enough to be secured with two bolts, for example. FC

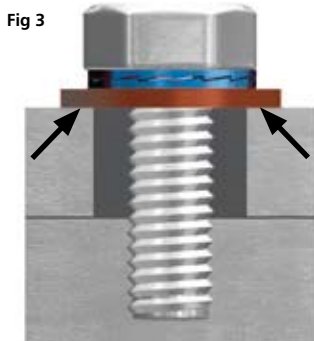


Fig 3
If the red underlying washer is not locked in place, rotation between the red washer and the grey mating surface is possible.

Why does torque vary when tightening and untightening?

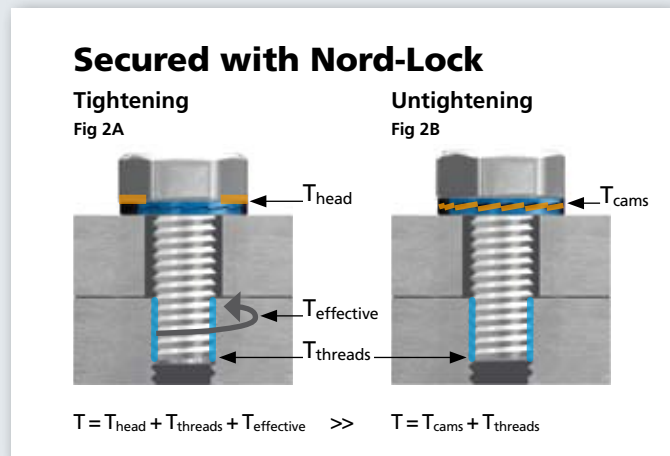
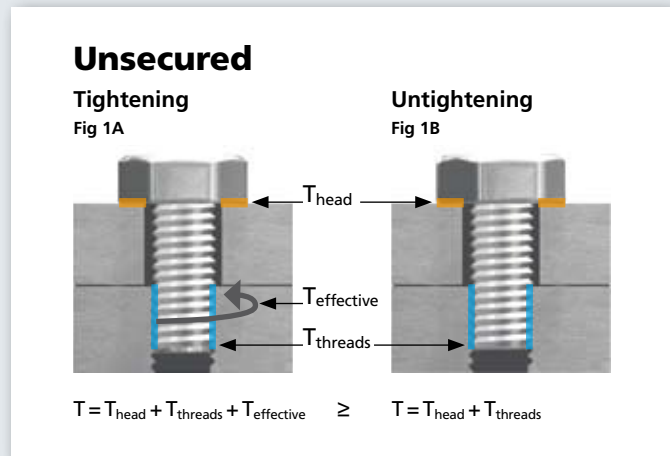
Q: Why is the untightening torque lower than the tightening torque when tightening a bolt or nut?

A: When tightening a bolt or nut, the applied torque must overcome the thread friction, the friction under the bolt head or nut and the inclined plane of the thread, to obtain a bolt preload (see Fig 1A).

While untightening, provided that the assembly remains in the same condition, the applied torque only has to overcome frictional forces. As a result, untightening a fastener requires a lower torque (see Fig 1B).

There are some exceptions to this rule. Since friction conditions vary, higher torque can be required to untighten a fastener. Corrosion, seizing, or surface roughness can considerably increase friction and subsequently the untightening torque.

With Nord-Lock washers, the difference between the tightening and untightening torque is even more significant. During tightening, sliding occurs between the bolt head or nut and the serrated surface of the upper Nord-Lock washer (see Fig 2A). However, during untightening, sliding occurs between the cam faces of the washers, where friction is



significantly lower (see Fig 2B).

This is a valuable feature of Nord-Lock washers, as a low un-

tightening torque facilitates maintenance and thereby reduces downtime. DT

Can I yield my bolt by over-tightening?

Q: Do I risk yielding my bolt, due to over-tightening, when using Nord-Lock?

A: It is true that the clamp load increases during untightening, as a result of the so-called “wedge effect”. During dismantling, the cams slide against each other, thereby increasing the distance between the wash-

ers. This stretches the bolt and creates an increase in clamp load. This increase is at a maximum when the washers pass over the top of a cam.

However, the rises of the cams have been optimised to make it impossible to overstretch the bolts during untightening, provided that tightening guidelines are followed. Nord-Lock’s guidelines are based

on clamp load levels of between 62 and 75 percent of the bolt’s yield strength, depending on bolt quality and use of lubricant. To utilise more of the bolt capacity, further control of the tightening method and tightening tool is required to prevent the bolt from exceeding its yield point and starting to deform permanently. OK



IT'S ALL ABOUT THE COATING



PROTECTION The coating is a fastener's skin – an extra-durable protective shell that preserves the steel that it encases. But what types of coatings are there and what are their purposes? Bolted will provide you with a quick guide.

WORDS: ANDERS NILSSON | **PHOTOS:** JOHAN EKSTAM



I F YOU HOLD a steel fastener in your hand, it is almost never the actual steel that you touch. There is a thin coating between your fingers and the steel – just a few micrometers thick – that improves the fastener's performance in one or more ways. It can protect against corrosion; it can give the material reduced friction; it can also enhance the aesthetic value, which is the case with chromed wheel bolts.

“The cheapest and simplest type of corrosion-preventive coating is

pure galvanisation. Galvanisation offers adequate corrosion protection in many, but not all, cases,” says Lars Askengren, MD of SYF (the Swedish coating association).

When pure galvanisation is not enough, zinc alloys – a blend of zinc and other metals – can be used instead. If even greater protection is needed, zinc flakes can be used. Zinc flakes offer a number of advantages such as equal or better corrosion protection with a thinner layer and eliminated risk of hydrogen embrittlement.

Another purpose of the coating can be to lubricate the material. In order for torque-controlled pneumatic screwdrivers to tighten a bolt →



Corrosion protection is a complex process since it all depends on the ambient conditions. The choice of corrosion protection is determined by the exact conditions that the material will be exposed to. This makes it essential to always consult an expert when choosing a coating.

