

# BOLT HEAD

**BIG LIFT**

**HOLDING TOGETHER  
THE WORLD'S  
LARGEST CRANE**

**SAFETY AND  
QUALITY ARE KEY  
IN THE NUCLEAR  
INDUSTRY**

**THE DESTRUCTIVE  
EFFECTS OF**

# CORROSION

**MINING**

**WHY YOU DON'T WANT  
TO COMPROMISE  
BOLT SECURITY**

**EXPERT ADVICE**

**HOW TO DEAL WITH  
GALLING, SEIZING  
AND SLACKENING**

# Multiple challenges, **one solution**



*Spontaneous bolt loosening.  
Settlement. Relaxation.*

Nord-Lock X-series washers help you solve multiple bolt securing challenges at once. To find out how, go to [www.x-series.com](http://www.x-series.com).



See X-series washers  
in action!

[www.nord-lock.com](http://www.nord-lock.com)

**NORD-LOCK**<sup>®</sup>



Bolting magazine is published by Nord-Lock and strives to increase knowledge about bolt assemblies. Nord-Lock Group is a world leader in bolt securing systems and offers a wide product portfolio, including wedge-locking technology and Superbolt tensioners. These unique solutions withstand vibration and dynamic loads. For further information visit [www.nord-lock.com](http://www.nord-lock.com)

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**NORD-LOCK®**

## What's a nice bolt like you doing in a joint like this?

**C**ORROSION, THE THEME of this issue, is receiving more attention because of today's increased environmental focus.

One of the tasks of an engineer is to ensure corrosion develops as slowly as possible. It's a challenge that is being met by finding new and environmentally-friendly forms of corrosion protection, which you can read about on page 8.

Many of our customers require durable solutions that can last over long periods of time, which makes corrosion resistance of the up-most importance. A good example of a durable solution is the City Tunnel in Malmö, Sweden, where we secure the anchor bolts that hold the ventilation pipes. Trains must run at even intervals, which does not allow for maintenance stops, and connections must remain functional for a guaranteed period of 120 years (see Bolting No 1, 2009 p.16 or search for 'Tunnel vision' on our website).

The best time to tackle corrosion is in the design phase. When failures occur during operation, it leads to expensive modifications. I'm witnessing more and more examples of how we help customers using cause-and-effect methodologies, such as Ishikawa, where we break down everything related to a specific bolted joint and find the root cause. Being able to identify the problem and suggest a solution is what we do

best. To my knowledge, we have never encountered a problem where we couldn't suggest a cost effective, reliable and durable solution.

However, as we keep emphasising, it is often far more cost effective to involve Nord-Lock from the beginning, so that we can help foresee potential problems before they have a negative impact. You would be stunned at how much you can save by increasing the focus on joints at an early stage!

Besides corrosion, this issue also offers articles about unique and interesting applications. For example, how about one of the biggest cranes in the world (page 6) or an interview with Velan, a strong player in the nuclear industry (page 15)? We hope you enjoy the magazine!



**CARIN ESBERG**  
GLOBAL MARKETING  
MANAGER



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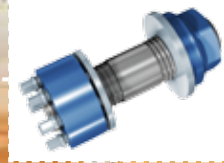
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# SECURED BY THE NORD-LOCK GROUP

WORDS: NIC TOWNSEND, LINDA KARLSSON ELDH



## HASSLE-FREE

Superbolt tensioners are used to connect components as they can be assembled and disassembled easily without hydraulic tooling.



## THE WORLD'S BIGGEST CRANE

**CUSTOMER:**  
BIGGE CRANE & RIGGING CO.

**PRODUCT:**  
BIGGE 125D AFRD SUPER CRANE

**MAXIMUM CAPACITY:**  
7,500 TONNES

**HEIGHT:**  
170 METRES

**COVERAGE:**  
113,000 SQUARE METRES

**HORSEPOWER:**  
3,450 HP

**GROWING DEMAND IN** the world's construction industry has seen the rise of a new breed of super cranes. However, one of the biggest and best in the world is the Bigge 125D AFRD (A-Frame Ring Derrick). Not only can it lift loads of up to 7,500 tonnes, it can manage this from one single location, thus eliminating the need for crane relocation or multiple lifting devices. Once installed the Bigge 125D can move anything, anywhere – quickly and efficiently – and offers a degree of flexibility unprecedented in the construction industry.

Currently, two Bigge 125D cranes are being used to construct two new side-by-side reactor units at two dif-

ferent nuclear power plants in the U.S. By deploying the Bigge 125, the new reactors can be built at once without relocating the crane.

It goes without saying that a machine of this size and capacity needs a strong bolting solution. However, when construction is complete, it also needs to be dismantled, transported and reassembled at another site. For this reason, Bigge Crane & Rigging has chosen to use Superbolt tensioners to connect large components. Not only can they offer the required security, they can also be assembled and disassembled easily, without the need for hydraulic tooling. ■



# SECURED BY THE NORD-LOCK GROUP



## THE GENUINE

The Nord-Lock X-series washers guarantee perfect container placement.

## IN PERFECT ROTATION

<b>CUSTOMER:</b> LAXO MEKAN AB		<b>MODEL:</b> LAXO CONTAINER ROTATOR	<b>NET WEIGHT:</b> 300 KILOS
<b>MATERIAL:</b> STEEL	<b>DIAMETER:</b> 2.1 METRES	<b>ROTATING LOAD CAPACITY:</b> 15 TONS	

**SINCE 1947, TRUCKS** from all large manufacturers such as Volvo, Scania and MAN find their way to Swedish truck body builder Laxo Mekan AB for customised chassis

construction work. The company is known in Scandinavia for regularly introducing new trailer solutions, with the 2010 hydraulic driven container rotator being its most recent

innovation. With a 360 degree rotation, the rotator makes it possible to load containers off a truck in the exact direction required, regardless of the truck's position. This has made it especially popular in the waste management sector, which is characterised by limited space and cluttered construction sites.