→ correctly, the right amount of friction is required. Friction-reducing substances such as polytetrafluoroethylene (most commonly known by the brand name Teflon) can be mixed in with the coating to control the amount of friction. Waxing is also used as a coating method for the same purpose.

ENVIRONMENTALLY DRIVEN DEVELOPMENT. The transition to more environmentally sound techniques is a clear trend with respect to coatings.

“Above all, there is a major transition underway to minimise the use of hexavalent chrome (Cr6+). Since 2000, the EU has introduced tough restrictions regarding the way in which Cr6+ may be used in e.g., cars and electronic products,” says Ingegerd Annergren, department manager at the corrosion and metal research institute Swerea Kimab.

“Hexavalent chrome has been used extensively as the outermost layer on top of the actual coating. This applies, not least, to screws, which are handled in large quantities where they come in contact with each other and the outer coating is damaged. Cr6+ can repair this damage by forming different surface compounds but this reactive characteristic also makes it hazardous to the environment. As an alternative, nano-additives are being studied to see if they can

provide the same self-repairing effect,” says Ingegerd Annergren.

Acceptable replacements for Cr6+ are available today but they are currently more expensive.

Other coatings also have an environmental impact to one extent or another, through e.g., the use of chemicals and energy consumption. However, in many cases they nevertheless result in a reduced overall environmental impact in the opinion of Csaba Madru, an Applications Engineer at Nord-Lock.

“Dealing with corrosion damage not only costs companies vast sums of money; it also has an impact on the environment since replacement parts have to be produced, shipped, kept in stock and so on. Consequently, a coating that extends the service life of a metal can result in a reduction of the overall impact on the environment,” says Csaba Madru.

MORE FUNCTIONS SAVE MONEY. Another trend in this area is the demand by more and more customers for coatings with a greater number of functions. Companies are increasingly conscious and it is becoming more common to pay a bit more for e.g., self-lubricating screws since this eliminates one working step and results in more efficient assembly.

“Companies focus more and more on the total

cost. They see that a small increase in the purchase cost can lead to a considerable reduction in the ‘life-cycle-cost,’” says Csaba Madru.

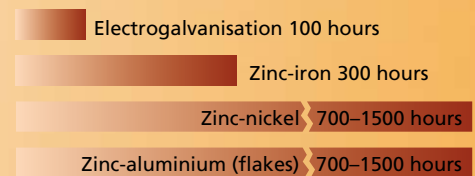
It is also becoming more common to colour the fastener when the coating is applied. This is sometimes for aesthetic reasons but it is also customary to use colour-coding to distinguish different components from one another.

Corrosion protection is a complex process since it all depends on the ambient conditions. Material that is highly resistant to corrosion in a particular environment may be completely unsuitable and corrode quickly in other environments. Carbon steel and low-alloy steel, which eventually rust in damp environments, are otherwise very corrosion-resistant to concentrated sulphuric acid. And aluminium holds up well against nitric acid despite the fact that it corrodes readily when exposed to other strong acids and alkalis. Therefore, the choice of corrosion protection is determined by the exact conditions that the material will be exposed to: which acids, alkalis, salts, organic compounds, etc., will there be in the ambient environment? This makes it essential to always consult an expert when choosing a coating. □

Salt spray tests

Standardised salt spray tests are used to measure the effectiveness of different types of corrosion protection. The results show the number of hours that the material can withstand a sprayed saline solution before visible white rust (zinc oxide) and red rust (ferric oxide) are formed.

Approximate values for different types of corrosion protection (hours to red rust)



Source: Proton Technology AB

Business arguments

■ **HIGH-QUALITY COATINGS** reduce costs for, among other things, replacement parts, repairs and the loss of revenue due to corrosion damage.

■ **HIGH-QUALITY COATINGS** make work more efficient, for example, by enabling self-lubrication and colour-coding.

■ **HIGH-QUALITY COATINGS**, if carefully selected, result in a lower environmental impact (longer service life, reduced need for replacement parts, reduced need for transport, greater possibilities to recycle components).

■ **HIGH-QUALITY COATINGS** lower the need for corrosion damage inspections in structures with high safety requirements.

“A coating that extends the service life of a metal can result in a reduction of the overall impact on the environment.”

CSABA MADRU, APPLICATIONS ENGINEER AT NORD-LOCK

FACTS:
METHODS

Passivation

By creating a thin outermost layer of corrosion products, e.g. a metal oxide on a coating, the rate at which corrosion takes place can be reduced. This is called passivation and it is often done as a follow-up coating of zinc or a zinc alloy.

Hot dip galvanisation, hot dipping process

The material is given a coating by being dipped in molten metal (above 420 degrees Celsius for pure zinc). In most cases, this provides better protection than electrogalvanisation.

Chromisation

Chromisation, i.e., follow-up coating with hexavalent chrome (Cr6+), is now used less and less due to the fact that Cr6+ is very hazardous to the environment. Passivation is used instead (see above).

Electrogalvanisation, electrolysis

In the process of electrogalvanisation, the material is dipped in a solution containing metal ions and is connected to a source of electrical current, resulting in the formation of a thin coating on the surface of the material. One negative side effect is that hydrogen embrittlement – a reduction in structural strength – can occur in, for example, high-strength steel. However, this can be eliminated by follow-up treatment.

Phosphatising

During phosphatising, a thin coating of iron or zinc phosphate is deposited on the material. The phosphate coating offers a certain amount of corrosion protection while at the same time providing a good surface for painting or lubrication. Both untreated and zinc-coated steel objects can be phosphatised.

Zinc flakes

The material is dipped in a solution containing metal flakes/scales. It is then heated so that the flakes melt together, forming a durable shell that bonds strongly to the material. Coating with flakes is becoming more and more common for several reasons: it provides very effective corrosion protection, it can be combined with a mixture of e.g., lubricants and it is a relatively environmentally friendly process.



Polytetrafluoroethylene

The plastic PTFE, known by the brand name Teflon, is often used in combination with metallic corrosion protection to give fasteners the desired amount of friction. In addition to extreme friction characteristics, PTFE is also a durable plastic that does not age, is not broken down by UV rays and is highly resistant to heat and chemicals.

Xylan

Xylan is a brand name and a family of fluoropolymer coatings which often contains PTFE. Xylan® provides lubrication as well as wear, heat and corrosion resistance. The coating can be colored to suit different applications.

FACTS:
COMPOUNDS

Zinc

Zinc is less noble than iron, which in simple terms means that zinc will corrode first in water when zinc and iron are together. Even when the iron is directly exposed to corrosion, it gets a certain amount of protection from the presence of zinc. In relative terms, zinc is also an environmentally friendly metal that is available in large quantities and is reasonably cheap. And despite the fact that it "sacrifices itself" for the iron, it corrodes very slowly in most conditions. The combination of all of these characteristics gives zinc a unique position with respect to corrosion protection. Zinc is used both in pure form and in alloys. It is applied through the processes of electrogalvanisation, hot dip galvanisation or flakes (see the section Zinc flakes to the left).

Zinc alloys

Combining other metals enhances the zinc coating's characteristics in various ways.

ZINC-IRON contains a very small amount of iron – only about 1–1.5 percent – but this is enough to make the material better suited to passivation (see the section Passivation to the left).

ZINC-NICKEL normally has a nickel content of about 12 percent, which gives this alloy several advantages compared to pure zinc. Among other things, it can withstand higher temperatures and functions better in contact with certain other materials such as aluminium and pressure-treated wood.

ZINC-ALUMINIUM is applied in the form of flakes and is a common coating on high-strength steel used in very demanding conditions such as offshore and the auto industry.

Sources: Swerea Kimab, Swerea IVF, SYF, NE.





HOW CORUS STOPPED MELTING MONEY AWAY

STEEL Corus Strip Products UK, based at its integrated steelworks in Port Talbot, South Wales, has a continuous casting operation in which engineers spotted an opportunity to make further improvements to their maintenance regime with the simple expedient of switching to the Nord-Lock Bolt Securing System.

WORDS:
GUY RICHARDS

PHOTOS:
RICARDO AZOURY AND CORUS

CORUS IS EUROPE'S SECOND largest steel producer. In normal trading conditions it generates annual revenues of more than 13 billion euro and produces about 20 million tonnes of steel a year. Part of the Tata Steel Group, it supplies many of the most demanding metal customers across the UK and EU.

At roughly 30 km² the CSP UK Port Talbot site covers a huge area, taking several minutes at motorway speed to pass, and directly employs some 3,500 people. It supplies hot rolled coil for applications as varied as construction, the automotive industry and domestic appliances. The underlying production process is called continuous casting – or →



Corus integrated steelworks in Port Talbot, South Wales.

“We went with Nord-Lock because of how its system resists vibration, and I’m happy to say the outcome has been very positive.”

GRAHAM THOMAS, PLANNING ENGINEER

→ Con-Cast – whereby a continuous stream of molten metal is solidified and cut into “semi-finished” slabs of steel about 20 meters long which are then re-heated and rolled according to customers’ requirements.

THE MACHINERY at Port Talbot is still comparatively new, having been installed in 2004, but engineers at the site had noticed that vibration was tending to cause some of the fastenings on parts of the machinery in one of its Con-Cast plants to work loose, creating the risk of unplanned maintenance and costly repairs or even replacement.

So in early 2008, Corus contacted its fastener supplier, Williams Fasteners, for advice on reducing these costs. Williams has been associated with Nord-Lock almost since the company entered the UK market about 15 years ago, so it knew who to contact about this problem.

Initial discussions between Williams’ business development manager Richard Cliffe and Peter Higgins, Nord-Lock’s technical sales engineer for the UK’s South West, led to Higgins demonstrating the Nord-Lock Bolt Securing System to a group of key Corus maintenance staff at Port Talbot.

As Mr Cliffe recalls, “Close collaboration between the Nord-Lock technical representatives, maintenance management at Corus, and ourselves as fastener suppliers to Corus for the whole of the UK, quickly enabled Corus to appreciate the advantages of the Nord-Lock range.”

As a result, maintenance engineers identified two applications in one of the Con-Cast plants; in



Caster 3, equipped with Nord-Lock washers.

one casting machine, Caster 1, the performance of the driveshaft was dropping off as 22 mm bolts worked loose; and on a rotating ring in the turret of the Caster 3 machine, 36 mm bolts were shearing as a result of vibration. Both problems had been arising three or four times a year, with the necessary repairs causing costly delays and in some instances partial shutdown of the steel-making process.

“Initially, we fitted Nord-Lock washers to the Caster 1 driveshaft, which sits on the critical middle section of the plant that forms the steel slabs,” explains Graham Thomas, Caster 1’s planning engineer. “This was a stiff first test, as the potential of losing the shaft would have meant stopping the plant. But we went with Nord-Lock because of how its system resists vibration, and I’m happy to say the outcome has been very positive.”

Having proved their value there, Mr Thomas then had them fitted to the Caster 3 turret, with equally positive results.

SINCE FITTING NORD-LOCK, none of the previous problems have been reported – in fact, such is their dependability that Mr Thomas can’t put a figure on how much it has saved in maintenance costs.

As he explains, “The savings are unquantifiable because using Nord-Lock washers has allowed us to avoid the unplanned shutdowns these issues used to cause.”

“In practice, for example, one of my maintenance teams tells me that introducing Nord-Lock washers has meant that, even with our strict checking regime, they are confident that maintenance checks need to be carried out far less often now than the weekly ones we used to have to make.”