The first rotators were fitted with washers supplied by Nord-Lock, but after changing its bolt supplier, Laxo was talked into

using similar looking washers from another company. However, these copies were not able to secure the 31 bolts that keep the rotator attached to the boom of the truck. As the bolts loosened, the rotator detached from the truck. Laxo therefore decided to revert to the proven solution, this time fitting the rotator with Nord-Lock's new X-series washers. Today, the copies are long gone – and so is the problem of bolt loosening. ■

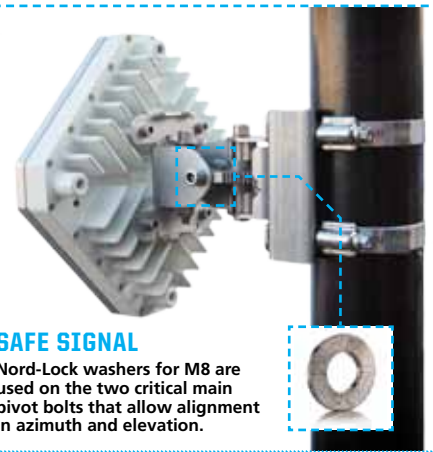
## NORD-LOCK GOES MOBILE

<b>CUSTOMER:</b> SUB 10 SYSTEMS	<b>PRODUCT:</b> LIBERATOR V320 & V1000 ETHERNET BRIDGE
<b>FREQUENCY:</b> 60 GHZ	<b>DATA RATE:</b> 320 MBPS-1 GBPS
<b>WEIGHT:</b> 2.5 KILOS	<b>RANGE:</b> 800 METRES-1 KILOMETRE

**MOBILE COMMUNICATION HAS** gone through the roof. With the massive rise in smartphones and other connected devices, there has been an exponential increase in both voice and data traffic. This, in turn, is putting pressure on the wireless infrastructure that provides mobile signals. For example, in city centres where cellular base stations become saturated, people can experience dropped calls or no signal at all. The solution is to provide a network of microcells to cover local areas, such as shopping centres or sports venues. These microcells need to be linked back to base stations where the signal is processed and fed into the subterranean cable network.

Sub 10 is a UK company which develops and manufactures point-to-point, microwave frequency communications equipment. Sub 10's Liberator matched antennas transmit mobile data through the air over distances of up to one kilometre. This allows a dense population of microcells to communicate with a base station without the need to dig up urban streets in order to lay cables.

An industrial design company, Frazer Designers, together with Sub 10, has developed a patented adjustable mounting bracket which allows pairs of antennas to be rapidly and accurately aligned. The antennas are mounted globally in both rural and urban locations and



## SAFE SIGNAL

Nord-Lock washers for M8 are used on the two critical main pivot bolts that allow alignment in azimuth and elevation.



must be capable of withstanding environmental extremes. Not only must the stainless steel bracket remain rigid in wind speeds of up to 150 miles per hour, it must ensure that the antenna is always safely secured when sited over busy public spaces. Frazer Designers chose Nord-Lock washers to ensure that the main bolts remain tightened when subjected to wind loading, vibration and thermal cycling. ■



**LENA KALMYKOVA**  
APPLICATION  
ENGINEER



**ULF WENDT**  
APPLICATION  
ENGINEER

Email your questions about bolt securing to [experts@nord-lock.com](mailto:experts@nord-lock.com)



## ASK THE EXPERTS

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

### Preventing galling and seizing

**Q: When and why does galling and seizing appear?**

**A:** Galling is caused by a combination of friction and adhesion between metallic surfaces during sliding. When galling occurs material is adhesively pulled from one surface leaving it stuck on the other in the form of a lump. This process spreads rapidly as the built up lumps induce more galling.

The tendency of material to gall is affected by the material's ductility. Typically, softer materials are more prone to galling while harder materials are more resistant.

In bolting, thread galling appears during fastener tightening as pressure builds up between the contacting and sliding thread surfaces. Thread galling commonly oc-



Galling can lead to seizing of the threads, and even to breakage of the fastener or torn off threads.

cur with fasteners made of stainless steel, aluminium, titanium, and other alloys.

In extreme cases galling leads to seizing – the actual freezing together of the threads and bolt lock-up. Continued tightening may lead

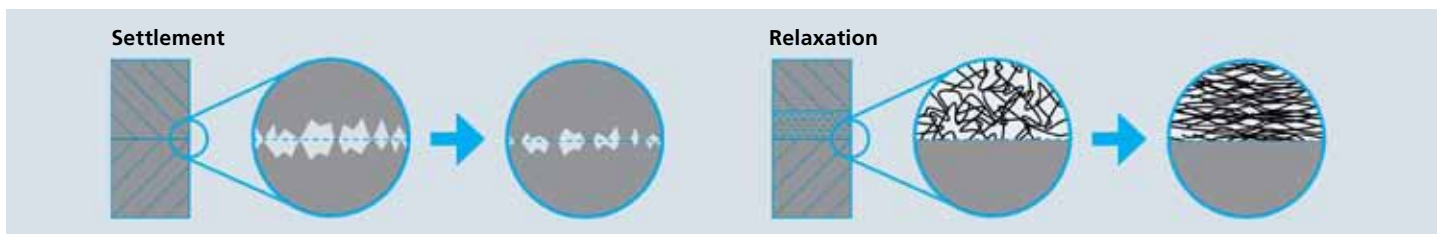
to the breakage of the fastener or result in torn off threads.

Solution:

1. Lubrication of the internal and/or external threads.
2. Reduction of the installation RPM speed.

3. Selecting different stainless alloy grades for the bolt and the nut reduces galling resulting from different degrees of hardness. However, the strength of the nut always needs to be greater than the strength of the bolt.