That has enabled the engineers to eliminate this particular cause of unscheduled repairs and allows them more scope to concentrate on scheduled maintenance and keep all areas of the plant running smoothly.

And these initial applications at the site look set to be only the beginning. “Although we are the first people at the site to use the Nord-Lock system,” says Mr Thomas, “the potential here is vast – simply because it’s such a vast plant.” □

FACTS:

CORUS CONTINUOUS CASTING STEEL-MAKING FACILITY

PRODUCTS:

SUPPLIER OF HOT-ROLLED COIL TO A RANGE OF MARKETS

INDUSTRIES:

INCLUDE AUTOMOTIVE, APPLIANCES,

CONSTRUCTION, PACKAGING STEELS

AND OTHER APPLICATIONS USING STRIP STEEL

ANNUAL PRODUCTION:

ABOUT 4.7 MILLION TONNES

NUMBER OF EMPLOYEES:

3,500 (DIRECTLY EMPLOYED)

FOUNDED:

1923

BOLT SECURING:

NORD-LOCK



Business arguments

THIS IS HOW Corus Strip Products UK benefits from Nord-Lock washers:

- **LOWER PLANT MAINTENANCE COSTS** – even if the initial investment is higher.
- **LOWER FRICTION** – lubricants can be used.
- **LESS MACHINERY WEAR**, such as that caused by heat, vibration and corrosives.
- **EASE OF MAINTENANCE** – engineers need to check less frequently.
- **NO ADAPTATION NEEDED** – the Nord-Lock system fits existing nuts and bolts.
- **OPTIMIZATION OF JOINT SECURITY** was made possible by collaboration between Williams and Corus and with Nord-Lock’s representative Peter Higgins, Technical Sales Engineer.

Physical testing guarantees joint safety

WORDS: ISABELLE KLIGER | PHOTO: ERIC SMITH

TESTING “DEVELOPMENT TESTING can disprove many of the common misconceptions surrounding joint failure,” says Dave Archer, President of Archetype Joint.

What is Archetype Joint?

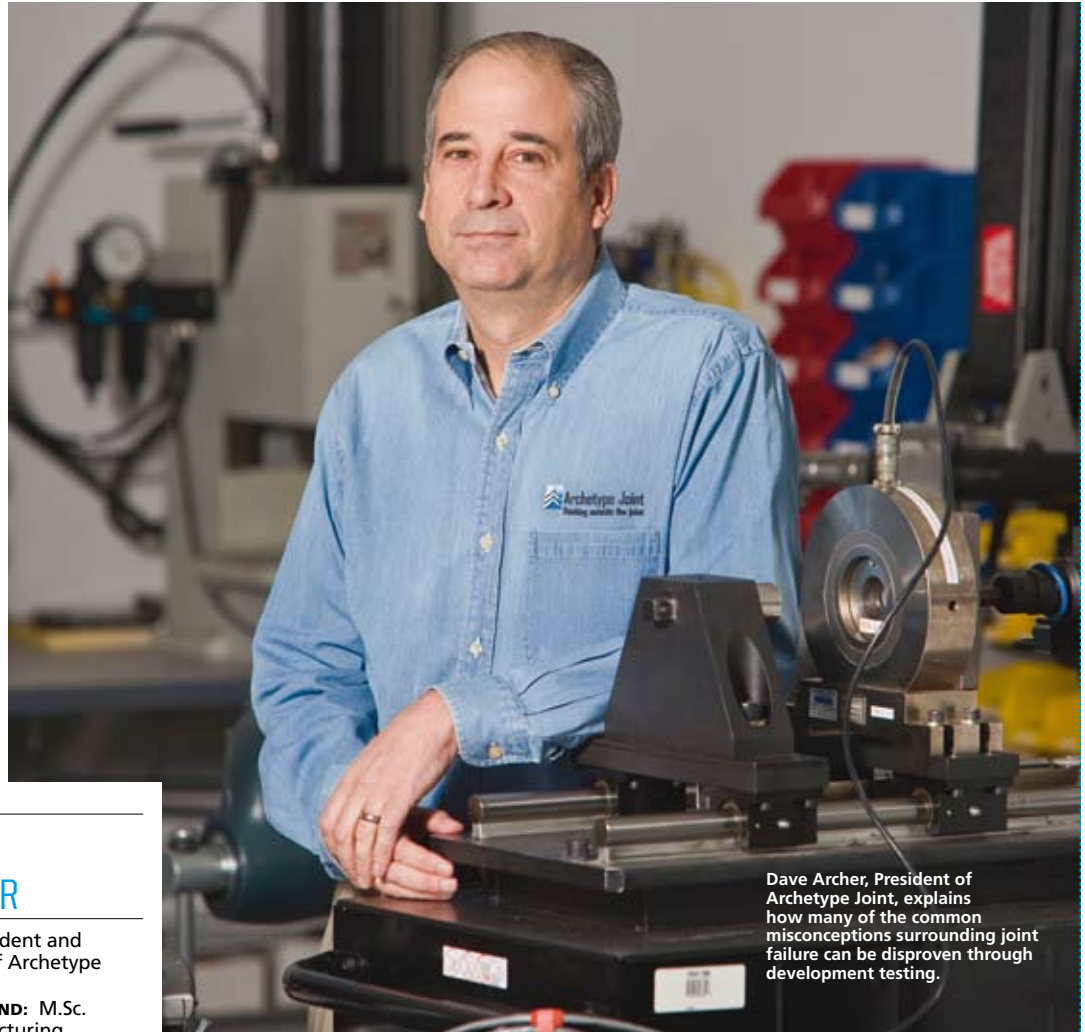
“We provide our clients with independent design, testing and validation services focused exclusively on joints; primarily bolted joints. Approximately half our work involves performing specific design validation tests – primarily for automotive and aerospace companies. The other half is to solve joint problems and provide independent competitive comparisons of fasteners, tools and assembly techniques.”

Why is testing so crucial?

“The performance of assemblies such as bolted joints cannot simply be analyzed in theory, as the results are not accurate. When several pieces are used together, the effect of variable interaction explodes exponentially. As a specific example, there is no way to accurately calculate the amount of bolt tension generated for a given torque input. Instead, physical testing is required. As the vast majority of bolted joints never undergo development tests focusing specifically on joint integrity, most engineers are unaware of the level of knowledge that can in fact be gained from tests of this kind.”

How do you hope to help improve the quality and safety of bolted joints?

“It’s crucial to educate anyone involved in designing, assembling or maintaining critical joints to eliminate once and for all the misconception that joint failure can be prevented through luck rather than engineering. In many cases, this belief may appear to be sufficient – especially as a manufacturer may not suffer significant failure for some time. But the day their luck runs out, the consequences



Dave Archer, President of Archetype Joint, explains how many of the common misconceptions surrounding joint failure can be disproven through development testing.

FACTS:
DAVE ARCHER

ROLE: President and founder of Archetype Joint.

BACKGROUND: M.Sc. in Manufacturing Engineering from the University of Rhode Island. Previously held senior design and manufacturing engineering positions within the industrial equipment and defence industries.

LIVES: In Lake Orion, Michigan with his wife Nancy and son Troy.

can be devastating. I have been an expert witness in cases where bolted joint failure led to profound injury or death – and nobody wants to be the person with ‘misconception’

being deposited on that day.”
How can customers improve the quality and safety of their bolted joints?

“Many people believe that bolted joints are a ‘pre-engineered’ solution, requiring no more effort than picking an element from a CAD library, along with a torque from a table in a book. We must therefore seek to elevate the status of bolted joints to ensure that users understand their complexity. As bolted joints

“It’s crucial to eliminate the misconception that joint failure can be prevented through luck rather than engineering.”

DAVE ARCHER, PRESIDENT AND FOUNDER OF ARCHETYPE JOINT

are usually a part of all product sub-systems, we need to consider the best ways in which to manage joint design, fastener selection and assembly parameters from a global perspective. In many cases, this also requires us to re-consider the way we calculate cost, by adopting a more long-term perspective.”

How would you advise customers to approach product cost?

“The question is an easy one to answer: life-cycle costs should drive

product development decisions. Unfortunately, implementing the obvious is sometimes difficult. People tend to be slaves to unit cost – largely because life-cycle costs are so much more difficult to quantify. The cost of a more expensive washer, such as a Nord-Lock, must be justified, often through indirect savings and cost avoidance. Nord-Lock should therefore be compared for its ability to ensure joint integrity rather than on unit cost alone.” □

RESISTING VIBRATION

The reaming head ready for action. Bolts coming loose was previously a problem. Nord-Lock washers provided the solution.



Underground operations

WORDS:
DAVID WILES

PHOTO:
SANDVIK

THE CHALLENGE Deep in the iron ore mines of Kiruna in the far north of Sweden, raise boring machines are used to make vertical shafts linking horizontal tunnels at different depths. A machine in the upper tunnel drills down a narrow pilot hole to the tunnel below. When it breaks through, a reaming head, which can be up to 6 meters in diameter, is attached. This tool is pulled back up, chewing its way through the rock as it goes to leave a larger shaft, often for ventilation. Sandvik Mining and Construction was having problems with the bolts clamping the cutting tools to the reaming head; they were sometimes coming loose under the extreme vibrations, loads and torque involved. Replacing the bolts which vibrated loose was a costly, time consuming and often dangerous job.

THE SOLUTION Sandvik tried different configurations to solve this serious problem. They tried fewer bolts with higher grade steel, and

more bolts with lower grade for more flexibility. Welding the bolts was not the answer as it complicated the regular maintenance the tools require. Sandvik came across the Nord-Lock bolt securing system and immediately recognised its suitability for the job. The Nord-Lock solution meant increased cost effectiveness but also improved safety; meaning less need for potentially dangerous servicing underground by engineers.

THE RESULT "These situations call for very secure clamping of each component," says Göran Strand, product line manager for raised boring equipment at Sandvik Mining and Construction. "Since we chose Nord-Lock we have greatly reduced the number of cases where the bolts rattle loose. I would not consider going back to using plain washers. We have very few problems with the bolts today – and that's how we would like it to stay." □

Launching revolutionary wheel nut

The safety and cost implications of loose wheel nuts on heavy vehicles, both on- and off-road, are massive – as are the potential losses in terms of time, money and even human lives. The Nord-Lock wheel nut, launched in the spring of 2010, is set to revolutionise the concept of safe wheels on heavy vehicles.



EVERY YEAR, in the UK alone, some 11,000 wheel-fixing defects, 400 wheel detachments and 134 accidents involving vehicle or property damage are recorded. Furthermore, 27 accidents resulting in human injury and up to seven fatalities occur every year; all as a result of wheel loss from heavy-duty trucks. These are the findings of a report commissioned by the UK Department for Transport entitled "Heavy Vehicle Wheel Detachment". In other countries, wheel loss occurs at a comparable rate.

Wheel detachment takes place when wheel nuts work loose and lose their clamp load. Regular re-tightening can prevent the wheel nut from loosening, but this takes time and can not always be done correctly. Up to now, loosening wheel nuts have been a recurring problem for transport companies but, as no solution has been available to prevent it from happening, operators and drivers



Extensive testing, in both laboratory conditions and controlled real-life field tests, has proven that the Nord-Lock Wheel Nut provides safe wheels and maintains the clamp load.

have accepted the phenomenon as an unavoidable part of their business.