LK



Settlement is the process whereby pressure on clamped surfaces causes pressure on such a surface to flatten. Relaxation occurs as materials become more compact over time.

### Picking up the slack

**Q: Why is slackening becoming an increasing problem?**

**A:** One of the main reasons for bolt loosening is slackening. Slackening leads to loss of preload and can be divided into three subgroups: Slackening caused by settlement, slackening due to relaxation over time or slackening resulting from gradual temperature changes (creep).

Settlements are related to surface roughness and surface irregularities. The pressure on the clamped surfaces after pre-loading causes any irregularities on the surface to start to flatten. When the irregularities have been flattened out the parts will be less tightened and the pre-load will decrease. If the reduction of pre-load is sig-

nificant enough the joint may rotate loose. Low pre-load also increases the risk of fatigue failure.

Relaxation occurs when materials become more compact over time, resulting in additional loss of pre-load. This is common for materials such as polymers, composites, copper and soft metals.

Creep is the tendency of a solid material to move slowly or deform permanently under the influence of stresses. It occurs as a result of long-term exposure to high levels of stress that fall below the yield strength of the material. Creep is more severe in materials that are subjected to heat for long periods, and close to their recrystallization temperature. Creep

always increases as the ambient temperature rises.

Today, increasingly more joints are exposed to more extreme conditions such as higher speed, high temperature and higher loadings. If components were still manufactured out of steel the 'old way', they would be cumbersome and heavy. In order to reduce the total weight, components these days are made from composites, plastics and aluminium. This is why slackening is becoming an increasing problem. Nord-Lock has developed the X-series washers to counteract these slackening effects so designers no longer have to worry about how to compensate for slackening in the joints.

UW

PHOTO: JASON MILBURN

If you thought corrosion was merely about unsightly patches of red oxide – rust – which plague steel and iron products in coastal areas and offshore applications, think again. Corrosion is present everywhere and can occur in even the most arid land-locked countries. It's also a case of prevention being better than cure as corrosion can be delayed but never prevented.

WORDS:  
ALANNAH EAMES

PHOTO:  
CHRISTER EHRLING



# COMBATING CORROSION

**ANY METAL PRODUCT** – especially those derived from iron or steel – will eventually rust and disintegrate over time when coming into contact with oxygen and water.

There are two types of reaction during corrosion: oxidation whereby electrons leave the metal and the metal becomes corroded, and reduction, where the electrons convert water or oxygen into hydroxides. Rust forms when the hydroxide and ferrous ions combine. As the metal corrodes, its surface changes and, in ferrous metals, rust spreads across the entire surface of the metal.

Coastal and offshore applications rust more easily than other applications due to their exposure to saltwater, which is pH neutral or slightly acidic. Products close to the shore are subject to atmospheric salinity as well as the tidal salt water spray, which leaves surface residue. Atmospheric salt levels are also higher the closer you get to the equator.

However, corrosion is not just limited to exposure to saltwater. Cleaning agents, high hu-

midity and 'dirty' environments like sewage and mining, all exacerbate the corrosion process. Chemical process environments – rich in carbon dioxide – are also tough on metals.

Eva Coronado is Corrosion Laboratory Manager at Element Materials Technology in Houston, Texas.



Eva Coronado

“Corrosion is a natural phenomenon which occurs under certain moisture, temperature and atmospheric conditions; it cannot be avoided, only mitigated,” she explains.

“Corrosion weakens products thus affecting their function and integrity. Besides having a high economic cost, corrosion impacts safety and affects the esthetic appearance of the product.”

**FORMER PRESIDENT OF NACE** International, the Corrosion Society – the world's largest authority on corrosion with 30,000 members worldwide – Kevin Garrity, has spent most of his →







Any metal product – especially those derived from iron or steel – will eventually rust and disintegrate over time when coming into contact with oxygen and water. The pictures show the effect of corrosion over time on a bolt head.

## Types of corrosion which attack metals

- **General corrosion:** characterised by a uniform attack over the surface of the material when exposed to a corrosive medium.
- **Pitting:** a form of localised corrosion that leads to the creation of small holes in the metal. The driving power for pitting corrosion is the depassivation of a small area, which becomes anodic, while an unknown but potentially vast area becomes cathodic, leading to very localised galvanic corrosion.
- **Galvanic corrosion:** dissimilar metals and alloys have different electrode potentials and when two or more come into contact in an electrolyte, one metal acts as anode and the other as cathode. The potential difference between the dissimilar metals is the driving force of the accelerated attack on the anode member of the galvanic couple.
- **Intergranular corrosion (IGC):** occurs where the boundaries of crystallites of the material are more susceptible to corrosion than their insides.
- **Crevice corrosion:** occurs in confined spaces within which the access of the working fluid from the environment is limited.
- **Stress corrosion cracking (SCC):** is the growth of cracks in a corrosive environment. It can lead to unexpected, sudden failure of normally ductile metals subjected to a tensile stress, especially in the case of metals at elevated temperatures.

→ 38-year career in the field of corrosion engineering. “I started out as an electrical engineer but became intrigued by the fact that corrosion takes in so many different facets of engineering – stress, electrical components, chemical and biological reactions.”

Corrosion, he emphasises, has been a problem since man started to use steel in applications.

So how can you avoid corrosion? The simple answer is that you can't. The best form of 'protection' is to factor in the impact of corrosion from the moment you start designing a product to ensure the materials used are as corrosion resistant as possible for the application it will be used for, and the environment in which the product will operate. And, most importantly, you need to make sure that the metals used do not accelerate the corrosion process by reacting against each other – better known as the Galvanic theory which was born when electro-chemistry guru Sir Humphry Davy unravelled the mystery of galvanic currents.

According to the Galvanic theory, engineers and manufacturers need to place materials and products in such a way as to limit galvanic corrosion occurring. For example, if you want to

Corrosion has been a problem since man started using steel in applications. Corrosion can be delayed but never prevented.