"Unfortunately, transport operators have had no choice but to accept the significant cost of service and downtime, as well as the potential safety risks associated with loosening wheel nuts, as something inevitable," explains Csaba Madru, Applications engineer. "However, thanks to the new Nord-Lock wheel nut, this no longer needs to be the case."

The brand-new Nord-Lock wheel nut will be available in 2010. It has

been developed for heavy vehicles, including buses, trucks and construction machines, in the on-road and off-road categories. Based on the same unique technology and design as the Nord-Lock washers it will provide the safest possible wheel joint on the market.

EXTENSIVE TESTING, in both laboratory conditions and controlled real-life field tests, has proven that the Nord-Lock wheel nut provides safe wheels and maintains the clamp load. In a recent test conducted by independent German testing institute IMA (in accordance with the DIN 65 151 standard) the Nord-Lock wheel nut safely secured all tested joints even after being reused multiple times. However, the other wheel nut types in the test rotated and lost a significant amount of clamp load.

"Independent lab tests and real-life tests have proven that this prod-

uct is second to none – in terms of safety, cost savings and quality. Our customers cannot fail to recognise the massive advantages of a product that will prevent unexpected breakdowns, costs and injuries," Csaba Madru concludes.

The Nord-Lock wheel nut will become available worldwide. To find out more, visit www.safe-wheels.com □

FACTS: THE NEW NORD-LOCK WHEEL NUT

Benefits

- Cost savings thanks to:
 - reduced down time
 - reduced need for spare parts
 - less wear and tear
 - enhanced fuel efficiency
- Increased productivity
- Safe vehicles
- Minimised risk of accidents and injury
- Strengthened brand



Julie Pereyra, selected as the "Great Idea Winner of 2009".

Nord-Lock solution voted tops at US trade show

NORD-LOCK EMPLOYEE, Julie Pereyra, was recently selected as the "Great Idea Winner of 2009" following her presentation at a trade show on maintenance, organised by the US Department of Defense.

As part of the US Department of Defense's Maintenance Symposium and Exhibition, Julie Pereyra, Nord-Lock's Regional Sales Manager, was

invited as one of six speakers to present her company's "great idea" for maintenance-related solutions.

JULIE PEREYRA delivered a 15-minute presentation to more than 100 senior military personnel and, when given the opportunity to vote for their favourite "great idea", the audience chose Julie's presentation on Nord-

Lock's unique bolt securing system as the winner.

"I was honoured to present the Nord-Lock principle to so many high-ranking officials, offering them a practical and effective maintenance solution. Winning this award confirms the appeal of Nord-Lock in numerous applications to a variety of industries," Julie Pereyra says. □

Introducing the Junker Test

THE MOST RIGOROUS method for testing bolted joints is known as a Junker test. Thanks to their unique design and high quality standards, Nord-Lock's products consistently outperform the competition in this challenging test environment.

As the loosening of bolted joints has been a problem ever since the bolt was invented, numerous studies have been carried out on this phenomenon. In the 1960s, German professor Gerhard H. Junker discovered that shear loading perpendicular to the fastener axis is the most severe form of loading for vibration-induced loosening. The testing method he devised, in which a joint is mounted on a test rig and exposed to a simulated vibration at a right angle to the joint, subsequently became a DIN standard – DIN 65151 – and is commonly known as the Junker test.

TO PROVE THE RELIABILITY of its products, Nord-Lock runs 400 Junker demonstrations worldwide, every week, in the presence of its customers. In addition, nearly 100 customer-specific Junker tests are carried out in Nord-Lock's laboratories every year.

Harlen Seow, Sales Manager at Nord-Lock, is confident that Nord-Lock's products will continue to pass this rigorous test, thanks to their unique design, along with the company's commitment to quality and safety through technical verifications.

"Nord-Lock's products consistently do well because, unlike most fasteners on the market today, they rely on tension rather than friction to secure the joint. As this is the most challenging test available, a method that passes a Junker test is also likely to perform well in real-life applications," he says. □



The Junker test: a joint is mounted on a test rig and exposed to a simulated vibration at a right angle to the joint. The result is displayed on the computer screen.

In every edition of *Bolted*, we present one of the areas in which Nord-Lock is working actively on quality assurance and competitiveness. In this issue we focus on the rigorous testing of Nord-Lock products.

QUALITY IN EVERY STEP

Rigorous testing guarantees top quality

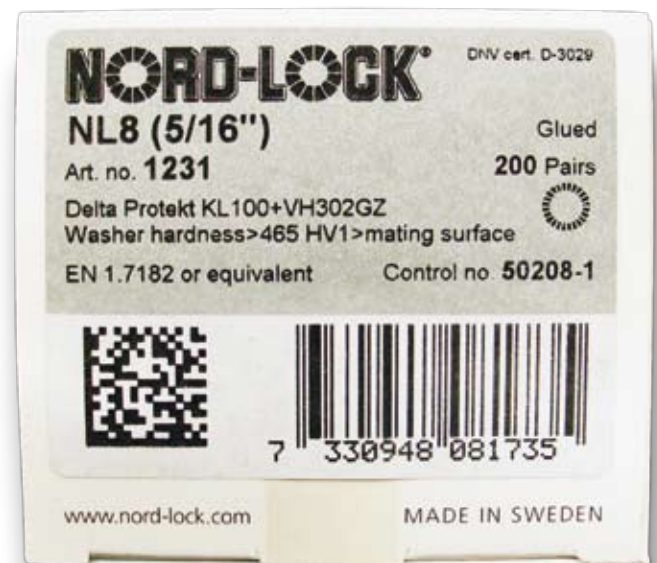
When it comes to developing top-quality products, Nord-Lock is firmly committed to staying ahead of the competition. Nord-Lock continuously employs the most meticulous testing routines on the market to safeguard the superior quality of its deliveries.

"**NORD-LOCK IS** a safety product and safety cannot be compromised," comments Harlen Seow, Sales Manager. "Many of our customers operate in the offshore, nuclear power and railway industries, where safety is absolutely critical; bolts or nuts that work loose are simply not an option. Every pair of washers must work flawlessly and this can only be guaranteed through rigorous testing, without any compromises."

Nord-Lock has been certified according to the ISO9001 quality standard since 1998 and its quality routines remain the most thorough on the market. During the production process, operators conduct quality controls on every batch. Later, before the washers are released for gluing, packing and delivery, every single batch undergoes a final quality inspection in Nord-Lock's own test lab.

NORD-LOCK'S TESTING routines include the following steps:

1. When coils are delivered from Nord-Lock's approved suppliers, random tests are carried



A unique batch number is printed on the label of every box of Nord-Lock washers. Using this number, every batch can be traced from the material certificate on the coils, through the entire production process, to the finished washer.

out to verify dimensions. To guarantee the material quality, Nord-Lock only purchases coils with material certificates.

2. When the washers are pressed, all the dimensions are rigorously controlled.

3. During the hardening process, all process parameters are strictly monitored.

4. Following the hardening phase, steel washers are surface coated at Nord-Lock's own coating plant, at which point the layer thickness and adhesion are tested.

5. The final quality inspection is carried out at Nord-Lock's test lab. A series of tests are used to check thickness, inner and outer dimensions and hardness. Here, corrosion, bending and mechan-

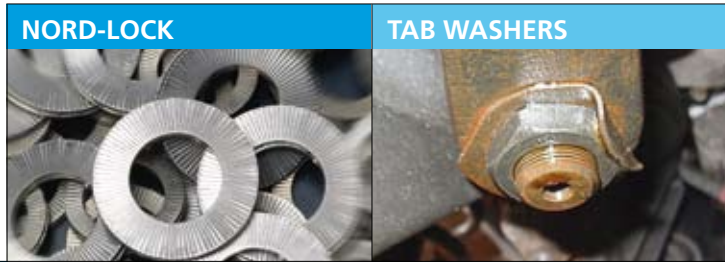
ical tests, as well as a visual inspection, also take place.

A unique batch number is printed on the label of every box of Nord-Lock washers. Using this number, every batch can be traced from the material certificate on the coils, through the entire production process, to the finished washer.

"Every one of our products is a piece of safety equipment and we must therefore be able to guarantee the highest levels of quality," says Bert Persson, Quality and Environmental Coordinator. "That's why we make sure we can trace all our washers back to their origin and through the production process. In our business, we can't afford to take any short cuts." □

Comparing solutions for bolt securing

Tab washers or Nord-Lock washers? Finding the ultimate bolt securing system is no easy task. Here is a guide to making the right choice.



	NORD-LOCK	TAB WASHERS
LOCKING CAPABILITY	Reliable.	Relatively good.
RANGE	M3–M130.	Normally not available for large sizes.
TEMPERATURE	Same temperature characteristics as regular bolts/nuts.	Same temperature characteristics as regular bolts/nuts.
ASSEMBLY/ DISASSEMBLY ROUTINES	Simple and rapid assembly/ disassembly. No special tools or preparation required.	Complex and time-consuming assembly/ disassembly. Requires enough space, additional tools and a skilled operator.
CONTROL OF CLAMP LOAD	Linear relationship between torque/load – thus possible to predict the clamp load.	Friction conditions must first be verified in order to predict the clamp load.
RISK OF DAMAGE TO ASSEMBLED PARTS	No risk. Fine impression marks on bolt head/nut, as well as underlying surfaces.	Some risk. Requires deformation of the washer through shocks, which can damage the assembled parts.
REUSABILITY	Reusable.	Not reusable.
ENVIRONMENT AND SAFETY	Recyclable. Minimal risk of human injury or error. Rapid assembly time results in minimal exposure in dangerous areas.	Recyclable. Manual assembly routines and long assembly time increase risk of injury, human error and damage to parts.
LUBRICATION	Possible to lubricate.	Possible to lubricate.
USE IN CONFINED SPACES	Suitable for use and easy to assemble in confined spaces.	Limited use in confined spaces, due to complex assembly requirements.
USE WITH THROUGH HOLES	Suitable. Note that washers on both sides of the assembled parts are required.	Time-consuming and difficult to use with through holes. Note that washers on both sides of the assembled parts are required.
USE WITH HEX CAP SCREW (ISO 4762)	Possible.	Not possible.
COUNTERBORES	Possible.	Not possible.
LIFE CYCLE COST (LCC)	Low. Relatively high price per unit. Long life cycle. Standardised and reusable items improve stability and minimise maintenance cost.	High. Short life cycle. A large number of units must be purchased as washers are neither reusable nor standardised.

Nord-Lock joins the Finnish Wind Power Association

NORD-LOCK recently became a member of the Finnish Wind Power Association (FWPA), founded in 1988. The organisation aims to promote wind energy in Finland, a

sector which is increasing rapidly. The first tests in Finland with Nord-Lock in the wind sector was made in 2001 and now the system is used for critical joints. Globally, Nord-

Lock is a popular supplier for wind power applications and is used in innumerable places; for example in the tower, in the rotor blades and in the turbines. □

CALENDAR

Exhibitions

EACH YEAR, Nord-Lock participates in over 60 large exhibitions and events for various industries. In the Nord-Lock stands you will find experts on bolt securing and you can also see Junker demonstrations, a comparative worst-case scenario test for bolted joints. Here are some of this spring's highlights:



□ Underhåll/Maintenance 2010 Gothenburg, Sweden

WHAT: Underhåll is Scandinavia's leading maintenance exhibition. It offers a direct interface between buyers and suppliers from all segments of the maintenance sector, as well as matchmaking to broaden your business network.