“Each year at NACE we train around 12,000 engineers in the field of corrosion. However, there are probably over 3.5 million engineers in the world, so there is a big gap.”

KEVIN GARRITY, FORMER PRESIDENT OF NACE INTERNATIONAL

couple copper and stainless steel alloys, a protective coating is necessary to reduce corrosion. Aluminium alloys and copper should not be combined, especially where there is a higher pH due to the salinity of the environment. Further, always remember that the differences between electrode potentials are affected by the environment in which the application or product is placed.

Lack of awareness of galvanic reactions can have devastating financial and safety effects, tarnishing the image of a company. An oil refinery in the US suffered major failure due to caustic cracking, caused by corrosion, incurring costs of around USD 500 million.

Garrity has seen quite a few undesirable gal-

vanic reactions during his career at NACE. One incident at a US nuclear power station springs to mind. “Copper grounding systems at the plant – meant to protect personnel and equipment in case of electrical fault – were connected to tritium-based water pipe systems, building a battery-like reaction. Due to the reaction between the copper and tritium, the piping will eventually corrode to the copper, causing leaks and the risk of low level radioactive material escaping.”

**THERE ARE SEVERAL** ‘norms’ to delay corrosion of a product or application: choose materials of a similar electrode potential; use a special paint or coating to create a protective barrier;

use sacrificial anodes to protect the core product; or introduce a current to offset any galvanic reactions.

The type of corrosion protection used depends on the metals in question, the use of the application, the environment it will be used in, and how much money a company is willing to spend.

While coatings are the standard – and cheapest – form of corrosion protection, they are not fool-proof. Using a coating which may be corrosion



Kevin Garrity

proofed for a saltwater environment, may not be resistant to degreasing solutions, for example.

The environmental friendliness of corrosion-resistant coatings is also widely debated, especially within the automotive industry. Some argue it is better to use a tough corrosion proofing method – applied in a contained environment – as the product will last three times longer than one which has a more environmentally-friendly coating but whose parts will need to be replaced three times during the product's lifecycle.

Another form of protection against galvanic reactions is to introduce a sacrificial or galvanic anode metal – such as magnesium, aluminium or zinc blocks, rods, plates or extruded ribbon – to protect a metal structure or application. It works as a cathodic protector by absorbing the oxidation reaction to prevent it from attacking the main part of the structure. For this to happen, there needs to be an electron pathway – such as a wire or direct contact – between the anode and the metal. There must also be an ion pathway between the oxidising agent such as water or damp soil, and the anode to form a closed circuit.

Magnesium, aluminium and zinc are the most commonly used galvanic anodes. While lightweight aluminium is a common choice for saltwater and offshore applications like ship hulls, offshore pipelines and storage tanks, it is not reliable in an explosive environment as it can react with sparks when it comes into contact with a rusty surface. Magnesium, on the other hand, is the most negative electropotential anode and is often used for underground and soil-related applications.

**MANY CORROSION CASES** could have been avoided if adequate measures had been taken when designing or developing the product. “Each year at NACE we train around 12,000 engineers in the field of corrosion. However, there are probably over 3.5 million engineers in the world, so there is a big gap,” he says.

However, companies and organisations, Garrity says, are starting to recognise that investing in corrosion prevention may be more costly in the beginning, but saves money in the long term.

To calculate the return on the investment, he

recommends establishing a risk matrix. “Prioritise the potential corrosion risks based on the criticality of the structure or facility and from this stand point work your way down the list to the lower ones.”

**BOLTS MAY BE** a small component in the construction process but must also be designed with care. If the bolt corrodes, the danger is that the larger structure or product will fall apart.

“Fasteners, as an integral part of modern life, must be dependable,” states Coronado. “Corrosion of fasteners not only results in metal loss and possible failure, but in the case of high-strength fasteners, cracking and sudden failure. The use of corrosion resistant fasteners is not always practical, so other methods of corrosion mitigation, such as coatings, are used to protect them.”

Zinc flake coatings – such as Delta Protekt® or Delta-Tone® – are currently the most popular protection for steel bolts and washers. Such coatings are applied like a paint and then baked

to create a barrier; if more layers are added, the coating also acts as a friction-proof coating. Other options include Teflon coatings and hot dip galvanising.

Choosing the right material and corrosion protection for the bolt is crucial, according to Franz Raymann, Service Manager at Nord-Lock. “Customers often don’t understand why we ask them so many questions about the materials they are using and the environment the product will be used in. But we have to know all these details if we are to supply the right bolts,” he says.

He refers to a 4,000 ton offshore platform which is suspended on four legs and is held together by 16 gigantic bolts. “If these bolts corrode, everyone on the platform would end up in the North Sea.”

“Strategic bolts need regular checks for corrosion. If corrosion is discovered in the bolt, depending on the severity of the situation, it is removed and cleaned, checked for cracks and re-coated, or the entire bolt is replaced.” ■

## How to design against corrosion

- Analyse the corrosive environment and requirements.
- Choose materials which have sufficient corrosion resistance (and similar galvanic potential).
- Avoid geometrical shapes which collect water and dirt, create stress risers, cause erosion, etc.
- Choose a suitable corrosion protection method (surface coatings, sacrificial anodes, direct currents, etc.).
- Define requirements: For example, the ISO 9227 salt spray corrosion test, ASTM G48 electrochemical corrosion test for stainless steel, ISO 12944 corrosion classes for environments.