WHEN: March 9–12, 2010

WHERE: Stand no. A01:30



□ Offshore Technology Conference, Houston TX, USA

WHAT: The Offshore Technology Conference (OTC) is the world's foremost event for the development of offshore resources in the fields of drilling, exploration, production, and environmental protection.

WHEN: May 3–6, 2010

WHERE: Booth no. 8321



□ Global Electric Power Tech 2010, Seoul, Korea

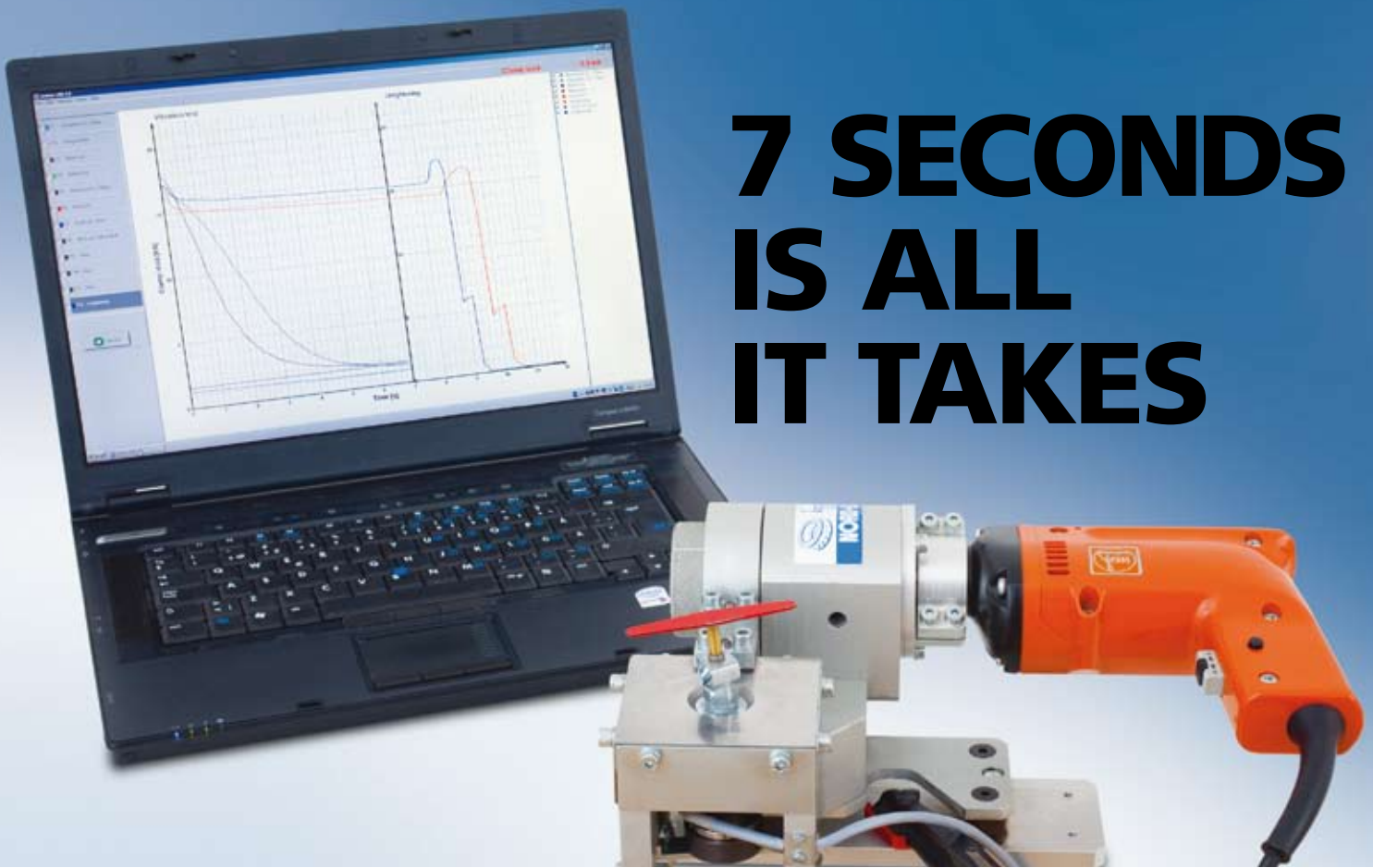
WHAT: This international smart grid and electric equipment exhibition is not just a conventional exhibition. The event is also organized into one-to-one business meetings, seminars and lectures.

WHEN: May 18–20, 2010

WHERE: Stand no. 910

You'll find the complete list of exhibitions at www.nord-lock.com/events.

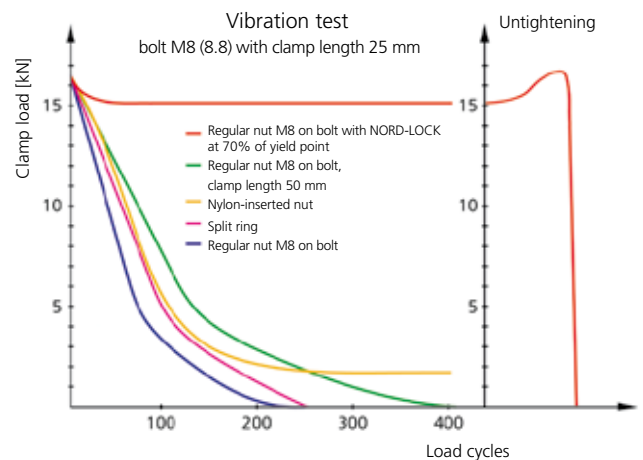
7 SECONDS IS ALL IT TAKES



Nord-Lock's international team of sales engineers meet clients locally with a Junker demonstration tool, which illustrates the difference between Nord-Lock and other locking methods.

7 seconds is all it takes to learn how effective Nord-Lock's bolt securing system is.

We help optimize your bolted joints in order to minimize overall costs and maximize safety.



NORD-LOCK[®]
Bolt securing system