## The classification of corrosive environments

ISO 12944	IMPACT	INTERIOR	EXTERIOR
C1	Very low	Heated buildings with clean air, such as offices, shops, schools, hotels, etc.	None
C2	Low	Unheated buildings, where condensation may occur, such as warehouses and sports halls.	Atmosphere with low pollution. For example, a rural environment.
C3	Middle	Buildings used for production with high atmospheric humidity and some air pollution, such as food manufacturers, breweries, dairies and laundries.	Urban and industrial areas, moderate sulphur dioxide pollution. Coastal areas with low salt content.
C4	High	Chemical manufacturers, swimming baths and shipyards and boatyards close to the sea.	Industrial areas and coastal areas with moderate salt impact.
C5-i	Very high-industry	Buildings or areas with almost permanent condensation and high pollution.	Industrial areas with high humidity and an aggressive atmosphere.
C5-m	Very high	Buildings or areas with almost permanent condensation and high pollution.	Coastal and offshore areas with high salt content.

Source: ISO 12944

Joy Global's P&H products are amongst the most robust in the industry and can be found in more than 90 percent of the world's surface mines.



# TOUGH MACHINES FOR A TOUGH INDUSTRY



In the mining industry, every minute of downtime results in lost income, and one loose fastener can cost a small fortune. This is why Joy Global doesn't compromise when it comes to bolt security.

WORDS:  
NIC TOWNSEND

PHOTO:  
JOY GLOBAL



**A**T AN OPEN-CUT mine, virtually no other sound is audible amongst the constant grind of large, heavy-duty machinery smashing, crushing and drilling into solid rock. With minerals buried deep underground, undisturbed for millions of years, it takes a lot of force to extract them.

The machines and vehicles on an average mining site are exposed to some of the harshest operating conditions imaginable, including lifting extreme loads and being subjected to constant vibration. As they continue to chip away at the earth's surface, the whole landscape is radically changed, creating a deep, man-made canyon.

To describe mining as 'big business' is a huge understatement. There are whole industries that rely on a steady supply of raw resources. There are entire nations and communities who rely on the mining industry for their livelihoods. In fact, the continued development and industrialisation of human civilisation is based on our ability to dig deep and extract resources from beneath the earth's surface.

With so much riding on the end product, any hindrance or delay has major consequences, so it's imperative that everything works smoothly. "Every minute is quantifiable in dollars," says Nicholas Dame, Senior Engineer at Joy Global Surface Mining. "A one hour delay can cost thousands in lost income, so uptime is extremely important."

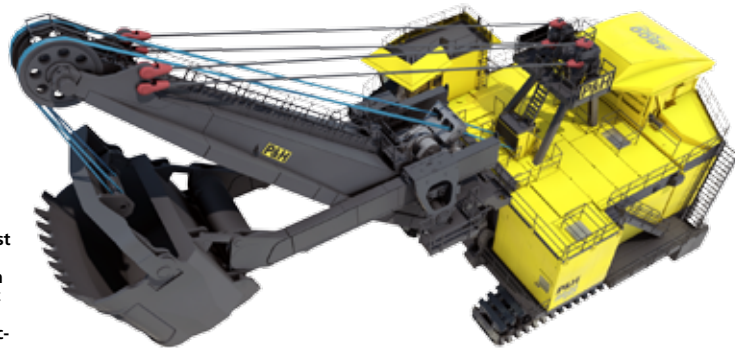
**FOR OVER 125** years Joy Global's P&H products have been recognised as amongst the most reliable and productive in the industry. In fact, more than ninety percent of the world's surface mines use P&H brand equipment. The company's →

**“Nord-Lock products eliminate a failure that, as an engineer, is the most difficult to calculate and predict – loose bolts.”**

NICHOLAS DAME, SENIOR ENGINEER AT JOY GLOBAL



“Nord-Lock washers are a proven, low risk solution that give a good sense of security”, says Nicholas Dame, senior engineer at Joy Global.



The P&H 4800XPC, Joy Global's latest and largest electric mining shovel, is a 135 ton machine. It can provide up to 20 percent increased productivity with a five percent reduction in cost per ton.

→ success is built on its ability to understand the excessive demands of the industry, and build machines that can deliver continuous production. The company prides itself on its fastidious attention to every component, including bolts and nuts. For all their horsepower and ability, even the biggest machines are only one loose bolt away from inaction.

For a number of years, P&H products have used Nord-Lock washers to connect the gearbox to the boom on its electric shovels – an area subjected to heavy vibration. Previously, a fastening solution with a special anti-vibration thread had been used. However, this required a unique tap. When the boom was shipped, it was necessary to fill the tapped holes with lubricant in order to prevent corrosion. Since the assemblers did not have access to the unique tap, they had to use a standard thread tap to remove the corrosion protectant, which also resulted in removal of the thread. When operational, it was not possible to see what type of thread was inside the hole.

“Nord-Lock eliminates this concern completely and allows a quick spot-check to ensure proper installation,” says Nicholas Dame. “It is a proven, low risk solution that gives a good sense of security. It is also less cumbersome and time-consuming. We were using washers anyway, so it

was easy to replace it and use a Nord-Lock washer pair instead to eliminate the risk of loosening.”

Joy Global's latest and largest electric mining shovel – the P&H 4800XPC – is a 135 ton machine. Compared to its predecessor, the 120 ton 4100XPC AC, it can provide up to 20 percent increased productivity with a five percent reduction in cost per ton.

**FOR THE P&H 4800XPC**, Joy Global decided to make the transition to Nord-Lock's new X-series. “I see this as the latest version of what is already a very good product,” adds Dame. “It has the same properties with the added benefit of removing relaxation out of the equation.”

In addition to Nord-Lock washers on its gearboxes, Joy Global also use Superbolt tensioners on its crawlers – an area that can be prone to malfunction.

“This is another fastener that's easy to work with,” continues Dame. “Because they're standard bolts, field assemblers are familiar with them and can fasten them quickly. They're easily tensioned within minutes.”

With all critical joints secured, P&H machines can do what they do best – maintain production in one of the world's most important and demanding industries. ■

**FACTS:**

**JOY GLOBAL SURFACE MINING**

**ABOUT:**

Leading manufacturer of surface mining equipment with more than 125 years experience in the industry.

**PART OF:**

Joy Global Inc.

**FOUNDED:**

1884



**Commercial benefits**

- **PROVEN SECURITY** – resistant to vibration and significantly reduces risk.
- **EASY TO INSTALL** – does not require tapped holes.
- **VISUAL** – easy to identify whether the bolt has been secured or not.

# “Safety and quality are key”

WORDS:  
DAVID WILES

PHOTO:  
VELAN

**VELAN'S VALVES PLAY** a critical role in the world's nuclear power stations. Jean-Luc Mazel, Industrial Director of Velan SAS, the French affiliate of Velan Inc, discusses safety, the aftermath of the Fukushima accident, and the importance of reliable bolt securing in the nuclear industry.

**What is Velan's role in the nuclear industry?**

“Velan started supplying the emerging nuclear industry soon after its creation in the 1950s. It began supplying valves to the first US nuclear submarine (US Nautilus) and to Oak Ridge National Lab. During the 60s, Velan developed its full range of forged valves and successfully supplied North American nuclear reactors. Today, Velan supplies classified valves to approximately 350 nuclear reactors around the world and is recognised as a major player in the industry. One nuclear power plant requires around 20,000 valves for the nuclear island and the conventional island. Of these valves, approximately 200 large, safety-related valves are in the nuclear island. We supply these valves as well as approximately 4,000 smaller modular maintenance valves located in the safety systems.”

**How has Velan been able to become dominant in the nuclear industry?**

“We have considerable experience and we always try to develop the right products for this very demanding market. Other factors are our focus on product qualifications, the tremendous amount of operational feedback and expertise we've gained over the years, and the fact that our company is big enough to deal with large nuclear projects worldwide.”

**How has the Fukushima incident affected Velan?**

“The sudden freeze on much of the new nuclear power station projects has had a moderate impact on our activity. However, there is a rising demand for safety modifications and spare parts from nuclear operators in existing plants. Fukushima has also led to an even stronger focus on safety, reliability, and high quality, which is perfectly in-line with our business approach.”

**Security is top priority in the nuclear industry. What does this mean for bolted joints?**

“Bolted joints are a key element in the design of our valves. They must secure not only the integrity of the parts under pressure but also guarantee the performance of motor-operated valves when they are submitted to various loadings. Once all the loads applied on the bolted joint have been calculat-



**FACTS:**  
**JEAN-LUC MAZEL**

**ROLE:** Industrial Director for Velan SAS, the French affiliate of Velan Inc.

**BACKGROUND:** Master's degree in mechanical engineering from the Ecole Nationale d'Ingénieurs France. He started his career in 1988 at Velan. Mazel has considerable experience in the design and manufacturing of valves for heavy duty applications and in the field of nuclear and cryogenic valves. He was previously the company's Engineering Manager.

**LIVES IN:** Lyon, France.

ed, it is essential that the stress is maintained during operation, regardless of what the external loads might be. This underlines the importance of using a reliable solution to ensure the continued locking of the joint over time.”

Read the full interview with Jean-Luc Mazel at [www.nord-lock.com/velan](http://www.nord-lock.com/velan).

**Many customers say that Nord-Lock products are cost efficient and enable them to simplify their production. Does this also apply to Velan?**

“Although keeping costs under control and simplifying production are important factors, safety and quality remain the key words in our business. If all the stresses are considered at an early stage during the design phase for the selection of washers, and provided the design is validated by a qualification test performed in real operating and accidental conditions, it is obvious that the Nord-Lock solution can bring additional safety to nuclear facilities, and also reduce maintenance work.” ■

# Propelled upwards

## SIMPLIFY

Compared to safety wire, Nord-Lock washers are far quicker and easier to apply and remove.



WORDS:  
NIC TOWNSEND

PHOTO:  
SENENICH

**THE CHALLENGE** Sensenich has been manufacturing aircraft propellers since 1932, and as the industry has grown and developed, it has continued to develop new propellers to match. With the connection between the propeller and aircraft clearly being a critical joint, regular safety inspections are mandatory.

For many years Sensenich used safety wire to secure all bolted connections. However, because safety wire is difficult to remove and re-apply, inspections have always been time-consuming.

**THE SOLUTION** In 2006, Sensenich decided to use Nord-Lock washers for the installation of its propellers on experimental aircraft. Due to the fact that the washers could be removed and re-applied quickly and easily, it was hoped that

they would act as a time-saving measure, and contribute to an overall improved product for its customers.

**THE RESULT** Sensenich has found that the prospect of not using safety wire is a concept many customers are eager to embrace. The Nord-Lock washers, with their greater ease of use, have made maintenance and inspections far less time-consuming, which means more flying time. ■





## D2FC saves time and money through Nord-Lock

D2FC, a French company that manufactures critical high pressure control valves for hydro-electric power plants, has decided to generalise the use of Nord-Lock washers.

**BERNARD DANGREAU, D2FC'S** Technical Manager, states "Our commercial relationship with Nord-Lock began when we started using Superbolt multi-jackbolt tensioners. We then discovered the washers and were able to verify their real aptitude at securing a bolted assembly, particularly when the latter was submitted to vibrations."

He adds that the washers enabled the company to make "real progress in fixing the valve seats on our double eccentric ball valves. These

shutters are located underwater and vibrate. In order to block them we previously used hexagonal washers that were soldered to a small plate and thus stopped the bolt from loosening. However, this was a costly solution which also posed problems

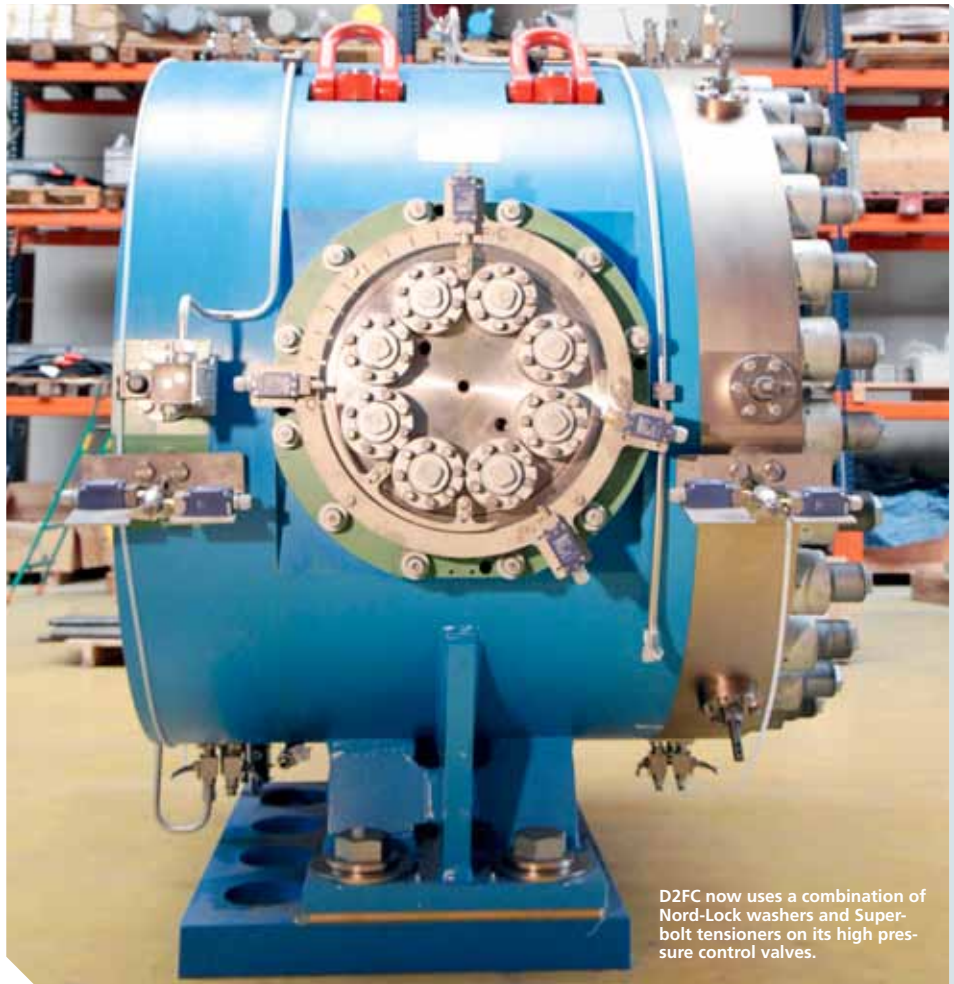


**Bernard Dangreau**

during maintenance operations and the washers were advantageously replaced by the simple use of Nord-Lock washers."

D2FC's introduction to Nord-Lock came just over two years ago when the company started using Superbolt tensioners. "These were chosen based on several criteria", explains Mr. Dangreau, not the least of which was cost-effectiveness. Because Superbolt tensioners don't require special tools it becomes possible to place the bolts very close to each other and thereby reduce the size of the bolted component." This has meant, for example, that the diameter of the shaft of the machines has been reduced and, as a consequence, the resistive torque and the actuators. The special tools he is referring to are hydraulic tensioners. However, in order to use them there needs to be space around the bolt, and the bolts themselves must be of a certain size.

As there is no need to use special tools when tightening Superbolt tensioners, operators save a lot of time. Mr. Dangreau states that these tensioners can be manipulated by hand, "with no need for mechanical assistance" and he remarks that "they can be tightened with a simple dynamometric spanner." In many other cases, he adds, "the necessity to use a hydraulic jack



D2FC now uses a combination of Nord-Lock washers and Superbolt tensioners on its high pressure control valves.

PHOTO: D2FC

means the operator needs help to manipulate it and this noticeably slows down tightening operations."

Another reason cited by Mr. Dangreau is that in order to tighten Superbolt tensioners it is not necessary to apply anything greater than the nominal pretension required, contrary to ordinary bolts. When the studs on these are tightened with a hydraulic jack, it is necessary to use a pretension up to 40% greater than the nominal value sought, in order to obtain this nominal value after the hydraulic tension exercised by the jack is removed. "This is principally because the bolted parts become compressed," explains Mr. Dangreau, adding that this 40% extra tension means that in some cases the stud has to be made bigger than is really necessary in order for the initial tightening operation to be undertaken.

The combination of Superbolt tensioners and Nord-Lock washers enables D2FC's products to be perfectly adjusted and very reliable. "Because of the optimisation and limited maintenance of the valve, this translates into cost and time savings, making our products more competitive."

Indeed, D2FC has been chosen by EDF, the electricity giant, to supply some of the major hardware to modernise one of France's landmark hydro-electric complexes high up in the Alps. Work began in March 2013 on the three-year project to renovate and update the Tignes-Malgovert hydro-electric complex which opened over 60 years ago and encompasses three dams and seven plants. In the decade up to 2015, EDF will have invested almost one billion euros to optimise and modernise its 435 hydroelectric plants in France. ■

CHRISTINA MACKENZIE

## New press heralds new era in Mattmar

**AN IMPORTANT STEP** in the expansion of Nord-Lock's manufacturing plant in Sweden has been reached with the arrival of a new high-speed press. The press, which stands some 5.5 metres tall and can exert a pressure of 180 tonnes, will be used predominantly for the manufacture of the new Nord-Lock X-series washers.

The press arrived at the Port of Gothenburg in mid-May following a three-week crossing from Pittsburgh in the USA, and was then moved by truck to its new home in Mattmar, central Sweden.

It complements an existing press at the plant, allowing for a significant increase in production capacity to meet an ever-growing demand for Nord-Lock products. "The arrival of the press was a big day for us and is an important part of the expansion of this plant," says Mattias Andersson, Engineering Manager in Mattmar.

To make room for the new press, as well as being able to handle larger volumes, the factory's production area is being expanded by 1,000 m<sup>2</sup>, an increase of approx. 30%. Several other new machines have also been installed to handle other stages of the manufacturing process. Production with the new press commenced in June. ■



PHOTO: MATTIAS ANDERSSON

The new high-speed press arrives at the factory in Mattmar, central Sweden.



Left to right, Anke Sauter, Marketing Coordinator Nord-Lock GmbH, Andreas Weiss, Managing Director Nord-Lock GmbH and Jamie Mitchell, Publications Director at Fastener + Fixing Magazine.

## X-series wins Silver at Fastener Innovator 2013

**IN FEBRUARY THIS** year at the Fastener Fair in Stuttgart, Nord-Lock's new X-series washer won Silver in the Fastener Technology Award 2013. This year a record high 19 innovative technologies were entered into the competition, with the top three being chosen by a panel of experienced industry judges.

"We are very proud to have been awarded the Silver Prize," says Andreas Weiss, Managing Director of Nord-Lock GmbH. "This proves that the continuous innovation at

Nord-Lock and our efforts in the field of bolted joint design are not only recognised by our customers, but also by independent judges."

The Fastener Fair attracts a large number of visitors from all over the world, offering a first hand opportunity to assess new products, technologies and market trends. For the X-series, to win such an award at an international forum of this magnitude is a huge boost for Nord-Lock's new multifunctional wedge-locking washer. ■

## THE COMPARISON

	WEDGE-LOCKING TECHNOLOGY	MULTI-JACKBOLT TENSIONING
RANGE	M3–M42 as standard, but up to M130 have so far been produced.	M16–M160 as standard, unlimited size options for customer specials with M1500 produced as the largest size so far.
SPONTANEOUS LOOSENING	Unrivalled wedge-effect prevents loosening even under the most severe vibrations.	High preload above the separating forces prevents your bolting from loosening on properly designed joints.
SLACKENING	Exceptional spring effect in multifunctional wedge-locking technology compensates for loss of preload due to settlements or relaxation.	Increased elasticity with jack-bolt tensioning compensates loss of preload due to settlements or relaxation.
BOLT FAILURE DUE TO FATIGUE	Locking function is not affected by lubrication, which provides a good level of control over clamp load and prolongs fatigue life of the joint.	Added elasticity and high preload increases fatigue life of the joint.
BOLT FAILURE DUE TO TORSION	Allows use of lubrication to minimise torsion stress.	Tightening in pure tension totally eliminates torsion stress.
ASSEMBLY/ DISASSEMBLY	Easy installation using standard tools.	Only hand tools are required to tighten any size of the bolt or stud.
REUSABILITY	Reusable. Does not affect reusability of bolts/nuts.	Reusable. Increases reusability of bolts/studs.



## MYTH BUSTERS

**THE MYTH:** A common misconception is that stainless steel is never affected by corrosion.

**THE TRUTH:** In fact, all kinds of stainless steel can rust in poor conditions. It is, however, rarely a question of uniform or general corrosion but rather pitting or crevice corrosion, which is a consequence of the passive layer becoming damaged or being prevented from being rebuilt (repassivation).

Steel with a minimum chromium (Cr) content of 10.5% is known as 'stainless steel'. Stainless steel has the ability to create a protective layer of chromium oxide, also known as a 'passive layer'. Other alloying elements such as Nickel (Ni), Molybdenum (Mo) or Niobium (Nb) help to increase the corrosion resistance.

Crevice corrosion can be a result of repassivation being prevented due to lack of oxygen, for example, under the bolt head. Pitting corrosion may occur when the passivation layer is damaged locally. The unprotected steel underneath the passivation film then becomes anode and the material that is covered by the passivation layer becomes cathode. The corrosion process then progresses in a similar way to galvanic corrosion. Chloride-rich environments such as seawater, as well as acid environments or high temperatures, will always increase the risk of corrosion problems occurring. ■

## X-series earns TÜV certification

**THE X-SERIES**, Nord-Lock's newest wedge-locking solution, has been certified for safety and quality by the renowned German inspection organisation TÜV. Achieving certification has required rigorous testing of the product, as well as intensive scrutiny of Nord-Lock's production processes, in order to comply with TÜV's high standards.

"Our mission is to safeguard human lives and customer investments," says Klaus Vogt, Field Applications Engineer at Nord-Lock GmbH. "With this external assessment conducted by TÜV Süd, our customers have an additional

reason to trust us, and they feel confident using our products. The seal emphasises and supports our statement of quality and sets us apart from our competitors."

TÜV is renowned for its vigorous and transparent quality assessments and its seal is internationally recognised as proof that a product meets the highest standards of safety and quality. For the new X-series, which was only launched last year, the certification is a huge achievement.

In recent years, Nord-Lock's washers and wheel nuts have also achieved TÜV certification. In



**TÜV seal is internationally recognised as a sign of safety and quality.**

line with all certified products, in order to maintain the approval, Nord-Lock's production will be subjected to regular audits from TÜV within a period of 1-2 years, to ensure these standards are being maintained. ■

# Your trusted **global partner** in bolting solutions



The Nord-Lock Group offers cutting edge bolting technologies, all designed and developed in-house. Our products are well known in the market and hold a vast amount of certificates and approvals. Through Nord-Lock Performance Services we add expertise knowledge to any project and make sure that your bolting application pays back multiple times.

Our mission is to safeguard human lives and customer investments. We look forward to taking on your toughest challenge!

Scan to see how Nord-Lock speaks about safety.

